Bedside Clinical Guidelines Partnership

Surgical Guidelines

2006

General Adult Surgery

The Guidelines are advisory, NOT mandatory
Published by
The Bedside Clinical Guidelines Partnership

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CONTENTS • 1/3

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preface</td>
<td>6</td>
</tr>
<tr>
<td>Classification of Surgical procedures</td>
<td>10</td>
</tr>
<tr>
<td>ADMINISTRATION</td>
<td></td>
</tr>
<tr>
<td>Admissions policy</td>
<td>12</td>
</tr>
<tr>
<td>Arranging a theatre list</td>
<td>13</td>
</tr>
<tr>
<td>Consent</td>
<td>14</td>
</tr>
<tr>
<td>Medical Records</td>
<td>17</td>
</tr>
<tr>
<td>On-call pathology service</td>
<td>19</td>
</tr>
<tr>
<td>On-call radiology service</td>
<td>21</td>
</tr>
<tr>
<td>Modified early warning scoring (MEWS) system for patient monitoring</td>
<td>22</td>
</tr>
<tr>
<td>Management of the aggressive patient</td>
<td>24</td>
</tr>
<tr>
<td>Verification of death</td>
<td>27</td>
</tr>
<tr>
<td>ACUTE PROBLEMS</td>
<td></td>
</tr>
<tr>
<td>Acute right iliac fossa pain</td>
<td>30</td>
</tr>
<tr>
<td>Acute upper abdominal pain</td>
<td>31</td>
</tr>
<tr>
<td>Small bowel obstruction</td>
<td>32</td>
</tr>
<tr>
<td>Large bowel obstruction</td>
<td>34</td>
</tr>
<tr>
<td>Acute abdominal aortic aneurysm</td>
<td>35</td>
</tr>
<tr>
<td>Acute pancreatitis</td>
<td>37</td>
</tr>
<tr>
<td>Acute limb ischaemia</td>
<td>39</td>
</tr>
<tr>
<td>Acute retention of urine</td>
<td>42</td>
</tr>
<tr>
<td>The acutely painful testis</td>
<td>43</td>
</tr>
<tr>
<td>PERIOPERATIVE MANAGEMENT</td>
<td></td>
</tr>
<tr>
<td>Pre-operative assessment</td>
<td>46</td>
</tr>
<tr>
<td>Routine pre-operative investigations</td>
<td>50</td>
</tr>
<tr>
<td>Bowel preparation</td>
<td>55</td>
</tr>
<tr>
<td>Pre-operative fasting</td>
<td>56</td>
</tr>
<tr>
<td>Artificial nutritional support</td>
<td>57</td>
</tr>
<tr>
<td>Management of the diabetic patient in the perioperative period</td>
<td>62</td>
</tr>
<tr>
<td>Thromboprophylaxis</td>
<td>67</td>
</tr>
<tr>
<td>Screening for MRSA and ESBL/MGNB</td>
<td>69</td>
</tr>
<tr>
<td>Pre-operative management of MRSA</td>
<td>71</td>
</tr>
<tr>
<td>Chronic anaemia</td>
<td>73</td>
</tr>
<tr>
<td>PERIOPERATIVE DRUGS POLICY</td>
<td></td>
</tr>
<tr>
<td>Patients taking aspirin</td>
<td>79</td>
</tr>
<tr>
<td>Patients taking clopidogrel</td>
<td>80</td>
</tr>
<tr>
<td>Patients taking corticosteroids</td>
<td>81</td>
</tr>
<tr>
<td>Patients taking oral contraceptives and hormone replacement therapy</td>
<td>83</td>
</tr>
<tr>
<td>Patients taking warfarin</td>
<td>84</td>
</tr>
<tr>
<td>ANTIBACTERIAL PROPHYLAXIS</td>
<td></td>
</tr>
<tr>
<td>Antibacterial prophylaxis</td>
<td>90</td>
</tr>
<tr>
<td>Antibacterial prophylaxis for patients at risk of bacterial endocarditis</td>
<td>92</td>
</tr>
</tbody>
</table>
Antibacterial prophylaxis for gastrointestinal, biliary and general surgery ...............94
Antibacterial prophylaxis for orthopaedic surgery .............................................96
Antibacterial prophylaxis for ophthalmology .....................................................98
Antibacterial prophylaxis in ear, nose and throat surgery .................................99
Prevention of infection in patients with absent/dysfunctional spleen or sickle cell disease ..............................................................101

MANAGEMENT OF PERIOPERATIVE PAIN

Pre-operative assessment and explanation ......................................................104
Post-operative pain relief .............................................................................105
Post-operative nausea and vomiting ..............................................................109
Codeine and dihydrocodeine ......................................................................110
Opioids .........................................................................................................111
Patient controlled opioid analgesia ..............................................................116
Paracetamol and NSAIDs ............................................................................118
Epidural analgesia .........................................................................................119
Naloxone ......................................................................................................125
Entonox ..........................................................................................................126

INFECTION CONTROL

Standard infection control measures ..............................................................130
Hand hygiene ...............................................................................................131
The use of personal protective equipment ..................................................132
Management of patients with MRSA ............................................................133
Management of patients with ESBL ..............................................................134
Management of patients with Clostridium difficile ......................................135

FLUID & ELECTROLYTES

Electrolyte disturbances .............................................................................138
Fluid replacement ..........................................................................................143

TRANSFUSION

Administration of blood and blood components .........................................146
Maximum blood ordering schedule ..............................................................153

VENOUS THROMBOEMBOLISM

Deep venous thrombosis ............................................................................158
Pulmonary embolism ....................................................................................164

SURGICAL EMERGENCIES

Hypotension ..................................................................................................170
Post-operative haemorrhage ......................................................................171
Wound infection & dehiscence ...................................................................172

MEDICAL EMERGENCIES (for other emergencies see Medical Guidelines)

Acute severe asthma in adults ....................................................................175
Acute renal failure .......................................................................................178
Acute upper gastrointestinal haemorrhage (including H. Pylori eradication) 180
### CONTENTS • 3/3

Cardio-pulmonary resuscitation .............................................186
CPR - Clinical Justification ..................................................185
Diabetic Ketoacidosis and non-ketotic hyperosmolar coma ........188
Sepsis, severe sepsis and septic shock .................................192

**PRESCRIBING REGIMENS & NOMOGRAMS**

<table>
<thead>
<tr>
<th>Prescribing Regimens &amp; Nomograms</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acid Base</td>
<td>196</td>
</tr>
<tr>
<td>Aminophylline</td>
<td>197</td>
</tr>
<tr>
<td>Digoxin</td>
<td>199</td>
</tr>
<tr>
<td>Gentamicin</td>
<td>200</td>
</tr>
<tr>
<td>Glasgow Coma Scale</td>
<td>203</td>
</tr>
<tr>
<td>IV Unfractionated heparin</td>
<td>204</td>
</tr>
<tr>
<td>Heparin induced thrombocytopenia</td>
<td>205</td>
</tr>
<tr>
<td>Pain control in palliative care</td>
<td>208</td>
</tr>
<tr>
<td>Salbutamol</td>
<td>210</td>
</tr>
<tr>
<td>Vancomycin</td>
<td>211</td>
</tr>
<tr>
<td>Warfarin</td>
<td>213</td>
</tr>
</tbody>
</table>

**PRACTICAL PROCEDURES**

<table>
<thead>
<tr>
<th>Practical Procedures</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arterial puncture</td>
<td>218</td>
</tr>
<tr>
<td>Insertion of arterial lines</td>
<td>221</td>
</tr>
<tr>
<td>Intercostal tube drainage</td>
<td>224</td>
</tr>
<tr>
<td>Percutaneous central venous cannulation</td>
<td>226</td>
</tr>
<tr>
<td>Pleural aspiration of air</td>
<td>230</td>
</tr>
<tr>
<td>Tapping ascites and paracentesis</td>
<td>231</td>
</tr>
<tr>
<td>Urethral catheterization</td>
<td>233</td>
</tr>
</tbody>
</table>
This booklet has been compiled as an aide-memoire for all staff concerned with the management of general surgical adult in-patients. The guidelines have been drafted with reference to published literature and amended after extensive consultation. Wherever possible, the recommendations made are evidence based. Where no clear evidence has been identified from published literature the advice given represents a consensus of the expert authors and their peers and is based on their practical experience.

No guideline will apply to every patient, even where the diagnosis is clear-cut; there will always be exceptions. These guidelines are not intended as a substitute for logical thought and must be tempered by clinical judgement in the individual patient.

The guidelines are advisory, NOT mandatory

The booklet is divided into fourteen sections:

1. ADMINISTRATION

Good administration is central to efficient and safe patient care. This starts with the patient’s admission and clerking. Notes must be named and signed and kept up to date. Theatre lists must be clearly written to avoid unsafe practice. Consent must be properly taken and recorded and must not be ambiguous. The operative side and site must be clearly recorded and marked. Knowledge of how to contact the on-call services is mandatory to enable early diagnosis and good patient management Request forms must be clearly filled in to avoid confusion and subsequent delays which may both increase risk and cause costly increases in the patient length of stay.

2. ACUTE PROBLEMS

Surgical problems are often acute, whether as emergency admissions or involving in-patients. Timely management of such problems is vital so that unnecessary morbidity and mortality do not occur. Early treatment of acute problems is dependent on early recognition of these problems. Advice on many acute problems is given, both from a diagnostic and treatment perspective.

3. PERIOPERATIVE MANAGEMENT

Underlying medical problems affect fitness for surgery and anaesthesia. This section includes a wide range of guidelines common to all patients undergoing surgery, and for which investigations are required. It also includes guidance on when a patient should have their surgery cancelled.

4. PERIOPERATIVE DRUGS POLICY

Patients undergoing surgery are often taking multiple drug therapy. While it is appropriate to withhold certain drugs, others must be continued. This section includes guidance on which drugs should be withheld, and alternative drugs and routes of administration when the patient is nil by mouth.

5. ANTIBACTERIAL PROPHYLAXIS

Antibiotics are in widespread use for prophylaxis in operative surgery. They must not, however, be overused as drug resistance, superinfection (e.g. *clostridium difficile* colitis), and unnecessary financial wastage will ensue.
6. MANAGEMENT OF PERIOPERATIVE PAIN
Pain limitation is vital in surgical patients. Poor control can cause respiratory problems due to poor chest expansion as well as unnecessary stress to the patient. Uncontrolled pain will also delay mobilisation and increase DVT risk.

7. INFECTION CONTROL
The human and financial cost of hospital infection is vast. Excellent infection control is central to safe surgery. Infection is easily spread from patient to patient if basic skills are neglected. These include hand washing, use of sterile instruments, and the wearing of sterile gloves and aprons where necessary.

8. FLUID AND ELECTROLYTES
Good fluid balance is essential for surgical patients. This includes intravenous fluid regimes which are vital in the many patients who cannot tolerate fluid by mouth. Also many surgical conditions, particularly those which affect bowel absorption or secretion, require increased fluid intake, usually by intravenous lines, to maintain both cardiac and renal function.

9. TRANSFUSION
Administration of blood and blood products is not without risk, and requires great care if hazardous errors are to be avoided. This section includes guidance on indications, requisitions, administration and complications of transfusion.

10. VENOUS THROMBOEMBOLISM
Venous thromboembolism is a major cause of morbidity and mortality in the surgical patient. The incidence and sequelae of deep venous thrombosis and pulmonary embolus is dramatically reduced by good prophylaxis and treatment.

11. SURGICAL EMERGENCIES
Complications can occur after surgery. This section includes advice on the management of some common postoperative complications.

12. MEDICAL EMERGENCIES IN THE SURGICAL PATIENT
Surgical patients often have underlying medical problems, and/or may develop them postoperatively. This section includes advice on the emergency management of some common medical conditions and when to refer. For ease of reference, the layout adopts a standard format, covering Recognition and Assessment, Immediate Treatment, Subsequent Management, Monitoring Treatment and Discharge Policy.

13. PRESCRIBING REGIMENS AND NOMOGRAMS
The administration of certain drugs, especially those given intravenously, requires great care if hazardous errors are to be avoided. This section includes guidance on the indications, contraindications, dosage and administration for all drugs in this category referred to in the Guidelines. For some, there are Tables or Nomograms to assist dose selection or adjustment.

14. PRACTICAL PROCEDURES
This section includes advice on how to perform most forms of clinical intervention feasible at the bedside. Drafted with reference to published recommendations, they have also been subject to wide consultation with local experts and put to the test to check their reliability. The layout adopts a standard format, covering Indications, Contraindications, Equipment,
Procedure, Specimens and Aftercare. The recommendations should not be applied rigidly to every patient and must be tempered by clinical judgement. The illustrations in this section are reproduced with the permission of the BMJ Publishing Group.

**DO NOT attempt to carry out any of these Practical Procedures unless you have been trained to do so and have demonstrated your competence**

**New guidelines**

The following new guidelines have been included in this edition:

- Classification of surgical procedures
- Medical records
- MEWS (Modified early warning scoring system for patient monitoring)
- Management of the aggressive patient
- Acute right iliac fossa pain
- Acute upper abdominal pain
- The acutely ischaemic limb
- Acute pancreatitis
- Small bowel obstruction
- Large bowel obstruction
- Acute abdominal aortic aneurysms
- Acute retention of urine
- The acutely painful testis
- Standard infection control
- Hand hygiene
- The use of personal protective equipment
- Screening for MRSA
- Management of patients with MRSA (flowchart)
- Management of patients with ESBL (flowchart)
- Management of patients with *Clostridium difficile* (flowchart)
- Antibacterial prophylaxis for orthopaedic patients
- Antibacterial prophylaxis for gastrointestinal, biliary and general surgery
- Antibacterial prophylaxis for patients at risk of bacterial endocarditis
- Prevention of infection in patients with absent / dysfunctional spleen or sickle cell disease
- Antibacterial prophylaxis for ear, nose and throat surgery
- Antibacterial prophylaxis for ophthalmology
- Codeine and dihydrocodeine
- Opioids
- Patient controlled opioid analgesia
- Paracetamol and NSAIDs
- Epidural analgesia
- Pre-operative assessment and explanation
- Post-operative pain relief
- Post-op nausea and vomiting
- Naloxone
- Entonox
- Chronic anaemia
- Vancomycin
- Fluid replacement

The editors acknowledge the infinite time and trouble taken by numerous colleagues in the drafting and amendment of the text. The accuracy of the detailed advice given has been subject to exhaustive checks. However, any errors or omissions that become apparent should be drawn to the notice of the editors, via the Clinical Guidelines Co-ordinator (Telephone...
01782 552300), so that these can be amended in the next review or, if necessary, be brought to the urgent attention of the users. Constructive comments would also be welcome.

**Supporting Information**

Where possible, the guidelines are based on evidence from the published literature. It is intended that the evidence relating to statements made in the guidelines and its quality will be made explicit.

Where supporting evidence has been identified it will be graded I to V, according to standard criteria of validity and methodological quality as detailed in the table below. A summary of the evidence supporting each statement will appear, with the original sources referenced (ward-based copies only). The evidence summaries are being developed on a rolling programme which will be updated as the guideline is reviewed.

<table>
<thead>
<tr>
<th>Level of evidence</th>
<th>Strength of evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Strong evidence from at least one systematic review of multiple well-designed randomized controlled trials</td>
</tr>
<tr>
<td>II</td>
<td>Strong evidence from at least one properly designed randomized controlled trial of appropriate size</td>
</tr>
<tr>
<td>III</td>
<td>Evidence from well-designed trials without randomization, single group pre-post, cohort, time series or matched case-control studies</td>
</tr>
<tr>
<td>IV</td>
<td>Evidence from well-designed non-experimental studies from more than one centre or research group</td>
</tr>
<tr>
<td>V</td>
<td>Opinions of respected authorities, based on clinical evidence, descriptive studies or reports of expert committees</td>
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JA Muir-Gray from Evidence Based Healthcare, Churchill Livingstone London 1997

Evaluating the evidence-base of these guidelines involves continuous review of both new and existing literature. The editors encourage you to challenge the evidence provided in this document. If you know of evidence that contradicts, or additional evidence in support of, the advice given in these guidelines please forward it to:

Clinical Guidelines Co-ordinator  
Department of Respiratory Medicine  
City General Hospital  
Stoke on Trent  
ST4 6QG  
(Telephone 01782 552300)
INTRODUCTION

● There is no general agreement on how to classify the severity of an individual operation

MINOR, INTERMEDIATE OR MAJOR

● Used mainly in these guidelines. See box for examples
● clinicians classify into these groups by experience

OTHER CLASSIFICATIONS

● Local anaesthetic or general anaesthetic
● Day case or overnight stay
● High risk or low risk indicates the fitness of the patient in addition to the complexity of the procedure. For example, an appendicectomy in a patient with cardiac disease would be ‘high risk’, but in a fit 20 year old it would be ‘low risk’
● Urgency of the case, rather than by its complexity
● emergency refers to patients requiring surgery within hours
● urgent to those needing surgery within a day or two
● elective, routine, or planned to those placed on a waiting list

### Surgery grades as suggested by NICE

<table>
<thead>
<tr>
<th>Grade</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade 1 (minor)</td>
<td>Excision of lesion of skin; drainage of breast abscess</td>
</tr>
<tr>
<td>Grade 2 (intermediate)</td>
<td>Primary repair of inguinal hernia&lt;br&gt;Excision of varicose vein(s) of leg&lt;br&gt;Tonsillectomy/adenotonsillecrtomy&lt;br&gt;Knee arthroscopy</td>
</tr>
<tr>
<td>Grade 3 (major)</td>
<td>Total abdominal hysterectomy&lt;br&gt;Endoscopic resection of prostate&lt;br&gt;Lumbar discectomy&lt;br&gt;Thyroidectomy</td>
</tr>
<tr>
<td>Grade 4 (major+)</td>
<td>Total joint replacement&lt;br&gt;Lung operations&lt;br&gt;Colonic resection&lt;br&gt;Radical neck dissection&lt;br&gt;Cardiac surgery&lt;br&gt;Neurosurgery</td>
</tr>
</tbody>
</table>
ADMINISTRATION
ELECTIVE ADMISSIONS

● Check notes against admission list from appropriate consultant’s secretary
● Check correct patient admitted for correct investigation, intervention or operation
● When there are bed shortages, check priority against other admissions
● Ensure relevant staff and departments are aware of admission or failure to admit, (e.g. imaging for an X-ray investigation)
● Clerk patient according to clinical priority, (e.g. patients for same morning or day procedure first)

EMERGENCY ADMISSIONS

GP Admissions

● Obtain clinical details and provisional diagnosis from GP
● Give details and provisional diagnosis to SAU and ensure bed available
● For serious clinical conditions, inform SpR of the nature of the patient accepted
● If immediate need for surgery anticipated (e.g. ruptured aneurysm), warn emergency theatre and anaesthetist (second-on for CGH or third on for NSRI)
● Assess less urgent cases on arrival and contact SHO or SpR as appropriate
● Initiate appropriate investigations as soon as possible

for young person with appendicitis – FBC
for perforated abdominal viscus – U&E, amylase, ECG, X-ray of abdomen or erect chest
ARRANGING A THEATRE LIST - 1/1

**ELECTIVE LISTS**

- Obtain admission list from secretary
- Check list order/addition of extra cases with SpR and/or consultant
- Submit handwritten (capital letters) list to appropriate theatre block reception before 1200 hr on day before the list
- Ensure correct patient for correct procedure
- Ensure patient fit for procedure
- Check patient has been consented by appropriate surgeon e.g. SpR or consultant
- Check appropriate blood tests, X-rays, and ECG have been done (see Pre-operative investigations) and results are available
- Arrange for relevant imaging pre-operatively or in theatre, or both

**Order of list notes**

- Where possible:
  - diabetics first
  - major cases early in the day
  - day cases early if possible
  - infected cases last

**24-HR EMERGENCY LISTS**

- Ensure necessary tests performed:
  - baseline investigations – FBC, U&E
  - inform SpR of potential cases and discuss specific investigations
- Inform emergency (CEPOD) theatre of likelihood for surgery (ext 2871 for theatres 1-10)
- Inform on-call anaesthetist when decision to operate made or for assessment
- Check anaesthetist requires no further tests (e.g. chest X-ray, ECG)
- Prioritize surgery with SpR and other specialties using emergency theatre

**DAY CEPOD LISTS**

- Inform theatre of likely cases at earliest opportunity
- Give details of the patients requiring surgery to the anaesthetist responsible for CEPOD list
- When cases confirmed on 0800 hr ward round, give final order to theatre
- Ensure theatre tickets are sent from ward to theatre
- Check necessary tests and consent have been obtained

Where ‘minor’, ‘intermediate’ and ‘major’ surgical procedures are mentioned in the text - see classification of surgical procedures for clarification
CONSENT • 1/3

INTRODUCTION

Consent is a difficult and complex subject; this guideline provides a brief outline of the issues involved in obtaining consent from adult patients (aged 18 yr or older). For patients aged under 18 yr see Trust policy.

A copy of the full Trust policy C43, ‘Policy and procedures for obtaining consent’ is available in all wards and departments and must be adhered to at all times.

Consent is required before a competent adult is:
- examined
- treated
- cared for

Obtain consent before commencing a procedure or treatment other than in exceptional circumstances such as:
- life-saving procedures
- emergencies

Giving and obtaining consent is usually a process not a one-off event

Patients can withdraw consent at any time

If there is any doubt, check that the patient still wishes to proceed

Patients have the right to stop treatment at any stage

Format of consent

Consent can be:
- written
- verbal
- neither oral nor written

A signature on a consent form does not in itself prove that consent is valid – the purpose of the consent form is to record the patient’s decision, and the discussions that have taken place.

Implied consent

Obtained when, following an explanation of the proposed procedure/treatment, the patient indicates their willingness to proceed by co-operating, for example:
- extending an arm to have blood taken

Expressed consent

Must be obtained for any procedure carrying material or significant risk

Usually given in writing by signing a consent form, but can be given orally, following which a record should be made in the patient’s medical notes.

SEEKING CONSENT

It is always best for the doctor actually treating the patient to seek the patient’s consent.

Consent may be sought on behalf of colleagues if the doctor is capable of performing the procedure in question, or if they have been specially trained to seek consent for that procedure.

Essential information

Before they can decide whether to give their consent, patients need sufficient information about the proposed procedure/treatment:
- nature
- purpose
- benefits and risks
- alternatives

If the patient is not offered as much information as they reasonably need to make their decision, and in a form they can understand, their consent may not be valid.
Assessing competency

● Adult patients are always assumed to be competent unless demonstrated otherwise
● Competence is assumed if the patient is able to understand and weigh up the information needed to make the decision
● Unexpected decisions do not prove the patient is incompetent, but may indicate a need for further information or explanation
● Patients may be competent to make some healthcare decisions, even if they are not competent to make others

Refusal of treatment

● Adult competent patients are entitled to refuse treatment, even when it would clearly benefit their health
● A competent pregnant woman may refuse any treatment, even if this would be detrimental to the fetus

Exception to this rule

● The only exception is where the treatment is for a mental disorder and the patient is detained under the Mental Health Act, 1983. However, this does not preclude the individual from giving or withholding consent to treatment for physical conditions

Patients not competent to give consent

No one can give consent on behalf of an incompetent adult

● Patients may still be treated if the treatment would be in their best interests
● Best interests go beyond best medical interests and include factors such as:
  ● Wishes and beliefs of the patient when competent
  ● Current wishes
  ● General well-being
  ● Spiritual and religious welfare
  (Patient’s relatives, friends or carers may be able to provide information on some of these factors)

● Where the patient has never been competent, relatives or carers can provide useful insights into patient’s needs and preferences

Procedure for obtaining consent from competent adults

● Identify the patient using their:
  ● Name
  ● Date of birth
  ● Hospital number

● Ensure a senior colleague in clinic or the hospital has seen patient, and that the procedure or operation is still needed. This information can be obtained from the notes and by speaking to the patient

● The doctor must ensure that he/she is familiar with the procedure or operation, including the adverse effects, risks and benefits, and likely outcome. If there are any doubts, discuss these with the colleague who will be performing the procedure or operation before approaching the patient

● Never use the standard consent forms for adult patients unable to consent for themselves

● Where an adult patient does not have the capacity to give or withhold consent for a significant intervention, this fact should be documented in Consent Form 4 (form for adults who are unable to consent to investigation or treatment), along with the assessment of the patient’s capacity, why the health professional believes the treatment to be in the patient’s best interests, and the involvement of the people close to the patient. Where second opinion sought, he/she should also sign the form to confirm agreement with the decision to proceed

● For more minor interventions, this information should be entered in the patient’s notes

Procedure when the patient lacks capacity to give or withhold consent

● Identify the patient using their:
  ● Name
  ● Date of birth
  ● Hospital number

● Ensure a senior colleague in clinic or the hospital has seen patient, and that the procedure or operation is still needed. This information can be obtained from the notes and by speaking to the patient

● The doctor must ensure that he/she is familiar with the procedure or operation, including the adverse effects, risks and benefits, and likely outcome. If there are any doubts, discuss these with the colleague who will be performing the procedure or operation before approaching the patient

● Never use the standard consent forms for adult patients unable to consent for themselves

● Where an adult patient does not have the capacity to give or withhold consent for a significant intervention, this fact should be documented in Consent Form 4 (form for adults who are unable to consent to investigation or treatment), along with the assessment of the patient’s capacity, why the health professional believes the treatment to be in the patient’s best interests, and the involvement of the people close to the patient. Where second opinion sought, he/she should also sign the form to confirm agreement with the decision to proceed

● For more minor interventions, this information should be entered in the patient’s notes
CONSENT • 3/3

- Ensure the patient is fully competent to consent to the procedure
- In addition to examination of the patient, the doctor should involve nursing staff and family members/carers to determine this
- Ensure the patient understands the explanation. If the patient does not speak English an interpreter should be made available. If an interpreter has been used the consent form must be signed by the doctor and interpreter, in addition to the patient
- Use a standard NHS consent form
- Consent Form 1: for patient agreement to investigation or treatment
- Short Consent Form 3: for patient agreement to investigation or treatment for procedures where consciousness is not impaired
- The doctor must read the notes on the consent form carefully so that he/she is fully aware of the content
- The box containing the patient’s details should be correctly completed, and the ‘type of operation, investigation or treatment’ **must state the side, right or left, in full (not R or L)** where this is relevant
- After full discussion of the procedure or operation with the patient, hand them the form to read

Document the discussion in the case notes, including risks and benefits explained

- If the patient is satisfied with the explanations given by the doctor, that doctor must fill in and sign the part to be completed by doctor/dentist/healthcare professional
- If the explanation was given by a colleague and the patient is satisfied with the explanation from that colleague, document the name of doctor/dentist/healthcare professional who explained the procedure

Patients wishing to refuse some aspects of treatment or care (e.g. Jehovah’s Witnesses refusing blood transfusion) must list the procedures in which they do not want to be involved in the space provided on the statement of the patient form

- If the patient agrees to the procedure or operation, they should fill in and sign the statement of the patient form
- Patients have the right to refuse to be involved in training programmes, but this should be clearly documented on the consent form and in the medical notes, and the consultant responsible for their care must be informed. The patient should be reassured that their care is not compromised by this refusal
- The doctor must sign the form having given a detailed explanation of the consequences of refusal
- The doctor must make a detailed record of this in the patient’s medical notes
- The doctor must also ensure that all members of the team, including the surgeon and anaesthetist performing the procedure or operation, are fully aware of these refusals and are able to perform the procedure or operation whilst complying with the patient’s wishes
- The patient must be offered the copy of the consent form
INTRODUCTION
● The medical record forms part of the patient’s clinical record, together with the drug chart, nursing record etc.
● Poor medical records can put the patient at risk.
● Entries may later be scrutinised by the patient, their relatives or legal representatives.
● Entries must therefore be:
   • accurate
   • unambiguous
   • legible
   • contemporaneous
   • chronological
   • suitably frequent
   • unaltered
   • relevant
   • confidential
   • attributable

MINIMUM STANDARDS
● The notes folder must include:
   • the patient’s full name
   • their hospital number, full address, postcode and telephone number
   • their emergency contact details and their GP’s name
   • their gender, religion, ethnic origin and first language

● The clerking notes must include:
   • the name of the admitting consultant with date and time of initial consultation
   • the reason for admission/referral
   • the history and examination and provisional diagnosis
   • all treatments/interventions given
   • all drugs given
   • the results of all investigations
   • written details of oral instructions relating to the patient’s care
   • all relevant interactions with the patient, relatives and/or carers

   • Clinical records must be accurate and documented as soon as possible after the event.
   • Each notes sheet must have the patient’s name and hospital number recorded.
   • The entering doctor must date each entry (day, month, year), sign it, print his/her name legibly (with a bleep number if appropriate) and record his/her grade.
   • If the clinical picture is changing rapidly, entries must be timed.
   • Always use black ink (Never use green ink as it does not scan or photocopy).
   • Never write offensive comments about the patient, relative, carer or staff in the notes – not even as an acronym.

Documenting consent for surgical procedures
● The records must contain:
   • record of consent on correct consent form - see Consent guideline
   • pre-operative diagnosis or indication for treatment/surgery/investigations
   • medical care plan, including the site and side of the procedure.

● The operation notes must include:
   • name of consultant responsible
   • name of operating surgeon and assistant(s) and anaesthetist(s)
   • the date and time
   • the incision(s) used
   • a description of findings
   • diagnosis made and procedure performed
   • details of any tissue removed, altered or added
   • details and serial numbers of prostheses used
   • details of sutures used and the wound closure method
   • details of blood loss/transfusions
   • accurate description of difficulties (including needle stick injuries) and how they were managed
   • immediate post-operative instructions
   • the signature of the
Correction of errors

- When making a correction:
  - cross through the original entry but do not obliterate
  - do not use correction fluid
  - sign and date correction

- the signature of the anaesthetist on the anaesthetic record
**NORMAL WORKING HOURS**
- Monday-Friday: 0830-1800 hr
- Saturday: 0830-1300 hr
  
  [contact microbiology (4651) if sending a sample]

**OUT-OF-HOURS SERVICE**

<table>
<thead>
<tr>
<th>Mon</th>
<th>1800 – 0830 hr Tue</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tue</td>
<td>1800 – 0830 hr Wed</td>
</tr>
<tr>
<td>Wed</td>
<td>1800 – 0830 hr Thur</td>
</tr>
<tr>
<td>Thur</td>
<td>1800 – 0830 hr Fri</td>
</tr>
<tr>
<td>Fri</td>
<td>1800 – 0830 hr Sat</td>
</tr>
<tr>
<td>Sat</td>
<td>1300 – 1900 hr</td>
</tr>
<tr>
<td></td>
<td>1900 – 0830 hr Sun</td>
</tr>
<tr>
<td>Sun</td>
<td>0830 – 1800 hr</td>
</tr>
<tr>
<td></td>
<td>1800 – 0830 hr Mon</td>
</tr>
</tbody>
</table>

- Mark all cards **urgent**
- The request card must include the patient name (or emergency ID), unit number, consultant and ward. This is essential for electronic reporting of results
- All request cards must contain clinical information relevant to the investigation requested
- Inadequately completed or illegible cards or sample containers may result in the investigation not being performed
- Results will be phoned only if there is likely to be a delay in transmitting results to HISS/EPR, the biomedical scientist has already agreed to phone, or the results alert the biomedical scientist to the possibility that immediate action may be required

**Investigations available out of hours by written request**

- Do not bleep the biomedical scientist unless the results are very urgent and need to be telephoned

**For all urgent specimens except blood cultures, bleep microbiology**

### Department | Investigation
--- | ---
Blood Transfusion | Group and Save
Haematology | Full blood count (FBC) including WBC differential
              | International Normalised Ratio (INR)
              | Activated Partial Thromboplastin Time (APPT)
              | D-dimer for screening suspected DVT or PE patients
Biochemistry | Amylase
              | Blood gases
              | Cardiac profile
              | General profile
              | Liver function tests
              | Urate (in pregnancy)
              | U&E, including creatinine
              | Urine U&E, osmolality
              | Ethanol
              | Some drug concentrations (in overdose or monitoring IV infusions only):
              | - paracetamol, salicylate
              | - digoxin, phenytoin, theophylline, lithium, iron
              | Other toxicology requests (e.g. ethylene glycol, methanol) should be referred directly to the Regional Toxicology Laboratory, City Hospital Birmingham (speed call 1056) transport 2137
Microbiology | Blood cultures

**Investigations available out of hours requiring prior discussion with biomedical scientist**

- Be certain that the investigation cannot wait and will influence the immediate clinical management of the patient.

If the biomedical scientist is in any doubt about the relevance of the request they will ask the medical registrar or more senior doctor to contact the clinician on-call for the relevant laboratory specialty.
Department | Investigation
--------------|--------------------------------------
**Blood Transfusion** | Crossmatch red cells (see Administration of Blood and Blood Components)
- acute blood loss – transfuse (irrespective of Hb)
- massive blood loss – contact own consultant or specialist registrar to discuss the case
- if major bleeding continues after transfusion of 12 red cell units, or earlier in the event of thrombocytopenia or abnormal coagulation – contact the on-call clinical haematologist
- severe anaemia (see Severe anaemia)
Blood components e.g. FFP, Platelets; request may be referred to the on-call clinical haematologist
Urgent blood group
Direct Coombs’ test

**Haematology** | ESR in patients with suspected temporal arteritis
Blood films for morphology or differential white count
Malarial parasites
Infectious mononucleosis screen
Sickle cell screen in appropriate patients requiring urgent general anaesthesia
D-dimer with fibrinogen for assessment of DIC
Fibrinogen

**Microbiology** | CSF and theatre specimens at any time
Microscopy, culture and sensitivity on all other urgent fluids or swabs only up to 2300 hr each day. After 2300 hr, these will require prior agreement of the on-call clinical microbiologist
Antibiotic monitoring assays – these are batched and run at 1500 hr on Saturday, Sunday and Bank Holidays

**Histopathology** | Out of hours, a consultant histopathologist is available through Call Centre, for advice only

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### OUT-OF-HOURS CONTACT DETAILS

**Biomedical Scientists** – First line enquiries and requests for investigations

- **Biochemistry:** hospital bleep 389
- **Haematology/blood transfusion:** hospital bleep 390
- **Microbiology:** external pager 1822

**Clinical/Medical Staff** – Clinical advice/requests for some blood products and non-routine investigations

- **Haematology:** Via Call Centre or 715444
- **Biochemistry:** Via Call Centre or 715444
- **Microbiology:** Via Call Centre or 715444
- **Histopathologist:** Via Call Centre or 715444
ON-CALL RADIOLOGY SERVICE • 1/1

NORMAL WORKING HOURS
- Weekdays: 0900-1700 hr

HOT REPORTING/ RADIOLOGY ADVICE
- Weekdays: Main x-ray, NSPD 0900-1700 hr

LIMITED LISTS
- Saturday and Sunday: 0900-1200 hr:
  - doppler ultrasound studies for deep vein thrombosis (DVT)
- Saturday: 0900-1100 hr:
  - four V/Q scanning slots are available. Contact Nuclear Medicine 07740 845189

OUT-OF-HOURS SERVICE
Only investigations essential to the acute management of a clinical condition that cannot wait until normal working hours will be performed immediately:
- Plain radiography is requested from the on-site radiographer on call
- Emergency ultrasound, CT, and barium studies are requested from the on-call radiology registrar by a clinician of registrar grade or above
- Requests for vascular and urological interventional procedures may only be made with the agreement of the Vascular, Surgical or Urological Teams:
  - contact the on-call radiological registrar, who will liaise with the consultant interventional radiologist
  - if the consultant interventional radiologist is not available, patients may need to be transferred to another hospital for the intervention

ALL OTHER REQUESTS
- Contact the consultant surgeon on call. Explain the problem. The consultant surgeon must contact the consultant radiologist on call
- Urgent MRI scan is limited to Consultant referrals for acute conditions such as acute spinal cord compression which requires urgent treatment (see Acute spinal cord compression in the Medical Guidelines)

ON-CALL TELEPHONE AND BLEEP NUMBERS
- Radiographer:
  City General - hospital bleep 116
- Radiological registrar and consultant:
  Contact through hospital Call Centre (0)
The Modified Early Warning Scoring (MEWS) system identifies trends in patient’s physiology. A score based on routine nursing observations detects subtle changes in physiology. Triggers alert to improvement or deterioration in condition.

**MEWS is an aid to good clinical judgement, not a substitute for it.**

## INTRODUCTION

- The Modified Early Warning Scoring (MEWS) system identifies trends in patient’s physiology. A score based on routine nursing observations detects subtle changes in physiology. Triggers alert to improvement or deterioration in condition.

- **Respiration** counted over **1 full minute**
- **Temperature**
- **Pulse**
- **Blood pressure**
- **Oxygen saturation**
- **AVPU score** (Alert, Verbal, Pain, Unresponsive - see table below)
- **Urine output**
- If urine output unknown, score 0. If not catheterised, ask patient if they have passed urine recently.

## MEWS SCORING

### Complete a full set of patient observations

- Follow the MEWS escalation strategy as soon as the MEWS score is:
  - 6 or more OR
  - 3 in any single parameter OR

### Record observation on MEWS chart in nursing documentation

- If any observation falls into a red area on the chart, calculate MEWS score.
- Calculate the MEWS score by checking each parameter on the score chart. The chart gives a score according to each observation category. Add these scores to give MEWS score.

## MEWS SCORING TABLE

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Score 0</th>
<th>Score 1</th>
<th>Score 2</th>
<th>Score 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respiratory rate</td>
<td>8-14</td>
<td>15-20</td>
<td>21-30</td>
<td>&gt; 30</td>
</tr>
<tr>
<td>Systolic BP</td>
<td>70-80</td>
<td>81-100</td>
<td>101-179</td>
<td>180-199</td>
</tr>
<tr>
<td>Heart Rate</td>
<td>40-50</td>
<td>51-100</td>
<td>101-110</td>
<td>111-129</td>
</tr>
<tr>
<td>Oxygen Saturation</td>
<td>85.9%</td>
<td>90-94%</td>
<td>≥ 95%</td>
<td></td>
</tr>
<tr>
<td>AVPU score</td>
<td>New confusion/agitation</td>
<td>Alert</td>
<td>Responds to verbal stimuli only</td>
<td>Responds to painful stimuli only</td>
</tr>
<tr>
<td>Urine output mL/hr</td>
<td>&lt; 10 mL/hr</td>
<td>&lt; 30 mL/hr</td>
<td>&gt; 30 mL/hr</td>
<td></td>
</tr>
<tr>
<td>Temperature ºC</td>
<td>&lt; 35°C</td>
<td>35.35.9°C</td>
<td>36-37.9°C</td>
<td>38-39°C</td>
</tr>
</tbody>
</table>

## ACTION

- Shows a rise of 3 or more from the previous score, but is still less than 6
## MEWS Escalation Strategy

<table>
<thead>
<tr>
<th>Priority One</th>
<th>Priority Two</th>
<th>Priority Three</th>
</tr>
</thead>
<tbody>
<tr>
<td>MEWS score 6-7 or a rise of 3 or more from previous reading</td>
<td>MEWS score 8-14 or a rise of 3 or more within this range</td>
<td>MEWS score 15-21 or a rise of 3 or more within this range</td>
</tr>
<tr>
<td>Contact Nurse Practitioner/PRHO/SHO for patient review and/or advice re clinical management</td>
<td>Contact Nurse Practitioner/SHO for immediate patient review who should consider contacting a Registrar/Consultant for advice Discussion should include advice re ITU referral</td>
<td>Contact Nurse Practitioner/SHO/Registrar/Consultant FOR IMMEDIATE PATIENT REVIEW</td>
</tr>
</tbody>
</table>

- Have relevant clinical data (e.g. history/current and previous observations/MEWS score/most recent bloods) available at time of referral
- Ensure all observations charts (e.g. TPR/fluid balance/BMs) are accurate and up to date
- Increase frequency of observation as directed by ANP/MNP/SHO
- Establish IV access and take bloods as directed
- Establish IV access and take bloods as directed, obtain an ECG and place on cardiac monitor
- Have notes/prescription chart/X-rays at hand and monitor patient until nurse practitioner or doctor arrives
- Stay with patient until nurse practitioner or doctor arrives

If MEWS score:
- > 7 OR
- rises more than 3 from previous reading OR
- rises despite clinical interventions/therapies, escalate and action patient according to a Priority Two

If a priority Two MEWS score (8-14) rises by 3 or more despite clinical intervention/therapies, contact Registrar for further advice

If a priority Two MEWS score rises beyond 14, escalate and action patient to a Priority Three

A patient who has a MEWS score > 14 is at risk of catastrophic deterioration. Refer for review by SpR/Consultant
AGGRESSIVE AND VIOLENT PATIENTS • 1/3

PREVENTION
- Often very minor incidents can escalate into a violent situation. Communicate clearly to prevent violent situations.

RECOGNITION

Warning signs of impending violence
- Spontaneous self-reporting of angry or violent feelings or fluctuating levels of consciousness with prominent persecutory ideas.
- Carers warn of imminent violence:
  - increased restlessness, bodily tension, pacing, arousal
  - increased volume of speech, erratic movements
  - facial expression tense and angry, discontented
  - refusal to communicate, withdrawal
  - unclear thought processes, poor concentration
  - delusions or hallucinations with violent content
  - audible threats, or aggressive gestures
  - recognition of signs apparent in earlier episodes

PERSONAL (OWN) BEHAVIOUR
- Maintain adequate distance
- Move towards safe place, avoid corners
- Explain intentions to patient and others
- Be calm, self-controlled, confident
- Ensure own body language is non-threatening
- Avoid sudden movements

SAFETY
- Do not attempt to deal with a violent patient on your own
- Keep other patients clear
- Keep other staff clear but within helping distance
- If possible, move patient to a quiet area

Context
Aggression or agitation can occur in:
- psychiatric illness
- substance abuse
- personality abuse
- confusional state
- irrespective of underlying cause

ASSESSMENT

Assessment must be by a registered doctor (SHO or above). PRHOs are not qualified to assess mental capacity and must not attempt to do so. Inform senior member of medical team (registrar or consultant).

If there are signs of impending violence, inform site manager, who will identify any staff on duty who have been trained in restraint techniques.

Verbal de-escalation
- Engage in conversation, acknowledge concerns and feelings
- Ask for reasons for disquiet, encourage reasoning
- Ask for any weapon to be put down (not handed over)

If patient too disturbed for such measures, or fails to respond:
- consider physical restraint by trained staff and/or Police (see below)

Assessment
- Try to take a history from the patient and those who know the patient
- ask whether this has happened before and how it was handled
- ask about any regular psychotropic medication
- Do a mental state
examination by noting:
- general appearance and behaviour of the patient
- speech
- attention and concentration
- mood: subjective and objective
- thought: evidence of loosening of association, irrelevant thoughts, delusions, thoughts of self harm or harm to others
- hallucinations
- evidence of cognitive impairment
- insight
- Assess mental capacity.
  Does patient:
  - comprehend and retain information?
  - believe what he/she is told?
  - use the information given to make a decision or a choice?
- Attempt a thorough physical examination, looking for sources of infection and/or neurological deficits

Risk factors for violence
- Young, male, history of violence
- Alcohol or other substance misuse, irrespective of other diagnosis
- Poor collaboration with suggested treatments
- Antisocial, explosive or impulsive personality traits
- Active symptoms of schizophrenia or mania, in particular with:
  - delusions or hallucinations focused on a particular person
  - delusions of control, particularly with a violent theme
  - specific preoccupation with violence
  - agitation, excitement, overt hostility or suspiciousness

Immediate treatment

Principles
- If acute mental illness, such as schizophrenia or hypomania, suspected, refer to on-call Psychiatry team
- If patient elderly with acute confusion, see Confusion: Mental illness in older people - in the Medical Guidelines
- If patient has symptoms and signs of alcohol withdrawal, see Alcohol withdrawal - in the Medical Guidelines
- If patient intoxicated, but fit to be arrested and taken into custody, request Police assistance (if urgent, dial 9-999; if non-urgent, dial 08453 302010)
- If none of the above applies, the options available depend on the patient’s mental capacity

Incapable of making decisions

Always ensure that any intervention used is:
- the least restrictive or harmful
- immediately necessary
- reasonable, and
- in best interest of patient

- Conduct multidisciplinary discussion to decide whether rapid sedation is safe and appropriate
- Take all necessary means to prevent injury to self or staff, or damage to property
- consider use of physical restraint and/or medication - see below
- Manage underlying cause of agitation

Physical Restraint

Physical restraint is the last resort. Once staff attempt to restrain a patient, a threatening situation will turn violent. The doctor should not attempt to physically restrain the individual, but should request assistance from any member(s) of staff on duty trained in restraint techniques

- Use restraint only if there are sufficient staff to achieve this effectively

- Hold patient accountable for his/her actions

- Manage underlying cause of agitation
- Do not administer medication without patient’s consent
and you perceive imminent danger because the patient is:

- displaying prolonged and serious verbal abuse, threatening staff, or disrupting ward
- threatening or attempting self-injury
- at risk of prolonged over-activity with risk of exhaustion
- at risk of serious accident to self and others
- attempting to abscond (if detained under Section and in an open ward)
- Do not, under any circumstance, inflict deliberate pain
- Avoid restraining a patient in the prone position (face-down). If there is no other way, do not restrain the patient in that position for more than three minutes
- If no suitably trained staff available, or the patient is making significant physical attacks or serious efforts to destroy property, leave the scene immediately and request Police assistance (dial 9-999 and say clearly 'I am in fear for my safety')

**The Police will always respond to a call for assistance, but are not allowed to assist in restraining patients for treatment**

### MEDICATION

**If new brain damage suspected, avoid medication until after CT scan. Check prescription chart for previously prescribed drugs. Use medication sparingly in the elderly**

- In cases of substance misuse, treat any symptoms suggestive of withdrawal – see Drug withdrawal - in the Medical Guidelines
- Try to persuade patient to accept oral medication
- If this is unacceptable, use parenteral route
- Recommended alternatives (Do **NOT** exceed BNF limits) are:
  - haloperidol 5 mg oral/IM (elderly 2.5 mg oral/IM)
  - lorazepam 1 mg oral/IM [(elderly 0.5-1 mg (15 mcg/kg)]
- If patient known or believed to have epilepsy or ischaemic heart disease, use lorazepam as first choice
- Observe physical and mental state carefully following sedation
- If no response 1 hour after haloperidol, give lorazepam
- If no response 1 hour after lorazepam, give haloperidol
- If haloperidol causes acute extrapyramidal effects, treat with procyclidine 5 mg IM

- If no response to two forms of medication, seek advice from **on-call psychiatry team**

### SUBSEQUENT MANAGEMENT

- Monitor vital signs
- Record BP, pulse, respiratory rate, hydration and level of consciousness as agreed by multidisciplinary team until fully conscious
- Record further care plan

### Documentation

- Record the incident clearly and fully afterwards
- Complete an Adverse Incident Report Form with witness statements

### Once stable

- Continue close observation for at least 24 hr as inpatient
- Reassess mental state and review patient’s status under the Mental Health Act
- Continue management of underlying condition
- When transferring patient between units, send:
  - details of incident
  - medication management
  - subsequent management plan
  - any unwanted effects
  - any advanced directives

**UNIVERSITY HOSPITAL OF NORTH STAFFORDSHIRE NHS TRUST**

**AGGRESSIVE AND VIOLENT PATIENTS • 3/3**

**Issued: June 2006**

**Expires: June 2007**
## PROCEDURE
- Assess the patient’s condition against the following criteria:
  - no heart beat heard over a full minute
  - no brachial or carotid pulse felt over a full minute
  - no breath sounds heard and no chest movement seen over a full minute
  - pupils fixed and dilated
  - corneal reflex absent

## INFORMATION TO BE RECORDED IN PATIENT’S MEDICAL NOTES
- Date and time of examination of the body
- Entry stating that:
  - no heart beat heard over a full minute
  - no brachial or carotid pulse felt over a full minute
  - no breath sounds heard and no chest movement seen over a full minute
  - pupils fixed and dilated
  - corneal reflex absent
- Patient verified as dead
- Signature, name and designation of verifier

## LEGAL ISSUES
- A doctor who has attended a deceased person during their last illness is required to issue a medical certificate stating the cause of death ‘to the best of his/her knowledge and belief’
- The doctor is not obliged to view the body but good practice requires that if they have any doubt about the fact of death they should satisfy themselves in this way
- As the doctor is not obliged in law to see the body in order to issue a certificate, appropriately trained nurses may expand their role into the verification of expected death
- It is the hospital doctor’s responsibility to:
  - inform the coroner where necessary
  - issue the death certificate
  - inform the deceased’s GP

## THE CORONER
- When registering the death at the registration office (CGH 2811, NSRI 4116), ask if the coroner must be informed. The registrar is regularly updated with the coroner’s requirements
- The circumstances of death about which the coroner must be informed include:
  - sudden death (within 24 hr of admission to hospital)
  - patients in whom diagnosis is uncertain
  - self-neglect or neglect by others
  - suicide
  - unnatural/suspicious/accident/due to violence
  - patients in custody
  - patients with industrial diseases, even if not cause of death
  - operation in last 12 months
  - death during procedure or operation/before recovery from anaesthetic

The coroner must be contacted to discuss any case where there is any doubt regarding any of the above circumstances.
ACUTE PROBLEMS
Acute right iliac fossa (RIF) pain is one of the more common presentations of an acute abdomen in surgical practice.

**DEFINITION**

Pain in the RIF of < 72 hr duration

**HISTORY**

- Duration of symptoms
- Previous episodes and outcome
- Migration of pain, e.g. central to RIF
- Associated symptoms e.g. GI, renal or gynaecological

**EXAMINATION**

- Pulse rate, temperature and hydration
- Location of maximal tenderness
- Signs of peritoneal irritation – rebound tenderness, guarding, and rigidity
- ? mass in RIF
- Rectal and pelvic examination - ?tenderness, mass
- If findings inconclusive, reassess in 2-4 hrs

**INVESTIGATIONS**

**Blood**

- FBC looking for raised WBC
- U&E
- CRP. If normal, unlikely to be appendicitis

**Urine**

- Urine analysis for blood, protein, cells
- Pregnancy test dipstick

**Imaging**

- If diagnosis unclear:
  - ultrasound scan of abdomen
  - in selected patients (e.g. high BMI) consider limited CT scan
  - if ureteric colic suspected, consider IVU or CT urogram (after urology opinion)
- If investigations negative, consider later barium follow-through and/or enema

**MANAGEMENT**

- Fluid resuscitation
- Pain relief. If opiates necessary, ensure patient examined by SpR before administration
- Reassess (pain, tenderness, guarding, temperature, pulse, hydration) regularly
- If surgery required, prepare and consent patient. See Consent guideline
- In women of child-bearing age, if there are signs of RIF peritonitis but uncertainty as to its origin, consider diagnostic laparoscopy. The purpose of laparoscopy is to determine the site of significant pathology, not to ascertain whether there is any
- If diagnosis remains uncertain:
  - seek opinions from other specialties e.g. gynaecology, urology

**Remember**

- Organs not normally ‘resident’ in the RIF can cause pain there e.g. gall bladder, peptic ulcers, radicular pain, sigmoid diverticulitis
- In older patients, have a higher index of suspicion for ‘non appendiceal’ causes of RIF pain
- HIV infected patients may have a cause for RIF pain related to immune deficiency. Liberal use of imaging and laparoscopy are indicated. Liaise with infectious diseases team

**Antibiotics**

- For non perforated appendicitis, a single dose of antibiotics at induction is adequate - see Antibacterial prophylax for gastrointestinal, biliary and general surgery
- In established intra abdominal sepsis, see appropriate guideline or section 5.1 in current BNF
- Do not prescribe antibiotics if the diagnosis is uncertain

**POST-OPERATIVE MANAGEMENT**

- Appropriate to the procedure performed
- Uncomplicated appendicectomy does not require follow up
### RECOGNITION AND ASSESSMENT

#### Symptoms and signs
- Pain
  - may be constant or colicky
  - may radiate to back or chest
- Pyrexia, particularly if acute cholecystitis
- Vomiting of food, dark-brown, denatured blood (‘coffee-grounds’), or fresh blood (haematemesis)
- Melaena (black, tarry, smelly stool containing digested blood) suggests peptic ulcer

#### Previous history
- Enquire about:
  - peptic ulceration
  - liver disease
  - ulcerogenic medication (particularly non-steroidal anti-inflammatory drugs)
  - alcohol intake
  - weight loss

#### Examination
- Pulse, BP, temperature
- Anaemia
- Jaundice (suggests gallstones, cholangitis, or severe hepatic or pancreatic disease)
- Abdominal tenderness
- Rebound tenderness
- Guarding/rigidity
- Mass (including palpable gall bladder)

#### Differential diagnosis
- Biliary colic
- Acute cholecystitis
- Pancreatitis/carcinoma pancreas
- Acute peptic ulceration (including perforation)
- Hiatus hernia
- Perforation lower oesophagus (spontaneous/iatrogenic/foreign body)
- Trauma – ruptured spleen/liver/bowel/diaphragm
- Ruptured/dissecting abdominal aortic aneurysm. See **Acute abdominal aortic aneurysm**
- Referred chest pain in association with:
  - myocardial infarction
  - pulmonary embolism
  - pleurisy
  - pericarditis

#### Investigations
- FBC
- U&E
- Serum amylase
- If jaundice, LFT, INR
- Plain abdominal X-ray
- If suspecting:
  - upper GI perforation – erect chest X-ray
  - biliary colic or acute cholecystitis – abdominal ultrasound
  - malignancy – CT scan
  - acute abdominal aortic aneurysm, see **Acute abdominal aortic aneurysm**
  - peptic ulcer – upper GI endoscopy
  - If pyrexial – blood cultures

### IMMEDIATE TREATMENT
- Baseline observations:
  - temperature, pulse, blood pressure
- Establish IV access
- Administer 1L of sodium chloride 0.9% IV over 1 hr
- If infective cause suspected, give appropriate antibiotic (e.g. ciprofloxacin for cholecystitis/cholangitis)
- Insert nasogastric tube
- Seek senior help, at least SpR
- consider transfer to SSCU/HDU for resuscitation and invasive monitoring
- may require emergency surgery

### DISCHARGE POLICY
- Patients with malignant disease may need further investigation and treatment (discuss with Upper GI Cancer Team cancer nurse specialist 3101)
- Patients with *H. pylori*-positive peptic ulceration require $^{13}$C breath test (via Gastroenterology Department) to ensure eradication of *H. pylori*
SMALL BOWEL OBSTRUCTION • 1/2

AETIOLOGY

Within the lumen (rare)
- Gallstone
- Food bolus
- Bezoars (accumulations of ingested materials e.g. food or hair)
- Parasites (e.g. ascaris)
- Enterolith
- Foreign body

Within the wall
- Tumour: primary, secondary
- Inflammation
- Crohn’s disease
- Radiation enteritis
- Infection
- TB

Outside the wall
- Adhesions: congenital
- Acquired (most common cause in UK - 70% resolve spontaneously)
- Hernia: inguinal/femoral/incisional/umbilical/internal
- Intussusception
- Volvulus

Small bowel obstruction is less likely to resolve in the ‘virgin’ abdomen and operative intervention is more likely

SYMPTOMS AND SIGNS

- Central colicky abdominal pain
- Absolute constipation, (bowels not open and no flatus passed)
- Vomiting - occurs early in high small bowel obstruction (may be faeculent once obstruction established)
- Abdominal distension - most likely in low small bowel obstruction

Physical examination
- Temperature, pulse, BP
- Check hydration
- Look for abdominal distension, scars, lumps, herniae
- Check for tenderness, masses, peritonism
- High pitched ‘tinkling’ bowel sounds, often interspersed by silence
- Rectal examination

Differential diagnosis
- Gastric outlet obstruction e.g. duodenal ulcer or Ca stomach
- Infective conditions e.g. gastroenteritis caused by salmonella, shigella - usually accompanied by diarrhoea
- Superior mesenteric artery/vein thrombosis
- Ascites/carcinomatosis
- Pancreatitis

INITIAL INVESTIGATIONS

To assess general state, confirm diagnosis and establish cause
- FBC
- U&E
- Clotting studies - INR and APTT
- Consider arterial blood gases if unstable (metabolic acidosis may indicate bowel ischaemia)
- Plain X-ray supine abdominal/chest
- Bowel may be only slightly dilatated with high small bowel obstruction
- Consider gallstone ileus - look for calcified gallstone, and air in biliary tree

INITIAL MANAGEMENT

Resuscitation
- Give O2
- IV fluids
- Hartmann’s solution/sodium chloride 0.9% with KCl as necessary to replace fluid lost in third space

Always use commercially produced pre-mixed bags of sodium chloride 0.9% and potassium chloride. NEVER add potassium chloride to infusion bags
- Nasogastric tube (aspirated on insertion and 4 hrly) left on free drainage to decompress upper GI tract and reduce risk of aspiration pneumonia

To assess general state, confirm diagnosis and establish cause
In established small bowel obstruction do not wait for vomiting before inserting NG tube

- Give analgesia early and in adequate doses
- Catheterize and monitor urine output hrly
- Consider central venous line to monitor resuscitation/rehydration in elderly or patients with cardiac disease
- Give DVT prophylaxis

SUBSEQUENT INVESTIGATIONS

- CT with or without oral contrast can identify level of obstruction and/or presence of malignancy including metastases
- Contrast radiology e.g. small bowel follow-through or small bowel enema if low small bowel obstruction

MONITORING

- Assess hourly until stable, then 4-6 hrly
- Adequacy of resuscitation
- Progress of obstruction
- Any deterioration
- Temperature, pulse and BP
- Abdominal signs e.g. developing tenderness
- Volume of aspirate – increasing or reducing
- Quality of aspirate - becoming faeculent
- Repeated bloods increasing leucocytosis, rising CRP

Indications for surgery

- Generalised peritonitis
- Visceral perforation
- Irreducible hernia
- Localised peritonitis

- Palpable mass
- ‘Virgin’ abdomen
- Failure to improve

- Incomplete obstruction
- Previous surgery
- Advanced malignancy
- Diagnostic doubt

Absolute indication

Relative indication (surgery within 24 hr)

Trial of conservative management
LARGE BOWEL OBSTRUCTION • 1/1

AETIOLOGY

- Cancer
- Sigmoid volvulus
- Caecal volvulus
- Diverticular disease

SYMPTOMS AND SIGNS

- Abdominal pain
- Constipation
- Abdominal distension
- Vomiting (particularly if incompetent ileo-caecal valve)
- Constipation
- Abdominal distension
- Abdominal pain
- Vomiting
- Abdominal distension

DIFFERENTIAL DIAGNOSIS

- Colonic pseudo-obstruction (functional obstruction of the colon leading to megacolon in the absence of obvious colonic diseases or mechanical obstruction)

INVESTIGATIONS

- FBC
- U&E
- Erect chest X-ray – particularly if perforation suspected
- Abdominal X-ray
- Look for caecal distension vs small bowel dilation.
- Risk of caecal rupture increases if caecum > 10 cm diam. Probability of caecal perforation increased by competent ileo-caecal valve, causing ‘closed-loop’ obstruction.

MANAGEMENT

- Decision on method of decompression/laparotomy must be made by a consultant or SpR

General

- IV fluids – correction of hypokalaemia often necessary in pseudo-obstruction
- NG tube – if incompetent ileo-caecal valve and associated small bowel obstruction
- Analgesia
- Urinary catheter
- Oxygen

Non-operative decompression

- Rigid sigmoidoscopy and passage of flatus tube decompresses sigmoid volvulus in 80% of cases and may decompress colon in acute colonic pseudo-obstruction
- If decompression with rigid sigmoidoscope fails in sigmoid volvulus or pseudo-obstruction, and there are no signs of ischaemic or gangrenous colon, attempt colonoscopic decompression
- In malignant large bowel obstruction, self-expanding metal stents can decompress the colon, either temporarily to relieve obstruction and allow semi-elective surgery with reduced morbidity and mortality, or definitively if metastases present or surgery inappropriate

Operative management

- Bowel resection and/or colostomy/ileostomy/caecostomy will be decided by senior surgeon
**BACKGROUND**

- Abdominal aorta accounts for 90% of all aneurysms
- Any abdominal aorta > 3 cm in diameter is aneurysmal
- Probability of rupture increases with size

**AAA may present in three ways:**

- **Ruptured:**
  - overall mortality 80% - most die before reaching hospital
  - commoner if diameter > 5.5 cm
- **Symptomatic** – back or abdominal pain
- **Found incidentally** (asymptomatic) – 75% of all diagnosed AAA

**RUPTURED AAA**

**Symptoms and signs**

In the common retroperitoneal rupture (patient has contained retroperitoneal haematoma), the classical triad, (not exclusive) is:

- pain in abdomen and back (intermittent or constant)
- hypovolaemic shock/sudden collapse
- pulsatile abdominal mass – not always palpable because of low BP or obesity

**Rupture into duodenum (aorto-enteric fistula),** usually in patients with previous AAA repair, but can occur spontaneously

- Massive upper GI bleed (rare due to rupture into duodenum)

**Immediate Management**

- Group and crossmatch 12 units of blood
- Oxygen 5 L/min
- Insert 2 large bore cannulae and commence 1L sodium chloride 0.9% over 1 hr
- Monitor pulse, BP, oxygen saturation
- Notify on-call surgical and anaesthetic SpRs and surgical consultant
- Inform emergency theatre
- Arrange transfer for CT if required
- Transfer to theatre anaesthetic room
- Opiate analgesia after USS
- Catheterize bladder

**Investigations**

- FBC, U&E, APTT, INR, ESR, amylase, glucose
- ECG
- USS of abdomen
- confirms presence of AAA ± suprarenal
  - (may show if suprarenal)
  - cannot confirm rupture
- CT scan of abdomen (and chest if it may be thoraco-abdominal)
- shows AAA morphology and relationship to renal and visceral arteries
- usually confirms rupture

If cerebral function remains preserved, low blood pressure does not warrant major IV resuscitation

A systolic BP of 70-100 mmHg is acceptable in the short term as fluid replacement can cause further expansion and intraperitoneal rupture of a contained retroperitoneal haematoma

As a rule give no more than 2 L of sodium chloride 0.9%

Give plasma expanders and blood pre-operatively only if crystalloid fails to maintain BP

If rupture is confirmed, immediate surgery required unless pre-existing co-morbidity contraindicates it. The on-call surgical consultant will decide whether to operate

**Post-operative Care**

Will be decided by surgical and anaesthetic teams and will usually require ITU admission
ACUTE ABDOMINAL AORTIC ANEURYSM • 2/2

SYMPTOMATIC BUT NOT RUPTURED AAA

Symptoms and Signs
- Pain in abdomen and/or back associated with tender AAA
- Symptoms related to effect on adjacent structures (e.g. ureteric obstruction and weight loss, often related to inflammatory AAA)
- Acute embolism of lower limb(s) as a result of thrombus dislodged from aneurysm wall

Differential diagnosis
- Renal colic – always keep AAA in mind if man aged > 55 yr presents for the first time with renal colic
- Myocardial infarction
- Acute pancreatitis
- Mesenteric infarct
- Diverticulitis
- Lumbar spine pathology

Investigations
- As for ruptured AAA, including immediate USS and CT

Immediate management
- Crossmatch 4 units of blood
- Notify on-call surgical SpR and consultant surgeon
- Manage patient as ruptured AAA until rupture has been excluded. When CT confirms that there is no leak, Consultant surgeon will decide management

INCIDENTALLY FOUND AAA

- Usually as a pulsatile abdominal mass found during routine examination, or during imaging of abdomen requested for an unrelated problem
- Confirm with USS of abdomen if not already done
- Refer to Vascular Team for evaluation and further management

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ACUTE PANCREATITIS • 1/2

RECOGNITION AND ASSESSMENT

Symptoms and signs
- Epigastric pain +/- radiation to back
- Nausea
- Vomiting
- Abdominal tenderness
- Abdominal distension (in severe cases)
- Vague epigastric mass
- Discolouration in lumbar region and/or periumbilical area because of bleeding into retroperitoneal space
- Haemodynamic instability/hypovolaemic shock with a low (< 100 mm Hg) BP and/or tachycardia (> 100 beats per minute)

Causes
- Gallstones/alcohol (80%)
- Idiopathic (10%)
- Iatrogenic e.g. endoscopic retrograde cholangiopancreatograph; ERCP (5%)
- Miscellaneous (5%):
  - hypertriglyceridaemia
  - trauma
  - hyperparathyroidism
  - viral
  - drugs (e.g. thiazides)

Investigations
- FBC
- U&E
- Serum amylase* 
- LFT
- Blood glucose

*Serum amylase usually > three-times normal. Lower concentrations do not rule out diagnosis because amylase may fall towards, or to normal within the first 24-48 hr. Serum amylase can be raised in perforated peptic ulcer or ischaemic bowel, but usually < three-times normal

Differential diagnosis
- Biliary colic or acute cholecystitis
- Peptic ulcer
- Bowel perforation
- Intestinal ischaemia
- Ruptured aortic aneurysm
- Myocardial infarction

IMMEDIATE TREATMENT

Mild:
- nil by mouth
- NG tube
- sodium chloride 0.9% IV 8 hrly
- analgesia – pethidine may be required, even if mild

Severe; add:
- admit SSCU/HDU/ITU
- degree of hypovolaemic shock often underestimated. Insert CVP line
- IV fluids (crystalloid) – often need large volumes to maintain CVP over first 24-48 hr. If difficulty maintaining CVP and BP with crystalloid, discuss fluid management with ITU doctors
- Target urine output > 30 mL/hr

If abdominal CT scan suggests > 30% necrosis of the pancreas, and patient has no history of seizures, give pre-emptive imipenem 500 mg by IV infusion 8 hrly. If patient has history of seizures, prefer meropenem 500 mg IV 8 hrly. If penicillin allergic or if there is any doubt about whether the

Severity
- Severe disease present if three or more of the following are detected within 48 hr of onset:
  - > 55 yr
  - WBC > 15 x 10⁹/L
  - random blood glucose > 10 mmol/L
  - urea > 16 mmol/L
  - PaO₂ < 8.0 kPa
  - Albumin < 32 g/L
  - Calcium < 2.0 mmol/L
  - Lactate dehydrogenase > 600 u/L

Issue 03
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patient is truly penicillin allergic, contact Consultant Microbiologist (4666) or Consultant in Infectious Diseases (2299)

Complications

- Acute respiratory distress syndrome (ARDS) – discuss with ITU (3129, 3134)
- Renal failure (see Acute renal failure)
- Deterioration despite maximum support – consider infection/pancreatic necrosis

SUBSEQUENT MANAGEMENT

- ERCP recommended within 72 hr in presence of:
  - jaundice
  - cholangitis
  - dilated bile ducts
- If patient has gallstones, perform cholecystectomy on admission and no later than two weeks after presentation
- Refer patients with severe pancreatitis to Upper GI Team as biopsy, drainage, and/or necrosectomy of the pancreas may be needed
ACUTE LIMB ISCHAEMIA • 1/3

DEFINITION

Acute limb ischaemia results from sudden interruption of the limb blood supply by thrombus or embolus. It carries a high morbidity, including loss of limb. There are two major categories:

ACUTE LIMB ISCHAEMIA

- Most commonly caused by emboli
- Usually of cardiac origin
- Often occur in otherwise normal arteries
- Lodge at artery bifurcations, femoral artery bifurcation most commonly, followed by brachial
- Carry higher morbidity because the extremity has not had time to develop collateral circulation
- Whether embolus or thrombus, occlusion results in both proximal and distal thrombus formation due to stagnant flow

ACUTE-ON-CHRONIC LIMB ISCHAEMIA

- Existing atherosclerosis in a patient with a history of peripheral vascular disease (PVD) is acutely compounded by thrombus and this must be regarded as a vascular emergency

RISK FACTORS

- Diabetes
- Hypertension
- Hypercholesterolaemia
- Smoking
- Pre-existing PVD
- AAA/popliteal aneurysm
- Atrial fibrillation

SYMPTOMS AND SIGNS

- The limb becomes:
  - Pale (later mottled and cyanosed)
  - Painful
  - Pulseless
  - Perishing cold
  - Parasthaesia
  - Paralysis
- Acute total ischaemia with an acute 'white leg' indicates the threat of muscle necrosis within 12 hours

ASSESSMENT

- Ask about:
  - Claudication
  - Night pain
  - Tissue necrosis
- Determine site of occlusion
  - Examine for presence of all peripheral pulses, including abdominal aortic pulse
  - Assess quality and regularity of pulse, noting AF in particular
  - Auscultate for bruits (e.g. subclavian, axillary, femoral)

- Assess likely nature of occlusion
- Thrombus suggested by:
  - Pre-existing claudication with sudden deterioration
  - No obvious source for emboli
  - Reduced or absent pulses in contralateral limb
  - Evidence of widespread vascular disease (e.g. myocardial infarction, stroke, TIA, previous vascular surgery)
- Embolus suggested by:
  - Sudden onset of painful leg (< 24 hr)
  - No history of claudication
  - Clinically obvious source of embolus (e.g. atrial fibrillation, recent myocardial infarction)
  - No evidence of peripheral vascular disease (normal pulses in contralateral limb)
  - Evidence of proximal aneurysm (e.g. abdominal or popliteal)
ACUTE LIMB ISCHAEMIA • 2/3

Assess neurosensory deficit

Grade I  Variable  ● Painful, tender calf/painful plantar flexion  
         ● No neurosensory deficit  
         ● Audible Doppler signal

Grade II  Threatened  ● Reduced sensation in foot  
         ● No audible Doppler signal

Grade III Irreversible  ● Cold extremity with tense muscles  
         ● Complete neurological deficit  
         ● No audible Doppler signal

INVESTIGATIONS

● Bloods:  
  ● FBC, U&E  
  ● Clotting screen, group & save  
  ● Serum creatine kinase  
  ● ECG  
  ● Chest X-ray  
  ● Ankle Brachial Pressure Index (ABPI)  
  ● If aneurysm suspected – abdominal USS, duplex Doppler scan of popliteal arteries

IMMEDIATE TREATMENT

General

● Assess airway, breathing and circulation, and resuscitate as required  
● Give supplemental oxygen, starting with a 24% Venturi mask to improve oxygen supply to the leg  
● Give adequate analgesia

● Opioid analgesia with an anti-emetic e.g. morphine and cyclizine  
● Give IV fluids as increased viscosity can easily lead to dehydration. See Fluid Replacement in Medical Guidelines  
● Nil-by-mouth until opinion of Vascular Team obtained  
● Catheterize and monitor input/output  

Specific - see Flowchart

● Seek opinion from Vascular Team urgently; if not available, wait until the morning  
● Monitor vital signs and condition of leg regularly  
● If not for surgery within 4 hrs, give IV heparin (see IV heparin). If out-of-hours, IV heparin can be administered overnight to prevent propagation of thrombus  
● Discuss angiography with senior surgeon (if evidence of renal impairment, consider cover with N-acetylcysteine 600 mg bd)  
● If long history (days or weeks), give pain relief until next working day as ischaemia will be irreversible  
● If signs of infection, seek advice of Consultant Microbiologist (4666)
ACUTE LEG ISCHAEMIA

NEUROSENSORY DEFICIT

YES

CRITERIA FOR EMBOLUS

YES

Probable embolus
Proceed to embolectomy

NO

IV HEPARIN

Vascular surgical opinion and angiography
(Next day if out-of-hours)

SUBSEQUENT MANAGEMENT

- Monitor condition of leg closely post-operatively/post-thrombolysis to detect early re-occlusion
- Continue IV heparin infusion for at least a further 48 hr
- Individual decision regarding treatment with warfarin/aspirin/clopidogrel
- Ensure therapeutic anticoagulation with regular INR
- Treat AF as required (see Atrial fibrillation in Medical Guidelines)
- Encourage early mobilization
- Identify risk factors (e.g. fasting lipid screen)
- Give patient appropriate advice regarding lifestyle change:
  - smoking cessation
  - exercise
  - diet
- Treat hypertension and/or raised cholesterol appropriately
- Ensure appropriate outpatient follow-up with Vascular Team
ACUTE RETENTION OF URINE • 1/1

RECOGNITION AND ASSESSMENT

Definition

Inability to pass urine with a significant quantity of residual urine in the bladder – usually over 500 mL. It is more common in men. Acute retention is painful, whereas chronic retention is usually painless.

Symptoms and signs

- Patient unable to pass urine – often after frequent failed attempts
- Pain - may be severe
- Bladder is palpable and feels full
- Occasionally dribbling of urine

RISK FACTORS

- A history of continual urinary symptoms
- Large prostate
- Previous catheterization
- Recent anaesthetic/surgery (particularly lower abdominal)
- Increased fluid intake
- Diuretic therapy

DIFFERENTIAL DIAGNOSIS

- Ovarian mass
- Large uterus
- Dilated bowel
- Anuria (renal failure)
- Always consider a spinal cord lesion
  - always check patient can stand and walk – retention due to a spinal cord lesion needs rapid treatment if there is to be any chance of recovery

IMMEDIATE MANAGEMENT

- Catheterize immediately to relieve distress. See Urethral catheterization
- U&E, FBC
- If U&E normal, send patient home with a leg bag after arranging an outpatient appointment
- If U&E abnormal, admit for regulation of fluid and electrolyte balance
- If Hb low, it may be due to chronic retention, but consider other causes

INPATIENT MANAGEMENT

- Usually oral fluids are adequate for maintaining fluid balance
- If postural hypotension develops or weight continues to decrease after 48 hr, give IV fluid only
- Give IV sodium chloride 0.9% as daily output plus 500 mL
- Some patients may require dialysis in the short or long term

SUBSEQUENT MANAGEMENT

- If the residual bladder volume was not too large (< 1L) or if there was a precipitating event such as an anaesthetic or large fluid intake, give trial without catheter
- before a trial without catheter (TWOC), give an alpha blocker (e.g. tamsulosin or alfuzosin) for at least 48 hr before trial
- If residual volume > 1L, patient will usually be offered surgery

INPATIENT MONITORING

- Measure blood pressure lying and standing at least 4 times per day
- Weigh daily
- U&E daily

- If renal function fails to improve, this may be due to prolonged obstruction
- consider an ultrasound scan of the urinary tract to assess the amount of renal tissue present
- refer to Renal Team
THE ACUTELY PAINFUL TESTIS  • 1/1

DIFFERENTIAL DIAGNOSIS

- Testicular torsion
- Epididymo-orchitis
- Strangulated inguino-scrotal hernia
- Haematocoele
- Hydrocoele
- Testicular cancer
- Idiopathic scrotal oedema
- Torsion of appendix testis

TESTICULAR TORSION

- Can occur at any age but more common in adolescence

Symptoms

- Pain
- Swelling or high-riding testis, onset usually < 24 hr
- Chronic testicular pain is not an emergency

Signs

- Testicular tenderness
- Testicular swelling
- Scrotal erythema (occasionally)
- Fever suggests acute epididymo-orchitis, as it occurs only as a late manifestation of torsion

INVESTIGATIONS

- Consider isotope scan (available 0900-1700 only) (high uptake in infection and no uptake in torsion). However this investigation must not delay surgical exploration

MANAGEMENT

- Immediate surgical exploration – an acutely painful swollen testis in an adolescent is due to torsion until proven otherwise. If in doubt, explore
- Even if pain has been present for > 6 hr, immediate surgery can still rescue 25% of torted testes
PERIOPERATIVE MANAGEMENT
Pre-operative assessment starts in the outpatient department when a surgeon decides there are indications for surgery.

The surgeon or nurses in the preassessment clinic may refer more complex patients for anaesthetic assessment prior to admission.

An anaesthetist should assess the patient after hospital admission (when the operating list is published).

Contact Anaesthetic Department (2884) to find the appropriate anaesthetist.

Obtain all relevant details from the patient and any accompanying relatives.

Use checklist completed by patient before appointment as an aide memoire.

Ask about:
- previous anaesthetic history
- previous post-operative nausea and vomiting

Drug history

- Enquire about:
  - currently prescribed medications
  - over-the-counter medications and herbal preparations
  - alcohol and recreational drugs

Known allergies

- History of atopy, asthma or eczema
- allergic reactions including latex allergy (see Trust policy)
- sensitivity to anaesthetic drugs, e.g.: suxamethonium apnoea, malignant hyperpyrexia

ANATOMICAL ABNORMALITIES

- Draw the anaesthetist’s attention to:
  - loose or prominent crowned teeth
  - anatomical abnormalities of face, mouth and neck
  - unstable cervical spine
  - fused cervical spine
  - limitation of mouth opening
  - previous radiation therapy to the neck

RESPIRATORY SYSTEM

Assessment of respiratory system

- Symptoms:
  - chronic cough
  - exercise intolerance
  - unexplained dyspnoea
  - Signs:
    - reduced breath sounds
    - dullness to percussion
    - crackles
    - wheeze
  - Identify patients known to have:
    - asthma
    - chronic obstructive pulmonary disease (COPD)
    - sleep apnoea

Asthma and COPD

- Ensure patient is in optimal achievable condition
- ask how present breathing compares with patient’s best
- Consider pre-operative monitoring of peak flow and comparing these readings with tables of normal values (see Acute severe asthma) and patient’s personal best
- Ensure regular therapy continues until and including the day of surgery
- Additional nebulized beta, agonists (e.g. salbutamol) can be prescribed immediately before operation

Chest infection

- Cancel elective surgery and treat infection
Smoking

- Evidence shows that at one to eight weeks following smoking cessation, morbidity is higher due to increased mucus production and airway reactivity.
- Advise patient to stop smoking at least eight weeks prior to elective surgery. However, stopping just 24 hr pre-operatively is beneficial.

Obstructive sleep apnoea syndrome

- Inform respiratory physicians and technicians of the surgery date (3815).
- Inform anaesthetist of planned admission, so anaesthetic techniques can be discussed.
- Patients are:
  - sensitive to sedative and opioid medication
  - at risk of respiratory failure perioperatively
  - advised to bring in CPAP or BIPAP machines from home
  - likely to require HDU/SSCU bed for post-operative care.

Chest physiotherapy

- Notify physiotherapist of any patients with copious secretions likely to require intensive post-operative physiotherapy, e.g. bronchiectasis.

CARDIOVASCULAR SYSTEM

Myocardial infarction (MI)

- Delay elective (non-urgent) surgery until at least six months after MI.
- If surgery is urgent and benefits outweigh risks of reinfarction consider operating three months post-MI.

Patients who have recently had coronary artery bypass grafts, angioplasty or stenting

- During the first six weeks, after these procedures, only life-saving surgery should take place.
- From six weeks to three months, only urgent or cancer surgery should be done.
- From three months onwards elective surgery can be considered.

Warn anaesthetist about patients with coronary artery bypass grafts, angioplasty and stenting

Hypertension

- Cancel elective (non-urgent) surgery in patients with diastolic BP > 110 mmHg or systolic BP > 180 mmHg on 3 repeated measurements over 1-2 hr.
- Refer to GP for further follow-up treatment of hypertension or review of current management.

Do not cancel minor or intermediate surgery in patients with mild hypertension (diastolic BP > 90 mmHg but < 110 mmHg), but consider referral for investigation or treatment post-operatively.

Antihypertensive medications

- Continue all BP medication except ACE inhibitors.
- Omit one dose of ACE inhibitor prior to theatre.
- ACE inhibitors are associated with an increased risk of hypotension at induction.
- Reduce dose of beta-blocker pre-operatively in patients whose resting heart rate is < 35 beats/min.

Cardiac failure

- Patients with symptoms of left ventricular failure (orthopnoea, nocturnal dyspnoea) should be investigated before elective non-urgent surgery.
- Request GP referral, for cardiology opinion and possible echocardiogram.
- Ensure treatment has been commenced and that symptoms have improved before elective surgery.

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- From six weeks to three months, only urgent or cancer surgery should be done.
- From three months onwards elective surgery can be considered.

Warn anaesthetist about patients with coronary artery bypass grafts, angioplasty and stenting

Hypertension

- Cancel elective (non-urgent) surgery in patients with diastolic BP > 110 mmHg or systolic BP > 180 mmHg on 3 repeated measurements over 1-2 hr.
- Refer to GP for further follow-up treatment of hypertension or review of current management.

Do not cancel minor or intermediate surgery in patients with mild hypertension (diastolic BP > 90 mmHg but < 110 mmHg), but consider referral for investigation or treatment post-operatively.

Antihypertensive medications

- Continue all BP medication except ACE inhibitors.
- Omit one dose of ACE inhibitor prior to theatre.
- ACE inhibitors are associated with an increased risk of hypotension at induction.
- Reduce dose of beta-blocker pre-operatively in patients whose resting heart rate is < 35 beats/min.

Cardiac failure

- Patients with symptoms of left ventricular failure (orthopnoea, nocturnal dyspnoea) should be investigated before elective non-urgent surgery.
- Request GP referral, for cardiology opinion and possible echocardiogram.
- Ensure treatment has been commenced and that symptoms have improved before elective surgery.
**Angina**

- Refer to cardiologist any patient with unstable angina or angina at rest and any patient with angina not taking any medication, for investigation and treatment before elective non-urgent surgery
- Patients whose symptoms are well controlled by regular medication may be accepted for elective surgery, but should be made aware of the slightly increased risk of surgery and anaesthesia

**Arrhythmias**

**Atrial fibrillation (AF)**

- Consider and treat:
  - metabolic causes (hypokalaemia), endocrine causes (hyperthyroidism)
  - cardiac disease such as valvular or ischaemic heart disease
- If patient is unstable requiring further investigation, refer to cardiologist
- Optimizing patients with AF
  - Aim to reduce ventricular rate to < 100 beats/min. Refer to GP for management
- Many patients with previously diagnosed AF will be taking warfarin (see *Perioperative drugs policy – Warfarin*)

**Bradycardias or heart block**

- Consider halving the dosage of beta-blocker if resting heart rate < 35 beats/min
- Ask about symptoms such as unexplained syncopal attacks
- Check 12-lead ECG
- Patients who are in complete heart block or trifascicular block will require a cardiology opinion with a view to pacing

**Pacemakers**

- Arrange for pre-existing indwelling pacemakers to be checked before surgery if diathermy will be used
  - if necessary ask cardiac technicians to reprogramme (2348 or out-of-hours via call centre)
- Seek advice from cardiac technicians about safety of converting that model of pacemaker to a fixed rate using a magnet intra-operatively
- Ensure that pacemaker is reprogrammed/checked by cardiac technician before discharge home, if necessary

**Internal defibrillators**

- Inform cardiac technicians (2348 or out-of-hours via call centre) of the date and time of surgery in advance, so that they can arrange to be present throughout the surgery to reprogram the device if necessary

**Valvular heart disease**

- Fully investigate patients to assess their cardiac function; this should include a cardiac review within the last year, or more recently if symptoms have changed
- An echocardiogram within the last year may help assess LV function and pressure gradients across the chambers

**Grown-up congenital heart disease**

- These patients often have complex lesions and advice should always be sought from the cardiologist who has cared for them before embarking on any surgery and anaesthesia
- Contact Dr Clift or Dr Thorne at the Grown-up Congenital Heart Disease unit at the University Hospital of Birmingham 0121 627 2959 (in emergencies out-of-hours through switchboard 0121 432 3232)

**Prevention of endocarditis**

- Patients at risk:
  - known heart valve lesions
OBESITY

- Increases the risk of morbidity under anaesthesia
- Use body mass index (BMI) to estimate degree of obesity
- BMI = Weight (kg) / [Height (m)]²
- Normal 18-25 kg/m²
- Overweight but low risk 25-30 kg/m²
- Obese > 30 kg/m²
- Morbidly obese > 35 kg/m²
- Morbidity and mortality rise sharply when the BMI > 30 kg/m²
- Encourage all obese patients to lose weight before elective non-urgent surgery
- Enquire about symptoms of sleep apnoea

THYROID DISEASE

- Check TFTs
- Patients should be euthyroid before anaesthesia and surgery
- Ask patients with large or retrosternal goitres about dyspnoea on lying flat which may indicate tracheal compression

Hypothyroidism

- Patients at risk of a thyroid crisis
- Ensure that any antithyroid medication is continued through the perioperative period

Hyperthyroidism

- Continue medication

Warn anaesthetist (2884) of patients with chronic renal failure

- Complete haemodialysis a few hours before the surgical procedure. Ensure post-dialysis U&E available
- Continue CAPD (continuous ambulatory peritoneal dialysis) just before surgery, but drain the peritoneal cavity before theatre to ensure optimum ventilation under anaesthesia
- Chronic anaemia is common, and does not require correction prior to minor or intermediate surgery. For major surgery, consider pre-operative transfusion during dialysis if haemoglobin < 9 g/dL

Warn anaesthetist (2884) about patients who are morbidly obese

Warn anaesthetist (2884) about patients with large or retrosternal goitres

- Do not needle or apply BP cuffs to fistula arm

Check TFTs

- Patients should be euthyroid before anaesthesia and surgery
- Ask patients with large or retrosternal goitres about dyspnoea on lying flat which may indicate tracheal compression

Warn anaesthetist (2884) about patients with large or retrosternal goitres

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Warn anaesthetist (2884) about patients with large or retrosternal goitres

- Do not needle or apply BP cuffs to fistula arm
Pre-operative ECG

Pre-operative ECG is required in the following:

- Aged > 60-yr undergoing major surgery
- All diabetic patients with symptoms of breathlessness, palpitation or angina
- All diabetic patients presenting for major surgery
- Patients of any age with history of cardiovascular disease including:
  - Hypertension
  - Ischaemic heart disease
  - Valvular heart disease
  - Congenital heart disease
  - Cardiomyopathy
  - Symptomatic cardiovascular disease including:
    - Palpitations
    - Drop attacks
    - Angina
    - Breathlessness
  - Symptomatic respiratory disease
- If pre-operative ECG has been done, check trace and record findings in patient’s record
- Discuss significant abnormalities with a cardiologist or anaesthetist
- If surgery elective and non-urgent, refer patient for optimization pre-operatively

Pre-operative chest X-ray may be clinically useful in patients with:

- Acute respiratory symptoms
- Possible lung metastases
- Severe cardiorespiratory disease, who have not had a chest X-ray in the previous 12 months
- Mediastinal lesions or symptoms of tracheal compression
- Recent thoracic surgery, who have not had a chest X-ray in the previous 12 months
- Recent immigrants, or travellers from countries where TB is endemic, who have not had a chest X-ray in the previous 12 months

It is not essential to repeat an ECG if performed within the last 12 months and there has been no change in the patient’s symptoms

Routine pre-operative chest X-rays are not justified

Patients in above categories should not be x-rayed routinely and the reason for examination should always be given on the request form

If pre-operative chest x-ray has been done, check film and record findings in patient’s records
- Discuss significant abnormalities with an anaesthetist

Haemoglobin (Hb) required in patients with:

- History of anaemia
- Chronic bleeding disorder, e.g. menorrhagia
- Chronic renal disease
- Rheumatoid arthritis

White blood cell count is required in patients with concurrent infection

Patients presenting for cardiac surgery
- Patients with renal disease, concurrent hypertension or heart failure

If pre-operative chest x-ray has been done, check film and record findings in patient’s records
- Discuss significant abnormalities with an anaesthetist

Routine pre-operative investigations before proceeding with surgery

Where ‘minor’, ‘intermediate’ and ‘major’ surgical procedures are mentioned in the text - see classification of surgical procedures for clarification

Obtain results of pre-operative investigations before proceeding with surgery
See algorithm for management of pre-operative anaemia

Investigate and treat unexpected anaemia – see Chronic anaemia in Perioperative management

If surgery urgent (cancer surgery) or operation required with 2 weeks, consider pre-operative transfusion

Patients with shortness of breath or worsening angina due to anaemia; treat and postpone operation

Patients with chronic anaemia associated with diseases such as chronic renal failure or rheumatoid arthritis may undergo surgery, but take into account the risks of bleeding during surgery and order an adequate volume of blood

May be abnormal in patients:
- with immune thrombocytopenia
- with myeloproliferative disease
- with hypersplenism, or other haematological disorders
- having chemotherapy or radiotherapy

Patients with chronic renal failure or taking aspirin or other anti-platelet agent may have impaired platelet function, even though count normal

Consultant surgeon and haematologist should discuss management of patients with thrombocytopenia

For lumbar puncture, epidural anaesthesia, gastroscopy and biopsy, insertion of indwelling lines, liver biopsy, laparotomy or similar procedures, raise platelet count to at least 50 x 10^9/L

For operations in critical areas, (brain or eyes), raise platelet count to 100 x 10^9/L

Do not assume that the platelet count will rise just because platelet transfusions are given. Check pre-operative count to ensure that thresholds have been reached

Check if patient taking oral anticoagulation (see Perioperative drugs policy)

Obtain patient consent before testing

Seek haemoglobinopathy in patients of West African, North American, South and sub-saharan African and Afro-Caribbean descent although it is occasionally seen in patients of Italian, Greek and Cypriot descent

Family history of homozygous sickle cell disease or heterozygous trait

For identification send a sample for sickle cell screen (24-hr availability) and Hb electrophoresis (0900-1700 hr weekdays only)

Sickling can be precipitated by:
- hypoxia
- hypothermia
- dehydration
- pyrexia

Platelet count

White blood cell count

Haemoglobin

SICKLE CELL ANAEMIA AND SICKLE CELL TRAIT, AND OTHER HAEMOGLOBINOPATHIES

Clotting Screen
Routine pre-operative investigations • 3/5

- acidoses
- circulatory stasis, e.g. tourniquet application
- Avoid prolonged starvation leading to dehydration pre-operatively
- Keep patients with sickle cell trait warm, well oxygenated, normotensive and well hydrated throughout the perioperative period
- Seek advice of haematologist about patients with sickle cell anaemia. Some patients may require pre-operative transfusion to reduce the proportions of sickled Hb to < 30%
- Report the results of testing, even when negative, to families and document in the patient’s medical record to avoid unnecessary repeat testing
- Refer patient to a haematologist for follow-up and stipulate if they are newly discovered

CLOTTING SCREEN

- Pre-operative clotting screen (INR, APTT) is required only in patients:
  - with history of bleeding problems or uraemia on dialysis
  - with clinical evidence of liver disease (including a history of hepatitis or obstructive jaundice)

- taking anticoagulant therapy (see Perioperative drugs policy)
- undergoing major or major plus surgery including:
  - arterial and cardiac surgery where there is likely to be a significant blood loss requiring blood and blood product transfusion
  - neurosurgery where disturbance of coagulation is common and baseline coagulation screen is useful
  - any surgery in patients with metastatic cancer
- Moderate and major surgery

- Request U&E in any patient:
  - taking diuretics, digoxin or corticosteroids
  - with diabetes mellitus
  - with symptomatic cardiovascular disease
  - with renal failure

BLOOD GLUCOSE

- Minor, moderate and major surgery

- Check blood glucose in patients:
  - with known diabetes mellitus
  - with history suggestive of diabetes, (e.g. polydypsia, polyuria or weight loss)
  - whose urine analysis for glucose is positive
  - with recurrent infections or abscesses
  - taking diabetogenic drugs, (e.g. steroids)

LIVER FUNCTION TESTS

- Minor, moderate and major surgery

- Request pre-operative liver function tests in patients with:
  - pre-existing liver disease
  - pre-existing metabolic disease
  - abnormal nutritional state
  - history of alcohol intake > 8 units (= one bottle wine/four pints beer/one-quarter bottle spirits) per day

Routine pre-operative U&E is unnecessary in fit healthy patients aged < 60 yr undergoing minor surgery

- Request U&E in any patient taking diuretics, digoxin or corticosteroids
  - with diabetes mellitus
  - with symptomatic cardiovascular disease
  - with renal failure

- Major plus surgery

- Request U&E in all patients undergoing joint replacement, thoracic surgery, cardiac surgery and neurosurgery
ROUTINE PRE-OPERATIVE INVESTIGATIONS • 4/5

BONE PROFILE

● Request bone profile in patients:
  ● presenting for thyroid and parathyroid surgery
  ● with bone metastases

LUNG FUNCTION TESTS

● Consider in patients with respiratory comorbidity presenting for major upper abdominal or thoracic surgery
● Perform in all patients having spinal surgery
● Perform in all patients with asthma or chronic obstructive pulmonary disease (COPD) if reversibility with bronchodilators needs to be assessed

● Discuss significant abnormalities with an anaesthetist
● Refer patient for optimization pre-operatively prior to elective non-urgent surgery
● Compare results with predicted values to highlight patients who will respond to perioperative bronchodilators
● Increased risk of post-operative complications when FEV₁ or FVC is < 70% of the predicted value

PREGNANCY TEST

● Consider in any female of child-bearing age
● History of last menstrual period alone may not be sufficient
● Discuss with patient, and obtain consent before undertaking test
● Postpone elective non-urgent surgery and anaesthesia during first and third trimester

ARTERIAL BLOOD GASES (ABG)

● Consider in patients with severe respiratory disease, or COPD undergoing major upper abdominal or thoracic surgery. ABG do not necessarily predict the risk of post-operative complications
● In the event of post-operative respiratory problems, pre-operative ABG will help to define severity of deterioration
Algorithm for management of pre-operative anaemia

Hb ≥ 12.0 g/dL

List for surgery.
If major surgery planned, consider short course of ferrous sulphate up to a maximum of 200 mg tds if tolerated to improve iron stores

Hb < 12.0 g/dL

Look at MCV

Hb < 10.0 g/dL

Defer operation unless urgent. Take blood for ferritin/B12/folate and consider haematology referral via GP

Microcytic (? iron deficiency) MCV < 80

Take blood for ferritin and start ferrous sulphate up to 200 mg tds as tolerated for 4 weeks pre-op

Refer back to GP with ferritin result

Macrocytic (? B12/folate deficiency MCV > 100

Take blood for viatmin B₁₂, folate and ferritin Await results before considering treatment

Refer to GP with results

GP to review results, adjust medication as necessary and/or initiate investigation if appropriate

Even a short course of iron may be effective in rising haemoglobin levels and reducing the need for blood transfusion

GP to re-refer for surgery when patient is fully investigated and treated
Colon imaging, e.g. colonoscopy and barium enema

Pre-operatively before colorectal surgery including:
- transverse colectomy
- left hemicolectomy
- sigmoid colectomy
- anterior resection (to lessen intra-abdominal contamination)

Bowel obstruction (if suspected do unprepared barium enema first)

Perforated bowel

Toxic megacolon or ileus

Current rectal bleeding

Explain procedure and reassure patient

warn patients they will need to go to the toilet frequently

tell patients to drink large volumes of clear fluid and avoid solid food

in elderly patients who cannot tolerate large volumes of oral fluid and patietnts nil by mouth before surgery, prescribe sodium chloride 0.9% 1L IV 8 hrly

Obtain and record consent

**Indications**

**Administration**

- Picolax
  - Day before procedure, one sachet at 0800 hr and one sachet at 1400 hr
  - Add contents of each sachet initially to 30 mL water; after 5 min (when reaction complete) dilute solution further with water to 150 mL

**Monitoring**

- Check for dehydration
- U&E daily

**Complications**

- Diarrhoea
- Dehydration
- Bowel obstruction:
  - bowel preparation can precipitate overt symptoms of bowel obstruction in patients with strictures (malignant or benign) leading to the need for early surgery

**Colonic Surgery**

- Elective patients: give bowel preparation and sodium chloride 0.9% 1L IV 8 hrly
- Emergency admissions: avoid bowel preparation unless acute episode has settled

**Contraindications**

- Bowel obstruction (if suspected do unprepared barium enema first)
- Perforated bowel
- Toxic megacolon or ileus
- Current rectal bleeding

**Consent and Preparation**

- Explain procedure and reassure patient
- warn patients they will need to go to the toilet frequently
- tell patients to drink large volumes of clear fluid and avoid solid food
- in elderly patients who cannot tolerate large volumes of oral fluid and patients nil by mouth before surgery, prescribe sodium chloride 0.9% 1L IV 8 hrly
- Obtain and record consent
**PRINCIPLES**

- Do not allow patients to fast for longer than necessary for their safety under general anaesthetic.

**POLICY**

- Patients may take solid food up to 6 hr before elective surgery.
- Patients should take oral fluids up to 2 hr before surgery.
- Milk in tea or coffee is acceptable in small volumes.
- Small sips of water may be taken to enable tablets to be swallowed.

**PROCEDURE**

- **Morning operating lists:**
  - no solid food after 0000 hr.
  - fluids allowed according to appetite to finish before 0700 hr.
- **Afternoon operating lists:**
  - Light breakfast (including toast, continental breakfast, or small bowl of cereal) must be finished before 0730 hr.
  - Fluids allowed according to appetite to finish before 1130 hr.
### GENERAL PRINCIPLES

- Oral or enteral feeding is safer than IV (parenteral nutrition) and should be first choice where possible.
- If patients are likely to be nil by mouth for a prolonged period (e.g. 5-7 days), because of their illness, investigations for their illness or anticipated post-operative course, careful consideration should be given to nutritional supplementation, either enteral or parenteral.

### ENTERAL TUBE FEEDING

#### Indications
- Functioning gut but patient unable to eat enough to meet nutritional requirements.

#### Contraindications
- Non-functioning gut, i.e. mechanical obstruction, ileus.
- High output upper gastrointestinal (GI) fistula.

### Routes for enteral tube feeding

- **Nasogastric (NG) tube**
  - standard route for those unable to eat adequately, e.g. poor intake.
- **Nasojejunal (NJ) tube**
  - ideal for patients with gastric stasis (of whatever cause), or severe pancreatitis.
  - placed endoscopically.
- **Percutaneous Endoscopic Gastrostomy (PEG)**
  - long-term feeding, e.g. CVA, neurological dysphagia, previous oropharyngeal NG.
  - request placement via clinical nutrition nurse specialist.
- **Surgical jejunostomy**
  - placed ideally at time of surgery, especially in those who are malnourished or in whom prolonged recovery is anticipated.
  - can be used within 24-48 hr of most surgery (including upper GI tract).

### Administration

**Starter regimens**

Contact the dietician (2113) as soon as possible during normal office hours to advise on the most appropriate regime.

- If the dietician is unavailable (e.g. weekends or bank holidays), start feed as follows:
  - standard feed (e.g. Nutrison Standard) 1 kcal/ml at 50 mL/hr for first 6 hr.
  - increase to 75 mL/hr for next 6 hr.
  - increase to 100 mL/hr for next 6 hr, providing 1350 mL/ 1350 kcal over 24 hr (includes 6 hr rest).
  - Day 2-3 increase rate to full requirements as assessed by dietician.
  - Do not feed continuously for 24 hr (except on ICU or MIU), but only 16-20 hr with 4-8 hr rest.

### How to obtain feed and storage

- Obtain all enteral feeds from the Hospital Pharmacy Department.
- Order appropriate feed on patient’s prescription chart.
- Store enteral feeds in a cool, dark place and always give at room temperature.
- Do not hang opened packs for > 24 hr. Discard any disconnected feeds.

### Preventative measures

- To avoid aspiration pneumonia:
  - use continuous, not bolus feeding.
  - position patient’s upper body at 45° minimum during feeding.
  - consider motility agent (see Nausea and vomiting).
- To prevent NG/NJ tube withdrawal:
**ARTIFICIAL NUTRITIONAL SUPPORT • 2/5**

- tape tube securely to patient’s face

### Flushing
- To prevent tube blockage, flush feeding tube with 30-50 mL water using a 50 mL syringe:
  - before and after each feeding period
  - before and after administration of any medication

### Medication
- Where appropriate, ask Pharmacy to provide medication in soluble or liquid form

### Monitoring
- **Daily**
  - fluid balance (input and output)
  - temperature
  - blood glucose and electrolytes (twice weekly when stable)
- **Weekly**
  - weight
  - liver function tests
  - serum calcium and phosphate
  - magnesium

### Complications

#### If possible, consult dietician before taking action

### Gastrointestinal side effects

#### Nausea and vomiting
- Possible remedies:
  - reduce administration rate of feed
  - metoclopramide 10 mg via tube or IV 8 hrly
  - NJ feeding

### Diarrhoea
- **It is not usually necessary to stop the feed**
  - Possible remedies:
    - review drugs (e.g. antibiotics) and stop if possible
    - stool sample for cultures and *Clostridium difficile*
  - if sample positive for *Clostridium difficile* and diarrhoea continues, give metronidazole 400 mg via tube 8 hrly for 10 days. If diarrhoea persists despite treatment, contact microbiologist (4666)
  - if sample negative for pathogens and *Clostridium difficile* give anti-diarrhoeal agent, e.g. loperamide syrup 2 mg via tube after each loose stool. Maximum dose 16 mg in 24 hr
  - reduce administration rate of feed by 50%
  - substitute fibre feed

### Constipation
- Possible remedies
  - enema (e.g. phosphate)
  - laxatives (e.g. lactulose 15 mL via tube 12 hrly and/or senna syrup 10 mL via tube at night)
  - extra fluid
  - substitute fibre feed
  - encourage mobility if possible

### Aspiration pneumonia
- Send any sputum for culture
  - Treat as for cavitating or aspiration pneumonia (see Community-acquired pneumonia in Medical guidelines)

- Consider NJ/nasoduodenal feeding

### Large gastric aspirates
- Reduce flow rate of feed
- Consider metoclopramide (see Nausea and vomiting)
- NJ feeding
- Consider parenteral feeding - seek advice from Nutrition Support Team

### Tube-related
- Tube blockage
  - regular flushing with water before and after feeds and medication should prevent this problem
  - Inadvertent tube removal
    - replace feeding tube
  - Unintentional removal of PEG tube
    - If PEG newly placed (within last three weeks) do not attempt to insert Foley catheter – cover stoma site and contact Nutrition Support Team or Gastroenterology Department (2381) at earliest opportunity
    - If stoma tract established (after three weeks) insert CH10-14 Foley catheter (depending on tract size) as a temporary measure as soon as possible, and within 2 hr of removal of PEG
Contact Nutrition Support Team or Gastroenterology Department (2381). If > 2 hr have elapsed since removal of PEG, contact Nutrition Support Team at earliest opportunity.

**Metabolic**
- Hypo/hyperglycaemia – regular blood glucose monitoring and appropriate insulin therapy. If there are problems contact diabetes specialist nurses (3434)
- Be vigilant for deficiencies or excesses of electrolytes/vitamins/trace elements, especially with prolonged feeding and correct if necessary. (see Monitoring)
- Patients who have been malnourished for a prolonged period or have a history of alcohol abuse are at risk of refeeding syndrome, and will need daily potassium, phosphate and magnesium checks at the initiation of feeding (contact Nutrition Support Team for advice about correction of deficiencies)

**Discharge**
- If patient is to be discharged on tube feeding, notify ward dietician five working days before discharge
- A prescription for seven days supply of feed as a TTO will be required along with a seven-day supply of giving sets and syringes

**PARENTERAL NUTRITION**

Parenteral nutrition is indicated only when GI tract is not working, or is unable to absorb or digest an adequate amount of nutrients on a temporary or permanent basis.

**Indications**
- Post-operative ileus
- A prolonged period (> 7-10 days) nil by mouth after surgery, in a previously well-nourished patient
- Consider earlier in malnourished patient
- If problems are anticipated at surgery, an alternative is a feeding jejunostomy (see Enteral tube feeding)
- Severe pre-operative malnutrition [Body Mass Index (BMI) < 16] - administer parenteral nutrition for at least 10 days. To calculate BMI see Pre-operative assessment
- Proximal GI distal fistulae (e.g. rectovaginal, rectovesical) can be enterally fed
- Short bowel syndrome where the small intestine is < 60-100 cm in length. Contact Nutrition Support Team
- Severe intestinal motility disorders (e.g. chronic pseudo-obstruction)

**Contraindications**
- GI tract is functioning
- Anticipated duration of parenteral nutrition less than five days

A low serum albumin in isolation is not a reflector of malnutrition, but more likely to reflect fluid overload and disease status – especially if the albumin was normal or near-normal pre-operatively.
ARTIFICIAL NUTRITIONAL SUPPORT • 4/5

Routes for IV feeding

The Nutrition Support Team will advise on the optimal route of administration for parenteral nutrition administration. It is important that if a ‘central’ bag is ordered it is not given ‘peripherally’ - if central line access becomes unavailable, contact Nutrition Support Team

Parenteral nutrition must be run through a dedicated feeding line, not alongside any other IV drug or fluid as this may cause precipitation or incompatibilities

Central access

● Peripherally-inserted central catheter (PICC)
● preferred route (inserted by Nutrition Support Team)
● Central line
● A single lumen tunnelled catheter dedicated for parenteral nutrition is much safer than a triple lumen catheter with one lumen dedicated for parenteral nutrition. However, patients usually require central access for reasons other than parenteral nutrition, and it is recognized that often one lumen of a triple lumen catheter is the only practical way of feeding. In this situation meticulous attention to asepsis is essential

Peripheral access

● For short term use only; owing to high risk of thrombophlebitis
● Venflon (20 G pink) in a large forearm vein with glyceryl trinitrate 5 mg patch placed proximally
● Do not use midline catheter (approx 20 cm in length)

How to obtain and storage

● Request parenteral nutrition via Nutrition Support Team unless the patient is on ITU/MIU, where the intensivists and unit dietician will manage them
● If there is any dispute over the appropriateness of the referral, the Nutrition Support Team will liaise directly with the referring clinical team

There is no weekend, bank holiday, or overnight service, but there are few, if any, indications that require immediate parenteral nutrition

● Nutrition Support Team require a recent weight, U&E and an estimate of fluid allowance to calculate requirements
● Patient’s daily requirements are met with a single bag of parenteral nutrition made under aseptic conditions in Pharmacy Manufacturing. Once made it is stable for seven days when stored in a refrigerator, but for only 24 hr once hung at room temperature. The parenteral nutrition must remain protected from light using a red bag
● Once disconnected, parenteral nutrition fluid will start to coagulate, and must be discarded. Replace the bag with a new one if available; if a new bag needs to be made, wait until the next day

Monitoring

Patient, having parenteral nutrition, will be reviewed daily by the Nutrition Support Team (excluding weekends and ITU/MIU).

Any biochemical deficiencies will be corrected by modifying the TPN and need not concern the ward team unless this is specifically requested

● Daily
○ Glucose via finger prick
○ Fluid balance
○ Biochemistry including general profile
○ Phosphate
○ Catheter site
● Three-times weekly
○ FBC
○ Liver function tests
○ Calcium
○ Magnesium
● Weekly
○ Weight
○ Nutrition screen, including lipids
Complications

- Nutritional/metabolic
- Fluid overload
- Electrolyte imbalances
- Hyperglycaemia
- Rebound hypoglycaemia, when parenteral nutrition is stopped abruptly
- Overfeeding/refeeding syndrome
- Patients who have been malnourished for a prolonged period or have a history of alcohol abuse are at risk of refeeding syndrome, and will need daily potassium, phosphate and magnesium checks at the initiation of TPN (contact Nutrition Support Team for advice about correction of deficiencies)
- Hepatobiliary complications
- Micronutrient deficiencies

Management of central catheter-related sepsis

- Signs include pyrexia and rigors during parenteral nutrition
- If catheter-related sepsis suspected, stop parenteral nutrition
- Obtain blood cultures: (see Collection of blood culture specimens in Medical Guidelines)
- Peripheral
- Drawback cultures from central catheter
- Start IV antibiotics to cover most likely organisms while waiting for the results of investigations (see Sepsis, severe sepsis and septic shock in Medical Guidelines)
- Do not remove line, but swab insertion site. If insertion site obviously infected (cellulitis or pus), remove line without waiting for culture results. Provided the regimen used can be given via a peripheral route, it may be possible to administer the parenteral nutrition fluid via a peripheral site for 48 hr while the central line is rested - check with Nutrition Support Team
- If blood cultures from catheter are positive, catheter-related sepsis is likely. If parenteral nutrition still required via central route, replace the line must be replaced. Contact Nutrition Support Team for advice about how to proceed

Careful monitoring of biochemistry should prevent these complications

- Line
- Problems resulting from central line insertion (e.g. pneumothorax, arterial puncture)
- Sepsis (see Management of central catheter related sepsis)
- Thrombophlebitis
- Venous thrombosis
- Occlusion
- Catheter damage or fracture of line
- Endocarditis

If both peripheral and drawback blood cultures are positive, catheter-related sepsis is confirmed. Remove the line immediately
- Send catheter tip for culture

If line removed wait 48 hr after starting IV antibiotics before inserting a new central line to reduce the risk of re-infection

- If temperature persists, exclude other sources of infection (e.g. chest, urinary tract, drains and wound). Send specimens for culture and sensitivity

Weaning off

- Stopping parenteral nutrition abruptly will cause rebound hypoglycaemia
- To prevent complications, wean parenteral nutrition over 48 hr while introducing the patient to regular fluid, diet/tube feeding. If necessary, contact Nutrition Support Team for advice
It is important to secure good control of diabetes during the perioperative period because of the risk of:

- Ketoacidosis/dehydration (often not considered in surgical patients), especially in patients with type 1 diabetes
- Following insulin omission
- Because of stress hormone response to surgery
- In the setting of a catabolic state
- Hypoglycaemia
- Because of starvation pre- and post-operatively, or anorexia post-operatively
- Infections – more likely and more difficult to control in the presence of hyperglycaemia

Do not assume that diabetes is well controlled; arrange capillary blood glucose (CBG) using meter at pre-operative assessment before listing for surgery.

If CBG and home charted glucose < 12 mmol/L, surgery may proceed.

In poorly controlled patients with either home chart showing glucose rising above or CBG ≥ 12 mmol/L, measure serum HbA₁c and check urine for ketones.

Arrange for results to be sent to GP.

Refer patient back to GP for improvement of control before elective non-urgent surgery.

Advise all patients to come to hospital without having either breakfast or insulin or oral hypoglycaemic agents on the day of surgery.

Give advice in perioperative management for each type of diabetes and operation.

Patients with type 1 diabetes are not suitable for day case afternoon lists; they must be first on the morning list where possible.

If non-urgent surgery in poorly controlled patient (CBG ≥ 12 mmol/L), discuss with senior surgeon whether to defer surgery and refer back to GP for improvement of control or control in hospital pre-operatively (discuss with diabetes nurse specialist (3434) or, if not available, medical SpR).

For urgent surgery in poorly controlled patient (CBG ≥ 12 mmol/L), discuss with diabetes nurse specialist (3434) or, if not available, medical SpR.

If proceeding with operation, use IV soluble insulin and glucose regimen (see below) peri-operatively.

Advice to Patients

Patients with poorly controlled Diabetes

Pre-Operative Clinic Assessment

Advising patients to come to hospital without having either breakfast or insulin or oral hypoglycaemic agents on the day of surgery.

Give advice in perioperative management for each type of diabetes and operation.

Patients with type 1 diabetes are not suitable for day case afternoon lists; they must be first on the morning list where possible.

On all diabetic patients, take CBG using meter.

If non-urgent surgery in poorly controlled patient (CBG ≥ 12 mmol/L), discuss with senior surgeon whether to defer surgery and refer back to GP for improvement of control or control in hospital pre-operatively (discuss with diabetes nurse specialist (3434) or, if not available, medical SpR).

For urgent surgery in poorly controlled patient (CBG ≥ 12 mmol/L), discuss with diabetes nurse specialist (3434) or, if not available, medical SpR.

If proceeding with operation, use IV soluble insulin and glucose regimen (see below) peri-operatively.
post-operatively refer such patients to their GP or the diabetes nurse specialists (3434) for improvement of their control

Patient proceeding with surgery on diet alone or oral hypoglycaemic agents

For minor surgery/day cases in well-controlled patients (CBG < 12 mmol/L), omit any oral hypoglycaemic agents on the morning of surgery and recommence normal treatment post-operatively

If CBG ≥ 12 mmol/L in patients proceeding with non urgent surgery, omit any oral hypoglycaemic agents on morning of surgery and use IV soluble insulin and glucose regimen (see below)

Minor/intermediate surgery

- Omit any oral hypoglycaemic agents on the morning of surgery
- Monitor blood glucose and urine ketones hrly from 1hr before, during surgery and for 2 hr after
- If CBG ≥ 12 mmol/L, in patients proceeding with non-urgent surgery or patient unlikely to eat or drink within 24 hr of major surgery, omit any oral hypoglycaemic agents on the morning of surgery and use IV soluble insulin and glucose regimen (see below)

Major surgery

- Omit any oral hypoglycaemic agents on the morning of surgery
- Monitor blood glucose and urine ketones hrly from 1hr before, during surgery and for 2 hr after
- If CBG ≥ 12 mmol/L, in patients proceeding with non-urgent surgery or patient unlikely to eat or drink within 24 hr of major surgery, omit any oral hypoglycaemic agents on the morning of surgery and use IV soluble insulin and glucose regimen (see below)
- Otherwise monitor and only if CBG becomes > 12 mmol/L, commence IV soluble insulin and glucose regimen (see below)

Patient proceeding with surgery on sc insulin

Minor day case surgery (duration < 20 min and not affecting post-operative eating)

- On evening before surgery, patients should take their usual diet and insulin
- Make sure last full meal taken before midnight, and last light snack (e.g. plain biscuit if absolutely necessary) before 0300 hr
- Make sure last clear fluid (may contain glucose if required) taken before 0700 hr
- Omit breakfast and all SC insulin on morning of surgery
- Post-operatively provide a breakfast containing calories equivalent to patient’s usual breakfast, and a normal dose of insulin at the same time
- Continue to monitor the patient; do not allow home if vomiting or nauseated
- Treat any derangement in blood glucose, as in-patient if necessary

Intermediate (operations > 20 min) and major surgery

- Morning lists
  - on evening before surgery, patients should take their usual diet and insulin
  - no food after midnight
  - no food or insulin on morning of surgery. If needed, sips of water only can be given before 0700 hr
  - start IV soluble insulin and glucose at 0700 hr according to regimen (see below)

- Afternoon lists
  - give usual types and doses of SC insulin the night before surgery
  - patients may have light breakfast before 0700 hr, and commence IV soluble insulin and glucose regimen at 0700 hr

Patients who are unlikely to resume eating and drinking after more than 48 hr post-operatively should have a management plan in place after discussion with the Nutrition Team (page via Call Centre) and Diabetes Nurse Specialists (3434)

IV SOLUBLE INSULIN AND GLUCOSE REGIMEN

- Both insulin (infusion 2) and glucose (infusion 1) must ALWAYS go through the same Venflon
Ensure that an antireflux valve is used in the IV line and that an antisyphon valve is used in the line from the insulin syringe to the patient (Vygon Protect-A-line 2 extension set)

Prescribe infusions 1, 2 and 3:
- remember to run infusions 1 and 2 through the same Venflon
- remember to check result of most recent serum potassium before writing prescription

Infusion 1 – Blood glucose maintenance regimen

- 500 mL glucose 10% (with or without potassium – see Table 1) at 75 mL/hr via volumetric pump

Table 1: Potassium content

<table>
<thead>
<tr>
<th>Serum potassium (mmol/L)</th>
<th>Content of potassium chloride (mmol) in 500 mL glucose 10%</th>
<th>Monitoring frequency of serum potassium</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥ 3.5</td>
<td>20</td>
<td>8 hrly</td>
</tr>
<tr>
<td>3.6–4.9</td>
<td>10</td>
<td>daily</td>
</tr>
<tr>
<td>≥ 5.0</td>
<td>0</td>
<td>8 hrly</td>
</tr>
</tbody>
</table>

Infusion 2 – Insulin for blood glucose regulation

50 units soluble insulin diluted to 50 mL (1 unit/mL) with sodium chloride 0.9% – START AT 3 ML/HR VIA SYRINGE PUMP

Infusion 3 – Post-operative fluid maintenance regimen (in emergency patients pre-operatively if required)
- sodium chloride 0.9% at minimum of 60 mL/hr until eating and drinking
- blood when required
Flowchart: Control of blood sugar in the perioperative period using infusions 1 and 2

Start infusions 1 and 2 pre-operatively (start 3 in theatre) and continue infusions 1, 2 and 3 post-operatively until stable

Check capillary blood glucose (CBG) with meter hrly

If blood glucose < 4 mmol/L do not switch off insulin infusion because the very short half-life of IV insulin will rapidly result in hyperglycaemia and ketoacidosis.

Avoid large steps in insulin infusion rate as these produce marked fluctuations in plasma glucose.

Flowchart:

- **CBG ≥ 20 mmol/L for 2 hr**
  - Glucose 5%
  - 75 mL/hr with or without potassium see Table 1
  - Insulin infusion rate 5 units/hr
  - Check CBG after 1 hr

- **CBG > 11-19.9 mmol/L**
  - Glucose 10%
  - 75 mL/hr with or without potassium see Table 1
  - Insulin infusion rate 4 units/hr
  - Re-check CBG after 1 hr

- **CBG 6–10.9 mmol/L**
  - Glucose 10%
  - 75 mL/hr with or without potassium see Table 1
  - Maintain insulin infusion rate at 3 units/hr
  - Recheck CBG after 1 hr

- **CBG 4-5.9 mmol/L**
  - Glucose 10%
  - 75 mL/hr with or without potassium see Table 1
  - Insulin infusion rate 2 units/hr
  - Recheck CBG after 1 hr

- **CBG < 4 mmol/L**
  - Glucose 10%
  - 150 mL/hr for 1 hr with or without potassium
  - Check CBG see Table 1
  - Insulin infusion rate at 1 unit/hr
  - Recheck CBG after 1 hr
  - If CBG still < 4, reduce insulin to 0.5 u/hr and check CBG after 30 min
  - If still < 4, start 20% glucose at 75 mL/hr, seek advice from senior doctor and refer to diabetes clinical nurse specialist
MONITORING

- Adjust glucose infusion rate according to blood glucose – see flowchart. Aim to keep blood glucose between 6 and 11 mmol/L
- Check CBG hrly using meter and adjust insulin infusion according to flowchart

RESTARTING MEDICATION POST-OPERATIVELY

- Oral agents
  - oral hypoglycaemic agents may be restarted once the patient is eating and drinking
  - continue IV insulin infusion for one further hour after first dose of oral hypoglycaemic agent

- SC insulin
  - Start patients on insulin dose 10% higher than their regular doses
  - if normally on SC short-acting insulin, **continue IV insulin infusion for one further hour** after giving first dose of short-acting insulin
  - if normally on SC intermediate-acting insulin, **continue IV insulin infusion for 4 hr** after giving first dose of intermediate-acting insulin
  - Monitor blood glucose before meals and increase insulin as necessary. Advice can be obtained from diabetes nurse specialists (3434)

Patients unlikely to resume eating and drinking

- If after 48 hr patient is still unable to eat or drink enough post-operatively:
  - assess for enteral or parenteral feeding – contact Nutrition Support Team (bleep 485)
  - contact diabetes specialist nurses for advice (3434) on prescribing regular SC insulin

Do not stop IV insulin infusion without an appropriate crossover period with SC insulin, to minimize risk of developing ketoacidosis
Where ‘minor’, ‘intermediate’ and ‘major’ surgical procedures are mentioned in the text - see classification of surgical procedures for clarification

**RISK FACTORS**

- The risk of thromboembolism depends not only on the illness, trauma or planned surgical procedure, but also on pre-existing patient-related variables (see Table 1)

### Table 1: Risk factors for venous thromboembolism for in-patients

Check and add up scores of all factors to obtain total. Each risk factor has a value of one unless otherwise stated.

<table>
<thead>
<tr>
<th>Patient factors</th>
<th>Risk factor value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aged 41-60</td>
<td>1</td>
</tr>
<tr>
<td>Aged 61-70</td>
<td>2</td>
</tr>
<tr>
<td>Aged &gt; 70-yrs</td>
<td>3</td>
</tr>
<tr>
<td>Obesity (20% or more above ideal body weight*)</td>
<td>1</td>
</tr>
<tr>
<td>Varicose veins</td>
<td>1</td>
</tr>
<tr>
<td>Pre-operative immobility (&gt; 72 hr)</td>
<td>1</td>
</tr>
<tr>
<td>Confining travel (air/rail/road) (&gt; 4 hr within four weeks of admission pre-operatively)</td>
<td>1</td>
</tr>
<tr>
<td>Pregnancy or postpartum (&lt; one month pre-operatively)</td>
<td>1</td>
</tr>
<tr>
<td>Oestrogen/hormone therapy</td>
<td>1</td>
</tr>
<tr>
<td>Previous DVT or PE</td>
<td>3</td>
</tr>
<tr>
<td>Pelvic or long bone fracture (within three months)</td>
<td>1</td>
</tr>
<tr>
<td>Major surgery (within six weeks)</td>
<td>1</td>
</tr>
<tr>
<td>Deficiency of antithrombin III</td>
<td>5</td>
</tr>
<tr>
<td>Protein C or S, antiphospholipid antibody or lupus anticoagulant</td>
<td>3</td>
</tr>
</tbody>
</table>

* To calculate ideal body weight - see Prescribing regimens and nomograms - Gentamicin

<table>
<thead>
<tr>
<th>Disease or surgical procedure</th>
<th>Risk factor value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trauma or surgery, especially of pelvis, hip, lower limb</td>
<td>1</td>
</tr>
<tr>
<td>Anticipated bed confinement for &gt; 72 hr</td>
<td>1</td>
</tr>
<tr>
<td>Planned operation lasting &gt; 2 hr</td>
<td>1</td>
</tr>
<tr>
<td>Malignancy, especially pelvic, abdominal, metastatic</td>
<td>2</td>
</tr>
<tr>
<td>Leg oedema, ulcers, stasis</td>
<td>1</td>
</tr>
<tr>
<td>Heart failure</td>
<td>1</td>
</tr>
<tr>
<td>Recent myocardial infarction within previous six months</td>
<td>1</td>
</tr>
<tr>
<td>Previous Stroke</td>
<td>1</td>
</tr>
<tr>
<td>Severe chronic obstructive pulmonary disease</td>
<td>1</td>
</tr>
<tr>
<td>Paralysis of lower limb(s)</td>
<td>1</td>
</tr>
<tr>
<td>Symptomatic inflammatory bowel disease</td>
<td>1</td>
</tr>
<tr>
<td>Active nephrotic syndrome</td>
<td>2</td>
</tr>
<tr>
<td>Polycythaemia</td>
<td>2</td>
</tr>
<tr>
<td>Paraproteinaemia</td>
<td>1</td>
</tr>
<tr>
<td>Paroxysmal nocturnal haemoglobinuria</td>
<td>2</td>
</tr>
<tr>
<td>Behçet’s disease</td>
<td>1</td>
</tr>
<tr>
<td>Homocystinuria</td>
<td>3</td>
</tr>
</tbody>
</table>
**Table 2: Thromboprophylaxis for general surgery**

<table>
<thead>
<tr>
<th>Risk group</th>
<th>Recommended prophylaxis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low risk (Risk factor value 0-1)</td>
<td>Graduated compression stockings, e.g. TEDS, early ambulation and adequate hydration</td>
</tr>
<tr>
<td>Moderate risk (Risk factor value 2-4)</td>
<td>Graduated compression stockings, e.g. TEDS plus a low molecular weight heparin e.g. dalteparin 2500 units SC once a day at 1700 hr</td>
</tr>
<tr>
<td>High risk (Risk factor value &gt; 4)</td>
<td>Graduated compression stockings, e.g. TEDS plus a low molecular weight heparin e.g dalteparin 5000 units once daily at 1700 hr Unfractionated heparin 5000 units BD may be better in patients due to undergo surgery with an epidural owing to shorter half-life, but the dose on the morning of surgery must be omitted</td>
</tr>
</tbody>
</table>

**Monitoring**
- Review leg measurements regularly especially in patients with swollen legs, as changes in leg girth significantly change the amount of pressure exerted, which can result in the stocking either becoming ineffective or threatening tissue oxygenation

**Unfractionated heparin and low molecular weight heparin (LMWH)**
- If an in-patient, give heparin 1700 hr the night before surgery and do not give heparin on the morning of surgery
- Do not administer heparin on the morning of surgery to patients:
  - who may require an epidural anaesthetic
  - undergoing vascular procedures

**Cautions**
- History of heparin allergy or heparin-induced thrombocytopenia (danaparoid is alternative). Contact haematologist
- Platelet count:
  - check before starting treatment
  - if heparin will continue for more than five days, check platelets twice weekly for first two weeks then once weekly thereafter looking for thrombocytopenia

**Monitoring**
- U&E:
  - in patients with diabetes mellitus, chronic renal failure, pre-existing metabolic acidosis or those taking potassium-sparing drugs, check for hyperkalaemia before starting heparin
  - if heparin will continue for more than seven days, check potassium weekly

**Duration**
- Continue unfractionated heparin or LMWH until patient independently mobile or discharged

**Contraindications**
- Peripheral arterial disease:
  - claudication and/or Doppler ankle: brachial index < 0.8
- Diabetic neuropathy:
- exclude significant arterial compromise and peripheral neuropathy before applying stockings
- Severe skin disease
- Recent skin graft
- Haemorrhagic disorders
- Thrombocytopenia

**Recommended prophylaxis**
- Use total from Table 1 to assess risk then use Table 2
- Stockings should be sized and fitted correctly
- Apply stockings before sending to theatre
- Use knee length stockings in preference to thigh length

**Monitoring**
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- Thrombocytopenia
SCREENING FOR MRSA AND ESBL/MGNB ON ADMISSION OR TRANSFER • 1/2

**Check with your ward manager or the Infection Control Team to see if you work in an MRSA high risk area**

<table>
<thead>
<tr>
<th>Patient admitted to:</th>
<th>Patient admitted/ transferred from:</th>
<th>Screen for MRSA</th>
<th>Screen for ESBL</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MRSA Bacteraemia</strong></td>
<td><strong>High Risk Area</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Another Hospital</td>
<td>Yes*</td>
<td>Yes*</td>
<td></td>
</tr>
<tr>
<td>Nursing or residential home</td>
<td>Yes*</td>
<td>Yes*</td>
<td></td>
</tr>
<tr>
<td>Another ward</td>
<td>Yes*</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Home</td>
<td>Yes*</td>
<td>No, unless ESBL or MGNB tag present on HISS/EPR</td>
<td></td>
</tr>
<tr>
<td><strong>All Other Areas</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Another Hospital</td>
<td>Yes*</td>
<td>Yes*</td>
<td></td>
</tr>
<tr>
<td>Nursing or residential home</td>
<td>Yes*</td>
<td>Yes*</td>
<td></td>
</tr>
<tr>
<td>Another ward</td>
<td>No</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Home</td>
<td>No, unless MRSA tag present on HISS/EPR</td>
<td>No, unless ESBL or MGNB tag present on HISS/EPR</td>
<td></td>
</tr>
</tbody>
</table>

* Admission screen may be omitted if a patient is likely to be discharged home within 3 days

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**ADMISSION SCREENING FOR MRSA**

- Take swabs from **nose**, **perineum** or any skin **lesions**, and if catheterized, **CSU**

**ADMISSION SCREENING FOR ESBL AND MGNB**

- Take swab from **rectum** (if unable to obtain rectum swab, obtain stool sample) and **CSU** if catheterized

**MANAGEMENT OF SCREENED PATIENTS**

- *Always adhere strictly to standard precautions to prevent spread of MRSA or ESBL/MGNB to other patients*

**Topical MRSA decolonisation treatment**

Decolonise all patients found to be colonised with MRSA unless patient is likely to be discharged home within 5 days

- Nasal mupirocin 8 hrly for **five days**. For mupirocin-resistant MRSA, use chlorhexidine 0.1% with neomycin 0.5% (Naseptin) nasal cream topically to each nostril **6 hrly for 10 days**
- Wash body once daily for **five days** and hair twice in five days with chlorhexidine gluconate solution 20% (Hibiscrub) or triclosan 2% skin cleanser (Aquasept)
- Mupirocin ointment topically to any superficial lesion up to 8 hrly for **five days**. Do not apply mupirocin to large wounds- it is unlikely to eradicate MRSA and contains polyethylene glycol, which can be absorbed from open wounds and damaged skin, and is renally excreted
- Do not use mupirocin for prolonged periods, or use repeatedly (for more than two courses of five days during an admission) as resistance may be encouraged
- If patient has medical device in situ that breaches the skin or mucous membranes (central venous catheter, trachea cannula, drain, external pacemaker), or a urinary catheter, carry out decolonisation treatment while device is in situ and again after all devices have been removed, since topical treatment in the presence of any such device may reduce colonisation but complete eradication is unlikely to succeed
- If a wound or ulcer is infected with MRSA (not just colonised), carry out

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Issue 03
Issued: June 2006
Expires: June 2007
decolonisation once the infection has improved, unless the patient is likely to be discharged home within 5 days

- If necessary, repeat course of topical decolonisation, but do not give more than two courses during a single inpatient episode

**Eradication is known to fail if 5 days of topical treatment are not completed**

**Management of ESBL/MGNB positive patients**

- In the event of active infection, identification of ESBL/MGNBs aids the selection of antibacterial treatment in the event of active infection. It is not uncommon for ESBL/MGNB to be resistant to quinolones, aminoglycosides and cephalosporins

- Do **not** treat colonised patients (those from whom an organism is isolated but who exhibit no signs of infection) with antibiotics
The aim is to reduce the carriage of MRSA and help minimize the risk of the patient acquiring an endogenous infection at the time of surgery.

Wherever possible, efforts should be made to eradicate MRSA before procedures involving prothetic implant material and any other high risk surgery, such as:
- prosthetic joints
- metal prosthesis
- pacemakers
- grafts
- valves
- skin flaps

Screening

- Screen pre-operatively patients:
  - identified from HISS/EPR who are known to be, or who have previously been (in last 12 months), colonized/infected with MRSA
  - requiring elective high-risk surgery

- Take premoistened swabs from:
  - nose
  - any skin lesions, including entry sites for invasive devices
  - perineum, if no skin lesions
  - If patient has productive cough, send a sputum sample
  - If patient has long-term urinary catheter, send a urine sample

Results will be available after 3-5 days. A negative result is unreliable if the patient has been using antibacterials (topical or systemic) in 48 hr before taking swabs

- Determines whether a patient who has been previously MRSA positive has become MRSA negative (either spontaneously or after eradication treatment)

Two sets of premoistened swabs taken at least 1 day apart from:
- nose
- perineum
- any skin lesion

Results will be available after 3-5 days. A negative result is unreliable if patient has been using antibacterials (topical or systemic) in 48 hr before taking swabs

Screening in patients previously known to be colonised with MRSA

- Ideally, start five days pre-operatively and complete on day of operation

Regimen:
- if MRSA sensitive, mupirocin 2% nasal ointment topically to each nostril 8 hrly for 5 days
- for mupirocin-resistant MRSA, chlorhexidine 0.1% with neomycin 0.5% (Naseptin) nasal cream topically to each nostril 6 hrly for 10 days
- wash body once daily for five days, and hair twice in five days, with chlorhexidine gluconate solution 20% (Hibiscrub) or triclosan 2% cleanser (Aquasept)
- mupirocin 2% ointment topically to any superficial lesion 8 hrly for 5 days. Do not apply to large wounds - this is unlikely to eradicate MRSA and contains polyethylene glycol which can be absorbed
When treatment cannot be commenced five days pre-operatively, the treatment should be started at the earliest opportunity and continued for a full 5 days.

OPERATIVE MANAGEMENT

Antibiotic prophylaxis

- See Surgical antibacterial prophylaxis guideline for appropriate speciality
- Always prescribe prophylaxis against MRSA in patients who have been identified as colonised or infected

POST-OPERATIVE MANAGEMENT

Post-eradication screening

- Re-screen 2 days after completing eradication treatment (see Screening in patients previously known to be colonised with MRSA)

Screen only when patient has not been using any antibacterial medications (topical or systemic) for 48 hr AND is likely to remain in hospital for at least 5 days after screening

GENERAL MANAGEMENT OF IN-PATIENTS

- MRSA isolated:
  - if possible, isolate patient

Topical treatment unlikely to eradicate MRSA in patients with invasive devices colonized or infected with MRSA (urinary catheters/percutaneous endoscopic gastrostomy tubes)

- if patient unlikely to be discharged within next five days or likely to be readmitted within next three months, start topical treatment (see Skin carriage)
- if systemic antibiotic therapy required, seek advice from microbiologist (4666 or bleep)
- screening (as above)
- MRSA still present:
  - repeat topical treatment once all invasive devices (drains, lines or catheters) have been removed (see Skin carriage)

Do not attempt to eradicate MRSA more than twice in one admission, as chances of success are remote
For anaemia from acute post-operative bleeding, refer to **Hypotension** and **Post-operative haemorrhage**

### RECOGNITION AND ASSESSMENT

**Definition**

Haemoglobin (Hb) < 12 g/dL

**Symptoms and signs**

- Shortness of breath (especially on exertion)
- Weakness, lethargy
- Palpitation
- Headaches
- Pallor of mucous membranes
- Tachycardia
- Features of cardiac failure
- Koilonychia (suggests iron deficiency)
- Jaundice (alerts to possibility of haemolytic or megaloblastic anaemia)
- Evidence of infection or spontaneous bruising (alerts to possibility of marrow failure)
- Abdominal or rectal mass (alerts to possibility of GI malignancy)

**Patients with severe anaemia may have no symptoms**

**Previous history**

- Ask about:
  - recent bleeds
  - menstrual loss
  - melaena
  - altered bowel habit
  - diet
  - family history of anaemia
  - Macrocytic:
    - MCV > 100 fl
  - megaloblastic (B12 or folate deficiency)
  - alcohol
  - liver disease

**Investigations**

- FBC and film
- U&E
- Liver function (non-urgent unless jaundiced)
- Group and save serum
- Serum ferritin (non-urgent, but take before blood transfusion)
- Serum B12 and folate (non-urgent, but take before blood transfusion)

**Patients admitted with severe anaemia have often had blood tests requested via their GP.**

Check with the laboratory as the diagnosis may have been made already!

**Interpretation of lab findings**

- **Microcytic/hypochromic:**
  - MCV < 78 fl
  - MCH < 26 pg
  - iron deficiency
  - anaemia of chronic disorders
- **Orthochromic:**
  - MCV 78-100 fl
  - MCH > 26 pg
  - anaemia of chronic disorders
  - acute blood loss
  - haemolytic anaemia
  - bone marrow failure, e.g. leukaemia, myeloma, infiltration by carcinoma

**SUBSEQUENT MANAGEMENT**

- **Urgent transfusion is not required unless there is active bleeding.**
- **EXCESSIVE AND RAPID TRANSFUSION CAN BE HARMFUL**
- If blood film indicates leukaemia discuss with on-call haematologist

- **Severe anemias due to haematin deficiency will have developed very slowly and respond to oral replacement therapy, depending on type of anaemia**
  - Iron deficiency – ferrous sulphate 200 mg orally 8 hrly – **ALWAYS** look for cause of blood loss, e.g. menstrual/GI bleed
  - Macrocytic anaemia – hydroxocobalamin 1 mg IM

**IMMEDIATE TREATMENT**

- None required unless evidence of GI bleed (see **Acute upper gastrointestinal haemorrhage**)

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Issue 03
Issued: June 2006
Expires: June 2007
alternate days, for six doses plus folic acid 5 mg twice daily (until results of vitamin assays available, then omit B12 or folate as appropriate)

- **Autoimmune haemolytic anaemia (AIHA)** – lab will perform direct Coombs’ test (DCT) if indicated. Positive DCT indicates AIHA. Discuss with on-call haematologist – give prednisolone 60 mg orally daily

- **Other anaemias** – ask for haematology opinion

- If symptomatic, consider blood transfusion - see flowchart

- If macrocytic anaemia, talk to Consultant before any transfusion

### Monitoring Treatment

- Reticulocyte count – after three days

- Hb – weekly (should rise by 1 g/week if treatment successful)

### Discharge Policy

- Arrange appropriate outpatient investigations

- Iron deficiency: upper GI endoscopy and either sigmoidoscopy plus barium enema or colonoscopy

- B12 deficiency: intrinsic factor antibody, Schilling test

- Folate deficiency: dietary assessment and advice. Anti-endomysial IgA if coeliac disease a possibility

- Other anaemias: consider follow-up in Haematology Clinic
Transfusion flowchart for anaemia

Hb < 10 g/dL

Yes

Symptomatic acute angina?

Crossmatch 2 units of bank blood

No

Symptoms of anaemia

No

Yes

Hb > 5 g/dL?*

Transfuse 1 unit packed cells and reassess – see algorithm for blood ordering. Transfuse to maximum 10 g/dL

Remains symptomatic?

No

No transfusion indicated at present

Yes

Transfuse 1 unit packed cells and reassess – see algorithm for blood ordering. Minimal acceptable Hb is 8 g/dL*

No

No transfusion indicated at present

Yes

Transfuse 1 unit packed cells and reassess – see algorithm for blood ordering. Transfuse to maximum 10 g/dL

* Some patients with long-standing anaemia may not require transfusion – Discuss with specialist in charge

Blood ordering algorithm

Crossmatch 2 units of bank blood

Transfuse 1 unit

Reassess symptomatically. Check for signs of pulmonary congestion

If clinically stable

Stop

If clinically unstable

Transfuse 2nd unit

Reassess

If clinically stable

Yes

No
PATIENTS TAKING ASPIRIN • 1/1

Where ‘minor’, ‘intermediate’ and ‘major’ surgical procedures are mentioned in the text – see classification of surgical procedures for clarification

INTRODUCTION
● Evidence is not clear whether long-term low dose aspirin (75-150 mg/day) should be stopped prior to surgery
● Balance the risks of post-operative bleeding against the possibility of thromboembolic complications if aspirin is stopped, particularly in those with unstable angina

MANAGEMENT

Who
● The decision to discontinue aspirin must be made by the senior surgeon and/or anaesthetist

When
● Consider discontinuing aspirin if epidural anaesthesia likely

How
● Stop aspirin 7 days before surgery to allow recovery of adequate platelet function

Discontinue aspirin before:
● Prostatectomy
● Major surgery when the risks of post-operative bleeding are high
● Major orthopaedic surgery (hips, knees, back)
● Minor or intermediate surgery where the consequences of minor bleeding are significant (e.g. retinal and intracranial surgery)

Continue aspirin in:
● Vascular surgical patients unless instructed otherwise by vascular surgeon
● Minor surgery (e.g. skin)
● Cataract surgery

How

When

Who

Discontinue aspirin before:
 Continue aspirin in:
● Clopidogrel is an anti-platelet agent. It has effects similar to aspirin and causes increased operative blood loss

**RECOMMENDATION**

● Stop clopidogrel 7 days before intermediate and major surgery unless continuation of therapy is specifically requested by a senior clinician

**CAUTION** - There is a high risk of myocardial infarction and stroke if clopidogrel is stopped inappropriately. Discuss patients who have had coronary artery angioplasty or stent insertion and patients with carotid disease with relevant specialist consultant

**NOTE**

● In patients undergoing minor surgical procedures, clopidogrel need not usually be withheld

● Bleeding caused by clopidogrel can be reversed only by the administration of platelets

Where ‘minor’, ‘intermediate’ and ‘major’ surgical procedures are mentioned in the text - see classification of surgical procedures for clarification
Surgery causes an increase in plasma adrenocorticotrophic hormone and cortisol secretion.

In a patient taking oral corticosteroids regularly, the hypothalamic-pituitary-adrenocortical axis (HPA) may be suppressed and the natural stress response impaired.

Without an adequate cortisol output, the patient is at risk of hypoadrenal crisis which can present as acute circulatory collapse.

Corticosteroid replacement therapy must take into account the following:

- dose and duration of maintenance corticosteroid therapy
- nature of surgery and, therefore, likely magnitude of stress

Patients currently taking prednisolone 10 mg (or equivalent - see Table 1) or less daily

Patients have normal HPA function and do not require perioperative corticosteroids greater than their usual requirements.

Patients currently taking more than prednisolone 10 mg (or equivalent - see Table 1) daily

Major surgery

- Give usual oral corticosteroid dose (or parenteral hydrocortisone equivalent – see Table 1) on morning of surgery, and hydrocortisone 50 mg IV at induction.
- Give hydrocortisone 50 mg IV 8 hrly for the first 48-72 hr post-operatively.
- If taking prednisolone > 40 mg daily, increase hydrocortisone dose to parenteral equivalent of usual corticosteroid dose for 48-72 hr.
- After 48-72 hr give the usual corticosteroid dose orally or parenteral hydrocortisone equivalent (see Table 1) until oral route available.

Minor surgery

- Give usual oral corticosteroid dose (or parenteral hydrocortisone equivalent – see Table 1) on morning of surgery.
- Restart usual oral corticosteroid post-operatively the following day.

Intermediate surgery

- Give usual oral corticosteroid dose (or parenteral hydrocortisone equivalent – see Table 1) on morning of surgery and hydrocortisone 50 mg IV at induction.
- Give hydrocortisone 25 mg IV 8 hrly for the first 24 hr post-operatively.
- After 24 hr give usual corticosteroid dose orally or parenteral hydrocortisone equivalent (see Table 1) until oral route available.
Patients who have taken corticosteroids recently:

- Assume that patients who have taken corticosteroids during the three months before surgery have some degree of HPA suppression and treat them as if they were still taking steroids (see Patients currently taking steroids).

- Patients who have received corticosteroids more than three months before surgery do not require perioperative corticosteroid therapy.

Post-operative complications:

- Continue corticosteroid administration consistent with the post-operative stress response (see Patients currently taking steroids).

Table 1: Equivalent anti-inflammatory dosages of corticosteroids

<table>
<thead>
<tr>
<th>Drug</th>
<th>Dosage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydrocortisone</td>
<td>20 mg</td>
</tr>
<tr>
<td>Prednisolone</td>
<td>5 mg</td>
</tr>
<tr>
<td>Betamethasone</td>
<td>750 mcg</td>
</tr>
<tr>
<td>Cortisone acetate</td>
<td>25 mg</td>
</tr>
<tr>
<td>Deflazacort</td>
<td>6 mg</td>
</tr>
<tr>
<td>Dexamethasone</td>
<td>750 mcg</td>
</tr>
<tr>
<td>Methylprednisolone</td>
<td>4 mg</td>
</tr>
<tr>
<td>Triamcinolone</td>
<td>4 mg</td>
</tr>
</tbody>
</table>

Example: prednisolone 15 mg orally each morning is approximately equivalent to 60 mg hydrocortisone e.g. 20 mg IV 8 hrly.

The table above takes no account of mineralocorticoid effects, nor does it take account of variations in duration of action.

Steroid equivalences are a guide. Bioavailabilities, absorption and peak times vary, therefore dosing also needs to be guided by clinical response.
PATIENTS TAKING ORAL CONTRACEPTIVES AND HORMONE REPLACEMENT THERAPY

**ORAL CONTRACEPTIVES**

**Progestogen-only contraceptives**
- Continue progestogen-only contraceptives (oral or injectable) as they are not associated with an increased risk of venous thromboembolism.

**Combined oral contraceptives**
- Combined oral contraceptives increase the risk of perioperative venous thromboembolism, the incidence of which varies with the nature of the procedure.
- Consider substituting with progestogen-only contraceptives (including those given by injection) for combined oral contraceptives before major elective surgery.

**Minor elective surgery (not including surgery to the legs)**
- Continue combined oral contraceptives.
- Thromboprophylaxis required (see Thromboprophylaxis).

**Major elective surgery (including all surgery to the legs)**
- Discontinue combined oral contraceptive four weeks before date of surgery.
- Discuss risks and benefits of discontinuation with patient and document in the surgical notes.
- Ensure adequate alternative contraceptive arrangements are made.
- If there is any possibility that unprotected sexual intercourse has occurred, arrange pregnancy test before surgery.
- Recomence combined oral contraceptive at the first menses occurring at least two weeks after full mobilization.

**HORMONE REPLACEMENT THERAPY**
- Hormone replacement therapy increases the risk of post-operative venous thromboembolism, but, this additional risk has not been quantified.
- Continue in the perioperative period.
- Prescribe thromboprophylaxis for all elective surgery (see Thromboprophylaxis).

**If it has not been possible to discontinue the combined oral contraceptive pill before major surgery or surgery to the legs, prescribe thromboprophylaxis (see Thromboprophylaxis)**
ACUTE VENOUS THROMBOEMBOLISM

- Delay elective non-urgent surgery in patients who are being treated for a first episode of venous thromboembolism until treatment is complete, or three months have elapsed, whichever is sooner
- For urgent elective surgery, management depends on the time elapsed from venous thromboembolism

Within one month

If acute venous thromboembolism has occurred within the two weeks before surgery or if the risk of pulmonary embolism is high, consider a vena caval filter. Discuss with consultant surgeon and consultant interventional radiologist

Pre-operatively

- Omit four doses of warfarin
- Monitor INR and start therapeutic unfractionated IV heparin once the INR is below the lower limit of patient’s target range for warfarin
- Give loading dose of unfractionated heparin 5000 units IV followed by 1400 units/hr
- Check APTT 4-6 hr later
- Adjust infusion rate

Post-operatively

- Restart unfractionated heparin IV 12 hr after major surgery (delay longer if any evidence of bleeding from the surgical site) at same rate as used before surgery. Do not give a loading dose
- Check APTT 6 hr after restarting therapy and adjust infusion rate aiming for APTT 1.5-2.5-times the control value
- Once patient is eating and can take oral medication, check INR before restarting warfarin
- If INR < 1.4, see Prescribing regimens and nomograms – Warfarin. Remember to halve the loading dose (5 mg) and all subsequent doses recommended by the nomogram in patients in whom any of the following apply:
  - age > 80 yr
  - frail and/or very ill
  - underweight
  - requiring parenteral nutrition
  - abnormal liver function

Where ‘minor’, ‘intermediate’ and ‘major’ surgical procedures are mentioned in the text - see classification of surgical procedures for clarification

Patients on warfarin are at increased risk of perioperative thromboembolism if the drug is stopped, and at increased risk of bleeding if it is continued

- Warfarin can be safely continued during the following types of minor surgery provided the INR is < 2.5, unless there is a risk of dangerous bleeding
  - skin
  - dental
- For intermediate and major surgery, the INR should be ≤ 2.0
Patients taking warfarin

- Taking drugs that potentiate warfarin (see BNF, Appendix 1)
- If INR ≥ 1.4, do not give a loading dose
- If INR 1.4-1.7 give warfarin (n+2) mg daily, where n is patient’s usual daily maintenance dose, until INR (checked daily) reaches 1.8 or more, then reduce to (n+1) mg daily until INR 2.0-3.0
- If INR 1.8-1.9, give warfarin (n+1) mg daily, where n is patient’s usual daily maintenance dose, until INR (checked daily) reaches 2.0 or more
- Once INR 2.0-3.0, resume usual daily maintenance dose
- Stop unfractionated heparin once INR has been in target range for two consecutive days

Within two to three months

Pre-operatively

- Omit four doses of warfarin
- Pre-operative therapeutic unfractionated IV heparin is not required unless risk of recurrent venous thromboembolism is moderate/high (see Thromboprophylaxis - risk factors)
- If pre-operative risk is moderate to high, manage as for ‘Acute venous thromboembolism within one month’ (see above)
- If hospitalized and pre-operative, therapeutic unfractionated IV heparin not required, prescribe thromboprophylaxis once INR is below the lower limit of patient’s target range for warfarin (see Thromboprophylaxis - high risk)
- Check INR on day before surgery. If > 2.0, give vitamin K 0.5 mg oral or IV if urgent and recheck INR 6 hr later, aiming for an INR ≤ 2.0

Post-operatively

- Start (or recommence) unfractionated heparin IV 12 hr after major surgery (delay longer if any evidence of bleeding from the surgical site) at 1400 units/hr (or rate as used prior to surgery). Do not give a loading dose
- Check APTT 6 hr after starting heparin and adjust infusion rate (see Prescribing regimens and nomograms) aiming for APTT 1.5-2.5 times the control value
- Once patient is eating and can take oral medication, check INR before restarting warfarin
- If INR < 1.4, see Prescribing regimens and nomograms – Warfarin. Remember to halve the loading dose (5 mg) and all subsequent doses recommended by the nomogram in patients in whom any of the following apply:
  - age > 80 yr
  - frail and/or very ill

Underweight
- Requiring parenteral nutrition
- Abnormal liver function
- Taking drugs that potentiate warfarin (see BNF, Appendix 1)
- If INR ≥ 1.4, do not give a loading dose
- If INR 1.4-1.7, give warfarin (n+2) mg daily, where n is patient’s usual daily maintenance dose, until INR (checked daily) reaches 1.8 or more, then reduce to (n+1) mg daily until INR 2.0-3.0
- If INR 1.8-1.9, give warfarin (n+1) mg daily, where n is patient’s usual daily maintenance dose, until INR (checked daily) reaches 2.0 or more
- Once INR 2.0-3.0, resume usual daily maintenance dose
- Stop unfractionated IV heparin or thromboprophylaxis once INR has been in target range for two consecutive days

Recurrent venous thromboembolism
(more than three months after previous episode)

Pre-operatively

- Omit four doses of warfarin
- If hospitalized, prescribe thromboprophylaxis once INR is below the lower limit of patient’s target range for warfarin (see Thromboprophylaxis -
PATIENTS TAKING WARFARIN • 3/5

high risk

● Check INR on day before surgery. If > 2.0 give vitamin K1 0.5 mg oral or IV if urgent and recheck INR 6 hr later, aiming for INR of ≤ 2.0

Post-operatively

● Prescribe or continue thromboprophylaxis (see Thromboprophylaxis - high risk)

● Once patient is eating and can take oral medication, check INR before restarting warfarin

● If INR < 1.4, see Prescribing regimens and nomograms – Warfarin. Remember to halve the loading dose (5 mg) and all subsequent doses recommended by the nomogram in patients in whom any of the following apply:
  ● age > 80 yr
  ● frail and/or very ill
  ● underweight
  ● requiring parenteral nutrition
  ● abnormal liver function
  ● taking drugs that potentiate warfarin (see BNF, Appendix 1)

● If INR ≥ 1.4, do not give a loading dose

● If INR 1.4-1.7 give warfarin (n+2) mg daily, where n is patient’s usual daily maintenance dose, until INR (checked daily) reaches 1.8 or more, then reduce to (n+1) mg daily until INR 2.0-3.0

● If INR 1.8-1.9, give warfarin (n+1) mg daily, where n is patient’s usual daily maintenance dose, until INR (checked daily) reaches 2.0 or more

● Once INR 2.0-3.0, resume usual daily maintenance dose

● Stop thromboprophylaxis when INR has been in target range for two consecutive days

ACUTE ARTERIAL EMBOLISM

During first month

● Avoid elective surgery in the first month after an arterial embolism

Pre-operatively

● Omit four doses of warfarin

● Monitor INR and start therapeutic unfractionated IV heparin once INR is below lower limit of patient’s target range for warfarin

● Give loading dose of unfractionated heparin 5000 units IV followed by 1400 units/hr

● Check APTT 4-6 hr later

● Adjust infusion rate according to APTT ratio (see Prescribing regimens and nomograms) aiming for a ratio of 1.5-2.5 times the control value

● If APTT in target range, stop unfractionated heparin 6 hr before surgery

● If risk of post-operative bleeding is low, recommence unfractionated heparin IV 12 hr after major surgery (delay longer if any evidence of bleeding from the surgical site) at same rate as used before surgery. Do not give a loading dose

● Check APTT 6 hr after restarting therapy

● Adjust infusion rate (see Prescribing regimens and nomograms) aiming for APTT 1.5-2.5-times the control value

● If risk of post-operative bleeding is high, prescribe thromboprophylaxis (see Thromboprophylaxis - high risk)

● Once patient is eating and can take oral medication, check INR before restarting warfarin

● If INR < 1.4, see Prescribing regimens and nomograms – Warfarin. Remember to halve the loading dose (5 mg) and all subsequent doses recommended by the nomogram in patients in whom any of the following apply:
  ● age > 80 yr
  ● frail and/or very ill
  ● underweight
  ● requiring parenteral nutrition
  ● abnormal liver function
  ● taking drugs that potentiate warfarin (see BNF, Appendix 1)

Post-operatively

● If risk of post-operative bleeding is low, recommence unfractionated heparin IV 12 hr after major surgery (delay longer if any evidence of bleeding from the surgical site) at same rate as used before surgery. Do not give a loading dose

● Check APTT 6 hr after restarting therapy

● Adjust infusion rate (see Prescribing regimens and nomograms) aiming for APTT 1.5-2.5-times the control value

● If risk of post-operative bleeding is high, prescribe thromboprophylaxis (see Thromboprophylaxis - high risk)
PATIENTS TAKING WARFARIN • 4/5

● If INR ≥ 1.4, do not give a loading dose
● If INR 1.4-1.7, give warfarin (n+2) mg daily, where n is patient’s usual daily maintenance dose, until INR (checked daily) reaches 1.8 or more, then reduce to (n+1) mg daily until INR 2.0-3.0
● If INR 1.8-1.9, give warfarin (n+1) mg daily, where n is patient’s usual daily maintenance dose, until INR (checked daily) reaches 2.0 or more
● Once INR 2.0-3.0, resume usual daily maintenance dose
● Stop IV unfractionated heparin or thromboprophylaxis once INR has been in target range for two consecutive days

PROSTHETIC HEART VALVES

Pre-operatively

● Omit four doses of warfarin
● Pre-operative therapeutic unfractionated IV heparin is not required unless risk of thromboembolism is very high (e.g. patients with mechanical prosthetic heart valves). If pre-operative unfractionated IV heparin required, manage as for ‘Acute venous thromboembolism - within one month’
● If hospitalized and pre-operative, therapeutic unfractionated IV heparin not required, prescribe thromboprophylaxis once INR is below the lower limit of patient’s target range for warfarin (see Thromboprophylaxis - high risk)
● Check INR on day before surgery. If INR > 2.0, give vitamin K1 0.5 mg oral or IV if urgent and recheck INR 6 hr later, aiming for an INR of ≤ 2.0

Post-operatively

● For minor procedures, e.g. day case, restart warfarin on the same day after surgery
● If patient nil by mouth and unable to restart warfarin within 12 hr of surgery, start (or recommence) IV unfractionated heparin 12 hr after major surgery (delay longer if any evidence of bleeding from the surgical site) at 1400 units/hr (or rate as used prior to surgery). Do not give a loading dose
● Check APTT 6 hr after starting or restarting therapy
● Adjust infusion rate (see Prescribing regimens and nomograms) aiming for APTT 1.5-2.5-times the control value
● Once patient is eating and can take oral medication, check INR before restarting warfarin
● If INR < 1.4, see Prescribing regimens and nomograms – Warfarin. Remember to halve the loading dose (5 mg) and all subsequent doses recommended by the nomogram in patients in whom any of the following apply:
  ● age > 80 yr
  ● frail and/or very ill
  ● underweight
  ● requiring parenteral nutrition
  ● abnormal liver function
  ● taking drugs that potentiate warfarin (see BNF, Appendix 1)
● If INR ≥ 1.4, do not give a loading dose
● If INR > 0.2 below lower limit of target range, give warfarin (n+2) mg daily, where n is patient’s usual daily maintenance dose, until INR (checked daily) is within 0.2 of lower limit of target range, then reduce to (n+1) mg daily until INR within target range
● If INR within 0.2 of lower limit of target range, give warfarin (n+1) mg daily, until INR within target range
● Once INR within target range, resume usual daily maintenance dose
● Stop unfractionated IV heparin once INR has been in target range for two consecutive days

Issue 03
Issued: June 2006
Expires: June 2007
**NON-VALVULAR ATRIAL FIBRILLATION**
(no history of systemic emboli)

### Pre-operatively
- Omit four doses of warfarin
- Therapeutic unfractionated IV heparin is not required in the perioperative period
- If hospitalized, prescribe thromboprophylaxis once INR is below the lower limit of the patient’s target range for warfarin (see **Thromboprophylaxis - high risk**)
- Check INR on day before surgery. If INR > 2.0 give vitamin K₁ 0.5 mg oral or IV if urgent and recheck INR 6 hr later, aiming for an INR of 2.0

### Post-operatively
- Prescribe or continue thromboprophylaxis (see **Thromboprophylaxis - high risk**)
- Once patient is eating and can take oral medication, check INR before restarting warfarin
- If INR < 1.4, see **Prescribing regimens and nomograms – Warfarin**. Remember to halve the loading dose (5 mg) and all subsequent doses recommended by the nomogram in patients in whom any of the following apply:
  - age > 80 yr
  - frail and/or very ill
  - underweight
  - requiring parenteral nutrition
  - abnormal liver function
  - taking drugs that potentiate warfarin (see BNF, Appendix 1)
- If INR ≥ 1.4, **do not give a loading dose**
- If INR 1.4-1.7 give warfarin (n+2) mg daily, where n is patient’s usual daily maintenance dose, until INR (checked daily) reaches 1.8 or more, then reduce to (n+1) mg daily until INR 2.0-3.0
- If INR 1.8-1.9, give warfarin (n+1) mg daily, where n is patient’s usual daily maintenance dose, until INR (checked daily) reaches 2.0 or more
- Once INR 2.0-3.0, resume usual daily maintenance dose
- stop thromboprophylaxis once INR has been in the target range for two consecutive days
ANTIBACTERIAL PROPHYLAXIS
**Introduction**

- Infection of the incised skin or soft tissue is a common but potentially avoidable complication of any surgical procedure.
- Prophylactic administration of antibacterials inhibits growth of contaminating bacteria and their adherence to prosthetic implants, thus reducing the risk of infection.
- The potential benefit of antibacterial prophylaxis must be weighed against the risk of promoting the selection for and spread of multi-resistant organisms, and the risk of inducing severe *C. difficile*-associated disease.
- Where antibacterial prophylaxis is indicated, a single IV dose at induction (ideally 60 to 30 min before incision to allow for optimal tissue penetration) is sufficient in most cases.
- Never continue administration longer than 24 hr post procedure for the purpose of prophylaxis, because of above risks and lack of evidence base.

**Goals of antibacterial prophylaxis**

- Reduce incidence of surgical site infection.
- Use antibacterials in a manner that is supported by evidence of effectiveness.
- Minimise the effect of antibacterials on the patient's normal bacterial flora.
- Minimise adverse effects.
- Cause minimal change to patient's host defences.

**Classification of operation**

- This guideline applies to all elective operations in the clean, clean-contaminated or contaminated categories.
- Recommendations for prophylaxis of emergency surgery are limited to clean and clean-contaminated operations.
- Emergency operations with contaminated or dirty wounds require antibacterial therapy rather than prophylaxis.
- Insertion of any prosthetic implant increases the risk of infection of the wound and surgical site.

---

<table>
<thead>
<tr>
<th>Class</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clean</td>
<td>Operations in which no inflammation is encountered and the respiratory, alimentary or genitourinary tracts are not entered. There is no break in aseptic operating theatre technique.</td>
</tr>
<tr>
<td>Clean-contaminated</td>
<td>Operations in which the respiratory, alimentary or genitourinary tracts are entered but without significant spillage.</td>
</tr>
<tr>
<td>Contaminated</td>
<td>Operations where acute inflammation (without pus) is encountered, or where there is visible contamination of the wound e.g. gross spillage from a hollow viscus during the operation or compound / open injuries operated on within 4 hr.</td>
</tr>
<tr>
<td>Dirty</td>
<td>Operations in the presence of pus, where there is a previously perforated hollow viscus, or compound / open injuries &gt; 4 hr old.</td>
</tr>
</tbody>
</table>
Antibacterial prophylaxis for prevention of endocarditis may be required in patients with any of the following (see Antibacterial prophylaxis for adult patients at risk of bacterial endocarditis):

- heart valve lesion
- septal defect
- patent ductus
- prosthetic valve
- history of endocarditis

Antibacterial prophylaxis for prevention of endocarditis should be additive to any antibacterial prophylaxis for a specific operation, although antibacterials should not be duplicated (see Antibacterial prophylaxis for adult patients at risk of bacterial endocarditis and Antibacterial prophylaxis guideline for appropriate surgical specialty). Contact Microbiologist on 4666 with any queries.

Where, dependent on the nature of the procedure, antibacterial prophylaxis is not recommended in the appropriate surgical specialty guideline and the patient has an increased risk of endocarditis, the guideline for Antibacterial prophylaxis for adult patients at risk of bacterial endocarditis should also be consulted to determine if there is a need for endocarditis prophylaxis.
Antibacterial prophylaxis for adult patients at risk of bacterial endocarditis

Advice on the prevention of endocarditis reflects the recommendations of a Working Party of the British Society for Antimicrobial Chemotherapy

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Antibacterial prophylaxis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dental and upper respiratory tract procedures - local or no anaesthesia</strong></td>
<td></td>
</tr>
<tr>
<td>Patients who have not received more than a single dose of a penicillin in the previous month - including those with a prosthetic valve - but not those who have had endocarditis</td>
<td>Amoxicillin 3 g orally 1 hr before procedure</td>
</tr>
<tr>
<td>Patients who are penicillin allergic OR</td>
<td>Clindamycin 600 mg orally 1 hr before procedure</td>
</tr>
<tr>
<td>Patients who have received more than a single dose of a penicillin in the previous month</td>
<td></td>
</tr>
<tr>
<td>Patients who have had endocarditis</td>
<td>As for special risk patients undergoing dental procedures under general anaesthesia</td>
</tr>
<tr>
<td><strong>Dental and upper respiratory tract procedures - general anaesthesia</strong></td>
<td></td>
</tr>
</tbody>
</table>
| No special risk Including patients who have not received more than a single dose of a penicillin in the previous month | EITHER
  amoxicillin 1 g IV at induction
  THEN
  amoxicillin 500 mg orally 6 hr later
  OR
  amoxicillin 3 g orally 4 hr before induction
  THEN
  amoxicillin 3 g orally as soon as possible after procedure |
| Special risk Patients with a prosthetic valve OR                           | Amoxicillin 1 g IV at induction
  PLUS
  gentamicin 120 mg IV at induction
  THEN
  amoxicillin 500 mg orally 6 hr later |
| Patients who have had endocarditis                                        |                                                                                           |
| Patients who are penicillin allergic OR                                   | Clindamycin 300 mg IV over at least 10 min at induction
  THEN
  clindamycin 150 mg oral / IV 6 hr later |
| Patients who have received more than a single dose of a penicillin in the previous month |                                                                                           |
### Antibacterial Prophylaxis for Adult Patients at Risk of Bacterial Endocarditis • 2/2

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Antibacterial prophylaxis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Genitourinary procedures</strong></td>
<td></td>
</tr>
<tr>
<td>As for special risk patients undergoing dental procedures under general anaesthesia except that clindamycin is not given (see below for alternative if penicillin allergic); if urine infected, prophylaxis should also cover infective organism</td>
<td>Teicoplanin 400 mg IV at induction PLUS gentamicin 120 mg IV at induction</td>
</tr>
<tr>
<td>Patients who are penicillin allergic</td>
<td></td>
</tr>
<tr>
<td>OR</td>
<td></td>
</tr>
<tr>
<td>Patients who have received more than a single dose of a penicillin in the previous month</td>
<td></td>
</tr>
<tr>
<td><strong>Obstetric, gynaecological and gastrointestinal procedures</strong></td>
<td>As for genitourinary procedures</td>
</tr>
<tr>
<td>Prophylaxis required for patients with prosthetic valves</td>
<td></td>
</tr>
<tr>
<td>OR</td>
<td></td>
</tr>
<tr>
<td>Patients who have had endocarditis</td>
<td></td>
</tr>
</tbody>
</table>

1. Dental procedures that require antibacterial prophylaxis are extractions, scaling, and surgery involving gingival tissues. Antibacterial prophylaxis for dental procedures may be supplemented with chlorhexidine gluconate gel 1% or chlorhexidine gluconate mouthwash 0.2% used 5 min before procedure.

2. For multistage procedures, a maximum of 2 single doses of a penicillin may be given in a month; use alternative drugs for further treatment and do not use penicillin again for 3-4 months.

3. If clindamycin is used, do not repeat periodontal or other multistage procedures at intervals of less than 2 weeks; clindamycin is not licensed for use in endocarditis prophylaxis but it is recommended by the Endocarditis Working Party.

4. Post-operative dose may be given parenterally if the patient is nil by mouth or swallowing is painful.
If patient has history of MRSA in preceding 12 months and antibacterial prophylaxis is indicated, see last row of table

<table>
<thead>
<tr>
<th>Surgery</th>
<th>Likely organisms</th>
<th>Antibacterial prophylaxis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clean surgery</td>
<td>Uncommon</td>
<td>Not recommended</td>
</tr>
<tr>
<td>Endoscopic biopsies (e.g. gastric, duodenal, colonic or sigmoid) OR Snare removal of polyps</td>
<td>Uncommon</td>
<td>Not recommended</td>
</tr>
<tr>
<td>Insertion of surgical and radiological drains</td>
<td>Uncommon</td>
<td>Not recommended</td>
</tr>
<tr>
<td>Laparoscopic cholecystectomy</td>
<td>Uncommon</td>
<td>Not recommended</td>
</tr>
<tr>
<td>Laparoscopic or non-laparoscopic hernia repair with mesh (no history of MRSA)</td>
<td><em>Staphylococcus</em> spp Gram negative bacilli Anaerobes</td>
<td>Cefuroxime&lt;sup&gt;1&lt;/sup&gt; 1.5 g IV at induction&lt;sup&gt;2&lt;/sup&gt; PLUS metronidazole 500 mg IV by infusion at induction&lt;sup&gt;2&lt;/sup&gt; If cefuroxime cannot be given (see footnote&lt;sup&gt;1&lt;/sup&gt;): Gentamicin 120 mg IV at induction&lt;sup&gt;2&lt;/sup&gt; PLUS metronidazole 500 mg IV by infusion at induction&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td>Colorectal OR small intestine (no history of MRSA)</td>
<td><em>Escherichia coli</em> <em>Streptococcus</em> spp Enterococci Other Gram negative bacilli Anaerobes</td>
<td>Cefuroxime&lt;sup&gt;1&lt;/sup&gt; 1.5 g IV at induction&lt;sup&gt;2&lt;/sup&gt; PLUS metronidazole 500 mg IV by infusion at induction&lt;sup&gt;2&lt;/sup&gt; If cefuroxime cannot be given (see footnote&lt;sup&gt;1&lt;/sup&gt;): Gentamicin 120 mg IV at induction&lt;sup&gt;2&lt;/sup&gt; PLUS metronidazole 500 mg IV by infusion at induction&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td>Surgery</td>
<td>Likely organisms</td>
<td>Antibacterial prophylaxis</td>
</tr>
<tr>
<td>------------------------------------------------------------------------</td>
<td>-----------------------------------</td>
<td>---------------------------------------------------------------</td>
</tr>
<tr>
<td>Oesophago-gastric (no history of MRSA)</td>
<td><em>Streptococcus</em> spp Gram negative bacilli</td>
<td>Cefuroxime(^1) 1.5 g IV at induction(^2)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>If cefuroxime cannot be given (see footnote(^1)):</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gentamicin 120 mg IV at induction(^2)</td>
</tr>
<tr>
<td>Percutaneous endoscopic gastrostomy (no history of MRSA) Screen for MRSA</td>
<td><em>Streptococcus</em> spp Gram negative bacilli</td>
<td>Cefuroxime(^1) 1.5 g IV at induction(^2)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>If cefuroxime cannot be given (see footnote(^1)):</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gentamicin 120 mg IV at induction(^2)</td>
</tr>
<tr>
<td>Open biliary OR Percutaneous insertion of biliary stent OR Pancreatic OR Liver (no history of MRSA)</td>
<td><em>Escherichia coli</em> <em>Klebsiella</em> spp <em>Enterococci</em> <em>Staphylococcus aureus</em> Anaerobes</td>
<td>Cefuroxime(^1) 1.5 g IV at induction(^2) PLUS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gentamicin 120 mg IV at induction(^2) PLUS metronidazole 500 mg IV by infusion at induction(^2)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>If cefuroxime cannot be given (see footnote(^1)):</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gentamicin 120 mg IV at induction(^2) PLUS metronidazole 500 mg IV by infusion at induction(^2)</td>
</tr>
<tr>
<td>ERCP (no history of MRSA)</td>
<td><em>Enterococci</em> Gram negative bacilli</td>
<td>Gentamicin 120 mg IV at induction(^2) OR Ciprofloxacin 750 mg orally 90 min before procedure</td>
</tr>
<tr>
<td>Appendicectomy (no history of MRSA)</td>
<td>Anaerobes</td>
<td>Metronidazole 1 g PR with premed OR 500 mg IV by infusion at induction(^2)</td>
</tr>
<tr>
<td>Breast surgery (no history of MRSA)</td>
<td><em>Staphylococcus aureus</em></td>
<td>Flucloxacin 1 g IV at induction(^2)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>If penicillin allergic:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Clindamycin 300 mg IV at induction(^2) over at least 10 min</td>
</tr>
<tr>
<td>History of MRSA in preceding 12 months AND antibacterial prophylaxis is indicated</td>
<td>MRSA found is gentamicin sensitive</td>
<td>Add gentamicin 120 mg IV at induction(^2) to appropriate regimen if not included</td>
</tr>
<tr>
<td></td>
<td>MRSA found is gentamicin resistant</td>
<td>Add teicoplanin 400 mg IV at induction(^2) to appropriate regimen if not included</td>
</tr>
</tbody>
</table>

NOTES:

1. If previous history of penicillin type I allergy (immediate hypersensitivity i.e. anaphylaxis, hypotension, laryngeal oedema, urticaria / angioedema or wheezing) or cephalosporin allergy is present, do not give cefuroxime. If history of penicillin allergy is morbilliform rash only (onset > 72 hr after first dose), cefuroxime can still be given.

2. In the event of major intraoperative blood loss (> 1500 ml), give an additional dose of prophylactic antibacterials after fluid replacement.

   If cefuroxime is used and surgery is prolonged (> 6 hr), consider giving an additional dose of cefuroxime 750 mg IV, to be repeated 6-hrly until end of procedure. The other above-mentioned antibacterials have such a long half-life that there is no indication to repeat a dose because of prolonged surgery.
If patient has history of MRSA in preceding 12 months and antibacterial prophylaxis is indicated see last row of table

<table>
<thead>
<tr>
<th>Surgery</th>
<th>Likely organisms</th>
<th>Antibacterial prophylaxis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Clean non-implant surgery</strong>&lt;br&gt;Arthroscopy OR Joint aspiration</td>
<td>Uncommon</td>
<td>Not recommended</td>
</tr>
<tr>
<td><strong>Elective implant surgery</strong>&lt;br&gt;(no history of gentamicin-resistant MRSA)</td>
<td>Coagulase negative staphylococci&lt;br&gt;<em>Staphylococcus aureus</em>&lt;br&gt;Polymicrobial&lt;br&gt;Aerobic Gram negative bacilli&lt;br&gt;Streptococci&lt;br&gt;Aerobes&lt;br&gt;Enterococci&lt;br&gt;Diphtheroids</td>
<td>Gentamicin 120 mg IV at induction²&lt;br&gt;PLUS&lt;br&gt;cefuroxime¹ 1.5 g IV at induction²&lt;br&gt;On consultant advice for individual patients, it may be appropriate to extend the cefuroxime prophylaxis beyond the procedure but no longer than 24 hr post-operatively</td>
</tr>
<tr>
<td><strong>Closed fractures</strong>&lt;br&gt;(requiring implants) OR <strong>Total hip replacement</strong> OR <strong>Total knee replacement</strong> OR <strong>Spinal surgery</strong></td>
<td>Wide spectrum, with higher proportion of Gram negative and anaerobic infections (<em>N.B. Tetanus prophylaxis</em>)</td>
<td>Gentamicin 120 mg IV at induction²&lt;br&gt;PLUS&lt;br&gt;cefuroxime¹ 1.5 g IV 8 hrly&lt;br&gt;Start as soon as possible and continue for 5 days post-operatively&lt;br&gt;PLUS&lt;br&gt;metronidazole 500 mg IV 8 hrly by infusion.&lt;br&gt;Start as soon as possible and continue for 5 days post-operatively&lt;br&gt;If cefuroxime cannot be given (see footnote³):&lt;br&gt;gentamicin 120 mg IV at induction²&lt;br&gt;PLUS&lt;br&gt;clindamycin 300 mg IV over at least 10 min at induction²&lt;br&gt;On consultant advice for individual patients, it may be appropriate to extend the clindamycin prophylaxis beyond the procedure but no longer than 24 hr post-operatively</td>
</tr>
<tr>
<td><strong>Open fractures</strong>&lt;br&gt;(no history of gentamicin resistant MRSA)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**History of gentamicin resistant MRSA in preceding 12 months AND antibacterial prophylaxis is indicated**

<table>
<thead>
<tr>
<th>Surgery</th>
<th>Likely organisms</th>
<th>Antibacterial prophylaxis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Substitute teicoplanin 400 mg IV for gentamicin to appropriate regimen at induction³</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Proportion of MRSA varies over time

**NOTES:**

1. If previous history of penicillin type I allergy (immediate hypersensitivity i.e. anaphylaxis, hypotension, laryngeal oedema, urticaria / angiooedema or wheezing) or cephalosporin allergy is present, do not give cefuroxime. If history of penicillin allergy is morbilliform rash only (onset > 72 hr after first dose), cefuroxime can still be given.

2. In the event of major intraoperative blood loss (> 1500 mL), give an additional dose of prophylactic antibacterials after fluid replacement. If cefuroxime is used and surgery is prolonged (> 6 hr), consider giving an additional dose of cefuroxime 750 mg IV, to be repeated 6 hrly until end of procedure. The other above mentioned antibacterials have such a long half-life that there is no indication to repeat a dose because of prolonged surgery.

3. Discontinue immediately if diarrhoea develops.
<table>
<thead>
<tr>
<th>Surgery</th>
<th>Likely organisms</th>
<th>Antibacterial prophylaxis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cataract</td>
<td><em>Staphylococcus</em> spp</td>
<td>Povidone-iodine 5% aqueous solution irrigated into the conjunctival sac immediately before anaesthetic, pre-operatively and at end of surgery</td>
</tr>
<tr>
<td></td>
<td><em>Streptococcus</em> spp</td>
<td>Cefuroxime 125 mg subconjunctival(^1) at closure</td>
</tr>
<tr>
<td></td>
<td></td>
<td>If cefuroxime cannot be given(^2):</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gentamicin 20 mg subconjunctival at closure</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Maxitrol® eye drops(^3)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 drop to affected eye 6 hrly</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Start as soon as possible and continue for 21 days post-operatively</td>
</tr>
</tbody>
</table>

NOTES:

1. Reconstitute 250 mg cefuroxime vial by adding 1.3 mL water for injection to give 250 mg in 1.5 mL (250 mg cefuroxime powder displaces 0.2 mL of water) and take 0.75 mL which gives 125 mg of cefuroxime

2. If previous history of penicillin type I allergy (immediate hypersensitivity i.e. anaphylaxis, hypotension, laryngeal oedema, urticaria / angioedema or wheezing) or cephalosporin allergy is present, do not give cefuroxime. If history of penicillin allergy is morbilliform rash only (onset > 72 hr after first dose), cefuroxime can still be given

3. Contains dexamethasone 0.1%, hypromellose 0.5%, neomycin 0.35% (as sulphate), polymyxin B sulphate 6000 units/mL
# Antibacterial Prophylaxis in Ear, Nose and Throat Surgery in Adults • 1/2

If patient has history of MRSA in preceding 12 months and antibacterial prophylaxis is indicated, see last row of table

<table>
<thead>
<tr>
<th>Surgery</th>
<th>Likely organisms</th>
<th>Antibacterial prophylaxis 1</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Clean surgery</strong>&lt;br&gt;Ear&lt;br&gt;OR&lt;br&gt;Head and neck including:&lt;br&gt;Parathyroidectomy&lt;br&gt;OR&lt;br&gt;Thyroidectomy</td>
<td>Uncommon</td>
<td>Not recommended</td>
</tr>
<tr>
<td><strong>Nose/sinus</strong>&lt;br&gt;OR&lt;br&gt;Tonsillectomy</td>
<td>Uncommon</td>
<td>Not recommended</td>
</tr>
<tr>
<td><strong>Clean-contaminated or contaminated surgery</strong>&lt;br&gt;Head and neck&lt;br&gt;OR&lt;br&gt;Sinuses transversed (no history of MRSA)</td>
<td><em>Staphylococcus aureus</em>&lt;br&gt;Streptococcus spp&lt;br&gt;Bacteroides&lt;br&gt;Gram positive cocci&lt;br&gt;<em>Haemophilus influenzae</em></td>
<td>Co-amoxiclav 1.2 g IV at induction 3&lt;br&gt;On consultant advice when pharynx opened, it may be appropriate to extend the co-amoxiclav prophylaxis beyond the procedure but no longer than 24 hr post-operatively&lt;br&gt;<strong>If penicillin allergic:</strong>&lt;br&gt;Cefuroxime 2 1.5 g at induction 3&lt;br&gt;plus&lt;br&gt;metronidazole 500 mg IV by infusion at induction 3&lt;br&gt;On consultant advice when pharynx opened, it may be appropriate to extend the cefuroxime and metronidazole prophylaxis beyond the procedure but no longer than 24 hr post-operatively</td>
</tr>
</tbody>
</table>

**History of MRSA in preceding 12 months AND antibacterial prophylaxis is indicated**

- MRSA found is gentamicin sensitive
- MRSA found is gentamicin resistant

**NOTES:**

1. Antibacterial prophylaxis or treatment may be continued for 5 days for trauma wounds (e.g. open fractures) that are grossly contaminated or infected. Systemic surgical antibacterial prophylaxis must never be extended beyond 24 hr after the procedure for any other reason, regardless of any positive pre-operative culture result, as studies have not shown any protective effect, but have shown increased risk of selection for multi-resistant organisms (e.g. MRSA, ESBL) and promotion of *C. difficile* associated diarrhoea. For the same reasons the presence of any type of line or catheter (e.g. CVC or suprapubic), or drain (e.g. EVD, intra-abdominal, wound) is never an indication for continued antibacterial prophylaxis.
2. If previous history of penicillin type I allergy (immediate hypersensitivity i.e. anaphylaxis, hypotension, laryngeal oedema, urticaria / angioedema or wheezing) or cephalosporin allergy is present, do not give cefuroxime and contact consultant microbiologist. If history of penicillin allergy is morbilliform rash only (onset > 72 hr after first dose), cefuroxime can still be given.

3. In the event of major intraoperative blood loss (> 1500 mL), give an additional dose of prophylactic antibacterials after fluid replacement. If cefuroxime is used and surgery is prolonged (> 6 hr), consider giving an additional dose of cefuroxime 750 mg IV, to be repeated 6 hrly until end of procedure. The other above-mentioned antibacterials have such a long half-life that there is no indication to repeat a dose because of prolonged surgery.
Give patients the Department of Health Information Leaflet and Card about splenectomy, so that they can alert health professionals to their risk of overwhelming infection.

**COMMON PATHOGENS**
- *Streptococcus pneumoniae*
- *Haemophilus influenzae type b*
- *Neisseria meningitidis*

**IMMUNISATIONS**
- Give the following immunisations (see table 1) unless previously immunised
- Inject in the upper arm or anterolateral thigh
- If possible, give each vaccine at a separate site, preferably in a different limb
- If given in the same limb, injections should be given at least 2.5 cm apart

### Table 1: Immunisation schedule

<table>
<thead>
<tr>
<th>Vaccine</th>
<th>Dose, route and timing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pneumococcal vaccine (Pneumovax II®)</td>
<td>0.5 mL by intramuscular* injection&lt;br&gt;&lt;strong&gt;Single dose&lt;/strong&gt;&lt;br&gt;At least 2 wk before elective splenectomy or as soon as possible after recovery from the operation and before discharge from hospital</td>
</tr>
<tr>
<td>Haemophilus influenzae type b</td>
<td>0.5 mL by intramuscular* injection&lt;br&gt;&lt;strong&gt;Single dose&lt;/strong&gt;&lt;br&gt;At least 2 wk before elective splenectomy or as soon as possible after recovery from the operation and before discharge from hospital</td>
</tr>
<tr>
<td>Meningococcal group C</td>
<td>0.5 mL by intramuscular* injection&lt;br&gt;&lt;strong&gt;Single dose&lt;/strong&gt;&lt;br&gt;At least 2 wk before elective splenectomy or as soon as possible after recovery from the operation and before discharge from hospital</td>
</tr>
<tr>
<td>Influenza</td>
<td>0.5 mL by intramuscular* injection&lt;br&gt;&lt;strong&gt;Annually&lt;/strong&gt;&lt;br&gt;To be given during season (usually in primary care)</td>
</tr>
</tbody>
</table>

* For individuals with a bleeding disorder, vaccines should be given by deep subcutaneous injection

### ANTIBACTERIAL PROPHYLAXIS
- Lifelong prophylactic antibacterials should be offered in all cases, especially in the first two years after splenectomy (see table 2)

**Table 2: Antibacterial Prophylaxis**

<table>
<thead>
<tr>
<th>Antibacterial</th>
<th>Dosing regimen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phenoxymethylpenicillin</td>
<td>500 mg orally 12 hrly&lt;br&gt;Start once able to take oral medication</td>
</tr>
<tr>
<td>If penicillin allergic: Erythromycin</td>
<td>250 mg orally 12 hrly&lt;br&gt;Start once able to take oral medication</td>
</tr>
</tbody>
</table>
MANAGEMENT OF PERIOPERATIVE PAIN
Preparation

- Identify how pain will be reported
- Consider need for a trained interpreter
- If patient unable to communicate, arrange to obtain information from carers
- Gain information about behavioural signs of pain

Questions

- Ask about any current analgesic medication with regard to:
  - pain type, location and intensity
  - efficacy
  - experience of adverse effects
  - duration of the prescription
- Seek information about previous surgery and pain experiences including:
  - method of analgesia and its effectiveness
  - experience of post-operative nausea/vomiting (see Post-operative nausea and vomiting) or other adverse effects
  - patient’s satisfaction with method of pain relief

Explain (attentive analgesia)

- Assess any anxieties or fears related to planned surgery and/or how pain will be controlled
- Discuss fears about analgesics such as addiction, sedation, nausea and vomiting, cognitive changes and fear of injections:
  - if patient expresses a fear of injections, discuss alternative routes of pain relief
- explain about possible experience of hallucinations or dysphoria
- Reassure patient that treating their pain is a priority
- Discuss how patient will be involved in their pain management by explaining importance of:
  - reporting unrelieved pain
  - reporting pain early rather than waiting until it is severe
- Explain use of verbal descriptor pain rating scale to measure pain intensity

Setting the patient’s pain relief goal

- Explain need for effective pain relief to enable mobilisation and reduce complications
- Explain that experiencing pain after surgery is normal but emphasise that comfort is a priority
- Agree a pain relief goal that allows restoration of function, such as deep breathing or movement

Select and demonstrate a pain control method

- See Post-operative pain relief
- Explain and demonstrate pain control method (e.g. patient-controlled analgesia) before surgery

Record

- Document the above actions with the patient’s response and pain relief goal in the nursing care plan

<table>
<thead>
<tr>
<th>Patient’s verbal descriptor</th>
<th>Pain score to be recorded</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>0</td>
</tr>
<tr>
<td>Mild</td>
<td>1</td>
</tr>
<tr>
<td>Moderate</td>
<td>2</td>
</tr>
<tr>
<td>Severe</td>
<td>3</td>
</tr>
</tbody>
</table>

Verbal Descriptor Rating Scale
Where ‘minor’, ‘intermediate’ and ‘major’ surgical procedures are mentioned in the text - see classification of surgical procedures for clarification.

**AIMS OF ACUTE PAIN MANAGEMENT**

- To provide optimal analgesia
- To involve patients in their pain management
- To facilitate early mobilisation and speed recovery

**ASSESSMENT**

A working diagnosis for the cause of the pain is essential.

**Verbal Descriptor Rating Scale**

<table>
<thead>
<tr>
<th>Patient's verbal descriptor</th>
<th>Pain score to be recorded</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
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</tr>
<tr>
<td>Mild</td>
<td>1</td>
</tr>
<tr>
<td>Moderate</td>
<td>2</td>
</tr>
<tr>
<td>Severe</td>
<td>3</td>
</tr>
</tbody>
</table>

Pain assessment at rest may not reveal inadequate analgesia.

**A. Assess pain**

Ask patient to score pain intensity on movement or deep inspiration using **verbal descriptor rating scale**.

- Verify location and type of pain

**B. Act**

- If pain intensity rating above patient’s pain relief goal, choose appropriate analgesia (see below)
- If adverse effects occur, see **Opioid analgesia**

**C. Assess effect of action**

- Pain relief (pain score); respiratory depression; other adverse effects. See **Opioid analgesia**

**Indicators of respiratory depression**

**Sedation score:**

- 0 = Awake
- 1 = Drowsy
- 2 = Difficult to rouse
- 3 = Unrousable
- NS = Normal sleep

**Respiratory rate:**

Less than 8 b/min (consider normal R/Rate)


**CHOICE OF ANALGESIA**

- If no specific form of analgesia indicated by type of pain, use **Acute pain analgesia ladder** to select analgesia
- Start at the point appropriate to pain score

**Acute pain analgesia ladder**

- Pain Score 3 (Severe)
  - Epidural (via Acute Pain Service)
  - OR
    - Morphine (IV if appropriate) according to predictors of dose and then titrated to effect. Then either:
      - PCA
      - Regular morphine

- Pain score 2 (Moderate)
  - Regular dihydrocodeine
  - OR *
    - Regular paracetamol + codeine phosphate
    - + morphine if required

- Pain score 1 (Mild)
  - Regular co-codamol (8/500)
  - OR *
    - Regular paracetamol

- Pain score 0-1 (None to mild)
  - Paracetamol if required

* How does one decide which: patient tolerance/preference; potency of the medication – see codeine & dihydrocodeine

**TIME**

- Pain decreases or goes away

**TYPES OF PAIN**

- Colicky pain (e.g. biliary colic, renal colic, bowel colic) consider NSAID see Paracetamol and NSAIDs or antispasmodic agent (hyoscine butylbromide)
- Procedural pain: consider Entonox. See Entonox
- Neuropathic pain contact APS (Acute pain service)
- Take any pre-existing pain condition into account when selecting analgesia

and surgery undertaken
- Aim to achieve adequate analgesia using weakest analgesic from ladder
- Severe acute pain usually requires strong opioid (e.g. morphine)
- Non-opioids e.g. paracetamol and/or NSAIDs given regularly can reduce the amount of opioid required
- When pain continuous or predictable, administer analgesia around the clock, supplemented by a stronger analgesic available as required

Regular paracetamol can apply at any step of the ladder beyond the first
NSAID as required can apply at any step of the ladder
## Route of administration

- See **Opioid analgesia**

<table>
<thead>
<tr>
<th>Route/agent</th>
<th>Indications</th>
<th>Contraindications</th>
<th>Cautions</th>
</tr>
</thead>
</table>
| INTERMITTENT INTRAVENOUS (IV): See **Opioids** | • Rapid pain relief  
• Initial pain relief (e.g. loading dose to establish PCA)  
• Procedural pain  
• Uptake from muscle or subcutaneous tissue poor | • Sedation score > 2  
• Respiratory rate < 8/min  
• Inadequate staff training/monitoring  
• Routine maintenance of analgesia on general wards | • Decreased respiratory reserve  
• Hypotension  
• Renal/hepatic impairment  
• Concurrent administration of CNS depressants  
• Opioid previously administered by another route |
| PCA: See **Patient-controlled opioid analgesia** | • Following major surgery or trauma  
• Painful medical conditions (e.g. pancreatitis)  
• To avoid repeated IM injections | • Patient not accepting  
• Impaired cognitive function  
• Unable to press PCA button  
• Staff not trained in PCA technique | • Loading dose required. See **Opioids**  
• Pump must be set up by assessed person  
• Only the patient may authorise a PCA demand |
| INTRA-MUSCULAR INJECTION (IM): See **Opioids** | • Unable to take drugs by mouth  
• Oral route ineffective  
• Rapid onset required but IV route impractical | • Fully anticoagulated patients  
• Fear of injections  
• Unacceptable to patient | • Unpredictable absorption: cold/hypovolaemic/dehydrated patients  
• Opioid-related respiratory depression difficult to anticipate  
• Fluctuating analgesia – brief peak effect  
• Reduced muscle mass  
• Administration subject to delay  
• Administration painful  
• Risk of infection increased in patients with diabetes  
• Avoid IM diclofenac – risk of sterile abscess |
| CONTINUOUS INFUSION: See **Opioids** | • Severe pain  
• To prevent rather than treat pain  
• Patient unable to use PCA  
• To avoid repeated IM injections | • Inadequate staff training/monitoring | • High incidence of respiratory depression  
• Not suitable for episodic pain – may require intravenous bolus doses. See **Opioids** |
### Monitoring/documentation

- If pain well controlled, assess hrly for first 3 hr and then at same time as routine observations of other vital signs/according to route of administration. See **Opioids**
- If pain poorly controlled or analgesic regimen has been changed, assess pain intensity at least once hrly until pain controlled
- **If pain persists, seek review of pain management technique**

### REFERRAL TO ACUTE PAIN SERVICE (APS)

#### Routine referral

- Refer all patients with epidural infusion analgesia, patient-controlled analgesia (IV), continuous opioid infusion and any patient with a pain problem to APS by either:
  - completing the anaesthetic referral form (Theatre/Recovery only)
  - contacting the Acute Pain Nurse (APN)
- Consider pre-operative referral of patients with a history of:
  - use of regular opioid medication
  - current chronic pain problem
  - previous problem with severe post-operative pain

#### Non-routine referral

- Acute/post-operative pain
- Type, location and intensity of pain have been formally assessed
- Any underlying contributory pathology (e.g. constipation) has been considered

**If Analgesic Ladder fails to control pain or if adverse effects remain uncontrolled, refer patient to APS and/or admitting Surgical Team**

### Route/agent | Indications | Contraindications | Cautions
--- | --- | --- | ---
**ORAL/ ENTERAL**
See Paracetamol and NSAIDs and Opioids

- Oral route established

- Nil by mouth nausea
- Unable to swallow

- Opioids: unpredictable absorption – may accumulate
- NSAIDs: best taken with food

**RECTAL:**
See Paracetamol and NSAIDs

- Oral route not established

- Unacceptable to patient
- Following rectal/lower bowel surgery
- Painful rectal condition

- Risk of NSAID-related gastrointestinal pathology not reduced

**Epidural:** See **Epidural analgesia**

- Specialised technique
- Contact APS or on call anaesthetist
**Risk factors**

<table>
<thead>
<tr>
<th>Patient</th>
<th>Surgery</th>
<th>Anaesthetic</th>
<th>Post-operative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>Abdominal, especially gastrointestinal</td>
<td>Choice of premedication</td>
<td>Pain</td>
</tr>
<tr>
<td>Children</td>
<td>Gynaecological</td>
<td>Opioid analgesics</td>
<td>Dizziness</td>
</tr>
<tr>
<td>Obesity</td>
<td>Laparoscopy</td>
<td>Nitrous oxide</td>
<td>Early ambulation</td>
</tr>
<tr>
<td>Migraine</td>
<td>Ear, nose and throat</td>
<td>Some inhalation agents</td>
<td>Use of opioids</td>
</tr>
<tr>
<td>History of travel sickness</td>
<td>Ophthalmic</td>
<td>Longer procedures and greater depth of anaesthesia</td>
<td>Hypotension</td>
</tr>
<tr>
<td>Previous experience of PONV</td>
<td></td>
<td></td>
<td>Premature oral intake</td>
</tr>
<tr>
<td>Prolonged/inadequate fasting</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Prior to or on admission**
- Identify patients at risk of PONV—see Table
- Inform anaesthetist/surgical team so that prophylactic treatment can be prescribed
- Discuss treatment with patient

**Following surgery**
- Move patient slowly and smoothly
- Discourage patient from moving from lying to sitting too rapidly
- Monitor for nausea and record on observation chart
- Encourage patients to report any nausea immediately
- Once reported, treat promptly

**Prevention / treatment of PONV**
- Prochlorperazine 12.5 mg IM 6 hrly (6.25 mg if age ≥ 60 yr)
- If nausea/vomiting not prevented by prochlorperazine, add ondansetron 4 mg IV 6 hrly
- Provide privacy, support and reassurance
- Encourage patient to rinse his/her mouth
- Measure and record any vomiting
- If feasible, reduce opioid consumption by adding paracetamol/NSAID

**Table**

- Female
- Children
- Obesity
- Migraine
- History of travel sickness
- Previous experience of PONV
- Prolonged/inadequate fasting
Indications

- Mild to moderate steps of analgesic ladder

Contraindications

- Known sensitivity

Choice of agent

- Co-codamol 8/500 (codeine phosphate 8 mg and paracetamol 500 mg)
  1-2 tablets orally 4-6 hrly as required to a maximum of 8 tablets in 24 hr
- Codeine phosphate 30-60 mg orally 4-6 hrly as required to a maximum of 240 mg in 24 hr
- Ineffective as sole agent – administer with regular paracetamol
- Dihydrocodeine 30-60 mg orally 4-6 hrly as required to a maximum of 240 mg in 24 hr

Unwanted effects

- Nausea
- Constipation
- Consider aperient
- Dizziness (especially with higher doses of dihydrocodeine)

Cautions

- Combined effervescent preparations of paracetamol and codeine phosphate have high sodium content – avoid in renal failure and hypertension
**GENERAL PRINCIPLES**

**Indications**
- Moderate-severe pain

**Contraindications**
- Respiratory depression (see below)
- Allergy/pseudo-allergy to the intended drug

**Routes of administration**
- See Post-operative pain relief

**Precautions/predictors of initial dose**
- Individuals vary greatly in the amount of opioid required to achieve analgesia and response to treatment with strong opioids
- Follow precautions/predictors of initial dose, then titrate subsequent doses
- Consider factors affecting drug absorption. See Post-operative pain relief

---

**Precaution / Predictors**

<table>
<thead>
<tr>
<th>Precaution / Predictors</th>
<th>Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>• Opioid requirement decreases with age</td>
</tr>
<tr>
<td></td>
<td>• See IM analgesia: Suggested starting doses</td>
</tr>
<tr>
<td>Renal impairment (moderate-severe)</td>
<td>• Dose reduction and increased intervals required. Contact APS</td>
</tr>
<tr>
<td></td>
<td>• Avoid pethidine</td>
</tr>
<tr>
<td>Hepatic impairment (severe)</td>
<td>• Use lower doses with cautious titration of analgesic effect against sedating effect. Contact APS</td>
</tr>
<tr>
<td></td>
<td>• Avoid pethidine</td>
</tr>
<tr>
<td>Respiratory disease (severe)</td>
<td>• Use lower doses with cautious titration of analgesic effect against sedating effect</td>
</tr>
<tr>
<td>Previous exposure to opioids</td>
<td>• Gain information about unwanted effects or tolerance</td>
</tr>
<tr>
<td></td>
<td>• Opioid tolerance may require increased doses</td>
</tr>
<tr>
<td></td>
<td>• Opioid analgesia is not contraindicated in substance misuse</td>
</tr>
<tr>
<td></td>
<td>• Contact APS</td>
</tr>
</tbody>
</table>

---

**Titration of subsequent doses**
- According to:
  - Pain relief (pain score)
  - Presence of adverse effects. See below

**MANAGEMENT/MONITORING**
- Following administration of opioid by any route:
  - monitor pain relief (pain score); presence of adverse effects including respiratory depression (sedation score, respiratory rate)

Significant respiratory depression can be avoided by monitoring and managing sedation
Sedation is an early indicator of respiratory depression

- Monitor in all patients having opioid analgesics by any route
- If sedation occurs, reduce opioid dosage (see below)
- Discreetly check the patient is asleep (rather than unconscious) – should stir when name is spoken

Respiratory depression may co-exist with normal respiratory rate

- Risk increased with simultaneous administration of sedatives (including benzodiazepines)
- Normal O₂ saturation in patients breathing supplemental oxygen is not a reliable indicator of respiratory function

### Sedation scoring

- 0 = Awake
- 1 = Drowsy
- 2 = Difficult to rouse
- 3 = Unrousable
- NS = Normal sleep

### Route of administration

<table>
<thead>
<tr>
<th>Route of administration</th>
<th>Monitoring of pain relief and adverse effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oral (morphine sulphate solution)</td>
<td>20-30 min after administration and then at same time as other vital signs. No less often than 3 hrly</td>
</tr>
<tr>
<td>Intramuscular opioid</td>
<td>30-60 min after administration and then at same time as other vital signs. No less often than 3 hrly</td>
</tr>
<tr>
<td>Intermittent IV bolus</td>
<td>Monitor and record every 5 min until at least 15 min after last bolus dose</td>
</tr>
<tr>
<td>Continuous intravenous morphine infusion</td>
<td>At same time as other vital signs. See continuous infusion</td>
</tr>
<tr>
<td>Patient controlled analgesia</td>
<td>At same time as other vital signs. See Patient controlled opioid analgesia (PCA)</td>
</tr>
<tr>
<td>Epidural analgesia</td>
<td>At same time as other vital signs. See Epidural analgesia</td>
</tr>
</tbody>
</table>

### Act:

- If pain not controlled, increase subsequent doses by 25-50%
- If sedated (score 1-2) reduce subsequent doses by 50%
- Consider supplemental non-opioid analgesia

### OPIOID-RELATED RESPIRATORY DEPRESSION

#### Recognition and assessment

- Difficult to rouse/unrousable – sedation score ≥ 2
- Respiratory rate < 6 breaths/min (unstimulated rate)
- Pinpoint pupils

#### Action

- If sedation score is 2-3
- Stop administration of the opioid/epidural
- Check airway, breathing and circulation
- If respiratory rate < 6 breaths/min, give naloxone – see Naloxone
- Give supplemental oxygen if prescribed
- Monitor the patient closely over the next hour and seek advice from
ORAL OPIOIDS

- Morphine sulphate solution (10 mg in 5 mL) 10-20 mg orally 1–3 hrly as required
- Oral dose should be twice corresponding IM dose

INTRAMUSCULAR OPIOID ANALGESIA

- Morphine sulphate (maximum 15 mg as single dose) IM 1-3 hrly:
  - In addition, consider a regular non-opioid analgesia. See Paracetamol and NSAIDs

OTHER ADVERSE EFFECTS OF OPIOIDS

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Prevention/management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nausea and vomiting</td>
<td>● Regular prochlorperazine 6.25-12.5 mg IM 6 hrly</td>
</tr>
<tr>
<td>See Postoperative nausea and vomiting (PONV)</td>
<td>● if ineffective, add ondansetron 4 mg IV 6 hrly</td>
</tr>
<tr>
<td></td>
<td>● Regular monitoring</td>
</tr>
<tr>
<td></td>
<td>● In all cases consider other causes</td>
</tr>
<tr>
<td>Movement-related nausea and vomiting</td>
<td>● Regular prochlorperazine 6.25-12.5 mg IM 6 hrly</td>
</tr>
<tr>
<td></td>
<td>● Avoid sudden changes in position</td>
</tr>
<tr>
<td>Urinary retention</td>
<td>● Regular monitoring</td>
</tr>
<tr>
<td></td>
<td>● Consider catheterization</td>
</tr>
<tr>
<td>Pruritus</td>
<td>● Regular monitoring</td>
</tr>
<tr>
<td></td>
<td>● Consider antihistamine</td>
</tr>
<tr>
<td>Bronchoconstriction</td>
<td>● Stop opioid</td>
</tr>
<tr>
<td></td>
<td>● Oxygen therapy, antihistamine, bronchodilator</td>
</tr>
<tr>
<td></td>
<td>● Consider alternative analgesia</td>
</tr>
<tr>
<td>Psychotomimetic effects (e.g. dysphoria,</td>
<td>● Regular monitoring</td>
</tr>
<tr>
<td>hallucinations, nightmares)</td>
<td>● Look for another cause (e.g. infection)</td>
</tr>
<tr>
<td></td>
<td>● Consider paracetamol/NSAID to reduce opioid requirement</td>
</tr>
<tr>
<td></td>
<td>● Consider alternative opioid</td>
</tr>
<tr>
<td>Pupillary constriction</td>
<td>● A diagnostic feature in overdose</td>
</tr>
</tbody>
</table>

APS/anaesthetist on continuing management
- Wait at least 30 min before recommencing opioid/epidural infusion
- Once respiratory rate > 8 breaths/min, continue analgesia at half previous rate

Subsequent management
- Seek advice on continuing management from APS/anaesthetist
- Add paracetamol or an NSAID for pain relief if feasible
- If problem recurs, repeat steps above but stop the epidural/opioid infusion and use alternative form of analgesia
- Inform admitting/on call team

Notify APS of all incidents requiring administration of naloxone

Choice of agent
- Regular prochlorperazine 6.25-12.5 mg IM 6 hrly
- if ineffective, add ondansetron 4 mg IV 6 hrly
- Regular monitoring
- In all cases consider other causes
Suggested starting doses of morphine

<table>
<thead>
<tr>
<th>Age</th>
<th>Dose range</th>
</tr>
</thead>
<tbody>
<tr>
<td>20-39</td>
<td>10-15 mg</td>
</tr>
<tr>
<td>40-59</td>
<td>7.5-12.5 mg</td>
</tr>
<tr>
<td>60-69</td>
<td>5.0-10 mg</td>
</tr>
<tr>
<td>70-85</td>
<td>2.5-5.0 mg</td>
</tr>
<tr>
<td>&gt; 85</td>
<td>2-3 mg</td>
</tr>
</tbody>
</table>

- For oral doses, multiply IM dose by 2
- S/C doses equivalent to the IM dose
- Starting doses must be titrated to effect
- Does not apply to patients with renal or hepatic insufficiency

**INTERMITTENT INTRAVENOUS OPIOIDS**

All staff following this guideline must be competent in the administration of IV opioids, including knowledge of potential hazards and management of adverse effects.

**TITRATION OF IV DOSES**

<table>
<thead>
<tr>
<th>Drug</th>
<th>General ward area</th>
<th>HDU, SAU, SSCU, Theatre Recovery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morphone sulphate</td>
<td>1 mg/mL with sodium chloride 0.9%</td>
<td>Morphone sulphate diluted to 1 mg/mL with sodium chloride 0.9%</td>
</tr>
<tr>
<td><strong>Dose range:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt; &lt; 60 yrs</td>
<td>1–2 mg</td>
<td>1–5 mg</td>
</tr>
<tr>
<td>≥ 60 yrs</td>
<td>0.5–1 mg</td>
<td>0.5–3 mg</td>
</tr>
<tr>
<td></td>
<td>Administer slowly: 2 mg/min</td>
<td>Administer slowly: 2 mg/min</td>
</tr>
<tr>
<td><strong>Dose interval:</strong></td>
<td>5 min</td>
<td>3–5 min</td>
</tr>
<tr>
<td>&gt; &lt; 60 yr</td>
<td>5 min</td>
<td>5 min</td>
</tr>
<tr>
<td>≥ 60 yr</td>
<td>5 min</td>
<td>5 min</td>
</tr>
<tr>
<td><strong>Frequency of administration:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(May take up to 15 min to exert maximum effect on CNS)</td>
<td>Until patient comfortable, to a maximum dose of 10 mg</td>
<td>Until patient is comfortable</td>
</tr>
<tr>
<td></td>
<td>Withhold further doses if sedation score ≥ 2 or respiratory rate &lt; 8/min</td>
<td>Withhold further doses if sedation score ≥ 2 or respiratory rate &lt; 8/min</td>
</tr>
</tbody>
</table>

- Indications/contraindications
  - Severe pain
  - See Post-operative pain relief

- Preparation
  - Ensure availability of:
    - intravenous cannula in situ
    - resuscitation equipment
    - oxygen supply and face mask
    - naloxone
CONTINUOUS INTRAVENOUS MORPHINE INFUSION

Indications / contraindications

- See Post-operative pain relief

Cautions

- The widely individual variation in opioid effect makes this method more dangerous and less effective for pain control, especially if pain episodic. PCA is preferable. See Patient controlled opioid analgesia (PCA)

Equipment

- Set up syringe driver according to manufacturer’s instructions
- Only staff who have been assessed as competent should set up the pump
- Use infusion set with anti-siphon valve (and anti-reflux valve if other IV fluid is administered by the same cannula)
- Observation/pain assessment chart

Dosage

- Morphine sulphate solution 1 mg/mL
- Run as continuous infusion at 0-5 mL/hr according to pain score and sedation score

Monitoring/documentation

- Expect to decrease rate of infusion by 25-50% each day after surgery as patient recovers
- Be alert to risk of respiratory depression and remember that it may take some hours for each alteration to infusion rate to have its full effect

If analgesia inadequate:

- Administer IV bolus doses until patient comfortable: see above
- Consider increasing rate of infusion by 25-50%
- Consider adding paracetamol/NSAID

If sedation excessive

- Stop infusion until sedation score is < 2
- See above

If analgesia inadequate:

- Administer IV bolus doses until patient comfortable: see above
- Consider increasing rate of infusion by 25-50%
- Consider adding paracetamol/NSAID

If sedation excessive

- Stop infusion until sedation score is < 2
- See above
INITIAL ASSESSMENT

Indications/Contraindications/Caution

- See Post-operative pain relief

Patient suitability for PCA

- Patient physically capable of using the device
- Patient able to understand the concept of PCA
- Patient willing to use PCA

Do not withhold PCA simply on basis of age

If patient has history of opioid consumption – contact the APN

PREPARATION

Equipment

- Graseby 3300 PCA Syringe pumps (available from Theatre Recovery)
- A dedicated infusion set with anti-reflux and an anti-siphon valve
- Administration of IV fluid alongside PCA (via anti-reflux) valve facilitates patency of the IV cannula
- Observation/Pain assessment chart

Graseby 3300 PCA

Syringe pumps (available from Theatre Recovery)

A dedicated infusion set with anti-reflux and an anti-siphon valve

Administration of IV fluid alongside PCA (via anti-reflux) valve facilitates patency of the IV cannula

Observation/Pain assessment chart

Standard programme / prescription for adult PCA: morphine sulphate

<table>
<thead>
<tr>
<th>Drug concentration</th>
<th>1 mg/mL (50 mL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loading dose</td>
<td>individual</td>
</tr>
<tr>
<td>PCA (bolus) dose</td>
<td>1 mg</td>
</tr>
<tr>
<td>Dose duration</td>
<td>Bolus</td>
</tr>
<tr>
<td>Lockout interval</td>
<td>5 min</td>
</tr>
</tbody>
</table>

+ Regular paracetamol (1 g 4-6 hrly max 4 g in 24 hr)

naloxone 400 mcg IV if required according to protocol

prochlorperazine 6.25-12.5 mg deep IM 6 hrly

ondansetron 4 mg IV 6 hrly according to protocol

Additional sedatives or opioids must be avoided whilst PCA in progress

Patient education/information

The safety and effectiveness of PCA depends on the patient understanding the technique and that they alone may authorise a PCA demand

Explain:

- That the drug is morphine, its possible adverse effects and how these will be managed
- Reassure if concerned about addiction or possibility of overdose
- About PCA handset, pump and 5 minute lockout

- About benefits of supplementary analgesia (e.g. paracetamol/NSAID – if not contraindicated)
- When to use PCA:
  - to control pain at rest
  - not to wait until pain severe
  - before activities that will cause pain (approx 5 min before)
How soon it takes effect and how long pain relief lasts

- Only the patient should press the PCA button

**Monitor/document**

- See Opioids and Post-operative pain relief plus:

  - Hourly pump observations: syringe contents; number of demands/good’s
  
  - If ‘demands’ greatly exceed ‘good’, assess effectiveness of technique, patient understanding and level of anxiety

- Daily morphine consumption (should decrease)

**TROUBLESHOOTING**

**Nausea/vomiting**

- Do not stop pump – treat nausea see Post-operative nausea and vomiting

- Ensure suitable non-opioid analgesia (paracetamol/NSAID) given by alternative/appropriate route (e.g. PR)

**Inadequate analgesia**

- Check PCA system and IV access intact

- Check patient’s understanding of technique and encourage to use if in pain

- Assess location and character of pain and whether an alternative analgesic is required (e.g. NSAID for spasmodic pain)

- Contact Acute Pain Team

**Mild sedation**

- Ensure patient understands technique

- Ensure regular non-opioid analgesia. See Paracetamol and NSAIDs

- Observe closely for increasing sedation/respiratory depression. See Opioid analgesia

- Contact Acute Pain Team or doctor on call (out-of-hours)

**Hallucinations/dysphoria**

- Exclude another cause (e.g. infection)

- Consider regular paracetamol/NSAID to reduce morphine consumption

- Contact Acute Pain Team

**Unexpected increase in analgesic use, or a change in the site, severity or character of the pain being treated**

- Investigate further as it may signal the development of a new diagnosis

**SUBSEQUENT MANAGEMENT**

**Discontinuation of PCA**

- Maintain PCA until oral analgesic can be used guided by nature of surgery/trauma (PCA is often better tolerated than regular codeine)

- Consider patient’s analgesic preference and opioid consumption to guide step-down prescription. See Post-operative pain relief

- Advise patient of adverse effects of medication and to reduce as indicated

- Continue pain assessment at same time as other vital signs
PARACETAMOL AND NSAIDS  • 1/1

Where ‘minor’, ‘intermediate’ and ‘major’ surgical procedures are mentioned in the text - see classification of surgical procedures for clarification

NSAID as required can apply to any step of the analgesic ladder
Regular paracetamol can apply at any step beyond the first

PARACETAMOL

Indications
- At any step of the analgesic ladder, for as required use, regularly for relief of mild pain, or as accompaniment to stronger analgesics – see Post-operative pain relief

Dosage
- Paracetamol 1g orally 4-6 hrly as required to a maximum of 4 g in 24 hr (weakest)

Avoid administering more than one product containing paracetamol so that the maximum dose of paracetamol (4 g in 24 hours) is not exceeded inadvertently

NSAIDS

Indications
- As sole analgesics for minor surgery, such as:
  - dentals
  - soft tissue
  - minor bone surgery
  - Colicky pain

- Use of NSAIDs in major surgery can lead to a 20% reduction in the requirement for opioids

Contraindications
- Active peptic ulceration, and patients with previous gastrointestinal ulceration or bleeding
- Coagulation defects/anticoagulated patient
- Allergy to aspirin or any other NSAID, especially those in whom attacks of asthma, angioedema, urticaria or rhinitis are known to have been precipitated by aspirin or any other NSAID

Cautions

Consider risks and benefits before administering an NSAID in the groups of patients listed below

- Renal impairment (creatinine > 150 micromol/L)
- Hepatic impairment (e.g. jaundice, ascites or encephalopathy)
- Cardiac diseases exacerbated by fluid retention (e.g. congestive cardiac failure)
- Gastrointestinal upset/ulceration

Choice of agent

- Premedication:
  - ibuprofen SR 1600 mg orally

- Post-operatively:
  - ibuprofen 400 mg orally 6 hrly, or 800 mg SR 12 hrly

- Or diclofenac 50 mg orally/per rectum 8 hrly - Consider route of administration, patient preference/tolerance, potency of medication

- Avoid diclofenac IM

- Or indometacin 100 mg per rectum 12 hrly

- In susceptible asthmatics, or if oral or PR route not available, consider parecoxib 40 mg IV

Unwanted effects

- Increased risk of bleeding during and after surgery due to reduced platelet aggregation
- Acute renal failure in hypovolaemic patients due to prostaglandin inhibition
- Acute bronchospasm in susceptible asthmatics due to leukotriene production
All nursing staff accepting care of patients with epidurals must be trained in the acute pain protocol (available in the Anaesthetic Department) and in use of the infusion pump

**Indications**
- Epidural analgesia is highly effective for controlling acute pain after surgery or trauma to the chest, abdomen, pelvis or lower limbs

**Contraindications**
**Absolute**
- Patient refusal
- Coagulopathy or therapeutic anticoagulation
- Skin infection at injection site
- Raised intracranial pressure
- Hypovolaemia
- Allergy to local anaesthetic/opioid
- Pre-existing neurological disorder
- Unstable cardiovascular system (fixed cardiac output states)
- Unstable spinal fracture
- Systemic infection/sepsis

**Relative**
- All nursing staff accepting care of patients with epidurals must be trained in the acute pain protocol (available in the Anaesthetic Department) and in use of the infusion pump

**Standard prescription/preparation**

<table>
<thead>
<tr>
<th></th>
<th>Levobupivacaine 2.5 mg/mL</th>
<th>Sodium chloride 0.9%</th>
<th>Diamorphine Hydrochloride</th>
<th>EPI</th>
<th>3-8 mL/hr (To protocol)</th>
</tr>
</thead>
<tbody>
<tr>
<td>30 mL</td>
<td>30 mL</td>
<td>5 mg</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Oxygen</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>3-5 L/min</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Prochlorperazine</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>6.25-12.5 mg</td>
<td>(To protocol)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Ondansetron (Escape only)</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>4 mg</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Naloxone</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>400 microgram</td>
<td></td>
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- Use strict asepsis when preparing solution for epidural infusion
- Ensure correct checking procedure when administering/attaching drugs for epidural infusion
- Use ‘no touch’ technique to maintain sterility of epidural system when replenishing syringe

**Equipment/preparation**
- Infuse via epidural catheter with in-line antibacterial filter (0.22 micron) attached to:
  - a yellow epidural infusion line (with anti-siphon valve and NO injection port) connected to the syringe/pump
  - Clearly label the syringe pump and epidural line
  - Observation/pain assessment chart
  - Ensure venous access

**Monitor/document**
- Pain score – at the same time as observations of other vital signs
- Do not titrate infusion downwards unless specifically indicated (see below) as this will lead to regression of block and ineffective pain relief
- Respiratory rate, sedation score, nausea, vomiting, itching, pulse and blood pressure – no less often than 3 hrly, precise interval determined by nature of the surgery and patient’s condition - see Opioids
- Motor, sensory and sympathetic block (see Troubleshooting: motor and sensory block, and sympathetic blockade)
- Measurement of block
height – see **Triggers for measurement of block height**

- Intraspinal infection – see **Detection of intraspinal infection**

- Site of epidural catheter insertion, integrity of dressing and security of delivery system:
  - Secure with a semi permeable occlusive dressing to allow observation of the site – bordered with Mefix, taped to patient’s back with the filter secured on patient’s clavicle
  - Do not change the dressing
  - Observe at least daily to detect signs of infection and leaks, to check dressing intact and delivery system secure – see **Troubleshooting**

- Pump observations: rate of infusion, syringe contents at hrly intervals

- Integrity of venous access must be maintained while epidural in use

- Patient’s understanding of the technique

---

**SYMPATHETIC BLOCKADE**

- Sympathetic blockade leads to peripheral vasodilatation (below the level of the block) and subsequent hypotension

- A high sympathetic block can lead to:
  - Hypotension both from blockade of cardiac sympathetic fibres (T1-T4) and from generally widespread sympathetic block
  - Impaired coughing through paralysis of the intercostal muscles (T1-T12)

- Impaired ventilation through paralysis of the phrenic nerve (C2-C4) that supplies the diaphragm

- Refer to **Triggers for measurement of block height**

---

**Measurement of block height (dermatome assessment)**

- Routine block height measurement not required, as block height not always demonstrable with standard dilute local anaesthetic solution

- Indicated by level at which patient reports a change in sensation when ice applied to the skin

- Problems from high or rising block would be detected from triggers below

- Maximum desirable block height:
  - T5 for abdominal work
  - T2 for thoracic work

(using a mid-thoracic catheter)

- Refer to dermatome chart and landmarks (below)
Dermatome chart

Dermatome landmarks (approximate)
- T4 indicates nipple line
- T6 indicates xiphoid process
- T10 indicates umbilicus

Significant hypotension as defined by agreed lowest BP and NOT responding to single volume load as recommended by strategy for management of hypovolaemia

Excessive sedation – score 3/unconscious

Difficulty breathing

Pins and needles in hands or face

If block above T5 (T2 in case of thoracic work):
- Stop epidural, and retest block height after 5 min (to check for dural penetration of the catheter resulting in cranial spread of solution)

If the block height continues to rise, contact APS/anaesthetist IMMEDIATELY – leave epidural off

Once complication (trigger for measurement of block height) has resolved, retest the block height

When block height below required level, restart epidural at half original infusion rate

If complication recurs, stop and remove epidural and use suitable alternative form of analgesia

Insertion site leaking

If no loss of analgesia, reinforce dressing (do not change dressing)

If patient in pain, see Pain not controlled

If pain remains uncontrolled and/or leakage severe, contact APS/anaesthetist and consider alternative analgesia

Pain not controlled

Verify location and character of pain

If pain level unexpectedly high, consider other causes (e.g. complication)

Check delivery system intact

Increase rate of infusion according to response

Consider supplemental paracetamol/NSAID

Contact APN/anaesthetist

Triggers for measurement of block height
- Significant hypotension as defined by agreed lowest BP and NOT responding to single volume load as recommended by strategy for management of hypovolaemia
- Excessive sedation – score 3/unconscious
- Difficulty breathing
- Pins and needles in hands or face

Action from block height measurement
- If block above T5 (T2 in case of thoracic work):
  - Stop epidural, and retest block height after 5 min (to check for dural penetration of the catheter resulting in cranial spread of solution)
### Sensory block – loss of sensation to leg(s)
- If pain controlled, sensation ‘patchy’ at top of thighs only and patient able to raise leg while straight, reduce infusion rate and review after 2 hr
- If sensory loss profound inform APS/anaesthetist/surgical team **immediately**

### Motor block – weakness of leg(s)
- Reduce EA if pain controlled
- Contact APS / anaesthetist
- Be cautious with mobilisation and monitoring of pressure areas
- If motor block profound inform APS/anaesthetist/surgical team **immediately**

### An increasing degree of motor or sensory weakness may be caused by:
- Excessive epidural drug administration
- Dural penetration of the catheter (resulting in cranial flow in CSF with no upper limit to the block)
- The development of epidural haematoma or epidural abscess

**These situations require IMMEDIATE review by the APS/anaesthetist**

### Excessive sedation/respiratory depression
- See **Opioids**
- Contact APS/anaesthetist for advice

### Bradycardia
- If blood pressure not compromised, monitor closely and inform APS/Surgical Team
- If blood pressure compromised, refer to **Triggers for measurement of block height**

### Hypotension
- May be due to hypovolaemia, oversedation, or excessive sympathetic blockade
- **Consider other causes (e.g. bleeding)**
- Beware of postural hypotension
- See **Hypovolaemia**

### Hypovolaemia
- Consider other causes of hypovolaemia
- Administer additional IV fluids according to lowest permissible systolic blood pressure as prescribed by anaesthetist (anaesthetist will prescribe additional IV fluids to be given if patient’s SBP according to a defined lowest permissible systolic BP)
- If no improvement, check block height (see **Triggers for measurement of block height**)
- To assess whether epidural analgesia is cause, stop epidural for 2 hr and monitor blood pressure
- If no improvement in blood pressure, restart epidural infusion
- Consider effect of pain on blood pressure

### Low urine output
- In catheterized patients, measure and record urinary output
- If average output over 3 hr falls below 0.5 mL/kg, consider fluid depletion initially and treat as for hypovolaemia

### Retention of urine
- Pain of retention may be blocked by epidural analgesia
- If anuria occurs post-operatively, feel for an enlarged bladder
- If retention likely, consider urinary catheterization

### Itching
- A common adverse effect of epidural opioids that can be difficult to treat
- Consider antihistamine (e.g. chlorphenamine)
- If very severe, stop epidural and prescribe alternative pain relief
TREATMENT WITH ANTICOAGULANTS

**Unfractionated heparin**
(e.g. sodium heparin, Calciparin)

- Prescribe unfractionated heparin 12 hrly
- Omit heparin on morning of surgery
- Allow at least 6 hr to elapse before inserting/removing epidural catheter
- Following removal of epidural catheter, a minimum of 1 hr should elapse before further dose of heparin is administered

**Low molecular weight heparin**
(e.g. Dalteparin)

- Prescribe dalteparin to be given once daily at 1700 hrs
- Allow at least 12 hr to elapse before inserting/removing epidural catheter
- Following removal of epidural catheter, a minimum of 2 hr should elapse before further dose administered

**Continuous IV heparin**

- Check APTT before removal of epidural catheter
- Contact APS/anaesthetist for further advice

---

**Warfarin**

- Epidural catheters should not be removed until INR < 1.5
- Remove epidural catheter before starting treatment with warfarin

---

**Unplanned anticoagulation during epidural analgesia**

- Contact APS or anaesthetist for advice

---

**DETECTION OF INTRASPINAL INFECTION**

**Causes of intraspinal infection**

- Infection can occur at time of insertion of catheter or subsequently, due to:
  - poor aseptic technique, contaminated equipment or solution
  - contamination of skin site or localised skin infection, resulting in infection tracking down catheter from site of insertion to epidural space
  - haematogenous spread of infection from other sites

**Risk factors**

- Length of time epidural catheter left in place; risk increased after 3 days
- Conditions that predispose to infection including: diabetes mellitus, steroid administration, chronic renal failure, alcoholism (list not exhaustive)

---

**Warfarin**

- Record temperature at 4 hrly intervals while epidural in situ
- Identify signs of infection not related to epidural
- Observe site of insertion at least daily for signs of infection
- If indicated, send swab of site for M C&S
- inform APS/anaesthetist

**Warfarin**

- Monitor closely for signs of epidural space infection:
  - increased sensory +/- motor deficit (particularly unexplained changes since last assessment)
  - back pain – especially if constant and diffuse
  - pyrexia, malaise
  - neurological signs: headache, neck stiffness, altered mental state
- Inform APS/anaesthetist of any of the above symptoms

---

**Disconnected of catheter from filter**

- Remove epidural catheter (see below)
- If catheter cannot be removed immediately (e.g. due to treatment with anticoagulants) wrap free end with sterile dressing until safe to remove
- Arrange suitable alternative analgesia
- Inform APS/anaesthetist

---

**Discontinuation of epidural analgesia**

- If effective, maintain epidural analgesia for 3 days
Continue further only after consideration of the risks (epidural infection) and benefits (pain relief, etc.)

Discuss with APS/anaesthetist

At time of discontinuation administer appropriate alternative analgesia (refer to analgesia ladder)

Continue to document pain scores

**Removal of epidural catheter**

Before removal, assess coagulation status and see Treatment with anticoagulants

See RMH guideline ‘Removal of an epidural catheter’ (p.273)

Cover site with sterile plaster – remove after 24 hr and check site again for signs of infection
## INDICATIONS
- Reversal of opioid related respiratory depression
- Do not use to treat drowsiness and/or delirium
- Consider other causes of sedation/respiratory depression

## Cautions
- Rapid administration can lead to projectile vomiting, ventricular dysrhythmias or severe pain that is difficult to control
- Giving too much can precipitate severe pain that is difficult to control
- Physical dependence on opioids can precipitate withdrawal—see Drug withdrawal in Medical Guidelines

## PREPARATION / TITRATION
- In post-operative use titrate dose for each patient to obtain sufficient respiratory response
- Dilute naloxone to 100 mcg/mL with sodium chloride 0.9%
- Dose: 200 mcg IV at 5 min intervals until respiratory rate > 8 breaths/min and sedation score < 2

## SUBSEQUENT MANAGEMENT
- Naloxone has short duration of action (20 min), so repeated doses may be required
- Stay with patient, encourage deeper breathing every 1-2 min, and monitor sedation and respiratory status until more alert
- Inform admitting/on call team
- Give paracetamol/NSAID for pain relief if feasible
- Resume opioid at 50% of original dose

Notify APS of all incidents requiring administration of naloxone
ENTONOX • 1/2

Entonox must be prescribed by a suitably qualified prescriber or used in conjunction with the Trust Patient Group Directive for the administration of Entonox

INDICATIONS

● Treatment of short-term pain
● When a planned procedure is likely to produce pain
● When repeated painful procedures may lead to patients becoming anxious and fearful

Examples of indications for use

● Fracture or dislocation of limb
● Lacerations or crush injuries
● Burns/suturing of wounds/drainage of abscess/dressing change/wound drain removal
● Manipulation of fractures
● Undressing patients while trying to reduce or splint fractures
● Relief of pain during transfer
● Allaying of anxiety/fear of planned painful procedure
● Relief of pain in labour

SUITABILITY

Do not use Entonox for procedures requiring greater level of analgesia and/or sedation

● Check that patient understands instructions and can hold demand valve while breathing normally
● Patient alone must maintain airtight fit between face and mask

● Take care, especially at the extremes of age, with mask fitting and instructions for use
● The high oxygen component (50%) can suppress respiration in those with ventilatory failure, owing to COPD, neuromuscular disorders, muscular dystrophies or respiratory depressant drugs although this is unlikely

GENERAL PREPARATION

Ensure Entonox is prescribed:

● route: inhalation
● directions regarding circumstances for use e.g. maximum length of time, number of times per day or for which procedure
● a statement that it should be by self administration only, supervised by staff who have had training in the use of Entonox

If administered daily or more frequently, perform routine blood cell counts

Ensure room is adequately ventilated

Contraindications

● Any condition where air is trapped within the body and where expansion may be dangerous
● Pneumothorax – confirmed/suspected
● Bowel obstruction or gross abdominal

Do not hold mask in place

The safety of Entonox depends on the patient’s ability to self-administer the gas

If Entonox inappropriate for patient or procedure, select alternative analgesia and/or sedation

Preparation of equipment

● Check cylinder contains enough Entonox for the procedure (at least one-quarter full)
● Prime administration set
● Attach antibacterial filter between mouthpiece/mask and demand valve

EQUIPMENT

● Entonox cylinder (colour-coded French blue with white quadrants on the shoulder)
● Regulator
● Hose
● Analgesic demand valve
● Antibacterial filter
● Clear facemask or mouthpiece – single patient use only
Preparing the patient

- Explain procedure to be carried out, how Entonox will be used, and that hissing noise may be heard as gas is inhaled
- Warn patient to report:
  - dry mouth
  - dizziness/disorientation
  - nausea / vomiting
  - earache (which can lead to middle ear damage)
- Administer supplementary analgesia in adequate time before the procedure. For example: Intramuscular morphine - 30 min beforehand; oral morphine sulphate solution - 20 min beforehand. If in use, PCA may be continued
- Allow patient to practice using Entonox before starting procedure
- If reluctant to start inhaling the gas, encourage to persevere until patient realises Entonox is working
- Before starting procedure, ensure 4 deep breaths are taken to allow onset of analgesia

If patient unable to maintain effective seal or inhale gas effectively, stop Entonox and arrange alternative analgesia and/or sedation

Encourage patient to breathe Entonox throughout procedure

- If patient hyperventilates, encourage him/her to exhale slowly
- If patient has a cardio-respiratory condition, monitor oxygen saturation
- If Entonox causes unwanted effects, cease inhalation until they wear off
- If patient vomits, remove demand valve immediately and clear any obstruction to breathing
- Recom mend inhalation with a clean mask if patient wishes
- If patient reports earache, stop inhalation, arrange alternative analgesia and advise never again to have Entonox

If patient becomes drowsy, the seal around the mask or mouthpiece will be lost and inhalation will cease. This prevents onset of deeper stages of analgesia and anaesthesia so that laryngeal airway is no longer protected

MONITORING AND SUPERVISION

- Monitor level of pain and effective use of Entonox
- If procedure particularly painful, wait until patient recommences inhalation before continuing

DOCUMENTATION

- How much Entonox the patient has used (gauge readings)
- Effectiveness, and management of any unwanted effects

STORAGE AND HANDLING OF EQUIPMENT

- Check cylinder is at least one-quarter full
- Turn cylinder off and depressurise system
- Discard single-patient-use filter but keep by patient’s bed if Entonox is to be used within next 24 hr
- Store cylinder attached to wall or in trolley away from patient area
- If used infrequently, check weekly the cylinder at least one-quarter full

Decontamination

- If used on daily basis, autoclave analgesic demand valve and hose at least weekly

DISCONTINUATION

- Continue monitoring patient for further 30 min
- Ensure any dizziness or disorientation has worn off before patient mobilises unaided
- Consider a period of continued oxygen therapy
- Advise patient not to drive or use machinery for 12 hr
INFECTION CONTROL
STANDARD INFECTION CONTROL MEASURES • 1/1

CLINICAL AREAS

**Hand hygiene is essential before and after visiting every patient**

At all times

- Maintain clean and dust-free environment
- Exemplary hand hygiene. See Hand hygiene
- Cover all cuts and grazes with waterproof dressing
- Decontaminate equipment between patients
- For invasive procedures, contact with sterile sites, non-intact skin and mucous membranes and handling sharps and contaminated equipment, wear gloves
- When there is a risk that clothing or uniform is likely to get contaminated, wear disposable apron
- Aprons and gloves are single use
- If there is a risk of splashing into the eyes or mouth, wear eye and face protection
- Assess risk in all patients, and isolate heavy dispersers – those at greatest risk of spreading infections to others (e.g. exfoliative skin condition, large open wound, productive cough)
- Handle linen and waste correctly
  - Place soiled linen in skip at bedside
  - Place clinical waste in yellow bag
  - After using a sharp, dispose of it immediately in sharps container
- Use aseptic techniques on wound care
- If alerted to identification of specific organism, follow appropriate guidelines. See flowcharts for Methicillin Resistant Staphylococcus (MRSA), Extended Spectrum Beta-lactamase (ESBL) and Clostridium difficile
- Use antibiotics rationally. See appropriate guideline in Medical, Surgical or Antimicrobial Prescribing Guidelines

INFECTION CONTROL TEAM

If in doubt, contact infection control team for advice – available 24 hr via call centre
Hand Hygiene

Decontaminate hands
- On arrival on duty and before leaving ward or department
- After visiting the toilet
- Before and after aseptic procedures
- Before every episode of care that involves direct contact with patient skin, food, invasive devices and dressings
- After any activity or contact that potentially results in hands becoming contaminated
- On entering and leaving an isolation cubicle
- After removal of gloves

Aseptic procedures
- Wash with liquid soap preparation, and then use alcohol hand gel. This will reduce transient microorganisms and resident hand flora resulting in hand antisepsis

Caring for patients with Clostridium difficile
- Wash hands with soap and water. Alcohol hand gel is not effective in killing spores

General social contact and most clinical care activities
- Apply alcohol-based hand rub or wash hands with liquid soap and water between caring for different patients, or between different care activities on the same patient
- Alcohol-based hand rubs are not effective in removing dirt and organic material, but offer a practical and effective alternative to hand washing when hands are not soiled, and are less likely to cause skin irritation
- Wash hands that are visibly soiled or potentially contaminated with dirt or organic material with liquid soap and water

Technique for Hand Hygiene
- Avoid wearing false nails, nail extensions and nail varnish
- Keep nails short and clean
- Remove wrist watches, stoned rings or other wrist jewellery before carrying out clinical care which includes hand hygiene
- Cover cuts and abrasions with waterproof dressings

Washing with soap and water
- Turn on taps using elbows if possible
- Use a technique that covers all surfaces of hands and wrists
- Wet hands before applying soap, lather well and rub vigorously for a minimum of 10-15 sec. Pay particular attention to the tips of fingers, thumbs and between fingers
- Rinse thoroughly and dry with paper
- Turn off taps using elbows

Alcohol hand rub
- Use a technique that covers all surfaces of the hands and wrists
- Apply alcohol gel and rub vigorously until solution has evaporated and hands are dry. Pay particular attention to tips of fingers, thumbs and between fingers

Skin Protection
- Apply an emollient hand cream regularly to protect skin from the drying effects of regular hand washing

If any of the decontamination products cause skin irritation seek occupational health advice
The personal protective equipment selected for a procedure will follow a risk assessment, which will be carried out by the person doing the procedure. Personal protective equipment will be required if there is a risk of transmission of microorganisms to the patient or healthcare practitioner or there is a risk of contamination of healthcare practitioner’s clothing and skin by blood, body fluids, secretions and excretions.

### GLOVES

**When**

Wear non-powdered disposable gloves for:

- Invasive procedures
- Contact with sterile sites, non-intact skin or mucous membranes
- Anticipated contact or exposure to blood, body fluids, secretions and excretions
- Handling sharp or contaminated instruments
- Application of topical preparations
- Contact with cytotoxic agents
- Contact with chemicals

**How**

- Check if patient or professional latex sensitive. If so, use non-latex gloves
- Following removal of gloves, wash or disinfect hands
- Change gloves between caring for different patients or between different care activities on the same patient. Gloves are single use items

**Choice**

- Latex gloves and an alternative to latex gloves must be available
- Gloves must conform to European Community (EC) standard

### PLASTIC APRONS AND WATER-REPELLENT GOWNS

**Water-repellent gowns**

- If there is a risk of extensive splashing of blood and body fluids (e.g. dealing with major trauma or during major surgical procedures) wear water-repellent gowns

**Plastic aprons**

- Where there is a risk that clothing or uniform may become exposed to blood, body fluids, secretions and excretions, wear disposable plastic aprons
- Change plastic aprons between patients. Aprons are single use items

### MASKS, AND EYE AND FACE PROTECTION

- Whenever there is risk of blood, body fluids, secretions or excretions splashing into face and eyes, wear mask and goggles/plain spectacles/a full face visor
- Masks are not required clinically during routine ward procedures, such as dressing wounds or invasive medical procedures

#### Pulmonary tuberculosis

- When direct exposure to respiratory secretions from patients with infectious pulmonary tuberculosis is unavoidable (e.g. sputum induction, bronchoscopy and dental surgery, or for prolonged care of a high-dependency patient) wear a good disposable theatre-type dust mist mask or HEPA mask (e.g. Tecnol PFR 95 or PFR P2)
MRSA isolated

High/Moderate risk areas (see below)

Nurse patient in single room or cohort nurse
Use standard infection control precautions

Commence decolonisation regime if advised by the Infection Control Team. See Topical MRSA decolonisation treatment in Screening Procedure for MRSA and ESBL

Decolonisation regimen

Screen patient after any systemic and/or tropical treatment has been stopped for 48 hr
Patient requires 3 consecutive clear screens

No decolonisation regimen
Screen weekly in high risk areas

Risk Assessment Has patient:
● an exfoliating skin condition OR
● productive sputum OR
● extensive wound areas OR
● multiple positive sites

NO

Use Standard infection control precautions
No further action required unless a further risk assessment (see above) identifies that patient is a significant risk to others

YES

Low risk areas (see below) Where possible nurse in a single room

Low risk areas:
● General Medical wards
● Elderly wards
● Paediatric wards

Moderate risk areas:
● General surgical wards
● Urology wards
● Gynaecology wards
● Maternity wards
● Dermatology ward

High risk areas:
● ICU/MIU/PICU/SCBU
● Burns and Plastics
● Vascular surgery
● Renal Unit
● Cardiothracic wards
● Orthopaedic wards
● Neurosurgical wards
● Oncology/haematology wards
ESBL isolated

Discuss with Infection Control (IC) Team (4282)

Standard IC precautions
Nurse patient in single room

If urinary catheter in situ, remove if possible

YES Does the patient have clinical signs of infection? NO

Contact Microbiologist (4666) for advice on treatment

48 hr after antibiotic treatment has stopped, send rectal swab (stool sample if patient unable to consent to rectal swab or has a stoma) and CSU to lab

Nurse in single room or as cohort in single bay if several patients infected

Send further rectal swabs, swab from site originally positive, and CSU (if catheter still in situ) weekly

Patients may be moved from side room or cohort after 1 set of negative screens
Stool positive for *Clostridium difficile* toxin

- **Patient has symptoms** – two or more loose stools in 24 hours
  - Standard infection control precautions.
  - If diarrhoea profuse, nurse patient in single room. Review any current antibiotic treatment and, if possible, discontinue
  - Additional cleaning whilst patient symptomatic

  - **Diarrhoea continues**
    - Patient requires treatment – ask doctors to review.
    - Metronidazole 400 mg orally 8 hrly for 7–10 days. If diarrhoea does not resolve, contact Microbiologist (4666) for further advice

    - Nurse patient in side room until symptom-free for 48 hr

- **Patient asymptomatic**
  - Standard infection control precautions
  - No treatment required

  - **Diarrhoea resolves**
    - Do not send further specimens unless symptoms recur
FLUID AND ELECTROLYTES
HYPONATRAEMIA (Serum sodium < 125 mmol/L)

Nausea, cramps, confusion, fits, varied CNS manifestations. Unless serum Na⁺ is falling rapidly, concentrations in the range 125-135 mmol/L are usually asymptomatic.

Investigations

U&E, glucose, osmolality (urine plus serum), urine Na⁺

Clinical assessment

Assess state of hydration: BP, pulse, skin turgor

- Dehydration
  - Relative depletion of salt to water
  - Uosm > 280 and Surea > 7 mmol/L
  - UNa⁺ > 20 and Sura < 7 mmol/L
  - UNa⁺ > 20
  - Uosm < Sosm

- No dehydration or oedema
  - Commonly
  - 1. Blood sample taken from drip arm
  - 2. Excess of water to salt
  - UNa⁺ < 20
  - Uosm > Sosm

- Oedema
  - Rarely
  - High concentration of lipid or protein in blood may give false Na⁺ result
  - Retention of water greater than salt

Expected results

- Uosm > 275 mmol/L
- Sosm > 275 mmol/L

Further information available from Clinical Biochemistry (ext 4669)
or from Renal or Endocrine Teams
Consider:
Addison’s, diuretics, renal tubular disease, osmotic diuresis

Fluid loss, e.g. GI loss, sweat, poor intake

Acute onset:
excess intake IV post-op, polydipsia

Chronic onset:
SIADH? cause, e.g. lung, CNS disorders, tumours, drugs - commonly diuretics, carbamazepine

“Pseudohyponatraemia”
The lab will usually comment that the sample is lipaemic or viscous and difficult to analyse

Cardiac, hepatic failure, nephrotic syndrome, renal failure

**Treatment**

**Cause**

**Fluid loss, e.g. GI loss, sweat, poor intake**

**Acute onset:** excess intake IV post-op, polydipsia

**Chronic onset:** SIADH? cause, e.g. lung, CNS disorders, tumours, drugs - commonly diuretics, carbamazepine

**“Pseudohyponatraemia”**
The lab will usually comment that the sample is lipaemic or viscous and difficult to analyse

**Cardiac, hepatic failure, nephrotic syndrome, renal failure**

**Treatment**

**ACUTE (< 48 hr) hyponatraemia** is usually due to inappropriate IV fluid administration. This usually self-corrects when infusion is discontinued.

**Restrict fluid intake 1.5 L/day initially, further restriction to 1 L/day depending on response, or add demeclocycline 300 mg orally 8 hrly. Serum Na⁺ should not increase by more than 10 mmol/L per day**

**Restrict fluid intake < 100 mmol/day and fluid < 1.5 L/day. For renal and cardiac failure: furosemide 80 mg oral or 40 mg IV (max rate 4 mg/min). For hepatic failure stop all diuretics. See respective guidelines. If hypokalaemic or HCO₃ > 32 mmol/L correct K⁺ deficit - see Hypokalaemia**

**No treatment for hyponatraemia. Check serum triglycerides and protein electrophoresis**

**Hypertonic saline is almost never justified, carries a significant risk and should only be given with consultant approval**

**Restrict Na⁺ intake < 100 mmol/day and fluid < 1.5 L/day. For renal and cardiac failure: furosemide 80 mg oral or 40 mg IV (max rate 4 mg/min). For hepatic failure stop all diuretics. See respective guidelines. If hypokalaemic or HCO₃ > 32 mmol/L correct K⁺ deficit - see Hypokalaemia**

*Treatment should usually be directed at the underlying cause. Failure to correct, or recurrence of, hyponatraemia merits referral to the team appropriate to the underlying cause, e.g. renal, endocrine, psychiatric. Review drug treatment before discharge.*
**HYPERNATRAEMIA (Serum sodium > 150 mmol/L)**

<table>
<thead>
<tr>
<th>Symptoms and signs</th>
<th>Various CNS symptoms from lethargy to coma and fits Dehydration - hypovolaemia</th>
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<tbody>
<tr>
<td>Mechanism</td>
<td>Loss of water in excess of salt</td>
</tr>
<tr>
<td>Investigations</td>
<td><strong>Serum:</strong> U&amp;E, glucose <strong>Urine:</strong> U&amp;E, osmolality</td>
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<tr>
<td>Clinical assessment</td>
<td>Assess volaemic status</td>
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</tbody>
</table>

**Expected results**

**Hypovolaemic**

- **Uosm > 300 mmol/L**

**Diabetes insipidus**
- a. pituitary
- b. nephrogenic

**Normovolaemic**

- **Uosm < 300 mmol/L**
- **UNa⁺ > 5 mmol/L**

**Cause**

1. Osmotic diuresis, e.g. hyperglycaemia
2. Excess water loss, e.g. sweat
3. Inability to drink, failure of thirst

**Immediate treatment**

- **Encourage oral fluids in conscious patient - the safest route**

**Asymptomatic**

- Monitor serum Na⁺ daily

**Oral fluids**

- Sodium chloride 0.9% sufficient to achieve haemodynamic stability (suggested rate 1 L in 2 hr). Then correct hypernatraemia with glucose 5%

**Hypovolaemic** and symptomatic

- Excess salt administration
- Discontinue Na⁺ excess

**Symptomatic and normovolaemic**

- Estimate the water deficit from:
  - 0.6 x lean body weight* x (serum Na⁺ - 140)/140
  - Aim to replace 50% of this in 24 hr as glucose 5% IV

**Further investigation**

- If the cause is not apparent at this stage, diabetes insipidus should be considered and patient referred to Endocrine Team

* see *Prescribing regimens and nomograms (Gentamicin)*
### HYPOKALAEMIA (Serum potassium < 3.5 mmol/L)

#### Symptoms and signs

Often none, or neuromuscular symptoms, e.g. muscle weakness, absent reflexes, ileus, ECG changes - depressed ST, flat T, U waves, arrhythmias

Metabolic alkalosis - increased HCO₃

#### Investigations

**Immediate**

1. ECG - see Symptoms and signs
2. Repeat K⁺ (U&E) on plasma sample (lithium heparin) as release of K⁺ from cells during clotting may give a falsely higher level in serum
3. FBC, glucose

**Helpful**

1. HCO₃ - a raised level indicates chronic depletion; if < 22 mmol/L in absence of GI loss - suspect renal tubular acidosis - refer to Renal Team
2. Urine K⁺ - if cause not obvious
3. Serum Mg²⁺ - for persistent urine K⁺ loss especially patients with diarrhoea or on diuretics

#### Common causes

1. Blood taken from drip arm
2. Renal loss: urine K⁺ > 20 mmol/L - diuretics, mineralocorticoid excess, Mg²⁺ deficiency, renal tubular disease, also occurs secondary to GI fluid loss and volume depletion.
3. Any GI fluid loss
4. Intracellular shift: insulin or bicarbonate treatment, theophylline, beta₂ agonists, periodic paralysis, rapid blood cell proliferation

#### Treatment

<table>
<thead>
<tr>
<th>Plasma K⁺</th>
<th>Plasma K⁺</th>
<th>Plasma K⁺</th>
<th>Plasma K⁺</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.0-3.5 mmol/L</td>
<td>&lt; 3.0 mmol/L and asymptomatic</td>
<td>&lt; 3.0 mmol/L and arrhythmia, paralysis or pre-existing cardiac disease</td>
<td>&lt; 2.5 mmol/L with persistent losses or poor absorption</td>
</tr>
</tbody>
</table>

Always use commercially produced pre-mixed bags of infusion fluid. NEVER add potassium chloride to infusion bags

No immediate treatment. If on digoxin or symptoms present, give Sando-K 2 tabs 8 hrly

Monitor level daily for change - identify and correct underlying cause, replace with oral K⁺, Sando-K 2 tabs 6 hrly, if cause is non-remediable

Give 500 mL sodium chloride 0.9% with 20 mmol potassium chloride IV, as commercially produced pre-mixed bag, over 2 hr, with continuous ECG monitoring. In intractable cardiac arrhythmia double infusion rate and contact Cardiology Team urgently

K⁺ deficit is difficult to estimate - monitor replacement with plasma K⁺ levels (at least daily if given IV)

If cause is not obvious, refer to Renal or Endocrine Team for further evaluation
HYPERKALAEMIA (Serum potassium > 6 mmol/L)

**Symptoms and signs**
- Frequently none, or non-specific neuromuscular symptoms
- Cardiac arrest without warning
- ECG changes (see Treatment)

**Common causes**
1. Artefact: release from blood cells, e.g. during clotting, blood dyscrasias, haemolysis, delayed centrifugation of sample (> 2 hr)
2. Low molecular weight heparin
3. Failure of excretion: renal failure, mineralocorticoid deficiency, drugs, e.g. K⁺ sparing diuretics, ACE inhibitors, NSAIDs, ciclosporin
4. Release from cell: severe tissue damage, acidosis

**Investigations**
1. Repeat K⁺ (U&E) on plasma sample (lithium heparin) as K⁺ released from cells during clotting in serum may give an artificially high level. Management should depend on plasma K⁺
2. FBC
3. HCO₃⁻ in venous blood (or from blood gases, if indicated for other reasons)
4. Monitor urine output
5. ECG
6. If cause not obvious take blood for cortisol

**Treatment**

<table>
<thead>
<tr>
<th>Plasma K⁺</th>
<th>ECG - No K⁺ related changes</th>
<th>Monitor plasma K⁺. Identify and correct cause</th>
</tr>
</thead>
</table>
| 6.1-6.4 mmol/L | ECG - Peaked T, small P | 1. Give 10 units Actrapid IV and 50 mL of glucose 50% IV over 10 min into a large vein or, if access poor, arrange insertion of, and give through, a central line  
2. Then give 1000 mL glucose 5% IV in 12 hr, no insulin unless glucose > 10 mmol/L |

<table>
<thead>
<tr>
<th>Plasma K⁺</th>
<th>ECG - No K⁺ related changes</th>
<th>Monitor plasma K⁺. Identify and correct cause</th>
</tr>
</thead>
</table>
| 6.5-6.9 mmol/L | ECG - Peaked T, small P | 1. Give glucose and insulin (as described to left)  
2. If persistent hyperkalaemia or renal failure present (poor urine output, rising creatinine or acidosis) consider dialysis early - refer to Renal Team  
3. If continuing K⁺ retention and dialysis unlikely within a few hours - start calcium resonium resin 15 g orally in water (not fruit juice) 6 hrly or rectally (see BNF) |

| Plasma K⁺ ≥ 7.0 mmol/L | ECG - Absent P, wide QRS, blurring of ST into T | 10 mL of calcium gluconate 10% IV over 5 min. This corrects only the ECG. Continue ECG monitoring and repeat as necessary while awaiting correction of K⁺ (see below) |

**Monitoring treatment**
- Monitor plasma U&E and glucose 2 hrly until K⁺ stable and < 6.0 mmol/L.
- Attend to underlying cause, e.g. drugs; if patient in renal failure, refer to Renal Team
Follow the appropriate condition-specific guideline if the patient has any of the following conditions:
- Diabetic ketoacidosis
- Non-ketotic hyperosmolar coma
- Acute adrenal insufficiency
- Acute GI haemorrhage
- Hypo/hypernatraemia
- Acute cardiac failure
- Acute liver failure
- Established acute renal failure

This guideline is applicable in the event of prerenal failure suggested by:
- urine sodium < 20 mmol/L
- urine osmolality > 500 mmol/kg
- urine/serum creatinine > 40

Each patient’s fluid balance needs careful review. In particular, guidance may need modifying if the patient suffers from:
- chronic cardiac failure
- chronic liver failure. Seek advice of liver specialist
- hyperkalaemia (K > 6.0 mmol/L). See Hyperkalaemia

If hypokalaemia present (serum potassium < 3.5):
- Use 1L sodium chloride 0.9% with potassium chloride 40 mmol in above regimen
- Monitor serum electrolytes 12 hrly. Stop potassium supplements if K+ > 5.0 mmol/L

There is no evidence of improved outcome through using colloids or albumin compared with isotonic saline
**Sodium chloride 0.9% is standard fluid**

**In unstressed patients** receiving IV fluid due to impaired oral intake with serum Na⁺ > 135 mmol/L, or in any patient with serum Na⁺ > 140 mmol/L:
- give on half of the required volume as 50% isotonic saline and the remainder as glucose 5%
- review U&E daily. If Na⁺ < 135 mmol/L, replace glucose 5% with sodium chloride 0.9%

**In stressed patients, hyponatraemia (< 130 mmol/L) is common even when sodium chloride 0.9% is given**
- if euvoaemic, reduce rate of infusion by 30%. If necessary, adjust rate further to obtain an increase in serum Na⁺ of 5 mmol/L
- If hypokalaemia present (serum K⁺ < 3.5):
  - use 1L bags of sodium chloride 0.9% or glucose 5% with potassium chloride 40 mmol

**Always use commercially produced pre-mixed bags of sodium chloride 0.9% or glucose 5% and potassium chloride. NEVER add potassium chloride to infusion bags**

**Fluid Overload**
- If signs of fluid overload, reduce rate of infusion to 1 litre/day of glucose 5% or if serum K⁺ ≤ 3.5 glucose 5% with potassium chloride 40 mmol
- When signs disappear, resume infusion at 50% of previous rate

**Subcutaneous infusion**
- Appropriate for long term rehydration but IV route best in the acutely ill dehydrated patient
- If venous access difficult, give up to 2 L/24 hr SC, but for volumes larger than this a subclavian line is preferable

---

**MONITORING TREATMENT**

- Daily fluid balance chart
- Daily serum U&E
- Daily body weight
- BP 6-hrly

**Examine**
- Daily:
  - check JVP
  - check peripheral oedema
  - auscultate lung fields

Withdraw IV fluids and restart oral replacement as soon as possible

---

**FLUID REPLACEMENT • 2/2**

**SUBSEQUENT MANAGEMENT/MAINTENANCE FLUIDS**

**Volume of isotonic fluid to be infused in 24 hr**

<table>
<thead>
<tr>
<th>Body weight (kg)</th>
<th>No fever</th>
<th>Fever present</th>
</tr>
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<tbody>
<tr>
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<td>3 L</td>
</tr>
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- Appropriate for long term rehydration but IV route best in the acutely ill dehydrated patient
- If venous access difficult, give up to 2 L/24 hr SC, but for volumes larger than this a subclavian line is preferable
Most incompatible blood transfusions result from administrative and clerical errors.

**ASSESSMENT**

The decision to transfuse is taken by a doctor or supplementary nurse prescriber (where an agreed clinical management plan exists for the individual patient) who should:

- explain to the patient the reason for transfusion and obtain agreement to transfuse
- record this in the patient’s notes
- give the patient a copy of the ‘Receiving a blood transfusion’ patient information leaflet (available from the Blood Transfusion Laboratory)

**Jehovah’s Witnesses:**

Transfusion without consent is a gross physical violation. Discuss consequences of not transfusing. Record the discussion in the medical notes signed by patient and doctor. For further advice, contact Jehovah’s Witness Liaison Officer (313014) or Patient Visitation Coordinator on (620903)

‘No Blood’ logo wristbands are available from specimen reception or blood bank

**PRESCRIPTION**

- Check patient identification details - these **must** include:
  - surname
  - first name
  - hospital number
- When no patient name is available, use patient’s A&E or HISS/EPR number and gender as a unique identifier
- Prescribe in IV infusion section of prescription chart:
  - type of blood product to be administered including any special requirements (e.g. irradiated)
  - quantity
  - date of administration
  - duration of transfusion - usually 2-3 hr for red cells and 30 min for a unit of platelets or FFP
- Record any required pre-medication, e.g.:
  - hydrocortisone and chlorphenamine for a previous reaction
  - furosemide for patients with CCF

**REQUESTING BLOOD PRODUCTS**

- Doctors/registered practitioners must complete the request form legibly
- a doctor must sign the request form unless it has been locally agreed (e.g. A&E) that registered nurses can authorize the request
- When no patient name is available, use the patient’s A&E or HISS/EPR number and gender as a unique identifier

**Telephone**

- Doctors/registered practitioners must telephone the Blood Transfusion Laboratory (4628/9) when:
  - ordering red cells by converting a group and save into a crossmatch (serum is saved for five days)
  - ordering blood components. If needed urgently, request blood bank to defrost
  - dispatching urgent specimens for crossmatching
BLOOD SAMPLING

- Every patient’s identification wristband must contain patient’s:
  - surname
  - first name
  - hospital unit number
  - date of birth
  - gender
- Positively identify patients by:
  - checking patient identification details on wristband match those on request form
  - asking them to state surname, first name and date of birth, if capable
- Take blood:
  - 7 mL into pink (clotted) tube
  - 4 mL into purple (EDTA) tube
- Label tube at bedside with a minimum of surname, first name, hospital number and date of birth using patient’s ID wristband
- Do not use addressograph stickers for sample labelling

Do not pre-label sample tubes. Take blood from only one patient at a time

- Send request samples to the Blood Transfusion Laboratory
  - allow 90 min for full crossmatch

Unconscious patients

Unconscious patient: identify carefully using notes and wristband

- In cases where major trauma, or an unconscious A&E patient requires transfusion, minimal acceptable labelling as a unique identifier will be:
  - hospital unit number
  - HISS/EPR number or major incident number
  - gender
- Send new request labels with patient’s full identification details to the Blood Transfusion Laboratory as soon as possible after these details are known

STORAGE

- Store red cells in designated blood refrigerators. Do not leave out for > 30 min
- Do NOT refrigerate platelets
- Blood components are dispatched directly to the ward/theatre for immediate use

Never store blood/blood products in a non-designated refrigerator

RECEIPT

- The units are received by a doctor/registered practitioner who:
  - checks the correct blood is delivered
  - records against the delivered units on the compatibility (pink) slip
ADMINISTRATION

- Only doctors/registered practitioners may administer units of blood

Bedside checks

Two members of staff (each of whom must be a doctor/registered practitioner) must perform the identification check of the patient and check unit of blood at the patient’s bedside according to Trust Policy C03

- do not involve HCSW in the checking process
- Check the identification details match on patient’s wristband, medical notes, prescription chart, compatibility (pink) slip and compatibility label attached to unit of blood
- ask conscious patients to state their surname, first name and date of birth

When no name is available, the patient’s A&E or HISS/EPR number and gender must be used as a unique identifier.

Remember that consecutive patients admitted through A&E or SAU will have HISS/EPR numbers that differ by only one digit

- check the product pack number and blood group match those on the compatibility (pink) slip and compatibility label attached to unit of blood
- if any discrepancies found, do not transfuse
- check expiry date on unit
- check unit for evidence of leaks, unusual discolouration or presence of clots

Transfuse the units as soon as possible.

Transfusion of red cells must start within 30 min of removal from the refrigerator and be completed within 4 hr

Procedure

To be carried out only by doctor/registered practitioner:

- Explain procedure and advise patient to report:
  - fever
  - itching/rashes
  - shortness of breath
  - general malaise
- Record temperature, pulse and BP
- Check cannula size is appropriate for the size of the vein and rate of infusion
- Check giving set
- administer red cells through a sterile giving set for blood and blood components
- use a blood component transfusion set for platelet administration
- Give any prescribed premedication
- Prime blood administration set with sodium chloride 0.9% (which must be prescribed)
- Flush required cannula with sodium chloride 0.9%
- Set up giving set and start transfusion
- Record date/time of commencement of each unit of blood/blood component on prescription compatibility (pink) slip
- Record stop date/time of each unit of blood/blood component on prescription and compatibility (pink) slip
- At each change of unit, repeat bedside checks
- Change giving set after 12 hr or 3 units of blood, whichever occurs first
- ensure that transfusion of each unit is completed within 4 hr from receipt of unit in ward/department
- In the event of transfusion reaction occurring during administration, return all unused blood products to the Blood Transfusion Laboratory

Monitoring

During transfusion:

- Record temperature, pulse and BP before and 15 min after starting each NEW unit, and when each unit has finished
- Maintain a fluid balance chart
- Monitor access site
- Watch for any change in patient’s condition
- If patient unconscious, unwell, develops reaction (see Adverse reaction), or is unable to communicate, continue formal observations hrly
### Documentation
- Ensure permanent record of transfusion is kept in medical notes
- Documentation must include:
  - completed compatibility (pink) slip with start and stop date/time of transfusion of each unit and signature of doctor/registered practitioner who administered it
  - nursing observations
  - indications for transfusion and outcome

### ADVERSE REACTIONS
- Acute and delayed complications can occur (See tables 1 and 2)
- If temperature $<1.5^\circ C$ above normal, prescribe and administer paracetamol 1 g orally and reduce transfusion rate to a unit of blood over 4 hr
  - re-check temperature after 1 hr
  - if temperature has fallen, continue transfusion at original rate; if not, inform doctor
- Signs of a **severe reaction** include:
  - pyrexia $>1.5^\circ C$ above normal
  - hypotension
  - tachycardia
  - headaches of sudden onset
  - rashes
  - swelling and pain at access site
  - bleeding
  - pain in abdomen, loin or chest
  - feeling of agitation or undue apprehension
  - shivering
  - sweating
  - dyspnoea

### Immediate management of severe reaction
- Stop the transfusion
- Inform doctor and Blood Transfusion Laboratory (4628/9)
- Return all used blood products together with details of the reaction, and a post transfusion ‘group and save’ request taken from a vein in arm opposite to that of access site
- If septic shock suspected (see Sepsis, severe sepsis & septic shock), send blood cultures (see Collection of blood culture specimens in Medical guidelines)
Table 1: Acute complications of transfusion

<table>
<thead>
<tr>
<th>Complication</th>
<th>Presentation</th>
<th>Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severe reactions</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Acute intravascular haemolysis of transfused red cells caused by ABO incompatibility – often due to clinical or administrative errors | ● Heat along the vein  
● Flushing  
● Pain in lumbar area and chest  
● Fever  
● Hypotension  
● Acute shock  
● Disseminated intravascular coagulation and renal failure may develop | ● Stop infusion immediately and replace giving set  
● Inform doctor and Blood Transfusion Laboratory (4628/9)  
● Check patient identity and blood unit for compatibility  
● Check patient’s temperature, pulse, BP and respiratory rate  
● Maintain systolic BP >100 mmHg and urine flow over 100 mL/hr without overloading:  
  ● 1 L sodium chloride 0.9% IV over 4-6 hr (review rate of infusion every 30-60 min)  
  ● furosemide 20-80 mg by IV infusion no faster than 4 mg/min  
  ● continue fluids and diuretics  
  ● Transfuse compatible red cells  
  ● Contact on-call consultant haematologist  
  ● Alert Renal and ITU outreach Teams  
  ● Return all used blood products together with details of the reaction, and a post-transfusion ‘group and save’ request taken from vein in arm opposite to that of access site |
| Septic shock | ● Severe shock  
● Subnormal temperature, later pyrexia | ● Stop infusion immediately and replace giving set  
● Inform doctor and Blood Transfusion Laboratory (4628/9)  
● Check temperature, pulse, BP and respiratory rate  
● Refer to Sepsis, severe sepsis & septic shock  
● Contact on-call consultant microbiologist  
● Return all used blood products together with details of the reaction, and a post-transfusion ‘group and save’ request taken from vein in arm opposite to that of access site  
● Send blood cultures |
<table>
<thead>
<tr>
<th>Complication</th>
<th>Presentation</th>
<th>Management</th>
</tr>
</thead>
</table>
| Anaphylaxis                        | ● Mild pyrexia with rash  
● Peri-orbital and/or laryngeal oedema with dyspnoea  
● Hypotension  
● Bronchospasm  
● Vomiting  
● Pain in abdomen or chest | ● Stop infusion immediately and replace giving set  
● Inform doctor and Blood Transfusion Laboratory (4628/9)  
● Check patient’s temperature, pulse, BP and respiratory rate  
● Give:  
  ○ adrenaline (epinephrine) 500 mcg IM (0.5 mL of 1:1000 solution)  
  ○ chlorphenamine 10-20 mg IV  
  ○ hydrocortisone 100 mg IV  
  ○ if bronchospasm apparent, salbutamol 5 mg via a nebulizer  
● Return all used blood products together with details of the reaction, and a post-transfusion ‘group and save’ request taken from vein in arm opposite to that of access site |
| Transfusion-related acute lung injury (TRALI) | ● Rapid onset of breathlessness  
● Raised pulmonary wedge pressure (if Swan-Ganz catheter in situ) | ● Stop infusion immediately and replace giving set  
● Inform doctor and Blood Transfusion Laboratory (4628/9)  
● Check patient’s temperature, pulse, BP and respiratory rate  
● Administer high concentration (60%) O₂  
● Treat as for acute respiratory distress syndrome  
● Alert ITU outreach Team  
● Mechanical ventilatory support may be urgently needed |
| Mild reactions                     |                                                                             |                                                                                                                                     |
| Urticaria                          | ● Intense itching  
● Urticarial hives                                                              | ● Inform doctor  
● Slow down transfusion rate  
● Give:  
  ○ chlorphenamine 20 mg IV/IM  
  ○ (if febrile), paracetamol 1 g orally |
| Febrile non-haemolytic reactions   | ● Chill  
● Fever  
● Hypotension                                                                  | ● Inform doctor  
● Check patient’s temperature, pulse, BP and respiratory rate  
● Slow down transfusion rate  
● Give paracetamol 1 g 6 hrly orally/rectally (maximum 4 g in 24 hr) |
<table>
<thead>
<tr>
<th>Complication</th>
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<th>Management</th>
</tr>
</thead>
</table>
| Delayed haemolysis of transfused red cells | ● Fever  
● Haemoglobinaemia or symptoms that resemble serum sickness             | ● No specific treatment. Antibodies will be a problem for further transfusions, contact consultant haematologist |
| Post-transfusion purpura                 | ● Severe thrombocytopenia, often causing bleeding                             | ● Contact consultant haematologist urgently                               |
| Post-transfusion viral infection          | ● Systemic infection including: fever, malaise, flushing, headache            | ● Contact consultant microbiologist                                       |
| Iron overload (patients on long-term transfusion only) | ● Iron deposits in the liver, heart and endocrine organs causing failure of organs | ● Contact consultant haematologist                                       |
| Transfusion associated graft vs host disease | ● Fever, rash, nausea, vomiting, diarrhoea, liver changes                    | ● Contact consultant haematologist                                       |
This Schedule lists the number of units of blood routinely crossmatched for elective surgical procedures.

**ADVANTAGES**
- Reduction in crossmatching workload for the Blood Transfusion Laboratory, allowing them more time to respond to emergency requests, and investigate complex serological problems.
- More efficient use of blood stocks, reducing wastage.

**BLOOD TRANSFUSION REQUEST**

**Group and save**
- Group and antibody screen only.
- If antibody screen is negative, no blood is crossmatched and serum is saved.

**Crossmatch**
- Crossmatch according to surgical procedure (see Table 1).
- If clinical circumstances indicate that extra blood may be required for a particular patient, extra units will be crossmatched provided the reason is clearly identified on the request form.

**Completion of pre-operative blood transfusion request form**
- Requests should reach Blood Transfusion Laboratory no later than 1200 hr on last routine day before surgery, since considerable time is required to provide antigen negative crossmatched blood for patients with red cell antibodies.
- Request forms must be clearly and correctly labelled with:
  - surgical procedure
  - date of operation
  - requirement - group and save/number of units to be crossmatched or group and save (see Table 1)
  - doctor’s signature
- Send blood samples in a 7 mL clotted (pink tube) and 4 mL EDTA (purple tube) correctly labelled with the following details (these are the minimum acceptable):
  - surname
  - first name
  - date of birth
  - hospital number

**Addressograph labels must NOT be used for labelling blood tubes**

**GROUP AND SAVE**
- Serum is saved for five days after group and save requests.
- To order red cells, doctor (or delegated nurse responsible for the patient) should telephone 4628/9 to convert request from group and save into crossmatch.

**CROSSMATCH**
- Units of crossmatched blood for designated patients will be derequisitioned two days after the operation date as detailed on the compatibility (pink) slip, unless prior arrangement is made with the Blood Transfusion Laboratory.

---

Keeping blood past its reservation date is potentially a dangerous practice.
<table>
<thead>
<tr>
<th>Surgical speciality</th>
<th>Procedure</th>
<th>Request</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>General surgery</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Breast</td>
<td>Mastectomy (simple)</td>
<td>Group and Save</td>
</tr>
<tr>
<td>Colorectal</td>
<td>Abdominoperineal resection</td>
<td>Group and Save</td>
</tr>
<tr>
<td></td>
<td>Colectomy (left, right, transverse)</td>
<td>Two units</td>
</tr>
<tr>
<td></td>
<td>Colostomy alone</td>
<td>Group and Save</td>
</tr>
<tr>
<td></td>
<td>Ileostomy alone</td>
<td>Group and Save</td>
</tr>
<tr>
<td>Hepatobiliary</td>
<td>Cholecystectomy and exploration of common duct</td>
<td>Group and Save</td>
</tr>
<tr>
<td></td>
<td>Liver biopsy</td>
<td>Group and Save</td>
</tr>
<tr>
<td></td>
<td>Pancreatectomy – partial/total</td>
<td>Four units</td>
</tr>
<tr>
<td>Upper gastrointestinal</td>
<td>Gastrectomy - partial</td>
<td>Two units</td>
</tr>
<tr>
<td></td>
<td>Gastrostomy</td>
<td>Group and Save</td>
</tr>
<tr>
<td></td>
<td>Hiatus hernia</td>
<td>Group and Save</td>
</tr>
<tr>
<td></td>
<td>Oesophagectomy</td>
<td>Four units</td>
</tr>
<tr>
<td></td>
<td>Oesophagogastrectomy</td>
<td>Four units</td>
</tr>
<tr>
<td></td>
<td>Vagotony and pyloroplasty or gastroenterostomy</td>
<td>Group and Save</td>
</tr>
<tr>
<td>Vascular</td>
<td>Amputation of leg</td>
<td>Group and Save</td>
</tr>
<tr>
<td></td>
<td>Aorto-femoral bypass</td>
<td>Three units</td>
</tr>
<tr>
<td></td>
<td>Aorto-iliac bypass</td>
<td>Three units</td>
</tr>
<tr>
<td></td>
<td>Aorto-iliac endarterectomy</td>
<td>Three units</td>
</tr>
<tr>
<td></td>
<td>Axillo-femoral bypass</td>
<td>Two units</td>
</tr>
<tr>
<td></td>
<td>Carotid endarterectomy</td>
<td>Group and Save</td>
</tr>
<tr>
<td></td>
<td>Femoral endarterectomy</td>
<td>Group and Save</td>
</tr>
<tr>
<td></td>
<td>Femoro-poplite bypass</td>
<td>Group and Save</td>
</tr>
<tr>
<td></td>
<td>Infra-renal aortic aneurysm</td>
<td>Three units</td>
</tr>
<tr>
<td></td>
<td>Ruptured aneurysm</td>
<td>Twelve units</td>
</tr>
<tr>
<td></td>
<td>Symptomatic acute aneurysm</td>
<td>Four units</td>
</tr>
<tr>
<td></td>
<td>Sympathectomy</td>
<td>Group and Save</td>
</tr>
<tr>
<td></td>
<td>Removal of cervical rib</td>
<td>Group and Save</td>
</tr>
<tr>
<td>Other</td>
<td>Adrenalectomy</td>
<td>Two units</td>
</tr>
<tr>
<td></td>
<td>Parathyroidectomy</td>
<td>Group and Save</td>
</tr>
<tr>
<td></td>
<td>Splenectomy</td>
<td>Two units</td>
</tr>
<tr>
<td></td>
<td>Thyroidectomy – partial/total</td>
<td>Group and Save</td>
</tr>
<tr>
<td><strong>Cardio-thoracic surgery</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Angioplasty</td>
<td>Group and Save</td>
</tr>
<tr>
<td></td>
<td>Lobectomy/pneumonectomy</td>
<td>Two units</td>
</tr>
<tr>
<td></td>
<td>Open heart operations –</td>
<td>Four units</td>
</tr>
<tr>
<td></td>
<td>CAVBG, MVR, AVR</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Open pleural/lung biopsy</td>
<td>Group and Save</td>
</tr>
<tr>
<td>Surgical speciality</td>
<td>Procedure</td>
<td>Request</td>
</tr>
<tr>
<td>------------------------------------</td>
<td>---------------------------------------------------------------------------</td>
<td>--------------------------</td>
</tr>
<tr>
<td>Head and neck/Maxillo-facial</td>
<td>Sternal refashioning</td>
<td>Group and Save</td>
</tr>
<tr>
<td></td>
<td>Bi-maxillary procedure</td>
<td>Two units</td>
</tr>
<tr>
<td></td>
<td>Major head and neck resection including reconstruction</td>
<td>Four units</td>
</tr>
<tr>
<td></td>
<td>Major post-traumatic reconstruction</td>
<td>Two units</td>
</tr>
<tr>
<td></td>
<td>Other head and neck procedures</td>
<td>Group and Save</td>
</tr>
<tr>
<td></td>
<td>Single jaw osteotomoty</td>
<td>Group and Save</td>
</tr>
<tr>
<td>Neurosurgery</td>
<td>Cranioplasty</td>
<td>Group and Save</td>
</tr>
<tr>
<td></td>
<td>Craniotomy, craniectomy</td>
<td>Two units</td>
</tr>
<tr>
<td></td>
<td>Disc surgery</td>
<td>Group and Save</td>
</tr>
<tr>
<td></td>
<td>Head injury, extradural haematoma</td>
<td>Two units</td>
</tr>
<tr>
<td></td>
<td>Laminectomy</td>
<td>Group and Save</td>
</tr>
<tr>
<td></td>
<td>Meningioma or other vascular tumour</td>
<td>Four units</td>
</tr>
<tr>
<td></td>
<td>Peripheral nerve surgery</td>
<td>Group and Save</td>
</tr>
<tr>
<td></td>
<td>Shunt procedures</td>
<td>Group and Save</td>
</tr>
<tr>
<td></td>
<td>Spinal decompression for tumours</td>
<td>Two units</td>
</tr>
<tr>
<td></td>
<td>Trans-sphenoidal hypophysectomy</td>
<td>Group and Save</td>
</tr>
<tr>
<td></td>
<td>Vascular surgery (aneurysms, A-V malformations)</td>
<td>Four units</td>
</tr>
<tr>
<td></td>
<td>Vascular transformations, posterior fossa exploration</td>
<td>Two units</td>
</tr>
<tr>
<td>Obstetrics and gynaecology</td>
<td>ERPC/D and C</td>
<td>Group and Save</td>
</tr>
<tr>
<td></td>
<td>Hydatidiform mole</td>
<td>Two units</td>
</tr>
<tr>
<td></td>
<td>Hysterectomy: abdominal or vaginal (extended)</td>
<td>Two units</td>
</tr>
<tr>
<td></td>
<td>Hysterectomy: abdominal or vaginal (simple)</td>
<td>Group and Save</td>
</tr>
<tr>
<td></td>
<td>LSCS</td>
<td>Group and Save</td>
</tr>
<tr>
<td></td>
<td>Myomectomy</td>
<td>Two units</td>
</tr>
<tr>
<td></td>
<td>Oophorectomy (radical)</td>
<td>Four units</td>
</tr>
<tr>
<td></td>
<td>Pelvic exenteration</td>
<td>Six units</td>
</tr>
<tr>
<td></td>
<td>Placenta praevia-retained placenta</td>
<td>Two units</td>
</tr>
<tr>
<td></td>
<td>Sterilization and reversal</td>
<td>Group and Save</td>
</tr>
<tr>
<td></td>
<td>Termination of pregnancy</td>
<td>Group and Save</td>
</tr>
<tr>
<td></td>
<td>Vulvectomy (radical)</td>
<td>Two (or four) units</td>
</tr>
<tr>
<td></td>
<td>Wertheim’s operation</td>
<td>Four units</td>
</tr>
<tr>
<td>Surgical speciality</td>
<td>Procedure</td>
<td>Request</td>
</tr>
<tr>
<td>--------------------</td>
<td>----------------------------------------------------------------------------</td>
<td>----------------</td>
</tr>
<tr>
<td><strong>Orthopaedics</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Arthroplasty (total elbow, hip, knee or shoulder)</td>
<td>Group and Save</td>
</tr>
<tr>
<td></td>
<td>Bone graft from iliac crest (one side)</td>
<td>Group and Save</td>
</tr>
<tr>
<td></td>
<td>Bone graft from iliac crest (both sides)</td>
<td>Two units</td>
</tr>
<tr>
<td></td>
<td>Changing hip prosthesis</td>
<td>Two units</td>
</tr>
<tr>
<td></td>
<td>Dynamic hip screw</td>
<td>Group and Save</td>
</tr>
<tr>
<td></td>
<td>Internal fixation – tibia or ankle</td>
<td>Group and Save</td>
</tr>
<tr>
<td></td>
<td>Internal fixation of femur</td>
<td>Two units</td>
</tr>
<tr>
<td></td>
<td>Laminectomy</td>
<td>Group and Save</td>
</tr>
<tr>
<td></td>
<td>Nailing fractured neck of femur</td>
<td>Group and Save</td>
</tr>
<tr>
<td></td>
<td>Osteotomy/bone biopsy</td>
<td>Two units</td>
</tr>
<tr>
<td></td>
<td>Removal hip pin or femoral nail</td>
<td>Two units</td>
</tr>
<tr>
<td></td>
<td>Spinal fusion</td>
<td>Six units</td>
</tr>
<tr>
<td><strong>Plastic surgery</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Abdominoplasty</td>
<td>Group and Save</td>
</tr>
<tr>
<td></td>
<td>Mammoplasty</td>
<td>Group and Save</td>
</tr>
<tr>
<td><strong>Urology</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cystectomy</td>
<td>Four units</td>
</tr>
<tr>
<td></td>
<td>Cystectomy and urethrectomy</td>
<td>Six units</td>
</tr>
<tr>
<td></td>
<td>Cystotomy</td>
<td>Group and Save</td>
</tr>
<tr>
<td></td>
<td>Nephrectomy</td>
<td>Group and Save</td>
</tr>
<tr>
<td></td>
<td>Nephrectomy and exploration of vena cava</td>
<td>Six units</td>
</tr>
<tr>
<td></td>
<td>Open nephrolithotomcy</td>
<td>Two units</td>
</tr>
<tr>
<td></td>
<td>Open prostatectomy (RPP)</td>
<td>Two units</td>
</tr>
<tr>
<td></td>
<td>Percutaneous nephrolithotomcy</td>
<td>Group and Save</td>
</tr>
<tr>
<td></td>
<td>Reimplantation of ureter</td>
<td>Group and Save</td>
</tr>
<tr>
<td></td>
<td>TUR bladder tumour (large tumour)</td>
<td>Group and Save</td>
</tr>
<tr>
<td></td>
<td>TURP</td>
<td>Group and Save</td>
</tr>
<tr>
<td></td>
<td>Ureterolithotomy</td>
<td>Group and Save</td>
</tr>
<tr>
<td></td>
<td>Ureterolithotomy and cystotomy</td>
<td>Group and Save</td>
</tr>
<tr>
<td></td>
<td>Urethroplasty</td>
<td>Two units</td>
</tr>
</tbody>
</table>
VENOUS THROMBOEMBOLISM
DEEP VENOUS THROMBOSIS (DVT) • 1/6

RECOGNITION AND ASSESSMENT

Symptoms and signs
- Swelling of calf or leg
- Pain and stiffness of affected limb
- Pitting oedema
- Increased skin temperature
- Erythema
- Tenderness
- Mild fever

Risk factors
- See Pulmonary embolism

Differential diagnosis
- Ruptured Baker’s cyst. There may be a history of arthritis and of a swelling behind the knee, or of trauma to the knee. Examine for arthropathy and effusion
- Torn calf muscles/damage to Achilles tendon. Usually follows sudden twisting of leg, resulting in sudden pain in the calf. Examine for haematoma and, if rupture severe, for disruption of the tendon
- Cellulitis. Margin of erythema may be more clearly demarcated. Look for portal of infection

If symptoms severe or patient requires admission to hospital for reasons other than suspected DVT, or out-patient management impractical, arrange admission and proceed as recommended under In-patient management (see following). Otherwise proceed as follows:

IMMEDIATE OUT-PATIENT MANAGEMENT

Investigation
- Determine pre-test probability (Table 1)
- If indicated by pre-test probability, request D-dimer assay, bearing in mind that certain diseases/conditions apart from DVT can raise D-dimer concentration (Table 2)
- If pre-test probability moderate/high request Doppler ultrasound scan. Otherwise await D-dimer result and then refer to algorithm and/or Table 4 for guidance
- If Doppler ultrasound indicated but cannot be arranged on day of presentation, take blood for FBC, INR, APTT (see Heparin-induced thrombocytopenia), weigh the patient and give suitable single dose of SC dalteparin (see Table 3) and issue information leaflet before patient leaves MAU
- If Doppler ultrasound negative, refer to algorithm and/or Table 4 for guidance
- If Doppler ultrasound positive, proceed to Immediate treatment

Table 1: Clinical Model for predicting pre-test probability for DVT

Clinical features
(Score 1 point for each of the following features. In patients with symptoms in both legs, use the more symptomatic leg)
- Active cancer (treatment within six months, ongoing or palliative)
- Paralysis, paresis or recent plaster immobilization of legs
- Bedridden for > three days or major surgery under GA within last 12 weeks
- Localized tenderness along distribution of deep venous system
- Entire leg swollen
- Calf circumference > 3 cm greater than asymptomatic leg (measured 10 cm below tibial tuberosity)
- Pitting oedema (confined to symptomatic leg)
- Collateral superficial veins (non-varicose)
- Previously documented DVT

Deduct 2 points if an alternative diagnosis is at least as likely as DVT

<table>
<thead>
<tr>
<th>Score</th>
<th>Pre-test probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥ 3</td>
<td>75% (high)</td>
</tr>
<tr>
<td>1 - 2</td>
<td>17% (moderate)</td>
</tr>
<tr>
<td>≤ 0</td>
<td>3% (low)</td>
</tr>
</tbody>
</table>
Table 2: Examples of clinical states other than venous thromboembolism associated with an elevated D-dimer concentration

- Acute myocardial infarction (MI)
- Chronic subdural haematoma
- Disseminated intravascular coagulation
- Gram negative bacteremia
- Leukaemia
- Liver disease
- Metastatic malignancy
- Peripheral vascular disease
- Pregnancy
- Recent surgery
- Renal disease
- Rheumatoid disease
- Sickle cell crisis
- Subarachnoid haemorrhage
- Thrombolytic therapy
- Trauma with pathological thrombosis

Immediate treatment

- Advise rest and elevation of leg
- Simple analgesia as individual patient pack of co-codamol
- Once diagnosis confirmed, check blood has been taken for FBC, INR, APTT

If platelet count < 100 x 10^9/L, seek advice from on-call haematologist (bleep 390) before starting anticoagulation (see Heparin-induced thrombocytopenia)

If platelet count ≥ 100 x 10^9/L, arrange for the patient to return daily for further SC injections of dalteparin sodium (see Table 3 for dosage) and check they have an advice sheet. Until the day of their appointment at Central Out-patients Department for initiation of warfarin (see below) daily injections will be given in MAU, thereafter in medical clinic, Central Out-patients Department. No further monitoring of APTT is required

Table 3: Out-patient administration of SC dalteparin

<table>
<thead>
<tr>
<th>Body weight</th>
<th>Dose SC dalteparin</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 46 kg</td>
<td>7,500 units</td>
</tr>
<tr>
<td>46-56 kg</td>
<td>10,000 units</td>
</tr>
<tr>
<td>57-68 kg</td>
<td>12,500 units</td>
</tr>
<tr>
<td>69-82 kg</td>
<td>15,000 units</td>
</tr>
<tr>
<td>≥ 83 kg</td>
<td>18,000 units</td>
</tr>
</tbody>
</table>

ALWAYS weigh the patient - do NOT guess the body weight or rely on the patient’s own estimate

Make sure that the form authorizing daily injections of dalteparin and provision of Class 3 compression hose (see Subsequent management) is completed fully once diagnosis is confirmed

- Complete referral form; (ensure every question is answered) requesting initiation of warfarin as out-patient in Pharmacy clinic at Central Out-patients department and give information sheet to patient. [Patients presenting on Monday or Tuesday will start warfarin the following day. Those presenting on Wednesday–Sunday should have baseline INR checked in MAU. If < 1.4, the patient should be given a single dose of warfarin (10 mg) to be taken at 1800 hr on Sunday evening prior to attending the pharmacy.

Whereas a normal D-dimer concentration virtually rules out thrombosis, a raised D-dimer cannot be used confidently to confirm that thrombosis has occurred
clinic on Monday am. This dose should be recorded in the yellow anticoagulant book. If INR ≥ 1.4, initiation of warfarin should be deferred until clinic attendance. On presentation to medical clinic in Central Out-patients department, INR will be checked, a further SC dose of dalteparin will be given, and warfarin tablets will be supplied with instructions on how/when to take them

● If there is no clear precipitating cause for the thrombosis, particularly if this is a recurrent event, consider occult malignancy or other cause of thrombophilia

● Continue warfarin for six weeks if DVT occurred post-operatively in an otherwise healthy patient; for three months after a first DVT without a clear underlying cause; and indefinitely for recurrent DVT and in patients with co-existent active malignant disease

● Arrange follow-up appointment in appropriate medical clinic after three months unless a shorter course of treatment or the need for investigation requires earlier follow-up; patients with confirmed DVT will remain under the care of the duty physician for the day on which the diagnosis was confirmed

● Complete letter to GP explaining management

● Determine pre-test probability (Table 1)

● If indicated by pre-test probability, request D-dimer assay, bearing in mind that certain diseases/conditions apart from DVT can raise D-dimer concentration (Table 2)

● If pre-test probability moderate/high, request Doppler ultrasound scan. Otherwise await D-dimer result and then refer to algorithm and/or Table 4 for guidance

● If Doppler ultrasound indicated but cannot be arranged on day of presentation, take blood for FBC, INR, APTT

● If platelet count < 100 x 10^9/L, seek advice from on-call haematologist (bleep 390) before starting anticoagulation (see Heparin-induced thrombocytopenia)

● If platelet count ≥ 100 x 10^9/L, weigh the patient, and prescribe SC dalteparin using the section on the front page of the prescription chart (see Immediate treatment)

### Algorithm for DVT management

![Algorithm for DVT management](image-url)

**IMMEDIATE IN-PATIENT MANAGEMENT**

**Investigation**

- Determine pre-test probability (Table 1)
- If indicated by pre-test probability, request D-dimer assay, bearing in mind that certain diseases/conditions apart from DVT can raise D-dimer concentration (Table 2)
- If pre-test probability moderate/high, request Doppler ultrasound scan. Otherwise await D-dimer result and then refer to algorithm and/or Table 4 for guidance
- If Doppler ultrasound indicated but cannot be arranged on day of presentation, take blood for FBC, INR, APTT
- If platelet count < 100 x 10^9/L, seek advice from on-call haematologist (bleep 390) before starting anticoagulation (see Heparin-induced thrombocytopenia)
- If platelet count ≥ 100 x 10^9/L, weigh the patient, and prescribe SC dalteparin using the section on the front page of the prescription chart (see Immediate treatment)
● If Doppler ultrasound negative, refer to algorithm for guidance

● If Doppler ultrasound positive, proceed to Immediate treatment

**Table 4: Interpretation matrix for DVT**

<table>
<thead>
<tr>
<th>Pre-test probability</th>
<th>D-dimer</th>
<th>Doppler scan</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low or moderate</td>
<td>- ve</td>
<td>Unnecessary</td>
<td>Discharge</td>
</tr>
<tr>
<td>Low or moderate</td>
<td>+ ve</td>
<td>- ve</td>
<td>Discharge</td>
</tr>
<tr>
<td>Low or moderate</td>
<td>+ ve</td>
<td>+ ve</td>
<td>Treat</td>
</tr>
<tr>
<td>High</td>
<td>- ve</td>
<td>- ve</td>
<td>Discharge</td>
</tr>
<tr>
<td>High</td>
<td>- ve</td>
<td>+ ve</td>
<td>Treat</td>
</tr>
<tr>
<td>High</td>
<td>+ ve</td>
<td>- ve</td>
<td>Do not anticoagulate but repeat Doppler after 4-7 days</td>
</tr>
<tr>
<td>High</td>
<td>+ ve</td>
<td>+ ve</td>
<td>Treat</td>
</tr>
</tbody>
</table>

+ ve, positive; - ve, negative

**Table 5: In-patient administration of SC dalteparin**

<table>
<thead>
<tr>
<th>Body weight</th>
<th>Dose SC dalteparin</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Increased risk of bleeding</td>
</tr>
<tr>
<td>&lt; 46kg</td>
<td>4,000 units 12 hrly</td>
</tr>
<tr>
<td>46-47 kg</td>
<td>4,500 units 12 hrly</td>
</tr>
<tr>
<td>48-52 kg</td>
<td>5,000 units 12 hrly</td>
</tr>
<tr>
<td>53-56 kg</td>
<td>5,500 units 12 hrly</td>
</tr>
<tr>
<td>57-62 kg</td>
<td>6,000 units 12 hrly</td>
</tr>
<tr>
<td>63-68 kg</td>
<td>6,500 units 12 hrly</td>
</tr>
<tr>
<td>69-72 kg</td>
<td>7,000 units 12 hrly</td>
</tr>
<tr>
<td>73-77 kg</td>
<td>7,500 units 12 hrly</td>
</tr>
<tr>
<td>78-82 kg</td>
<td>8,000 units 12 hrly</td>
</tr>
<tr>
<td>≥ 83 kg</td>
<td>8,500 units 12 hrly</td>
</tr>
</tbody>
</table>

**Immediate Treatment**

**General**
- Bed rest
- Analgesia
- Elevation of the limb

**Specific**
- As starting dalteparin, take blood for FBC, INR, APTT
- If platelet count < 100 x 10^9/L, seek advice from on-call haematologist (bleep 390) before starting anticoagulation (see Heparin-induced thrombocytopenia)
- If platelet count ≥ 100 x 10^9/L, start dalteparin before the diagnosis is confirmed for suspected iliofemoral DVT, but for suspected calf DVT, it is best to confirm the diagnosis first. However, if diagnostic tests are delayed and clinical suspicion of a DVT is high, start dalteparin
- Weigh the patient, and prescribe dalteparin (using the section on the front page of the prescription chart) according to Table 5
- Patients at increased risk of bleeding include those who have severe liver or renal failure, thrombocytopenia or defective platelet function and those following surgery, trauma or haemorrhagic stroke
- In rare cases the arterial circulation may be...
severely compromised. This is characterized by severe pain, swelling, cyanosis and the rapid development of tense oedema

- In such cases, elevate bed foot to 40° and ensure fluid replacement adequate to compensate for extravasation
- Refer to Vascular Surgical Team (bleep)

If there are contraindications to anticoagulation, a consultant physician, staff physician or registrar must make a decision as to which carries most risk - complications of therapy, or the DVT

SUBSEQUENT MANAGEMENT

- Mobilize patient after 36 hr if well-anticoagulated and pain and/or oedema are settling
- Start warfarin as soon as the diagnosis is confirmed, but may be started sooner if a long delay in obtaining the appropriate investigation is anticipated (see Prescribing regimens and nomograms)
- Refer to Vascular Surgical Team (bleep)

Compression hose

- Assess suitability for Class 3 (European standard) graduated compression hose (40 mmHg at ankle) to reduce risk of post-thrombotic syndrome (chronic oedema). If in doubt about suitability do not recommend hose
- Document your decision in notes
- Absolute contraindications:
  - advanced peripheral arterial disease (feel for foot pulses). Pulses may be impalpable because of oedema
  - heart failure
  - septic phlebitis
  - phlegmasia caerulea dolens
- Relative contraindications:
  - chronic arthritis of affected leg
  - leg ulcers
  - numbness/paralysis of affected leg
  - suppurative dermatosis
  - prognosis < six months
  - intolerance of elastic stocking fabric
- Write a prescription to the Surgical Appliance department to measure, fit and supply two (to wash and wear) open-toe below knee stockings to the affected leg as an outpatient once tenderness and swelling has subsided. Patients will be advised to wear a stocking on the affected leg during the daytime for two years
DEEP VENOUS THROMBOSIS (DVT) • 6/6

MONITORING TREATMENT

● INR
● If patient still on dalteparin, platelet count twice weekly from day 5 (day 2 if dalteparin, any other low molecular weight heparin, or unfractionated heparin given within the last three months) - see Heparin-induced thrombocytopenia

● Compare platelet count with pre-treatment result - see Heparin-induced thrombocytopenia

● Dalteparin may be discontinued when the INR has, for two consecutive days, been within the therapeutic range: 2-3 (3-4 for recurrent DVT occurring while INR within the range 2–3)

DISCHARGE POLICY

● Stabilize the patient on warfarin with the INR in the appropriate range

● Advise patient that many drugs (including alcohol) interact with warfarin and to remind their GP that they are taking warfarin if additional medication is added

● Give patient a yellow Anticoagulation Therapy Record booklet containing the following information: indication for warfarin, target INR, start date and duration of therapy, the last of four INR results and the date of the next INR

● Monitor anticoagulation initially on a weekly basis. Some consultants arrange this in their own clinics, whereas others have pharmacist-run anticoagulant clinics

● If patients are to be followed in the pharmacist-run clinics, complete a pharmacy anticoagulation form (primrose-coloured, NCR paper) to include the required duration of therapy

● Continue warfarin for six weeks if DVT occurred post-operatively in an otherwise healthy patient; for three months after a first DVT without a clear underlying cause; and indefinitely for recurrent DVT and in patients with co-existent active malignant disease

● If hospital supervision is planned, ensure that KMR form includes diagnosis, dosage of warfarin and date of clinic appointment

● If anticoagulation is to be monitored by GP, supply GP with written information (on separate sheet, stapled to KMR) about:
  ● indication for anticoagulation
  ● proposed duration of treatment
  ● proposed target range for INR
  ● details of anticoagulation in hospital (give dates, INR results and dosage taken)
PULMONARY EMBOLISM • 1/5

RECOGNITION AND ASSESSMENT

Pulmonary venous thrombo-embolism (PE) is often missed clinically; diagnosis should be suspected in patients with vague symptoms, those not responding to initial therapy, or when there has been an unexplained deterioration.

PE is rare in patients aged < 40-yr in the absence of risk factors. Most episodes follow popliteal or iliofemoral DVT; calf DVT rarely leads to PE although it can propagate to become a popliteal DVT.

Risk factors
- DVT (present in 50% of patients)
- Major trauma
- Recent surgery (especially abdominal/pelvic)
- Obesity
- Immobility
- Age (increasing)
- Malignancy
- Oral contraceptive pill
- HRT
- Selective Estrogen Receptor Modulator (SERM) therapy, e.g. raloxifene
- Late pregnancy
- Puerperium
- Hyperviscosity syndromes
- Nephrotic syndrome
- Defective fibrinolysis
- Antithrombin III deficiency
- Lupus anticoagulant
- Protein C & S deficiencies

MASSIVE PULMONARY EMBOLUS

Symptoms and signs
Massive PE is highly likely if there is:
- Collapse/hypotension, and
- Unexplained hypoxia, and
- Engorged neck veins, and
- Right ventricular gallop (often)
- Cardiac arrest. ‘Blue light’ patients with out-of-hospital cardiac arrest due to PE rarely recover

Management

Assess clinical state

<table>
<thead>
<tr>
<th>Cardiac arrest</th>
<th>Deteriorating</th>
<th>Condition seems stable</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Resuscitation (CPR)</td>
<td>(1) Contact consultant</td>
<td>(1) Unfractionated heparin immediately see IV unfractionated heparin</td>
</tr>
<tr>
<td>(2) Alteplase 50 mg IV</td>
<td>(2) Alteplase 50 mg IV</td>
<td>(2) Urgent echo or CTPA</td>
</tr>
<tr>
<td>(3) Reassess after 30 min</td>
<td>(3) Urgent echo or CTPA</td>
<td>In event of deterioration</td>
</tr>
</tbody>
</table>

D-dimer is not necessary in probable massive PE

Thrombolysis
- If life-threatening features present (right heart failure, shock), give alteplase 50 mg IV as bolus injection. Failure to respond to alteplase is an indication for emergency direct thrombolysis, catheter thrombo-emolectomy or pulmonary embolectomy. Contact Dr Watson (3086)/Dr Oxtoby (4244). If it is felt that right heart catheter monitoring would be helpful, arrange to transfer patient to Acute Coronary Unit or ITU
- In stable patients in whom massive PE has been confirmed, give alteplase 10 mg by IV injection over 1-2 min, followed by 90 mg by IV infusion over 2 hr (max 1.5 mg/kg in patients weighing < 65 kg)
- After thrombolytic therapy has ceased, wait until APTT ratio has fallen below 2 before
If there are contraindications to giving alteplase or anticoagulation, a consultant physician, staff physician or registrar must make a decision as to which carries most risk – the complications of therapy, or the embolism.

**General**
- O₂ 35-50% (higher if shocked)
- Adequate analgesia for pleuritic pain: indometacin 25-50 mg orally 8 hrly; if contraindicated or ineffective, diamorphine 5-10 mg SC 4 hrly with metoclopramide 10 mg IV
- Allow right atrial pressure (i.e. JVP) to remain high if elevated
- **AVOID** diuretics

**SMALL TO MODERATE EMBOLI**

**Symptoms and signs**
Small emboli present with dyspnoea and moderate-sized emboli present with signs of infarction and pleuritic pain
- Dyspnoea (present in 90% of cases) may be of sudden onset
- Pleuritic chest pain
- Haemoptysis
- Syncope
- Signs may be absent
- Tachypnoea (> 20 breaths/min)
- Fever
- Pleural rub
- Tachycardia

**Differential diagnosis**
- Pneumonia
- Myocardial infarction (MI)
- Exacerbations of dyspnoea in conditions such as asthma and chronic obstructive airways disease may be due to PE

**Confirming the diagnosis**
ECG and chest X-ray. These are often normal and should not be used to confirm/refute the diagnosis, but are useful for identifying other diseases and explaining symptoms. ECG may show sinus tachycardia, an S1 Q3 T3 pattern, right bundle branch block, p pulmonale or right axis deviation. Chest X-rays may show non-specific shadows or a raised hemidiaphragm, pulmonary oligaemia, linear atelectasis or small pleural effusion

- Determine pre-test probability (Table 1) and follow flowchart
Table 1: Clinical scoring system for PE

<table>
<thead>
<tr>
<th>Clinical features (Score points as shown for each of the following features)</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>● Symptoms of DVT with objective swelling of leg and pain on palpation over deep vein</td>
<td>3.0</td>
</tr>
<tr>
<td>● Heart rate &gt; 100 beats/min</td>
<td>1.5</td>
</tr>
<tr>
<td>● Bedrest (except for toilet access) for &gt; three consecutive days OR surgery in previous four weeks</td>
<td>1.5</td>
</tr>
<tr>
<td>● Previous confirmed DVT or PE</td>
<td>1.5</td>
</tr>
<tr>
<td>● Haemoptysis</td>
<td>1.0</td>
</tr>
<tr>
<td>● Cancer treated within previous six months or patient receiving palliative care</td>
<td>1.0</td>
</tr>
<tr>
<td>● PE as likely or more likely than alternative diagnosis, taking into account clinical features, chest X-ray and ECG. In absence of breathlessness and/or tachypnoea, pleuritic chest pain or haemoptysis is usually due to another cause</td>
<td>3.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Total score</th>
<th>Pre-test probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 2.0</td>
<td>Low</td>
</tr>
<tr>
<td>2.0-6.0</td>
<td>Moderate</td>
</tr>
<tr>
<td>&gt; 6.0</td>
<td>High</td>
</tr>
</tbody>
</table>

Flowchart for diagnosis of non-massive PE

Assess clinical probability – see above

- High clinical probability: D-dimer unnecessary
- Moderate or low clinical probability: D-dimer
  - D-dimer assay
    - Positive
    - Negative: Start LMWH
      - Abnormal CXR or cardiorespiratory disease?
        - Yes: Neither. Request (V/Q) scan.
          - Probability of PE reported as
            - High
            - Intermediate
            - Low
            - Very low or normal
          - Clinical reassessment
            - Still no other diagnosis as likely as PE
            - Another diagnosis now likely
    - CT pulmonary angiogram
      - PE present
      - No PE
      - Add warfarin

- Another diagnosis
Investigations

- If indicated by pre-test probability, request D-dimer assay. Do not request where an alternative diagnosis is highly likely, clinical probability of PE is high, or in probable massive PE. Only a negative result is of value. See table 2
- Request ventilation/perfusion (V/Q) scan or CT pulmonary angiogram (CTPA) as indicated by flowchart. If requesting CTPA, ring or see CT radiologist, try Dr Watson (3086) or Dr Oxtoby (4244) first
- In patients with clinical DVT, leg ultrasound is alternative to lung imaging
- FBC, INR, APTT

Table 2: Examples of clinical states other than venous thromboembolism associated with an elevated D-dimer concentration

<table>
<thead>
<tr>
<th>Acute MI</th>
<th>Chronic subdural haematoma</th>
<th>Disseminated intravascular coagulation</th>
<th>Gram negative bacteraemia</th>
<th>Leukaemia</th>
<th>Liver disease</th>
<th>Metastatic malignancy</th>
<th>Peripheral vascular disease</th>
<th>Pregnancy</th>
<th>Recent surgery</th>
<th>Renal disease</th>
<th>Rheumatoid disease</th>
<th>Sickle cell crisis</th>
<th>Subarachnoid haemorrhage</th>
<th>Thrombolytic therapy</th>
<th>Trauma with pathological thrombosis</th>
</tr>
</thead>
</table>

Table 3: Calculation of dalteparin SC dosage

<table>
<thead>
<tr>
<th>Body weight</th>
<th>Dose SC dalteparin</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Increased risk of bleeding</td>
</tr>
<tr>
<td>&lt; 46 kg</td>
<td>4,000 units 12 hrly</td>
</tr>
<tr>
<td>46-47 kg</td>
<td>4,500 units 12 hrly</td>
</tr>
<tr>
<td>48-52 kg</td>
<td>5,000 units 12 hrly</td>
</tr>
<tr>
<td>53-56 kg</td>
<td>5,500 units 12 hrly</td>
</tr>
<tr>
<td>57-62 kg</td>
<td>6,000 units 12 hrly</td>
</tr>
<tr>
<td>63-68 kg</td>
<td>6,500 units 12 hrly</td>
</tr>
<tr>
<td>69-72 kg</td>
<td>7,000 units 12 hrly</td>
</tr>
<tr>
<td>73-77 kg</td>
<td>7,500 units 12 hrly</td>
</tr>
<tr>
<td>78-82 kg</td>
<td>8,000 units 12 hrly</td>
</tr>
<tr>
<td>≥ 83 kg</td>
<td>8,500 units 12 hrly</td>
</tr>
</tbody>
</table>

IMMEDIATE TREATMENT

General

- O₂ 35-50% (higher if shocked)
- Adequate analgesia for pleuritic pain: indometacin 25-50 mg orally 8 hrly; if contraindicated or ineffective, diamorphine 5-10 mg SC 4 hrly with metoclopramide 10 mg IV
- Allow right atrial pressure (i.e. JVP) to remain high if elevated
- AVOID diuretics

Specific

- As starting dalteparin, take blood for FBC, INR, APTT
- If platelet count < 100 x 10⁹/L, seek advice from on-call Haematologist (bleep 390) before starting anticoagulation (see Heparin-induced thrombocytopenia)
- If platelet count > 100 x 10⁹/L, weigh patient and prescribe dalteparin (using the section on the front page of the prescription chart) according to Table 3:
- Patients at increased risk of bleeding include those who have severe liver or renal failure, thrombocytopenia or defective platelet function and those following surgery, trauma or haemorrhagic stroke
If there are contraindications to anticoagulation, a consultant physician, staff physician or registrar must make a decision as to which carries most risk – the complications of therapy, or the embolism.

**SUBSEQUENT MANAGEMENT**

- Daily clinical examination for signs of further embolization, right heart failure, and secondary infection of a pulmonary infarct. Start warfarin as soon as diagnosis confirmed (see Prescribing regimens and nomograms).
- Discontinue dalteparin when the INR has, for two consecutive days, been within the therapeutic range: 2-3 (3-4 for recurrent PE occurring while INR within range 2-3).

The INR may be elevated if the APTT ratio exceeds 2.5 in a patient on unfractionated heparin, and must not be used as a guide to adjustment of warfarin dosage.

**MONITORING TREATMENT**

- **INR**
- If patient still on dalteparin, platelet count twice weekly from day 5 (day 2 if dalteparin, any other low molecular weight heparin, or unfractionated heparin given within the last three months).
- Compare platelet count with pre-treatment result – see Heparin-induced thrombocytopenia.

**DISCHARGE POLICY**

- Stabilize patient on warfarin with INR in the appropriate range.
- Advise patient that many drugs (including alcohol) interact with warfarin and to remind their GP that they are taking warfarin if additional medication is prescribed.
- Give patient a yellow Anticoagulation Therapy Record booklet containing the following information: indication for warfarin, target INR, start date and duration of therapy, the last of four INR results and the date of the next INR.
- Monitor anticoagulation initially on a weekly basis. Some consultants arrange for this in their own clinics, whereas others have pharmacist-run anticoagulant clinics.
- If patients are to be followed in the pharmacist-run clinics, complete a pharmacy anticoagulation form to include the required duration of therapy.
- Continue warfarin for three months for a first thromboembolic event, and indefinitely for recurrent PE.
- If hospital supervision is planned, ensure that KMR form includes diagnosis, dosage of warfarin and date of clinic appointment.
- If anticoagulation is to be monitored by GP, supply GP with written information (on separate sheet, stapled to KMR) about:
  - indication for anticoagulation
  - proposed duration of treatment
  - proposed target range for INR
  - details of anticoagulation in hospital (give dates, INR results and dosage taken).
SURGICAL EMERGENCIES
RECOGNITION AND ASSESSMENT

Definition

● Falling BP
● Systolic BP < 100 mmHg

Causes

Hypovolaemia

● Bleeding from wound, GI tract, into chest or abdomen, into soft tissue (e.g. fractures)
● Gastrointestinal losses – vomiting, diarrhoea, into bowel lumen when obstructed
● Polyuria or inappropriate diuretic administration
● From skin in burns
● Relative hypovolaemia associated with a vasodilated state (see Vasodilated state)

Cardiac failure

● Valvular disease
● Myocardial infarction
● Bradycardia or other arrhythmia
● Pulmonary embolism or tension pneumothorax
● Cardiac tamponade

Vasodilated state

● Sepsis, particularly Gram–ve septicemia (see Sepsis, severe sepsis and septic shock)
● High spinal or epidural anaesthesia
● Spinal shock
● Anaphylaxis
● Adrenal failure (also leads to volume depletion)

Drugs

● Common examples include:
   ● abrupt withdrawal of corticosteroids
   ● angiotensin-converting enzyme (ACE) inhibitors/angiotensin II receptor antagonists
   ● antianginal agents
   ● antihypertensive agents
   ● diuretics
   ● phenothiazines

Timing of hypotensive episode

● Bleeding is much more likely to occur soon after surgery (see Post-operative haemorrhage)
● Thromboembolic complications occur later
● Septic shock can occur at any time and is associated with fluid extravasation and hypovolaemia

Examination

● Pulse, BP
● Check for visible bleeding (see Post-operative haemorrhage)
● Jugular venous pressure (JVP)
● CVP
● Chest examination for pneumothorax and heart sounds

Investigations

● FBC
● U&E

IMMEDIATE TREATMENT

● Protect airway and support respiration if necessary
● Commence O2 therapy—see oxygen therapy in acute adult wards in the Medical Guidelines
● Unless clear evidence suggests a cardiac problem, give sodium chloride 0.9% 1 L IV or Gelofusine 500 mL IV as quickly as possible
● Establish underlying cause and refer as appropriate
● Consider inserting CVP line in patients whose circulation is difficult to assess and/or who are not responding to simple measures

MONITORING

● Pulse, BP every 30 min
● CVP every 30 min
● Urine output hrly

SUBSEQUENT MANAGEMENT

● Treat underlying cause promptly
Haemorrhage may be:
- overt, e.g. wound
- concealed, e.g. intraperitoneal or into bowel, chest or soft tissue

Signs
- Visible bleeding, e.g.:
  - wound
  - haematemesis
  - rectal bleeding and/or melaena
  - haematuria
  - vaginal bleeding
  - Tachycardia
  - Falling BP
  - Decreasing CVP
  - Shortness of breath
  - Peripheral vasoconstriction
  - Restlessness
  - Falling Hb

If visible bleeding from superficial source, apply pressure immediately
- Seek help from nursing staff/senior colleague
- Insert two 14 G IV cannulae
- take blood for crossmatch if none available, plus FBC, INR, U&E
- Give 1 L sodium chloride 0.9% IV over 30-60 min
- Give blood as necessary, fully crossmatched if available, group specific if urgency demands
- monitor for pulmonary congestion
- if frail elderly patient do NOT rapidly transfuse unless clinically indicated
- Contact theatre and second on-call anaesthetist
- Obtain consent from patient for reoperation if applicable (see Consent)

Pulse, BP every 15-30 min
CVP every 30 min, if applicable
Urine output hrly
Hb daily or as necessary until stable (not falling)
<table>
<thead>
<tr>
<th>WOUND INFECTION AND DEHISCENCE</th>
<th>POST-OPERATIVE WOUND INFECTION</th>
<th>WOUND DEHISCENCE</th>
</tr>
</thead>
</table>

### POST-OPERATIVE WOUND INFECTION
- Usually becomes evident three to four days after surgery

#### Signs
- Superficial erythema around wound margins
- Swelling of the wound with serous discharge or pus
- Fluctuation occasionally elicited when there is an abscess or liquefying haematoma
- Crepitus may be present if gas-forming organisms involved
- Patient may have pyrexia and increased wound tenderness
- Deep infection:
  - sometimes no local signs just swinging pyrexia

#### Investigations
- FBC and CRP
- Obtain wound swab or specimen of pus for culture and sensitivity

#### Treatment
- Pack or drain as necessary
- Consider removal of sutures to aid wound drainage and/or debridement
- Consider secondary suture later
- **Do not give antibiotics** unless any of the following present:
  - spreading cellulitis
  - suspected deep infection (drain if possible)
  - signs of systemic infection (e.g. temperature ≥ 38°C, raised WCC)
  - check blood culture has been taken if any of above present

### WOUND DEHISCENCE
- More common in patients with:
  - obesity
  - abdominal distension due to ileus or ascites
  - a debilitating disease, (e.g. cancer)

#### Signs
- Usually occur 7-10 days after surgery
- Profuse serosanguineous discharge of peritoneal fluid from the wound
- Patient may be unaware, or may have felt ‘something go’ after a bout of coughing or sudden exertion
- Surface of wound may appear intact but disruption of the deeper layers can be demonstrated by swelling beneath skin (best achieved by asking patient to cough or to lift their head or to raise their straight legs from the bed)
- Protrusion of bowel or omentum through the wound

#### Treatment
- Dehiscence of skin alone can be packed
- Dehiscence of both skin and muscle requires immediate operative repair
MEDICAL EMERGENCIES IN THE SURGICAL PATIENT
ACUTE SEVERE ASTHMA IN ADULTS • 1/3

RECOGNITION AND ASSESSMENT

Symptoms and signs

- Cannot complete sentences in one breath
- Respiration ≥ 25 breaths/min
- Pulse ≥ 110 beats/min
- Use of accessory muscles
- Peak expiratory flow (PEF) < 50% of predicted (Figure 1) or best (if known)

Life-threatening features

- PEF < 33% of predicted (Figure 1) or best (if known)
- Silent chest, cyanosis, or feeble respiratory effort
- Bradycardia or hypotension
- Exhaustion, confusion, or coma

Patients with severe or life-threatening attacks may not be distressed and may not have all these abnormalities. The presence of any one of these should alert the doctor

Investigations

The only investigations needed before Immediate treatment are:

- PEF
- Oximetry

If $\text{SaO}_2 < 92\%$ or a patient has any life-threatening features or not responding to treatment, measure arterial blood gases (ABG)

ABG markers of a life-threatening attack

- Normal or high $\text{PaCO}_2$ (> 4.6 kPa)
- Severe hypoxia: $\text{PaO}_2 < 8$ kPa irrespective of treatment with $\text{O}_2$
- Low pH (or high H+)

No other investigations are needed for immediate management

IMMEDIATE TREATMENT

Call for advice from medical SpR on call

While awaiting, treat as follows:

- $\text{O}_2$
- medium concentration mask or a 40-60% Venturi mask, or a high concentration mask (60-100%) if required (CO$_2$ retention is not usually aggravated by $\text{O}_2$ therapy in asthma)
- Salbutamol 5 mg plus ipratropium 500 mcg via an $\text{O}_2$-driven nebulizer
- Prednisolone tablets 40 mg (if on maintenance prednisolone, increase daily dose by 40 mg) or hydrocortisone 100 mg IV bolus, or both if very ill
- No sedatives of any kind
- If patient has coincident chronic bronchitis (regularly produces sputum), consider antibiotic treatment (see Acute exacerbation of chronic obstructive pulmonary disease in Medical guidelines)
- Chest physiotherapy is not indicated

Further investigations

- Chest X-ray to exclude pneumothorax or consolidation
- U&E
- FBC

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- Chest physiotherapy is not indicated

Further investigations

- Chest X-ray to exclude pneumothorax or consolidation
- U&E
- FBC
Patients with life-threatening features

<table>
<thead>
<tr>
<th>Acute Severe Asthma in Adults • 2/3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SUBSEQUENT MANAGEMENT</strong></td>
</tr>
<tr>
<td>- Give magnesium sulphate 2 g made up to 50 mL with sodium chloride 0.9% by IV infusion over 20 min if not already given earlier, e.g. in ambulance. Never give a second dose of magnesium without discussion with consultant respiratory physician</td>
</tr>
<tr>
<td>- Transfer patient to ITU (3129) if continues to deteriorate with:</td>
</tr>
<tr>
<td>- falling PEF, worsening or persisting hypoxia, or hypercapnia</td>
</tr>
<tr>
<td>- exhaustion, feeble respirations, confusion, or drowsiness</td>
</tr>
<tr>
<td>- coma or respiratory arrest</td>
</tr>
<tr>
<td><strong>The patient should be accompanied by a doctor (usually an anaesthetist) prepared to intubate if patient’s clinical condition requires it</strong></td>
</tr>
<tr>
<td><strong>Medical SpR will advise (see Medical Guidelines)</strong></td>
</tr>
</tbody>
</table>

Ask medical registrar, staff physician or consultant physician, ideally respiratory, to review urgently
To find the predicted PEF value read off from the vertical axis the value corresponding to the point where a vertical line from the patient’s age and the line on the graph corresponding most closely with the patient’s height intersect.
**RECOGNITION AND ASSESSMENT**

Acute renal failure (ARF) is a rapid decline in renal excretory function, acid-base balance and removal of solutes and water, occurring over **hours** to **days**

<table>
<thead>
<tr>
<th>Recognition</th>
<th>Hospital-acquired renal failure is often multifactorial, with contributions from hypotension, sepsis and drugs</th>
<th>Look for evidence of multiple organ failure</th>
</tr>
</thead>
<tbody>
<tr>
<td>● See EPR for electronic estimations of GFR, ‘eGFR’</td>
<td>● Detailed history with particular reference to features associated with volume depletion, sepsis or multi-system disorder</td>
<td>● Hypotension (mean arterial pressure &lt; 80 mmHg) despite initial fluid administration. Inotrope dependency</td>
</tr>
<tr>
<td></td>
<td></td>
<td>● Impaired gas transfer: hypoxaemia (PaO₂ &lt; 10 kPa) despite 40% O₂</td>
</tr>
<tr>
<td></td>
<td></td>
<td>● Metabolic acidosis - compensated as well as non-compensated</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Risk of ARF</th>
<th>Clearance</th>
<th>Urine output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reversible risk</td>
<td>Increase in creatinine x 1.5 or GFR reduced by &gt; 25%</td>
<td>&lt; 0.5 mL/kg for 6 hr</td>
</tr>
<tr>
<td>Risk of injury</td>
<td>Increase in creatinine x 2 or GFR reduced by &gt; 50%</td>
<td>&lt; 0.5 mL/kg for 8 hr</td>
</tr>
<tr>
<td>Risk of failure</td>
<td>Increase in creatinine x 3 or GFR reduced by &gt; 75%</td>
<td>&lt; 0.3 mL/kg for 12 hr</td>
</tr>
</tbody>
</table>
| Established ARF | **ANURIA - DIALYSIS DEPENDENT**  
Persistent ARF: anuria > 4 weeks | |

<table>
<thead>
<tr>
<th>Causes</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>● Pre renal:</td>
<td>● Careful drug history</td>
</tr>
<tr>
<td>● volume depletion</td>
<td>● Pulmonary shadowing/oedema on chest X-ray</td>
</tr>
<tr>
<td>● hypotension, pump failure</td>
<td>● Patient looks severely ill/exhausted/obtunded</td>
</tr>
<tr>
<td>● sepsis</td>
<td></td>
</tr>
<tr>
<td>● Renal:</td>
<td><strong>Patients with developing or established multiple organ failure should be identified early and referred to Intensive Care for further investigation and management</strong></td>
</tr>
<tr>
<td>● established acute tubular necrosis</td>
<td></td>
</tr>
<tr>
<td>● glomerulonephritis/vasculitis</td>
<td></td>
</tr>
<tr>
<td>● nephrotoxins</td>
<td></td>
</tr>
<tr>
<td>● Obstructive</td>
<td></td>
</tr>
</tbody>
</table>

**Assessment**

- Careful drug history
- Obtain previous U&E for evidence of pre-existing renal dysfunction
- Careful assessment of hydration status - skin turgor, pulse, jugular venous pressure (JVP), lying and standing BP, signs of fluid overload
- Look for signs of urinary tract obstruction, (palpable bladder)
ACUTE RENAL FAILURE • 2/2

Investigations
● Urgent urine dipstick. Presence of haematuria/proteinuria may indicate acute glomerulonephritis/vasculitis
● FBC
● Biochemical screen
● Blood gases to assess acidosis, hypoxia
● Urgent renal ultrasound to assess renal size/exclude obstruction
● Chest X-ray looking for signs of fluid overload, infection
● Plasma protein and urine electrophoresis
● Immunology screen: (ANA/ANCA/C3/C4/ Anti-GBM) required only in patients with single organ failure and urinary sediment

Referral to Renal Team
● During working hours contact the renal registrar; out-of-hours contact the renal SHO on-call or renal consultant
● Discuss with Renal Team any patient with:
  ● creatinine > 300 µmol/L
  ● ARF without obvious cause (e.g. volume depletion, sepsis)
  ● ARF with haematuria/proteinuria
  ● ARF in the setting of multi-system disorder

IMMEDIATE TREATMENT
● Accurate charting of fluid input and urine output (urinary catheter may be required)
● If dehydrated, correct with IV crystalloid. CVP line if necessary to maintain pressure 10-14 cm H2O
● Once rehydrated, continue IV crystalloid to match urine output + 30 mL/hr
● If hypotensive despite rehydration, consider: (a) colloid (Gelofusine, blood); (b) inotropes. Discuss with Renal Team. Do not use dopamine or mannitol
● If fluid overloaded give furosemide 250 mg IV over 1 hr. If no response contact Renal Team urgently
● Daily U&E to assess changes in renal function
● Discontinue/avoid nephrotoxins (e.g. NSAIDs)
● Discuss patients with suspected tumour lysis syndrome (massively increased uric acid levels) with Renal Team or Oncology urgently

Patients whose renal function continues to decline (even if creatinine < 300 µmol/L) despite initial resuscitation should be referred to Renal Team within 48 hr of diagnosing ARF

SUBSEQUENT MANAGEMENT
● Often undertaken by the Renal Team

MONITORING TREATMENT
● Daily weight and fluid balance
● Daily biochemical screen
● Monitoring of underlying cause

DISCHARGE POLICY
● Arrange out-patient review by Renal Team if renal function remains abnormal despite treatment
RECOGNITION AND ASSESSMENT

Symptoms and signs
- Coffee-ground vomit (dark brown denatured blood in vomit)
- Haematemesis (bright red or clotted blood in vomit)
- Melaena (black, tarry, smelly stool containing digested blood). Rarely, severe upper GI haemorrhage can present as dark altered blood per rectum with no other features to suggest upper GI pathology
- Postural dizziness or fainting
- Evidence of severe bleeding - defined as the presence of shock (tachycardia [heart rate > 100 beats/min]), hypotension (systolic BP < 100 mmHg), clammy skin or postural hypotension in patient who is not clinically shocked
- Evidence of anaemia
- Features of precipitating disease, jaundice, stigmata of liver disease
- Features of bleeding disorder (petechiae)
- Buccal or facial telangiectasia

Bright red rectal bleeding in the absence of hypotension is likely to arise from the lower gastrointestinal tract

Previous history
- Enquire about:
  - peptic ulceration
  - previous bleeds
  - liver disease
  - family history of bleeding
  - ulcerogenic medication/anticoagulants
  - alcohol
  - weight loss

Assessment of risk

It is essential to categorize patients into high (severe) or low (non-severe) risk of death

If more than one of the following is present the patient is at high risk:
- Heart rate > 100 beats/min and systolic BP < 100 mmHg or postural hypotension (fall ≥ 10 mmHg)
- Severe liver, cardiovascular, respiratory or renal disease or disseminated malignancy, though these may render patient unfit for surgery
- Rebleeding after admission
- Actively bleeding ulcer or visible non-bleeding vessel at endoscopy
- Haemoglobin (Hb) < 10 g/dL
- GI bleeding arising after admission with another condition

Figure 1 is an aid to clinical judgement

Investigations

- Non-severe bleeding:
  - FBC - send with 10 mL clotted blood for Group and Save (non-urgent)
  - all other investigations can wait until normal working laboratory hours

- Severe bleeding:
  - FBC
  - U&E
  - LFT
  - INR
  - crossmatch (four units) - notify Blood Transfusion Laboratory of clinical problem and degree of urgency
Chronic liver disease

Yes

Consider adverse prognostic features:

● Heart rate > 100 beats/min
● Systolic BP < 100 mmHg
● Postural hypotension (≥ 10 mmHg)
● Hb < normal range

No

None present

Consider ‘pre-existing’ adverse prognostic features

● > 60-yrs-old or
● Any pre-existing liver, cardiovascular, respiratory or renal disease
● Disseminated malignancy

Yes

One feature present

Consider additional adverse prognostic features

● > 60-yrs-old or
● Severe liver, cardiovascular, respiratory or renal disease
● Disseminated malignancy
● Hb < 10 g/dL

No

Two or more features present

Yes

Consider managing as out-patient after arranging early endoscopy date

Manage in hospital as non-severe non-variceal bleeding

Manage in hospital as severe non-variceal bleeding

Manage in hospital as variceal bleeding (always severe)
ACUTE UPPER GASTROINTESTINAL HAEMORRHAGE • 3/5

IMMEDIATE TREATMENT

Non-severe non-variceal bleeding

- Baseline observations with a view to upper GI endoscopy within 24 hr/next available endoscopy list
- Allow food and drink until 4 hr prior to endoscopy
- No treatment is necessary prior to endoscopy
- If admission is needed, send patient to GI Bleeding Reception area on Ward 72

Severe non-variceal bleeding

The first priority is to replace fluid loss and restore BP

- Insert two large bore (14-16 G) venous cannulae, one in each antecubital fossa
- Infuse 1-2 L of sodium chloride 0.9% over 30-120 min to achieve systolic BP > 100 mmHg
- In patients with significant cardiovascular disease, a CVP line is advisable
- In patients with significant cardiac disease, consider inserting central venous pressure (CVP) line to guide IV fluid replacement
- Stop antihypertensives, diuretics, NSAIDS, anticoagulants
- If BP still low, give plasma expanders (Gelofusine) infusing one unit over 30 min until systolic BP > 100 mmHg
- Measure urine output. Adequately resuscitated patients have a urine output of > 30 mL/hr
- Keep patient nil by mouth
- Transfuse with blood as soon as available (see Administration of blood and blood components)
- packed cells if available
- If patient in extremis
- Once resuscitation has begun, give IV omeprazole - 80 mg IV bolus injection followed by IV infusion at a rate of 8 mg/hr for 72 hr
- Arrange Upper GI Endoscopy by phoning the Gastroenterology Unit (2381/2163/2165/3289) 0830-1700 hr weekdays and 0830-1200 hr Saturday
- After preliminary resuscitation, discuss all patients with severe non-variceal bleeding with the on-call Surgical Team. If appropriate, transfer the patient to general surgical care, usually in the SAU, for further management:
- if doubt about the realistic possibility of surgery, the duty surgeon sees the patient in joint consultation
- if not for surgery, admit preferably to the GI bleeding reception area on Ward 72, otherwise to Ward 73 or 80
- The indications for surgical intervention are:
  - exsanguinating haemorrhage (too fast to replace or requiring > 4 units of blood to restore blood pressure

Failed medical therapy

- special situation (e.g. patients with rare blood group or refusing blood transfusions)

Oesophageal variceal bleeding

Haemorrhage from oesophageal varices is always life-threatening

- Identify patients from clinical history, previous hospital notes or by clinical signs (e.g. jaundice, ascites, spider naevi)
- Insert two large bore (14-16 G) venous cannulae, one in each antecubital fossa. In patients with significant cardiovascular disease, a CVP line is advisable
- Initially infuse sodium chloride 0.9% 1 L over 2-4 hr:
  - if Hb < 10 g/dL, transfuse one unit of blood for every g/dL below 10 g/dL (see Administration of blood and blood components)
- Continue fluid replacement, aiming to restore heart rate < 100 beats/min, systolic BP > 80 mmHg and Hb ≥ 10 g/dL, but avoid rapid fluid replacement as it increases risk of rebleeding
- Whilst awaiting endoscopy, give an IV infusion of octreotide 50 mcg/hr (500 mcg in 50 mL sodium chloride 0.9% at 5 mL/hr)
If haemorrhage is still not controlled, discuss with Gastroenterology Team
Give co-amoxiclav 375 mg orally or 1.2 g IV 8 hrly for three days
Always obtain a blood culture before giving an IV antibiotic (see Collection of blood culture specimens in the Medical guidelines)
If septic - see sepsis, severe sepsis and septic shock
In patients with grade 4 encephalopathy (see Acute liver failure with encephalopathy in the Medical guidelines), discuss endotracheal intubation with Gastroenterology Team
Admit to Ward 80. If no bed available, admit to Ward 72 or 73
Contact Gastroenterology Team for advice on further management

Transfer to Medical Team do not refer to Surgical Team

Patients who rebleed:
If an otherwise stable patient who is potentially referable for surgery rebleeds, request urgent endoscopy and discuss with on-call Surgical Team
Indications for surgical intervention:
exsanguinating haemorrhage (too fast to replace)
failed endoscopic therapy
major rebleed after successful endoscopic therapy
special situation, e.g. patients with rare blood group or patients refusing blood transfusion. A major bleed may warrant early surgery
Once agreed with the Surgical Team, transfer high-risk patients to SAU

Variceal bleeding
Contact Gastroenterology Team for advice on management:
if not admitted directly, transfer patient to GI Wards 80, 72 or 73

MONITORING TREATMENT
All patients
4 hrly heart rate and BP
Observe vomit for blood content and test stools for occult blood
Daily Hb until it is stable (not falling)
In patients with severe bleeding, urine output. Aim for > 30 mL/hr

Preferred eradication regimen for Helicobacter pylori is:
- omeprazole 20 mg orally 12 hrly
- amoxicillin 500 mg orally 8 hrly
- metronidazole 400 mg orally 8 hrly
for one week, then continue omeprazole 20 mg orally daily
In patients allergic to penicillin:
- omeprazole 20 mg orally 12 hrly
- clarithromycin 500 mg orally 12 hrly
- metronidazole 400 mg orally 12 hrly
for a week, then continue omeprazole 20 mg orally daily

Absolute compliance with this regimen is essential in order to achieve an eradication rate of 90%

After successful eradication of Helicobacter pylori, if NSAID therapy must be reintroduced in patients who have had a bleeding peptic ulcer, continue omeprazole 20 mg orally daily
If neoplasm identified, refer to upper GI Cancer Nurse Specialist, (3101)
**DISCHARGE POLICY**

- This will depend on age, co-morbidity and cause of gastrointestinal haemorrhage but most patients will be discharged within five days.

**Non-variceal bleeding**

- If *H. pylori* positive **duodenal** ulcer, contact Gastroenterology (2381) to arrange a $^{13}$C urease breath test > four weeks after completion of eradication therapy.
- If *H. pylori* positive **gastric** ulceration, contact Gastroenterology (2381) to arrange a $^{13}$C urease breath test > four weeks after completion of eradication therapy and repeat upper GI endoscopy to check healing six to eight weeks following discharge.
- If Hb is still < 10 g/dL, start ferrous sulphate 200 mg orally 8 hrly.
- **Non-severe bleeding with transient pathology** (e.g. Mallory-Weiss tear, acute erosion):
  - discharge promptly after endoscopy with no follow-up.
- **Non-severe bleeding and ulcer-related disease**:
  - discharge young patients (< 45-yrs-old) promptly after endoscopy.
  - discharge older patients (> 45-yrs-old) when their condition is stable.
- **Severe bleeding and ulcer-related disease**:
  - discharge when condition and Hb stable.

**Variceal bleeding**

- Start propranolol 40 mg 12 hrly unless contraindicated as prophylaxis for further variceal bleeding.
- Refer to Dr Brind or Dr Bohan for follow-up.

**Neoplasia**

- Discuss further investigation and treatment with upper GI cancer team – Cancer Nurse Specialist (3101).
Cardio-pulmonary resuscitation (CPR) is mandatory when any person suffers a cardio-respiratory arrest unless there is a ‘Do not attempt resuscitation’ order written in the patient’s notes.

**DO NOT ATTEMPT RESUSCITATION**

- ‘Do not attempt resuscitation’ (DNAR) applies solely to CPR
- It does not affect any other aspect of treatment

**Clinical justification**

- A DNAR order is ‘in the best interests of the patient’ if one or more of the following applies:
  - the patient is irreversibly close to death in the short term
  - resuscitation presents an unacceptably high probability of death or severe brain damage even if the procedure is successful
  - the length and quality of life after resuscitation are unlikely to be valued by the patient
  - the patient, who is mentally competent and suffering from a terminal illness, has expressed a consistent desire not to be resuscitated

**Advanced directive**

- A patient’s informed and competently-made refusal of CPR which relates to the circumstances that have arisen is legally binding

**Procedure**

- If the patient is competent to state a preference, he/she must be consulted
- If the patient prefers not to be resuscitated, the next of kin should be notified, having due regard for patient confidentiality
- If the patient is not competent to state a preference, the consultant in charge must decide after consulting with:
  - relatives, partners, close friends or long term carers
  - senior nursing staff and any other consultant(s) involved
- If the consultant is unavailable, a staff physician or specialist registrar may deputise, provided the decision is endorsed by a consultant at the earliest opportunity
- Once the decision not to attempt resuscitation has been made, the most senior doctor present must:
  - write ‘not for cardio-pulmonary resuscitation’ prominently in the medical notes
  - record date and time, clinical justification, those consulted (and their views), and the patient’s documented consent, if applicable
  - sign the entry and write name and post in capitals
  - complete the red Trust DNAR form and place at front of medical notes
- The senior doctor and nurse must inform the ward team

**Legal Advice**

- If there is any doubt or disagreement among the clinical professionals or the patient’s close relatives, partners, close friends and long-term carers as to either the competence or the best interests of the patient, resuscitate

**Review**

- If the patient’s clinical condition changes, the DNAR order should be reviewed
- The procedure for review is the same as for the original order
- If the DNAR order is cancelled, it must be recorded in the medical notes and the red Trust DNAR form, placed in the front of the notes, must be removed and destroyed

**If in doubt, seek legal and professional advice**

- Trust Solicitors (via Medico-legal dept 5002), BMA or Medical Defence Societies
PROCEDURE FOR IN-HOSPITAL RESUSCITATION

This algorithm is an aide memoire for hospital personnel trained in Advanced Life Support (ALS). For full review of ALS, see Trust Intranet

Algorithm

Note that each successive step is based on the assumption that the one before has been unsuccessful

Collapsed/sick patient

Shout for HELP and assess patient

Signs of life?

NO

Call Resuscitation Team

Apply pads/monitor

CPR 30:2 with oxygen and airway adjuncts

Signs of life?

YES

Assess ABCDE
Recognise and treat
Oxygen, monitoring, IV access

If appropriate, call Resuscitation Team or senior medical support

Handover to Resuscitation team or senior medical support

Shockable (VF/Pulseless VT)

1 Shock
150-360 J biphasic or 360 J monophasic

Immediately resume CPR 30:2 for 2 min

During CPR:
- Correct reversible causes*
- Check electrode position and contact
- Attempt/verify: IV access
- Airway and oxygen
- Give uninterrupted compressions when airway secure
- Give adrenaline every 3-5 min
- Consider Amiodarone, atropine, magnesium

Non-Shockable (PEA/Asystole)

Immediately resume CPR 30:2 for 2 min

*Reversible Causes
- Hypoxia
- Hypovolaemia
- Hypo/hyperkalaemia/metabolic
- Hypothermia
- Tension pneumothorax
- Toxins
- Thrombosis (coronary or pulmonary)

*Reversible Causes

• Hypoxia
• Hypovolaemia
• Hypo/hyperkalaemia/metabolic
• Hypothermia
• Tension pneumothorax
• Toxins
• Thrombosis (coronary or pulmonary)
## POST-ARREST MANAGEMENT
- The immediate goals of post-resuscitation care are:
  - provide cardio-respiratory support to optimize tissue perfusion especially to the brain
  - transport the patient to an appropriately equipped critical care unit
  - attempt to identify the precipitating causes of the arrest
  - institute measures such as anti-arrhythmic therapy to prevent recurrence (see Cardiac arrhythmias in the Medical guidelines)

- Patients with ventricular tachycardia or ventricular flutter/fibrillation occurring $\geq 48$ hr after acute myocardial infarction or with no obvious reversible factors should be considered for implantation of an ICD (implantable cardioverter defibrillator). Seek advice of Cardiology Team

## IMMEDIATE POST-ARREST INVESTIGATION
- Blood gases
- U&E, glucose
- Chest X-ray
- Cardiac enzymes
- Diagnostic ECG

## DISCHARGE POLICY
- Dependent upon underlying cause

Establish cause of cardiac arrest and treat underlying diagnosis - if in doubt, seek advice from on-call medical registrar
**RECOGNITION AND ASSESSMENT**

### Symptoms and signs
- Thirst
- Polyuria
- Flushed appearance
- Sighing respiration (Kussmaul breathing)
- Odour of ketones on breath
- Dehydration
- Drowsiness
- Coma

### Investigations
- Blood glucose (capillary)
- Test for ketones in plasma or urine
- U&E
- Blood glucose (venous)
- Blood gases
- MSU
- If febrile, blood culture
- ECG
- Chest X-ray

**A history and initial examination should search for precipitating causes of diabetic ketoacidosis (DKA) or non-ketotic hyperosmolar coma (NKHC), sepsis, signs of shock or recent myocardial infarction.**

**IMMEDIATE TREATMENT**

### Call for advice from medical SpR on call

While waiting treat as follows:

#### General
- If patient febrile and septic and no obvious cause can be found, see **Sepsis, severe sepsis and septic shock**
- If patient is hypotensive or comatose, or fails to pass urine within 3 hr of starting IV fluids, introduce a urethral catheter to monitor urine volume
- If hypotension persists beyond 6 hr, look again for evidence of sepsis, myocardial infarction or pancreatitis. Discuss further management with medical registrar. Consider transfer to ICU
- If the patient is unconscious, request review by ITU Team for endotracheal intubation and insertion of a nasogastric tube in order to aspirate the stomach
- Admit patient to an endocrinology ward 64 or 65
- If hyperglycaemia (blood glucose usually > 15 mmol/L) accompanied by metabolic acidosis and dehydration, manage as **Diabetic ketoacidosis**
- If severe hyperglycaemia (blood glucose usually > 30 mmol/L) and severe dehydration without metabolic acidosis, manage as **Non-ketotic hyperosmolar coma**

#### Diabetic ketoacidosis

**Insulin**
- Soluble insulin infusion 1 unit/mL in sodium chloride 0.9% via IV syringe pump at 6 units/hr
- If no fall in glucose after 2 hr (very unusual – check pump and patency of IV cannula), double dose and continue doubling at hrly intervals until response occurs

**IV fluid and potassium**

Always use commercially produced pre-mixed bags of sodium chloride 0.9% and potassium chloride. **NEVER add potassium chloride to infusion bags.**

Measure serum potassium (K⁺) levels (together with venous glucose levels) on admission and whenever a bag of fluid is replaced. Use the last K⁺ level to determine which bag should be used in the following regimen (Table 1)
### Table 1

<table>
<thead>
<tr>
<th>Time (hr)</th>
<th>K⁺ &gt; 5.5</th>
<th>K⁺ 3.5 - 5.5</th>
<th>K⁺ &lt; 3.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>First 30 min before K⁺ known</td>
<td>1 L x sodium chloride 0.9%</td>
<td>1 L x sodium chloride 0.9%</td>
<td>1 L x sodium chloride 0.9%</td>
</tr>
<tr>
<td>Next 1 hr</td>
<td>1 L x sodium chloride 0.9%</td>
<td>1 L x sodium chloride 0.9% with potassium chloride 20 mmol</td>
<td>1 L x sodium chloride 0.9% with potassium chloride 40 mmol</td>
</tr>
<tr>
<td>Next 2 hr</td>
<td>1 L x sodium chloride 0.9%</td>
<td>1 L x sodium chloride 0.9% with potassium chloride 40 mmol</td>
<td>2 x 500 mL sodium chloride 0.9% with potassium chloride 40 mmol/unit. Each over 1 hr</td>
</tr>
<tr>
<td>Next 4 hr</td>
<td>1 L x sodium chloride 0.9%</td>
<td>1 L x sodium chloride 0.9% with potassium chloride 40 mmol</td>
<td>2 x 500 mL sodium chloride 0.9% with potassium chloride 40 mmol/unit. Each over 2 hr</td>
</tr>
</tbody>
</table>

**When potassium is infused, patient should be on cardiac monitor**

- Further fluid and K⁺ dictated by patient’s condition and serum K⁺, usually 1 L of fluid over the next 4-6 hr (Table 2), repeated until glucose fallen to 15 mmol/L, then move to Subsequent management

### Table 2

<table>
<thead>
<tr>
<th>Time (hr)</th>
<th>K⁺ &gt; 5.5</th>
<th>K⁺ 3.5 - 5.5</th>
<th>K⁺ &lt; 3.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Next 4-6 hr</td>
<td>1 L x sodium chloride 0.9%</td>
<td>1 L x sodium chloride 0.9% with potassium chloride 40 mmol</td>
<td>2 x 500 mL x sodium chloride 0.9% with potassium chloride 40 mmol/unit. Each over 2-3 hr</td>
</tr>
</tbody>
</table>

**Bicarbonate**

*Use only with extreme caution after discussion with a consultant physician*

- If initial pH < 7, recheck pH after 2 hr of infusing the fluid regimen as in Table 1
- If pH > 6.9, give nil sodium bicarbonate
- If pH 6.8–6.9, stop IV replacement fluid as in Table 1 and give 300 mL sodium bicarbonate 1.26% IV over 30 min and simultaneously give commercially produced pre-mixed bag of 500 mL sodium chloride 0.9% with 10 mmol potassium
- If pH < 6.8, stop IV replacement as in Table 1 and give 600 mL sodium bicarbonate 1.26% IV over 1 hr and simultaneously give commercially produced pre-mixed bag of 1 L sodium chloride 0.9% with 20 mmol potassium
- Resume IV fluid regimen (Table 1) after giving sodium bicarbonate
**Diabetic ketoacidosis and non-ketotic hyperosmolar coma**

### Table 3

<table>
<thead>
<tr>
<th>Time (hr)</th>
<th>$K^+ &gt; 5.5$</th>
<th>$K^+ 3.5 - 5.5$</th>
<th>$K^+ &lt; 3.5$</th>
</tr>
</thead>
<tbody>
<tr>
<td>First 8 hr</td>
<td>1 L x sodium chloride 0.9%</td>
<td>1 L x sodium chloride 0.9% with potassium chloride 40 mmol</td>
<td>2 x 500 mL sodium chloride 0.9% with potassium chloride 40 mmol/unit. Each over 4 hr</td>
</tr>
<tr>
<td>Next 8 hr</td>
<td>1 L x sodium chloride 0.9%</td>
<td>1 L x sodium chloride 0.9% with potassium chloride 40 mmol</td>
<td>2 x 500 mL sodium chloride 0.9% with potassium chloride 40 mmol/unit. Each over 4 hr</td>
</tr>
<tr>
<td>Next 8 hr</td>
<td>1 L x sodium chloride 0.9%</td>
<td>1 L x sodium chloride 0.9% with potassium chloride 40 mmol</td>
<td>2 x 500 mL x sodium chloride 0.9% with potassium chloride 40 mmol/unit. Each over 4 hr</td>
</tr>
</tbody>
</table>

**When potassium is infused, patient should be on cardiac monitor**

- Repeat Table 3 until glucose fallen to 15 mmol/L, then move to **Subsequent management**

**Subsequent management**

- Once blood glucose has fallen below 15 mmol/L, use glucose 5% in fluid and $K^+$ regimen (Table 4)

### Table 4

<table>
<thead>
<tr>
<th>Time (hr)</th>
<th>$K^+ &gt; 5.5$</th>
<th>$K^+ 3.5 - 5.5$</th>
<th>$K^+ &lt; 3.5$</th>
</tr>
</thead>
<tbody>
<tr>
<td>First and subsequent 8 hr</td>
<td>1 L x glucose 5%</td>
<td>2 x 500 ml x glucose 5% with potassium chloride 20 mmol/unit. Each over 4 hr</td>
<td>2 x 500 mL x glucose 5% with potassium chloride 40 mmol/unit. Each over 4 hr</td>
</tr>
</tbody>
</table>
● Reduce insulin infusion rate to 3 units/hr
● Blood glucose may rise as a result, **but do not revert to sodium chloride 0.9% unless plasma pH falls**
● If glucose falls below 6 mmol/L, reduce insulin infusion rate by 1 unit/hr. Check capillary glucose in 1 hr. If glucose continues to fall, change fluid regimen to glucose 10%
● If patient with DKA still acidic or very dehydrated, simultaneously give 1 L sodium chloride 0.9% over next 8 hr
● As a rule, SC insulin can be started within 48 hr of admission, by which time the patient should be normoglycaemic and eating normally. If patient previously on SC insulin, re-start usual insulin increasing previous dose by 10-20% for first two to three days. Otherwise, add up total insulin dose in previous 24 hr, divide into four equal doses. Give three of the doses as soluble insulin SC (e.g. Actrapid/Humulin S) one dose 20-30 min before each meal, and the fourth as Isophane insulin SC (e.g. Insulatard/Humulin I) at 2200 hr
● Continue IV insulin pump after first dose of insulin; for 1 hr if dose was soluble (e.g. Actrapid/Humulin S) or 4 hr if it was Isophane (e.g. Insulatard/Humulin I)
● Refer all patients to Diabetic Team within two to three days of admission: bleep medical registrar for Diabetes and Endocrinology or diabetes nurse specialist
● If patient usually on insulin analogue e.g. Lispro/Aspart ± Glargine/Detemir, may need additional Isophane – discuss with Diabetic team

### DISCHARGE POLICY

● Check that the Diabetic Team have made appropriate follow-up arrangements

### MONITORING TREATMENT

● Monitor patient for complications of over-rapid treatment:
  ● hypoglycaemia
  ● cerebral oedema (decreased conscious level)
  ● ARDS (Adult Respiratory Distress Syndrome; hypoxia resistant to high FiO₂). Consider transfer to ITU
● Use DKA flow chart (available on wards) to record:

<table>
<thead>
<tr>
<th>Investigation</th>
<th>Time (time 0 hr = admission)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood glucose - strip (capillary)</td>
<td>Hrly for 6 hr, then 2 hrly</td>
</tr>
<tr>
<td>Serum electrolytes</td>
<td>At change of each IV fluid bag</td>
</tr>
<tr>
<td>Blood glucose – laboratory (venous)</td>
<td></td>
</tr>
<tr>
<td>pH - if initial pH &lt; 7.0</td>
<td>2, 6 hr</td>
</tr>
</tbody>
</table>

Table 5
Sepsis is a systemic response to bacteraemia or septicaemia. It commonly occurs in immunosuppressed patients, or those who have recently undergone an invasive procedure (e.g. urethral catheterization). Common surgical causes are bowel perforation and indwelling lines and catheters.

**Symptoms and signs**
- Rigors, sweating, fever
- Headache, muscle pain
- Features of primary infection. Sources include urinary tract, lower respiratory tract, meningitis, skin, intra-abdominal infection, pelvic inflammatory disease, endocarditis, osteomyelitis, sexually-transmitted diseases
- Sepsis is the presence of one of the above symptoms plus two of the following:
  - heart rate > 100 beats/min
  - respiratory rate > 24 breaths/min
  - temperature > 38°C or < 36°C

**Life-threatening features**
- **Severe sepsis**: sepsis with impaired organ function [e.g. diminishing renal function, impaired cardiac function, hypoxia, acidosis, acute respiratory distress syndrome (ARDS), clotting disturbance lactate > 4.0 mmol/L]
- **Septic shock**: severe sepsis with systolic BP < 90 mmHg

**Investigations**
- **Check on HISS or EPR whether patient has been found positive for Extended Spectrum Beta-lactamase-producing Gram-negative bacilli (ESBL), Methicillin Resistant Staphylococcus Aureus (MRSA) or Multi-resistant Gram-negative bacilli (MGNB). This will be visible next to the patient’s hospital number and name in the investigations screen**
- **If patient tagged for ESBL or MGNB, re-screen for carriage of multi-resistant Gram-negative bacilli with rectal swab and, if urinary catheter in situ CSU**
- **FBC and differential WBC**
- **Chest X-ray**
- **Biochemical screen (save serum for cortisol)**
- **Glucose**
- **Arterial blood gases (ABG) and acid-base**
- **INR, APTT**
- **Culture**
- **blood x 2 (take 4-6 only if infective endocarditis suspected: see Infective endocarditis in Medical Guidelines)**
- **urine**
- **faeces (if patient is a traveller or enteric infections suspected)**
- **CSF (if any hint of meningitis; omit if patient confused or intracranial pressure raised)**
- **If source of infection not apparent, consider CT scan, ultrasound and nuclear medicine imaging**

**Differential diagnosis**
- **Systemic infections**: staphylococcal toxic shock syndrome, malaria, viral haemorrhagic fevers, rickettsial infections
- **Systemic disease**: occult haemorrhage, myocardial infarction, adrenal insufficiency, pulmonary embolism

**IMMEDIATE TREATMENT**
- **Supportive therapy** - see flowchart
- **If patient not tagged for ESBL or MGNB, refer to flowchart for antibacterials**
- **If patient tagged for**
ESBL or MGNB:

- check that blood, urine and, if appropriate, sputum cultures have been taken
- start monotherapy with imipenem 1 g IV by infusion 8 hrly. If patient has history of seizures give monotherapy with meropenem 1 g IV 8 hrly. If allergic to penicillin, seek advice from a Consultant in Infectious Diseases (2299) or Microbiologist (4666)
- isolate in single room using infection control measures
- inform Infection Control Team (4282) and contact Consultant in Infectious Diseases (2299) or Microbiologist (4666) for advice
- Ensure gentamicin given if patient has a history of MRSA or a hospital/nursing home admission in the last 12 months. Be aware that cefuroxime, tazocin and carbapenems do not cover for MRSA. Most of the MRSA isolates in the UHNS are sensitive to gentamicin. A single dose of gentamicin 7 mg/kg will not adversely affect an already impaired renal function, however under treatment of a sepsis will

SUBSEQUENT MANAGEMENT

- If improving:
  - adjust antibiotics to cover organism(s) and sensitivities reported. Change to oral route after resolution of sepsis and continue for a further five days
- If not improving:
  - reassess, reconsider diagnosis, discuss with ITU if appropriate

DISCHARGE POLICY

- Where severe sepsis resolves, recovery is usually complete. Outpatient follow-up depends on severity and source of infection
- Inform HM Coroner in the event of death
Flowchart 1: Immediate treatment of sepsis, severe sepsis and septic shock

Severe sepsis/septic shock

Ensure adequate fluid replacement 20-40 mL/kg immediately AND adequate O₂ therapy

AND

Discuss with specialist registrar and consultant ± ITU

Sepsis (≥ two markers but no organ dysfunction)

Source identified

Continue further investigation

Seek review by senior colleague

E.g., pneumonia, urinary tract infection, cellulitis

Treat as per appropriate guideline or BNF

Oral antibiotics often sufficient

No

Yes

Source identified

Deterioration

Stable/improving

Source unclear

Diagnosis made

Further investigations

No diagnosis made

Refer to Infectious Diseases for investigation

< 65- yrs-old and no risk of C. difficile - administer cefuroxime plus gentamicin *, †

≥ 65- yrs-old or at risk of C. difficile ‡ - administer tazocin plus gentamicin **, †

Further investigations

No diagnosis made

Refer to Infectious Diseases for investigation

* Cefuroxime dose 1.5 g 8 hrly
** Tazocin dose 4.5 g 8 hrly - consultant prescription only
† Gentamicin dose according to prescribing nomogram
‡ Risk of C. difficile: ≥ 65- yrs-old, recent antibiotic therapy, recent ITU stay, recent prolonged hospital admission

* Cefuroxime dose 1.5 g 8 hrly
** Tazocin dose 4.5 g 8 hrly - consultant prescription only
† Gentamicin dose according to prescribing nomogram
‡ Risk of C. difficile: ≥ 65- yrs-old, recent antibiotic therapy, recent ITU stay, recent prolonged hospital admission
PRESCRIBING REGIMENS and NOMOGRAMS
The diagram illustrates the relationship between pH and bicarbonate concentration ([HCO₃⁻]) in human whole blood in vivo. It shows the significance bands of single disturbances and highlights normal ranges.

**INDICATIONS**
- Acute severe asthma
- Reversible airways obstruction

**DOSAGE**

**Loading**

Only to be given if patient has NOT received oral theophylline/aminophylline within the last 24 hr

- 250 mg IV by infusion over 20 min
- Dilute in 100 mL bag of diluent (see Diluents)

**Maintenance**

- For obese patients [actual body weight > 120% ideal body weight (IBW)] use IBW (see Prescribing regimens and nomograms - Gentamicin for method of calculation of IBW)

**Doses of 0.25 mg/kg per hr - patients with reduced clearance* (disregard smoking status)**

* Patients with liver failure, heart failure or those taking ciprofloxacin, cimetidine or fluvoxamine (see BNF Appendix 1 for comprehensive list of interacting drugs)

- Add 250 mg (10 mL) to 500 mL of diluent after first removing 10 mL from the bag
- Concentration = 250 mg in 500 mL = 0.5 mg/mL

Table 1: Infusion rate (mL/hr) for a range of body weights (dosage 0.25 mg/kg per hr)

<table>
<thead>
<tr>
<th>Dosage mg/kg per hr</th>
<th>Weight (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.25</td>
<td>40  45 50 55 60 65 70 75 80 85 90 95</td>
</tr>
<tr>
<td></td>
<td>20 23 25 28 30 33 35 38 40 43 45 48</td>
</tr>
</tbody>
</table>

**Doses of 0.5 mg/kg per hr - adult non-smoker and ex-smoker > three months**

- Add 250 mg (10 mL) to 500 mL of diluent after first removing 10 mL from the bag
- Concentration = 250 mg in 500 mL = 0.5 mg/mL

Table 2: Infusion rate (mL/hr) for a range of body weights (dosage 0.5 mg/kg per hr)

<table>
<thead>
<tr>
<th>Dosage mg/kg per hr</th>
<th>Weight (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>40  45 50 55 60 65 70 75 80 85 90 95</td>
</tr>
<tr>
<td></td>
<td>40 45 50 55 60 65 70 75 80 85 90 95</td>
</tr>
</tbody>
</table>

**Doses of 0.9 mg/kg per hr - adult smoker**

- Add 500 mg (20 mL) to 500 mL of diluent after first removing 20 mL from the bag
- Concentration = 500 mg in 500 mL = 1 mg/mL

Table 3: Infusion rate (mL/hr) for a range of body weights (dosage 0.9 mg/kg per hr)

<table>
<thead>
<tr>
<th>Dosage mg/kg per hr</th>
<th>Weight (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.9</td>
<td>40  45 50 55 60 65 70 75 80 85 90 95</td>
</tr>
<tr>
<td></td>
<td>36 41 45 50 54 59 63 68 72 77 81 86</td>
</tr>
</tbody>
</table>
MONITORING

- Monitor plasma potassium concentration 1-2 hr after starting infusion and daily whilst infusion continued
- Monitor serum theophylline concentrations in all patients. Take the sample 24 hr after starting the infusion. Draw the sample from the opposite arm to that receiving the infusion. Target range = 10-20 mg/L. Adjust maintenance dosage of aminophylline accordingly

PREPARATIONS

- Aminophylline injection = 25 mg/mL, 10 mL ampoules

DILUENTS

- Sodium chloride 0.9% or 5% glucose

There are a number of medications that may increase or decrease theophylline levels. Always check in the current BNF Appendix 1 for full list of interactions.

Clearance of theophylline may be reduced (e.g., serum level increased) in the elderly, and in patients with viral infection or prolonged fever.
The nomogram for digoxin dosage provides a loading (L) and maintenance dose (M) for an adult patient whose plasma creatinine (A), age (B), and body weight (D) are known. To use, join A to B with a line that crosses C; then join this intercept on C to D with a line that crosses M and L.

Specific circumstances

- In elderly patients with reduced muscle mass, serum creatinine may be artificially low and will not reflect renal function. Assume a value of 100 \( \mu \text{mol}/\text{L} \) for A in such patients.
- In obese patients, body weight will not reflect distribution volume of digoxin. Use ideal body weight calculated from height (see Prescribing regimens and nomograms - Gentamicin) for D in such patients.

Instructions for using nomogram

- To question the need for continued treatment in patients with sinus rhythm.
- To monitor the effect of concurrent disease or drug treatment.
- To confirm a diagnosis of suspected toxicity, and to aid dose reduction.
- To investigate suspected treatment failure or non-compliance.

MONITORING

**Indications for measurement**

- To question the need for continued treatment in patients with sinus rhythm.
- To monitor the effect of concurrent disease or drug treatment.
- To confirm a diagnosis of suspected toxicity, and to aid dose reduction.
- To investigate suspected treatment failure or non-compliance.

**Sampling**

- Steady state is not achieved until one to three weeks after starting therapy or changing the dose, depending on the patient’s renal function.
- Samples should be taken at least 6 hr post-dose. It is often easier to sample immediately before a dose is due.

**Target range**

- \(< 0.8 \text{ mcg/L} \) have no useful inotropic effect.
- This is a general guide and should be interpreted taking other factors, such as serum potassium and thyroid function, into account.
- In atrial fibrillation, once treatment is established, ventricular rate is the best guide to the appropriate dosage for patients taking digoxin alone for rate control.

**Target range**

- 0.8 - 2.0 mcg/L
- Concentrations
**ONCE DAILY DOSING**

This protocol should **NOT** be used for patients in the following categories:

- ascites
- pregnant or breastfeeding women
- endocarditis (see Infective endocarditis in the Medical guidelines)
- cystic fibrosis (CF) (see Exacerbation of bronchiectasis in adults with cystic fibrosis in the Medical guidelines)
- major burns
- creatinine clearance (CrCl) < 20 mL/min
- neutropenia

In these situations, unless a specific protocol exists, use gentamicin nomogram to select an initial dosage and regimen then adjust on the basis of serum levels (see Monitoring multiple daily dose regimens)

If there are no contraindications to its use, once daily dosing with gentamicin is safer, more convenient, and cheaper than multiple daily dose regimens

---

**PROCEDURE**

- Weigh patient. If unfit to be weighed or obese, calculate ideal body weight (IBW) from height:
  - **males:**  
    \[
    \text{IBW (kg)} = 50 + [2.3 \times (\text{height in inches} - 60)] \quad (1\text{cm} = 0.394 \text{in})
    \]
  - **females:**  
    \[
    \text{IBW (kg)} = 45 + [2.3 \times (\text{height in inches} - 60)]
    \]

  If patient emaciated **do not** use this formula, use actual weight

- Give initial dose of gentamicin 7 mg/kg (based on IBW [see above] maximum 560 mg) in 100 mL glucose 5% or sodium chloride 0.9% by IV infusion over 1 hr. Note time of commencement

- Take blood samples for gentamicin (10 mL clotted blood) and creatinine 6-14 hr after start of infusion. Do not sample via cannula used for infusion. **Record time of sample and dose regimen on sample card**

- Request measurement of gentamicin concentration. Enter time infusion began and time of sample on request card

- If result not available within 24 hr
  - Measure serum creatinine and calculate CrCl from one of the following equations:
    - **male:**  
      \[
      \text{CrCl} = 1.23 \times \frac{(140 - \text{age}) \times \text{Wt (kg)}}{\text{Serum creatinine (µmol/L)}}
      \]
    - **female:**  
      \[
      \text{CrCl} = 1.03 \times \frac{(140 - \text{age}) \times \text{Wt (kg)}}{\text{Serum creatinine (µmol/L)}}
      \]

  - Use Table 1 to select dose interval according to CrCl

**Table 1: Gentamicin dose interval according to CrCl**

<table>
<thead>
<tr>
<th>CrCl (mL/min)</th>
<th>Dosing interval (hr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 60</td>
<td>24</td>
</tr>
<tr>
<td>40-59</td>
<td>36</td>
</tr>
<tr>
<td>20-39</td>
<td>48</td>
</tr>
<tr>
<td>&lt; 20</td>
<td>Do not use this guideline</td>
</tr>
</tbody>
</table>

- Give next dose (7 mg/kg by infusion as above) after interval indicated by Table 1
● Repeat U&E daily. Calculate CrCl from serum creatinine to check dose interval has not changed.

● If dose interval has to be changed, check gentamicin concentration 6-14 hr after start of next infusion (note time of start of infusion and time of sampling) and use Figure 1 to verify correct dose interval.

This protocol is based on that used at the Tayside area hospitals, Scotland.

---

**MONITORING**

Figure 1: Use values of plasma concentration and time interval to find intercept

(Example: a concentration of 6 mg/L after 10 hr yields a dose interval of 36 hr)

---

![Figure 1: Use values of plasma concentration and time interval to find intercept](image-url)

---

*This nomogram was developed and validated by Dr David Nicolau et al*, Division of Infectious Diseases, Hartford Hospital, Hartford, Connecticut, USA

Nomogram for gentamicin dosage (devised by Prof. G. Mawer), which provides a loading dose (L), a maintenance dose (M) and a suitable interval between doses for an adult patient whose serum creatinine concentration (A), age (B) and body weight (D) are known.

To use, join A to B with a line that crosses C; then join this intercept on C to D with a line which crosses M and L.

- Levels should be taken after 24 hr. A trough level should be taken immediately prior to the third dose, and a peak level 1 hr after dose.
- The target peak concentration is 5-10 mg/L.
- The trough should be maintained < 2 mg/L.
- The relationship between maintenance dose and steady state concentration is linear. Doubling the dose will double the peak and trough serum concentrations, assuming renal function is stable.

For patients with CF, refer to Exacerbation of bronchiectasis in adults with cystic fibrosis in the Medical guidelines.

For patients with infective endocarditis please refer to Infective endocarditis in the Medical guidelines.
## Glasgow Coma Scale

### Eye opening

<table>
<thead>
<tr>
<th>Score</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Spontaneous</td>
</tr>
<tr>
<td>3</td>
<td>To speech</td>
</tr>
<tr>
<td>2</td>
<td>To pain</td>
</tr>
<tr>
<td>1</td>
<td>Nil</td>
</tr>
</tbody>
</table>

### Best motor response

<table>
<thead>
<tr>
<th>Score</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>Obeys commands</td>
</tr>
<tr>
<td>5</td>
<td>Localizes pain</td>
</tr>
<tr>
<td>4</td>
<td>Flexion - withdrawal to pain</td>
</tr>
<tr>
<td>3</td>
<td>Flexion - abnormal (decorticate rigidity)</td>
</tr>
<tr>
<td>2</td>
<td>Extension to pain (decerebrate rigidity)</td>
</tr>
<tr>
<td>1</td>
<td>Nil</td>
</tr>
</tbody>
</table>

### Best verbal response

<table>
<thead>
<tr>
<th>Score</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Orientated</td>
</tr>
<tr>
<td>4</td>
<td>Confused conversation</td>
</tr>
<tr>
<td>3</td>
<td>Inappropriate words</td>
</tr>
<tr>
<td>2</td>
<td>Incomprehensible sounds</td>
</tr>
<tr>
<td>1</td>
<td>Nil</td>
</tr>
</tbody>
</table>

Normal aggregate score: 15

It is good practice to record score in each domain (e.g. eye opening 4, motor response 6, verbal response 5)
The anticoagulant response to IV unfractionated heparin varies widely among patients with thromboembolic disease, possibly because of variations in the plasma concentration of heparin-binding proteins. Unfractionated heparin treatment is, therefore, monitored to maintain the ratio of the patient's Activated Partial Thromboplastin Time (APTT) to the mean control APTT within a defined target range of approximately 1.5-2.5. Dose adjustment is complicated because unfractionated heparin displays saturation kinetics.

Before treatment, all patients requiring unfractionated heparin should have:
- FBC
- INR
- APTT

To initiate treatment for venous/arterial thromboembolism, give a bolus dose of unfractionated heparin 5000 units IV over 5 min.

Note different regimens may be used for coronary syndromes or post-thrombolysis. Check other guidelines.

Prepare an unfractionated heparin solution containing 500 units/mL.
(The pharmacy can provide a solution containing 20,000 units in 20 mL, this must then be diluted to a total volume of 40 mL with sodium chloride 0.9% injection)

Start the infusion at 2.8 mL/hr (1400 units/hr = 33,600 units/24 hr). Check the APTT after 6 hr and adjust the rate as dictated by the APTT ratio (Table 1).

After the first dose adjustment, if the ratio was >5.0, measure the APTT again after 2 hr. Otherwise, wait at least 10 hr before repeating the APTT.

Patients with renal impairment may have delayed clearance of heparin.

Once the APTT ratio has achieved the target range of 1.5-2.5 check the APTT daily.

Check platelet count twice weekly from day 5 (day 2 if unfractionated heparin, dalteparin or any other low molecular weight heparin given within the last three months), looking for thrombocytopenia.

Table 1: APTT ratio and corresponding change in infusion rate

<table>
<thead>
<tr>
<th>APTT ratio</th>
<th>Change in infusion rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 5.00</td>
<td>Stop infusion for 1 hr, then reduce by 1 mL/hr. If infusion rate ≤ 1 mL/hr stop infusion for 1 hr then reduce rate by one-third</td>
</tr>
<tr>
<td>4.10-5.00</td>
<td>Reduce by 0.6 mL/hr</td>
</tr>
<tr>
<td>3.10-4.09</td>
<td>Reduce by 0.2 mL/hr</td>
</tr>
<tr>
<td>2.60-3.09</td>
<td>Reduce by 0.1 mL/hr</td>
</tr>
<tr>
<td>1.50-2.59</td>
<td>No change</td>
</tr>
<tr>
<td>1.20-1.49</td>
<td>Increase by 0.4 mL/hr</td>
</tr>
<tr>
<td>&lt; 1.20</td>
<td>Increase by 0.8 mL/hr</td>
</tr>
</tbody>
</table>

All patients requiring unfractionated heparin or low molecular weight heparin (LMWH) (e.g. dalteparin) should have:

- FBC, INR and APTT before starting treatment
- Platelet count twice weekly from day 5 (day 2 if unfractionated heparin, dalteparin or any other LMWH given within the last three months) until day 21 or until treatment with heparin ceases

**Classification**

<table>
<thead>
<tr>
<th>Type 1</th>
<th>Type 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>● Non-immune (aggregation effect)</td>
<td>● Immune (platelet factor 4-IgG complex causes profound platelet activation)</td>
</tr>
<tr>
<td>● Onset within four days of exposure</td>
<td>● Onset 5-14 days after exposure (2-14 days if unfractionated heparin, dalteparin or any other LMWH given within the last year)</td>
</tr>
<tr>
<td>● Mild and clinically insignificant (seldom &lt; 100 x 10^9/L)</td>
<td>● Severe threat to life and limb</td>
</tr>
<tr>
<td>● Transient</td>
<td>● Dose-related and more common with unfractionated heparin</td>
</tr>
<tr>
<td>● Recovery spontaneous</td>
<td>● Among those exposed, 7% have specific IgG antibodies, but only 2-3% develop thrombocytopenia and only 1% experience thrombosis</td>
</tr>
</tbody>
</table>

**Clinical features of Type 2**

- A greater than 50% fall in platelet count
- Extension of previous thrombus occurring during treatment with heparin
- New arterial/venous thrombus, perhaps in unusual sites (cerebral, renal, skin necrosis)
- DIC
- Anaphylaxis (acute systemic reaction to heparin)
- Skin lesions at heparin injection sites

**Despite low platelet count, bleeding does not occur**

**Investigation (in suspected cases)**

- Request ELISA screen for heparin-dependent anti-PF4-IgG complex
- Send sample in red top serum bottle (Contact blood bank Haematology 4628)
- Result usually available within 24 hr
- If the test result negative but clinical features suggest heparin-induced thrombocytopenia, discuss with a consultant haematologist
HEPARIN-INDUCED THROMBOCYTOPENIA • 2/3

IMMEDIATE TREATMENT

- Stop unfractionated heparin, dalteparin or any other LMWH
- Defer introduction of warfarin until patient on maintenance infusion of danaparoid sodium and platelet count > 100 x 10^9/L
- If warfarin has been given for < 24 hr omit warfarin and give Vitamin K 5 mg by slow IV injection and fresh frozen plasma while introducing danaparoid sodium (see below)
- If warfarin has been given for > 24 hr introduce danaparoid sodium (see below) and discuss need to reverse warfarin with consultant haematologist

Alternative anticoagulation for patients with HIT (discuss with haematologist)

- Alternatives include danaparoid and lepirudin

Danaparoid dosing for HIT

<table>
<thead>
<tr>
<th>Clinical indication</th>
<th>Danaparoid dosing schedule</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment of thromboembolism in patients with acute HIT or a prior history of HIT</td>
<td>IV route: 2250 units IV bolus (weight-related)*, then 400 u/hr x 4 hr, then 300 u/hr, then 150-200 u/hr by continuous IV infusion</td>
</tr>
<tr>
<td></td>
<td><strong>OR</strong></td>
</tr>
<tr>
<td></td>
<td>SC route : 2250 units IV bolus*, then 1500-2250 units SC every 12 hr</td>
</tr>
<tr>
<td></td>
<td>Monitor danaparoid if</td>
</tr>
<tr>
<td></td>
<td>● Patient is grossly over or under weight</td>
</tr>
<tr>
<td></td>
<td>● Patient has severe renal failure</td>
</tr>
<tr>
<td></td>
<td>● Patient has a life threatening thrombosis to document an appropriate therapeutic level has been achieved</td>
</tr>
<tr>
<td></td>
<td>● There is a high risk of haemorrhage</td>
</tr>
<tr>
<td></td>
<td>● AntiXa assay can only be carried out Monday-Friday during working hours after discussion with Consultant Haematologist</td>
</tr>
<tr>
<td></td>
<td>○ Target level is 0.5-0.8 U/mL</td>
</tr>
<tr>
<td></td>
<td>○ Take sample within 24 hr of starting IV treatment and repeat at 72 hr in patients with renal failure</td>
</tr>
<tr>
<td></td>
<td>○ If SC dosing, take samples 6 hr post-injection</td>
</tr>
<tr>
<td>Prophylaxis of thromboembolism in patients with acute HIT and isolated thrombocytopenia</td>
<td>Strongly consider ‘treatment dose’ as described above**</td>
</tr>
<tr>
<td>Prophylaxis for venous thromboembolism in patients with prior HIT</td>
<td>750 units SC every 8-12 hr</td>
</tr>
</tbody>
</table>

*Adjust danaparoid bolus for body weight: < 60 kg 1500 units; 60-75 kg, 2250 units; 75-90 kg, 3000 units; > 90 kg, 3750 units

**750 units SC every 8-12 hr may be suboptimal for prophylaxis of thromboembolism in patients with acute HIT and isolated thrombocytopenia
### Lepirudin dosing schedule

<table>
<thead>
<tr>
<th>Clinical indication</th>
<th>Lepirudin dosing schedule</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment of thromboembolism in patients with acute HIT or a prior history of HIT</td>
<td>0.4 mg/kg/IV bonus, then 0.15 mg/kg/hr by continuous IV infusion. Target APTT ratio: 1.5-2.5*</td>
</tr>
<tr>
<td>Prophylaxis of thromboembolism in patients with acute HIT and isolated thrombocytopenia</td>
<td>0.10 mg/kg/hr by continuous IV infusion. Target APTT ratio for continuous IV infusion: 1.5-2.0*</td>
</tr>
<tr>
<td>Prophylaxis of venous thromboembolism in patients with prior history of HIT</td>
<td>15 mg SC twice daily</td>
</tr>
</tbody>
</table>

*The APTT should be measured 4-6 hr after initiation of IV infusion or any dose adjustment and at least daily if APTT within therapeutic range

### Lepirudin (recombinant hirudin)
- is a direct thrombin inhibitor
- In patients with renal failure, the half-life is greatly prolonged. Reduce dosage substantially
- There is no known antidote
- Rare cases of anaphylaxis have been associated with IV bolus infusion of lepirudin in patients with and without previous exposure to lepirudin

### Cases that fail to respond to danaparoid sodium, possibly due to cross-reactive antibody, should be discussed with the consultant haematologist

### MONITORING TREATMENT
- Daily platelet count and INR if/when started on warfarin
- If renal function impaired or body weight > 90 kg, contact consultant haematologist about measuring plasma anti-Xa activity
- If platelet count fails to rise, antibodies to platelet factor 4 may be cross-reacting with danaparoid sodium. Discuss with consultant haematologist

### DISCHARGE POLICY
- Warn patients that they are at increased risk of thrombosis if they require unfractionated heparin, dalteparin or any other LMWH during the next 120 days. Should rapid anticoagulation be necessary, they should be given an alternative agent
### PRINCIPLES

- Consider the patient, the history and the diagnosis:
  - obtain a description of the pain
  - tailor the treatment and dose to the individual
  - keep it simple - most cancer pain is controlled with oral drug therapy
- is the pain cancer-related? It may be related to treatment, or to concurrent illness, e.g. rheumatoid arthritis

Distinguish between:
- Non-opioid-responsive pain:
  - muscle spasm
  - neuralgia - shooting, stabbing, burning pain
- Partially opioid-responsive pain:
  - bone pain from secondary metastases
- Opioid-responsive pain:
  - visceral, soft tissue

### DOSAGE

Follow the analgesic ladder:

<table>
<thead>
<tr>
<th>Non-OPIOID</th>
<th>WEAK OPIOID</th>
<th>STRONG OPIOID</th>
</tr>
</thead>
<tbody>
<tr>
<td>paracetamol</td>
<td>dihydrocodeine</td>
<td>codeine phosphate</td>
</tr>
<tr>
<td>morphine sulphae solution</td>
<td>morphine</td>
<td>diamorphine</td>
</tr>
</tbody>
</table>

- Adjuvant therapy may be added at any rung of the ladder (e.g. NSAIDs, tricyclic antidepressants, dexamethasone, anti-epileptics)
- If regular weak opioid not controlling pain, initiate immediate release morphine (e.g. morphine sulphate solution 10 mg in 5 mL) 5-10 mg every FOUR hr (i.e. SIX-times/day). (Start with 2.5 mg every 4 hr in frail elderly and patients with moderate/severe renal failure)
- At the same time prescribe the same dose for ‘as required’ use, to treat breakthrough pain, this dose to be repeated as often as necessary
- Review after 24-48 hr, and convert to slow release morphine (e.g. MST or MXL). Add up total daily dose of morphine given. Give as a once daily dose of MXL. For MST, divide by two and give this dose twice daily (e.g. 10 mg 4 hrly = 60 mg/day. 30 mg 12 hrly MST or 60 mg MXL once daily)
- Overlap at changeover, giving the last dose of morphine sulphate solution 10 mg in 5 mL and the first dose of MST/MXL together
- Continue to treat breakthrough pain with morphine sulphate solution 10 mg in 5 mL ‘as required’ at one-sixth of the current total daily dose of MST/MXL (e.g. 30 mg 12 hrly 60 mg/day therefore one-sixth of this is 10 mg as required)
- Initiate regular laxatives, a stimulant and softener (e.g. senna and lactulose, or codanthramer two caps at night)
- Consider anti-emetics. (e.g. metoclopramide 10 mg orally or IM 8 hrly or haloperidol 1.5 mg orally or IM 8 hrly ‘as required’)

Pain relief should be

- by the clock
- by the mouth
- by the ladder
If further pain develops, reassess cause of pain and treat appropriately

If pain is opioid sensitive, increase dose of morphine by 30-50% and reassess. Alternatively summate doses required for breakthrough pain and increase the regular dose accordingly

Laxatives may need to be increased with the increased morphine dose

Use a pain chart to monitor efficacy

Watch for:
- sedation - usually wears off after three to seven days, but excessive drowsiness may necessitate reduction of morphine dose
- respiratory depression (respiratory rate < 8 breaths/min) is rarely seen. Should it occur:
  - withhold one or two doses and reduce dose by 25%
  - consider alternative drug treatment

If considering alternative opioid preparations to MST/MXL/syringe driver, seek specialist advice from Medicines Information (2905) or palliative care nurse via Call Centre

---

**INDICATIONS FOR SYRINGE DRIVERS**

- Inability to swallow
- Persistent nausea and vomiting
- Unconscious patient
- Malabsorption

**Opioids via a syringe driver will not give better analgesia than the oral route unless there is a problem with absorption or administration**

---

**Dosage**

- To convert oral morphine to SC diamorphine
- 3 mg oral morphine equivalent to 1 mg diamorphine SC
- Administer at a fixed rate, not variable

For use of syringe pump or syringe driver, follow instructions for the type of pump or driver used on your ward if you are confident to do so. If you are uncertain about the operation of the delivery device, seek advice from Specialist Hospital Palliative Care Team (4087)

Reassess pain, and increase diamorphine dose to take account of the need for ‘as required’ doses of SC diamorphine

If not nauseated on MST/MXL, anti-emetic unnecessary when converting to SC infusion

If unsure of compatibility when two or more drugs are required in a pump/syringe driver, seek specialist advice from Medicines Information (2905) or palliative care nurse (via Call Centre, or Douglas Macmillan Hospice out-of-hours)
**INDICATIONS**

- Severe bronchospasm

**DOSAGE**

**IV injection**

This is a slow bolus for immediate treatment (see Acute severe asthma - patients with life-threatening features)

- 250 mcg over 10 min
- If using 500 mcg in 1 mL preparation, take 0.5 mL and make up to 20 mL with diluent in a 50 mL syringe (see Diluents)
- Administer via a syringe driver at a rate of 120 mL/hr (= 2 mL/min)

**IV infusion**

- Initial rate = 5 mcg/min, adjusted according to response, usual range 3-20 mcg/min or more if necessary (Table 1)
- Use preparation for IV infusion (5 mg in 5 mL). Remove 5 mL from a 500 mL bag of diluent (see Diluents), then add 5 mL (5 mg) of salbutamol to the bag (5 mg in 500 mL = 10 mcg/mL)

**NOTES**

- Salbutamol increases heart rate which can lead to palpitation and may preclude further dosage increases. Cardiac monitoring is advised in patients with ischaemic heart disease
- Salbutamol also causes rapid cellular uptake of potassium which can lead to serious hypokalaemia. Check plasma potassium 1-2 hr after starting IV salbutamol and after each dosage increase

**PREPARATIONS**

- Salbutamol injection 500 mcg in 1 mL ampoule
- Salbutamol solution for IV infusion 5 mg in 5 mL ampoule (1 mg/mL)

**DILUENTS**

- Sodium chloride 0.9% or glucose 5%

---

Table 1: Salbutamol IV infusion (5 mg in 500 mL)

<table>
<thead>
<tr>
<th>Dose (mcg/min)</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infusion rate (mL/min)</td>
<td>0.3</td>
<td>0.4</td>
<td>0.5</td>
<td>0.6</td>
<td>0.7</td>
<td>0.8</td>
<td>0.9</td>
<td>1</td>
<td>1.1</td>
</tr>
<tr>
<td>Pump rate (mL/hr)</td>
<td>18</td>
<td>24</td>
<td>30</td>
<td>36</td>
<td>42</td>
<td>48</td>
<td>54</td>
<td>60</td>
<td>66</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dose (mcg/min)</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
<th>16</th>
<th>17</th>
<th>18</th>
<th>19</th>
<th>20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infusion rate (mL/min)</td>
<td>1.2</td>
<td>1.3</td>
<td>1.4</td>
<td>1.5</td>
<td>1.6</td>
<td>1.7</td>
<td>1.8</td>
<td>1.9</td>
<td>2</td>
</tr>
<tr>
<td>Pump rate (mL/hr)</td>
<td>72</td>
<td>78</td>
<td>84</td>
<td>90</td>
<td>96</td>
<td>102</td>
<td>108</td>
<td>114</td>
<td>120</td>
</tr>
</tbody>
</table>
**RECOGNITION AND ASSESSMENT**

- Use vancomycin IV for serious MRSA infections on advice of microbiologist (4666)

**DOSAGE**

- Require weight (kg) and creatinine clearance (CrCl) (see below), then use table 1 to select dosage

**Weight**

- Weigh patient
- If unfit to be weighed or obese, calculate ideal body weight (IBW) from height
  - **Males:** IBW (kg) = 50 + [2.3 x (height in inches - 60)] (1 cm = 0.394 in)
  - **Females:** IBW (kg) = 45 + [2.3 x (height in inches - 60)]

**Creatinine Clearance**

- Use serum creatinine and calculate creatinine clearance from one of the following equations:
  - **Male:** CrCl = 1.23 x (140 - age) x Wt (kg)* Serum creatinine (µmol/L)
  - **Female:** CrCl = 1.03 x (140 - age) x Wt (kg)* Serum creatinine (µmol/L)

*See weight calculation

If patient emaciated do not use this formula, use actual weight

---

**Table 1: Vancomycin dosages**

<table>
<thead>
<tr>
<th>CrCl (ml/min)</th>
<th>Ideal Body Weight (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>≤ 50</td>
</tr>
<tr>
<td>&lt; 40</td>
<td>750 mg&lt;sup&gt;1&lt;/sup&gt; IV single dose</td>
</tr>
<tr>
<td>40-49</td>
<td>750 mg&lt;sup&gt;1&lt;/sup&gt; IV every 24 hours</td>
</tr>
<tr>
<td>50-59</td>
<td>750 mg&lt;sup&gt;1&lt;/sup&gt; IV every 24 hours</td>
</tr>
<tr>
<td>60-69</td>
<td>750 mg&lt;sup&gt;1&lt;/sup&gt; IV every 24 hours</td>
</tr>
<tr>
<td>70-79</td>
<td>750 mg&lt;sup&gt;1&lt;/sup&gt; IV every 24 hours</td>
</tr>
<tr>
<td>80-89</td>
<td>750 mg&lt;sup&gt;1&lt;/sup&gt; IV every 24 hours</td>
</tr>
<tr>
<td>90-99</td>
<td>750 mg&lt;sup&gt;1&lt;/sup&gt; IV every 24 hours</td>
</tr>
<tr>
<td>≥ 100</td>
<td>750 mg&lt;sup&gt;1&lt;/sup&gt; IV every 24 hours</td>
</tr>
</tbody>
</table>

---

**NOTES**

1. 750 mg in 250 ml sodium chloride 0.9% or glucose 5% over 90 min
2. 1000 mg in 250 ml sodium chloride 0.9% or glucose 5% over 120 min
INITIAL MONITORING

- Therapeutic drug monitoring is vital to prevent toxicity

Peak levels do not have any clear significance and will only be measured after prior agreement with microbiologist

- See table 2 for monitoring

Samples will be rejected if request card does not indicate dose of vancomycin, time last administered and dosing regimen. Microbiology laboratory will measure vancomycin levels every day until 1500 hr, but not out of hours. Results available on HISS/EPR

Table 2: Serum concentration monitoring of vancomycin

<table>
<thead>
<tr>
<th>CrCl (ml/min)</th>
<th>Sample</th>
<th>Target Range (mg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥ 40</td>
<td>Trough immediately before the 3rd dose (2nd dose if on 24 hourly dosing)</td>
<td>5 – 15 (10 - 15 for endocarditis and MRSA pneumonia)</td>
</tr>
<tr>
<td>&lt; 40</td>
<td>Random sample 24 hours after dose and repeat every 24 hours until ≤ 15mg/L</td>
<td>≤ 15 mg/L Then give another stat dose according to weight from table above</td>
</tr>
</tbody>
</table>

For further advice, contact your ward pharmacist, antimicrobial pharmacist (bleep 470) or Medicines Information (2905)
However rapidly treatment with warfarin is initiated, coagulation will not be inhibited for 72 hr because warfarin does not affect the action of synthesised clotting factors. For immediate inhibition of clotting factor synthesis (e.g. in patients with established thrombosis or thromboembolism), initiation of warfarin therapy commonly comprises a loading dose of up to 30 mg given over 48 hr followed by an estimated maintenance dose (determined largely by trial and error). Despite daily adjustment, guided by measurement of International Normalized Ratio (INR) there is a variable interval before the correct maintenance dose is identified, and a stable ratio is seldom achieved in less than seven days from the outset. The following method, derived from the work of Fennerty et al., (Br. Med. J. 1984; 288: 1268-1270), allows the correct maintenance dose of warfarin to be identified much sooner, by optimal interpretation of timed daily INR measurements. The INR is used to guide the selection of daily warfarin dose, even while treatment with unfractionated heparin, dalteparin or another low molecular weight heparin continues.

Once the decision is made to give warfarin, proceed as follows:

### Day 1
- Take blood for measurement of INR
- If $\geq 1.4$, this predictive method cannot be used and the choice of dose must rely on clinical judgement alone
- If $< 1.4$ and there is no reason to believe that the patient will be more than usually sensitive to warfarin, give warfarin 10 mg between 1700 hr and 1800 hr
- Sensitivity is increased in frail, sick patients, those aged $> 80$ yr or who are significantly underweight, those who have congestive cardiac failure or abnormal liver function and those who are having parenteral nutrition or drugs that potentiate warfarin (see BNF, Appendix 1). In such patients, 5 mg may be adequate

### Days 2, 3 and 4
- Take blood between 0900 hr and 1000 hr (16 hr after the previous dose of warfarin)
- Measure INR and use the result to select the next dose from Table 1
- Give the dose between 1700 hr and 1800 hr. The dose selected on day 4 is the predicted maintenance dose necessary to achieve a stable INR in the range 2-4
- Further adjustment may be necessary depending on the target range desired

### NOTES
- Notify the laboratory if unfractionated heparin is being infused at the time a blood sample is drawn
- The INR may be increased in the presence of sufficient unfractionated heparin to raise the APTT ratio to $> 2.5$ and should not be used as a basis for a decision on warfarin dose in this circumstance, unless the laboratory staff can confirm that unfractionated heparin is not affecting the INR value
- The prediction will become less reliable if the interval between dose and blood sample deviates significantly from 16 hr
- Inaccuracies may also occur if drugs known to interact with warfarin (see BNF, Appendix 1) are started, altered in dose or stopped during this period
- All warfarin tablets are scored and any doses recommended in Table 1 can be administered by appropriate use of 1 mg, 3 mg and 5 mg tablets
- Table 1 has no predictive value beyond day 4 and should not be used
- Dose adjustments from day 5 onward must be made intuitively
Table 1: Dosage adjustment for rapid anti-coagulation based on INR measurements (days 2, 3 and 4)

<table>
<thead>
<tr>
<th>Day 2 (16 hr after first 10 mg dose)</th>
<th>Warfarin dose (mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>INR &lt; 1.8</td>
<td>10.0</td>
</tr>
<tr>
<td>1.8</td>
<td>1.0</td>
</tr>
<tr>
<td>&gt; 1.8</td>
<td>0.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Day 3 (16 hr after second dose)</th>
<th>Warfarin dose (mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>INR &lt; 2.0</td>
<td>10.0</td>
</tr>
<tr>
<td>2.0-2.1</td>
<td>5.0</td>
</tr>
<tr>
<td>2.2-2.3</td>
<td>4.5</td>
</tr>
<tr>
<td>2.4-2.5</td>
<td>4.0</td>
</tr>
<tr>
<td>2.6-2.7</td>
<td>3.5</td>
</tr>
<tr>
<td>2.8-2.9</td>
<td>3.0</td>
</tr>
<tr>
<td>3.0-3.1</td>
<td>2.5</td>
</tr>
<tr>
<td>3.2-3.3</td>
<td>2.0</td>
</tr>
<tr>
<td>3.4</td>
<td>1.5</td>
</tr>
<tr>
<td>3.5</td>
<td>1.0</td>
</tr>
<tr>
<td>3.6-4.0</td>
<td>0.5</td>
</tr>
<tr>
<td>&gt; 4.0</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Day 4 (16 hr after third dose)</th>
<th>Warfarin dose (mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>INR &lt; 1.4</td>
<td>&gt; 8.0</td>
</tr>
<tr>
<td>1.4</td>
<td>8.0</td>
</tr>
<tr>
<td>1.5</td>
<td>7.5</td>
</tr>
<tr>
<td>1.6-1.7</td>
<td>7.0</td>
</tr>
<tr>
<td>1.8</td>
<td>6.5</td>
</tr>
<tr>
<td>1.9</td>
<td>6.0</td>
</tr>
<tr>
<td>2.0-2.1</td>
<td>5.5</td>
</tr>
<tr>
<td>2.2-2.3</td>
<td>5.0</td>
</tr>
<tr>
<td>2.4-2.6</td>
<td>4.5</td>
</tr>
<tr>
<td>2.7-3.0</td>
<td>4.0</td>
</tr>
<tr>
<td>3.1-3.5</td>
<td>3.5</td>
</tr>
<tr>
<td>3.6-4.0</td>
<td>3.0</td>
</tr>
<tr>
<td>4.1-4.5</td>
<td>0 - give 2 mg from day 5</td>
</tr>
<tr>
<td>&gt; 4.5</td>
<td>0 - give 1 mg from day 6</td>
</tr>
</tbody>
</table>
Where anticoagulation can be achieved more gradually (e.g. to prevent thromboembolism in patients with atrial fibrillation), heparin is unnecessary and warfarin can be initiated on an out-patient basis, using the method described by Tait et al (Br J Haematology 1998; 101: 450-54). Once the decision has been made to give warfarin, proceed as follows:

- Take blood for measurement of INR
- Start treatment on a Monday, Thursday or Friday with warfarin 5 mg daily
- If it is not convenient to start treatment on these days as an inpatient, leave initiation of warfarin in hands of Pharmacy Anticoagulant Clinic
- Do not start treatment on other days of the week
- Measure INR on day 5, and adjust daily dosage according to algorithm

Causes of over-anticoagulation include:
- Concurrent disease/illness affecting clotting factor synthesis, Vitamin K availability, or warfarin handling
- cardiac failure
- liver disease
- cholestasis
- diarrhoea
- gastrocolic fistula
- hypoalbuminaemia
- malnutrition
- abrupt weight reduction
- renal impairment
- thyrotoxicosis
- fever
- Interaction with drugs that inhibit warfarin elimination and enhance its effect (see BNF, Appendix 1)
- Withdrawal of concurrent treatment with a drug that hastens warfarin elimination and reduces its effect (see BNF, Appendix 1)
- Overdosage (accidental or deliberate)

Table 2: Algorithm for dosage adjustment

<table>
<thead>
<tr>
<th>Day 5 INR</th>
<th>Dosage (mg) for days 5-7</th>
<th>Day 8 INR</th>
<th>Dosage (mg) from day 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 1.7</td>
<td>5</td>
<td>≤ 1.7</td>
<td>6</td>
</tr>
<tr>
<td>1.8 – 2.2</td>
<td>4</td>
<td>1.8 – 2.4</td>
<td>5</td>
</tr>
<tr>
<td>2.5 – 3.0</td>
<td>3</td>
<td>2.5 – 3.0</td>
<td>4</td>
</tr>
<tr>
<td>&gt; 3.0</td>
<td></td>
<td>3.1 – 3.5</td>
<td>3.5</td>
</tr>
<tr>
<td>2.3 – 2.7</td>
<td>3</td>
<td>2.3 – 2.7</td>
<td>2.5 for 4 days</td>
</tr>
<tr>
<td>2.8 – 3.2</td>
<td>2</td>
<td>2.8 – 3.2</td>
<td>3 for 4 days</td>
</tr>
<tr>
<td>3.3 – 3.7</td>
<td>1</td>
<td>3.3 – 3.7</td>
<td>2 for 4 days</td>
</tr>
<tr>
<td>&gt;3.7</td>
<td>0</td>
<td>&gt;3.7</td>
<td>1.5 for 4 days</td>
</tr>
</tbody>
</table>

At day 15 (or day 12) check INR and make fine dose adjustments as appropriate
Management

Management of over-anticoagulation depends on the INR and the degree of any haemorrhage occurring

<table>
<thead>
<tr>
<th>Table 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>High INR without bleeding</strong></td>
</tr>
<tr>
<td>INR &gt; 8</td>
</tr>
<tr>
<td>INR more than 0.5 units above target range but not &gt; 8</td>
</tr>
<tr>
<td><strong>Minor haemorrhage (non-life threatening)</strong></td>
</tr>
<tr>
<td>INR &gt; 8</td>
</tr>
<tr>
<td>INR more than 0.5 units above target range but not &gt; 8</td>
</tr>
<tr>
<td>INR in target range</td>
</tr>
<tr>
<td><strong>Major haemorrhage (life-threatening)</strong></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

In patients with prosthetic heart valves, reversal of anticoagulation can increase risk of valve thrombosis. Discuss management with Cardiothoracic Unit. Full reversal is inadvisable in such patients except after acute intracranial haemorrhage (discuss with Neurosurgical Unit)
DO NOT attempt to carry out any of these Practical Procedures unless you have been trained and have demonstrated your competence to do so.
You must be supervised by an experienced doctor until you are familiar with and competent to perform the procedure

Consent
- Explain procedure and reassure patient
- Obtain and record consent

Preparation
- If blood gas analysis is not going to be performed within a few minutes, have an ice bag ready to cool the sample
- Check concentration of O₂ the patient is breathing at time arterial sample is taken and that it remains constant for 15 min prior to sampling, and note it on request form
- Note patient’s temperature on request form

Aseptic technique and position patient
- Select site of puncture (see below) and position patient
- Wear gloves, cleanse skin

Local Anaesthetic
- Palpate artery and infiltrate skin with 0.5-1.0 mL of 1% plain lidocaine each side of artery

Always aspirate before injection of local anaesthetic to avoid injection of lidocaine into the artery

Sampling
- Hold blood gas syringe with 23 G needle, bevel up; for radial (Figure 1) and brachial arteries at about 30° to the skin surface; for femoral artery at 60°
- Advance needle towards artery. With special blood gas syringe, blood pulsates into syringe

If shooting pain felt, nerve may have been entered. Remove and redirect needle
- If no blood obtained, withdraw needle slowly, observing for pulsation at base of needle. Arterial blood often enters during withdrawal
- If necessary, try once more. If not successful, seek help
- Obtain 1.5-2 mL blood. A smaller volume may suffice for immediate analysis
- Withdraw needle. Pressure should be applied to site for 5 min, or longer if site bleeds
- Dispose of needle in sharps bin
- Remove bubbles in syringe by holding bevel up and gently tapping side and pushing plunger up
- Cap syringe
- If source of blood (arterial/venous) uncertain, take heparinized venous sample for comparison
Figure 1: Needle positioning for radial artery puncture

Table 1: Differences in technique, advantages, disadvantages and contraindications among puncture sites

<table>
<thead>
<tr>
<th>Artery</th>
<th>Positioning of patient</th>
<th>Angle of needle to skin (°)</th>
<th>Puncture site</th>
<th>Important anatomical structures in proximity to puncture site</th>
<th>Advantages</th>
<th>Disadvantages</th>
<th>Contraindications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radial</td>
<td>Arm extended and supported on pillow with wrist extended 20°</td>
<td>30</td>
<td>Proximal to proximal transverse crease lateral aspect of wrist</td>
<td>Easily accessible. Easily compressible, therefore useful if there is known bleeding tendency</td>
<td>Venous sample may be obtained</td>
<td></td>
<td>Buerger's disease Raynaud's disease Arteriovenous dialysis shunt present or imminent Absent ulnar collateral circulation</td>
</tr>
<tr>
<td>Brachial</td>
<td>Arm extended and supported on pillow</td>
<td>30</td>
<td>Medial to biceps tendon in antecubital fossa</td>
<td>Median nerve medial</td>
<td>Easily accessible</td>
<td>End artery, therefore theoretical risk of ischaemia Venous sample may be obtained</td>
<td></td>
</tr>
<tr>
<td>Femoral</td>
<td>Supine</td>
<td>60</td>
<td>Mid inguinal point 2 cm below inguinal ligament</td>
<td>Femoral nerve lateral Femoral vein medial</td>
<td>May be the only quickly accessible artery in the shocked patient</td>
<td>Venous sample more likely than at other sites</td>
<td>Severe peripheral vascular disease Aortofemoral bypass surgery</td>
</tr>
</tbody>
</table>
ARTERIAL PUNCTURE • 3/3

SPECIMEN

- Take sample to nearest blood gas analyser, enter appropriate data (e.g. patient’s temperature) and inject directly from syringe
- Ensure that printed record is identified with patient’s name, unit number and the inspired O₂ concentration
- Blood gas analysis should be carried out within not more than 10 min of removing sample from patient, and sample should not be cooled during this period
- If a greater delay inevitable or sample is to be sent to the laboratory, cool syringe and its contents on ice, but re-warm to body temperature before analysis, to minimize errors caused by continued metabolism of white cells within blood sample
**INDICATIONS**
- Frequent arterial blood sampling to avoid injury and discomfort
- Continuous arterial pressure monitoring
- Patients with unstable cardiovascular system, requiring inotropes
- Patients having operations requiring large fluid or blood transfusions
- Transport of the critically-ill patient

**CONTRAINDICATIONS**
- Coagulopathy
- it may be necessary to infuse clotting factors prior to line insertion - discuss with consultant haematologist
- Radial artery
- absence of a collateral blood supply at the wrist
- presence of arteriovenous fistula for dialysis
- Femoral artery
trouser graft
- Brachial artery
arteriovenous fistula in the arm
- humeral or radial fractures

**SITES IN ORDER OF PREFERENCE**
- Radial

**Only the radial approach is used in these guidelines. Only trained doctors should attempt other approaches**

- Ulnar
- Brachial
- Femoral
easier to insert in a shocked, hypotensive patient provided the operator is experienced
- use a Seldinger technique

**Femoral and brachial lines should be removed as soon as it is possible to catheterize the radial artery**

**EQUIPMENT**
- Sterile pack
- Sterile towel
- Sterile gloves
- Chlorhexidine skin cleanser 0.5% (Hydrex)
- Lidocaine 1% plain 2 mL
- Flush bag containing 500 units heparin 500 units in 500 mL sodium chloride 0.9% (available ready prepared from Pharmacy)
- Pressure bag
- Transducer and flush system
- Prepare by connecting flush bag and run through ensuring all air bubbles are removed from the system
- Pressurize bag to 300 mmHg and the system will provide a constant flush of 3 mL/hr to maintain line patency (Figure 1)
- Monitor capable of displaying a pressure trace

Figure 1: Configuration of equipment for transducing arterial blood pressure
Arterial cannula 20 G Floswitch suitable for cannulating end arteries:

- radial
- ulnar
- dorsalis pedis

18 G Vygon Leadercath for insertion into femoral artery or 20 G Vygon Leadercath for insertion into the brachial artery using the Seldinger technique. This should be undertaken only by trained doctors.

**INSERTION OF RADIAL ARTERIAL CANNULA**

Supervision by an experienced doctor is required until you are familiar with and competent to perform the procedure

**Consent**

- Explain procedure and reassure patient
- Obtain and record consent

**Aseptic technique, position of patient and local anaesthetic**

- Use aseptic technique
- Extend the patient’s wrist using rolled up pillow case or bag of fluid placed under dorsal surface of the forearm (Figure 2)
- Locate pulse of radial artery just proximal to lower end of radius
- Infiltrate skin over and to sides of the radial artery with lidocaine 1% plain

**Insertion of Flowswitch cannula**

- A small nick in the skin can facilitate entry of the catheter and stop it being damaged by kinking
- Insert Flowswitch cannula at 30° to skin surface along line of artery
- Advance until blood appears in the hub, reduce angle of approach and advance a fraction more
- Hold needle in fixed position and advance catheter over needle into artery
- Remove needle, and dispose of in sharps bin
- Close flow switch
- Secure cannula with sterile dressing
- Connect flush system to cannula, checking system is flushed through to end of tubing
- Open flow switch
- Aspirate to confirm placement, and gently flush using mechanism on flush system

**Figure 2: Needle positioning for radial arterial cannulation**
Connect transducer to visual display unit and check that an arterial trace appears on monitor

Zero system with transducer located at mid-axillary line

Arterial lines should be clearly labelled ‘Arterial line’

Take all blood samples using full aseptic precautions

Remove the line if there is:
- evidence of localized infection
- ischaemia of hand or digits (evident by pallor or poor capillary return in the hand or digits distal to the line)
- mechanical failure
- no longer an indication for it

Do not discharge patients to a general ward with an arterial line

Undetected disconnection and severe haemorrhage

Haematoma formation

If artery entered, but cannulation fails, apply pressure for 5 min before dressing

Accidental injection of drugs which may lead to ischaemia of hand or digits

Local infection or catheter-related sepsis

Remove lines sited initially without full aseptic precautions as soon as possible

Dissection or aneurysm of the artery

Arterial occlusion, distal ischaemia, thrombosis, necrosis of the overlying skin

Cerebral thrombosis or embolism caused by over vigorous flushing
INDICATIONS

- Drainage of pneumothorax (see Spontaneous pneumothorax in Medical guidelines)
- Therapeutic drainage of fluid from pleural space

If effusion is very small, or free air or fluid cannot be aspirated when giving local anaesthesia, insert drain under ultrasound guidance

CONTRAINDICATIONS

(All relative - discuss with consultant)

- Impaired blood clotting
- Suspected mesothelioma
- Post-pneumonectomy space (discuss with cardiothoracic surgeon)

EQUIPMENT

- Thoracic drainage sterile pack
- Sterile gloves, gown
- Lidocaine 2% plain 10-20 mL
- Pethidine and naloxone
- Pleural drains of various sizes (10-14 FG, 16-24 FG)
- Underwater seal drainage bottle and tubing

If effusion is very small, or free air or fluid cannot be aspirated when giving local anaesthesia, insert drain under ultrasound guidance

PROCEDURE

Consent

- Explain procedure and reassure patient
- Obtain and record consent

Premedication

- Give pre-medication pethidine 50-100 mg IM
- If respiratory depression occurs, give naloxone 100 mcg IV. If response unsatisfactory or unsustained, repeat naloxone 100 mcg IV every 2 min
- If pneumothorax due to non-surgical chest trauma, give cefuroxime 750 mg IV 8 hrly for 5 days

Site of insertion and position of patient

- Check correct site on chest X-ray – for simple pneumothorax, usual site fourth or fifth intercostal space (ICS), mid-axillary line
- Site must be just above rib
- Support patient with head of bed elevated to about 30°, arm behind head
- Mark site

Aseptic technique and local anaesthesia

- Scrub up and clean patient's skin over a wide area
- Check all equipment fits adequately
- Palpate intercostal space, infiltrate with 10-20 mL of lidocaine to parietal pleura and periosteum of lower rib, and into pleural space once fluid/air can be aspirated (see box above)

Insertion of drain

- If small bore drain (10-14 F) appropriate, the Seldinger technique is usually used, avoiding need for blunt dissection
- Use a needle and syringe to localise position by identification of air or fluid. Pass guidewire down hub of needle, remove needle and enlarge track with a dilator. Pass drain into thoracic cavity along the wire
- If medium bore drain (16-24 F) appropriate, use either the Seldinger technique – (see small bore drains) or blunt dissection – (see large bore drains)
- If large bore drain (> 24 F) appropriate, use blunt dissection
- Make horizontal incision similar to diameter of tube being inserted (< 2 cm) long in skin and SC fat just above and parallel to rib. Insert wound closing suture around incision and leave untied (Figure 1)
- Insert securing suture – one loop through skin (Figure 1)
- Perform careful blunt dissection with forceps
through intercostal muscles to and through parietal pleura
● note trocar-drain assembly must slide with minimal pressure into pleural space
● if resistance is felt, further blunt dissection is needed
● once pleural space entered, withdraw trocar about 5 cm and advance tube (apically to drain air; basally to drain fluid). Connect to underwater seal
● tie securing suture – one loop through skin and at least four ties on tube
● loop tube and secure with adhesive plaster. If there is a poor seal around drain, insert further vertical suture near drain and tie to partially close incision

**Figure 1**

<table>
<thead>
<tr>
<th>AFTERCARE</th>
<th>REMOVAL OF DRAIN</th>
</tr>
</thead>
<tbody>
<tr>
<td>● Prescribe adequate analgesia – indometacin 50 mg orally 8 hrly, (or co-codamol 8/500 2 tab orally 6 hrly) for first 24-48 hr, then as needed</td>
<td></td>
</tr>
<tr>
<td>● Repeat chest X-ray within 2 hr</td>
<td></td>
</tr>
<tr>
<td>● For care of intercostal tube and underwater seal, see Spontaneous Pneumothorax in Medical</td>
<td></td>
</tr>
<tr>
<td>● Remove only 1-1.5 L of fluid at any one time due to danger of re-expansion pulmonary oedema</td>
<td></td>
</tr>
</tbody>
</table>

● Once bubbling from pneumothorax (see Spontaneous pneumothorax) or drainage of fluid has stopped for at least 24 hr, cut drain-securing suture, withdraw tube while patient holds breath in expiration, and close wound with remaining sutures
● If malignant effusion, attempt talc pleurodesis before removal, to reduce rate of recurrence. See Pleurodesis in Medical guidelines
PERCUTANEOUS CENTRAL VENOUS CANNULATION • 1/4

Central venous cannulation can cause serious morbidity. Not to be performed by unsupervised inexperienced operators. Failure to use full sterile technique can lead to life-threatening infection. Always seek help from your registrar or consultant. Expertise and equipment to place the line under 2-D imaging ultrasound guidance is present in theatres and ICU for those trained in its use.

INDICATIONS
- Monitoring rapid changes in blood volume, especially if right heart function impaired
- Infusions of drugs irritant to veins
- Long term IV feeding
- Insertion of Swan-Ganz catheter or intracardiac pacing device

CONTRAINDICATIONS
- Sepsis at cannulation site
- Atypical emphysema or bullae (avoid infraclavicular or supraclavicular approaches to the subclavian vein)
- Carotid artery aneurysm (precludes use of internal jugular vein on the same side)
- Hypocoagulation and hypercoagulation states

EQUIPMENT
- Sterile gloves, mask, gown, and towels
- Dressing pack with cotton balls, gauze swabs, galley pots
- Scalpel holder with blade size 11
- Skin antiseptic. If not allergic, use alcoholic chlorhexidine gluconate. If allergic, use Povidone–iodine solution if patient is not allergic to iodine
- Lidocaine 1% plain in a 5 mL syringe fitted with an orange (25 G) needle
- Sodium chloride 0.9% in a 20 mL syringe
- Heparinized saline 10 units/mL in a 5 mL syringe
- Adhesive tape (1-cm-wide)
- 0 or 1 silk or nylon stitch suture
- Tourniquet
- Manometer
- Sodium chloride 0.9% (500 mL bag)
- Central venous catheter

CHOICE OF VEIN
- Table 1 lists approaches in order according to safety and effectiveness, the safest appearing first, the most effective last. In each, avoid air embolism by maintaining venous pressure above atmospheric by correct position or tourniquet on limb

In 50%, catheter cannot be threaded into an intrathoracic vein. If so, try finger pressure above clavicle, depressing the shoulder, or flushing the catheter. Use of Seldinger or a spiral J-shaped wire may help. DO NOT use excessive force.

Antecubital fossa - median (basilic) or cephalic veins
- Distend veins by tourniquet

External jugular vein
- Place patient at 20° head down
- Vein runs from angle of mandible to behind middle of the clavicle
- Choose most prominent of the right or left veins
- STOP if no vein visible or palpable
- Turn patient’s head to opposite side
- Insert catheter > 200 mm length

Catheter passage through cephalic vein may be impeded by fascia deep to axillary vein

Turn head to same side to compress neck veins
- Abduct arm
- Insert catheter > 600 mm length
- Before releasing tourniquet, position proximal end of the catheter below level of patient’s elbow to avoid air embolus
Table 1: Selection of cannula and catheter

<table>
<thead>
<tr>
<th>Route of insertion</th>
<th>Gauge of cannula needle</th>
<th>Minimum length of catheter (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arm vein</td>
<td>14 G</td>
<td>600</td>
</tr>
<tr>
<td>External jugular vein</td>
<td>16 or 14 G</td>
<td>200</td>
</tr>
<tr>
<td>Internal jugular vein</td>
<td>16 or 14 G</td>
<td>150*</td>
</tr>
<tr>
<td>Subclavian vein</td>
<td>16 or 14 G</td>
<td>150*</td>
</tr>
</tbody>
</table>

* Long cannulae are available (120-150-mm-long, 14-18 G)

Internal jugular vein (Figure 1)
- Place patient at 20° head down with head turned to left
- Use right vein (to avoid injury to thoracic duct) running behind sternomastoid close to lateral border of carotid artery
- Identify sternomastoid, cricoid cartilage and carotid artery
- With left hand, protect carotid artery at level of cricoid cartilage
- Attach needle to a sodium chloride 0.9% filled syringe
- Insert needle lateral to carotid artery midway between mastoid process and suprasternal notch
- Direct needle towards patient’s feet, parallel to the midline, with syringe raised 30° above the skin
- Gently aspirate as needle is advanced until a flush of blood signifies entry into vein

Operators of limited experience can try cannulation with small (21 G) needle to locate vein first and then use small needle as guide. If artery is punctured, compress firmly for 5 min.
PERCUTANEOUS CENTRAL VENOUS CANNULATION • 3/4

Intraclavicular subclavian vein (Figure 2)

 Often only patent route in circulatory collapse. Blind procedure risks major hazards (e.g. pneumothorax, death from uncontrollable haemorrhage).

To be performed or supervised ONLY by experienced operators

- Place patient at 20° head down with head turned away
- Identify mid-point of clavicle and suprasternal notch
- Attach long needle and cannula to sodium chloride 0.9% filled syringe
- Insert needle below lower border of midpoint of clavicle
- Advance needle tip close to undersurface of clavicle
- Aim at suprasternal notch, to enter vein lying in angle formed by middle one-third of clavicle and first rib
- Aspirate gently as needle is advanced until a flush of blood signifies entry into vein
- If unsuccessful, withdraw needle to just beneath skin before trying in a new direction

Figure 2: Infraclavicular subclavian vein puncture

(a)

(b)

(c)
PROCEDURE

Consent
- Explain procedure and reassure patient
- Check patient not allergic to skin antiseptic
- Obtain and record consent

Position of patient and site of insertion
- Place patient into correct position for chosen approach - see above
- Check site of introduction

Aseptic technique and local anaesthetic
- Scrub up using full sterile technique
- Put on gown, gloves, mask and face and eye protection
- Prepare skin with antiseptic
- Drape operative field
- Infiltrate local anaesthetic if patient conscious

Insertion of CVC
- Check fit and function of the equipment
- Proceed with chosen approach
- Aspirate blood to check catheter position before injecting fluid
- On connection to CVP fluid column, column should show slow oscillations with respiration and quicker oscillations due to heart beats
- Ensure cannula insertion site is covered by a clear sterile dressing
- Chest X-ray to confirm tip of catheter is above atrium, not more than 2 cm below a line joining borders of the clavicles; and for pneumothorax
- On connection to CVP fluid column, column should show slow oscillations with respiration and quicker oscillations due to heart beats

AFTERCARE

Strict asepsis at all times to avoid infection
- Fix catheter with adhesive tape (1-cm-wide) crossed over distal to venepuncture site to grip it firmly (antecubital fossa), OR affix with suture (other approaches)
- Change IV giving set as per hospital protocols using aseptic technique
- Do not inject drugs into the venous catheter or take blood samples through stopcocks if possible
- Monitor venepuncture site for infection daily
- Watch out for catheter-related infections. If an infection occurs remove catheter immediately and send tip for culture
- Maintain continuous flow through catheter to prevent clotting. If clotting occurs, try to clear by injecting 2-5 mL heparinized saline under pressure

COMPLICATIONS
- Injury to vital structure, pneumo- or haemothorax, arterial puncture, damage to thoracic duct or phrenic nerve
- Infection, local or systemic sepsis
- Catheter or air embolus
- Cardiac arrhythmias - usually stop spontaneously, if not withdraw catheter into IVC. Treat if severe
- Perforation of myocardium, mediastinum or pericardium - withdraw catheter and stop infusion

Figure 3: Measuring central venous pressure
PLEURAL ASPIRATION OF AIR • 1/1

INDICATIONS
- Treatment of pneumothorax (see Spontaneous pneumothorax for when to use the technique)

EQUIPMENT
- Pneumothorax simple aspiration pack plus:
  - cleansing pack
  - gloves
  - gown
  - lidocaine 2% plain 10-15 mL

PROCEDURE

Consent
- Explain procedure and reassure patient
- Obtain and record consent

Site of insertion and position of patient
- Check site of entry on chest X-ray
- If no adhesions, use second intercostal space in mid-clavicular line (axillary approach is an alternative)
- Support patient with head of bed elevated to about 30° (arm behind head if axillary approach chosen)

Aseptic technique and local anaesthesia
- Scrub up and prepare patient’s skin
- Infiltrate local anaesthetic down to pleura
- Aspiration of air confirms pneumothorax

Insertion of cannula
- Enter pleural cavity with the cannula attached to a 10 mL syringe
- Withdraw needle when air is freely aspirated
- Connect cannula via the plastic tube to the 3-way tap and a 50 or 60 mL syringe
- Withdraw air until 2.5 L (50 mL x 50) has been aspirated or no more can be aspirated

STOP if resistance is felt or patient coughs excessively
- If resistance is felt when only a small amount of air has been aspirated, cannula may be kinked; remove it and repeat procedure

AFTERCARE
- Apply a small adhesive dressing over puncture site
- Repeat chest X-ray - aspiration successful if pneumothorax smaller or resolved
- If unsuccessful and < 2.5 L of air aspirated, consider repeating in patients with no chronic lung disease

Insertion of cannula
- Enter pleural cavity with the cannula attached to a 10 mL syringe
- Withdraw needle when air is freely aspirated
- Connect cannula via the plastic tube to the 3-way tap and a 50 or 60 mL syringe
- Withdraw air until 2.5 L (50 mL x 50) has been aspirated or no more can be aspirated
INDICATIONS

- To investigate the cause (Table 1)
- To assess bacterial infection of ascitic fluid
- To treat, by removing fluid to relieve abdominal discomfort or severe dyspnoea, or by introducing chemotherapeutic agents

RELATIVE CONTRAINDICATIONS

- Paracentesis
  - coagulopathy
  - INR > 1.6
  - platelets < 50 x 10⁹/L
  - infected ascites < 48 hr after starting treatment with antibiotics
  - previous abdominal surgery

Table 1: Causes of ascites

<table>
<thead>
<tr>
<th>Common</th>
<th>Rare</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cirrhosis of the liver</td>
<td>Tuberculous peritonitis</td>
</tr>
<tr>
<td>Abdominal cancer, especially ovarian and lymphoma</td>
<td>Non-cirrhotic portal hypertension</td>
</tr>
<tr>
<td>Heart disease (esp constrictive pericarditis)</td>
<td>Hepatic vein occlusion</td>
</tr>
<tr>
<td></td>
<td>Severe hepatitis</td>
</tr>
<tr>
<td></td>
<td>Chronic pancreatic disease</td>
</tr>
<tr>
<td></td>
<td>Myxoeodema</td>
</tr>
<tr>
<td></td>
<td>Chronic renal disease</td>
</tr>
<tr>
<td></td>
<td>Polyserositis (e.g. SLE)</td>
</tr>
<tr>
<td></td>
<td>Severe hypoproteinaemia of any cause</td>
</tr>
<tr>
<td></td>
<td>Benign ovarian disease</td>
</tr>
</tbody>
</table>

EQUIPMENT

- Diagnostic sample:
  - syringe (20 mL) with green (21 G) needle
- Aspiration of ≥ 50 mL:
  - dressing pack
  - skin antiseptic
  - selection of needles: 19-23 G
  - selection of syringes: 5 mL for local anaesthetic; 50-100 mL for aspiration
  - lidocaine 1% plain 5 mL
- If paracentesis is planned:
  - Banano peritoneal dialysis catheter or similar catheter

- fluid collection system for catheter
- Specimen containers:
  - for ascitic WBC either EDTA tube to haematology or sterile pot to microbiology
  - for biochemistry, 10 mL in plain container
  - for cytology, 10-20 mL in universal container with 3.8% citrate anticoagulant (if unavailable, use clotting studies bottle)
  - for microbiology, 10 mL in sterile universal container and blood culture bottles

PROCEDURE

- Explain procedure and reassure patient
- Obtain and record consent
- Ask patient to empty his/her bladder

Tapping ascites

- Lie the patient supine
- Re-examine abdomen and select site where there is shifting dullness but no solid organs: the iliac fossae, away from the inferior epigastric blood vessels and scars, are most often used or suprapubic position
- Don mask and sterile gloves
- Cleanse skin and infiltrate 3-6 mL of lidocaine into anterior abdominal wall down to parietal peritoneum
**Troubleshooting**

- If no fluid aspirated, (failure to enter the peritoneal cavity, perforation of a viscus, or occlusion of the end of the needle by a piece of omentum), reposition tip of needle and continue to aspirate while withdrawing needle slowly. It is reasonable to make two attempts on each side of the abdomen.

- If no fluid obtained after these manoeuvres, request ultrasound scan to confirm presence of ascites, and to indicate best approach to small quantity of loculated fluid, or request radiologist to aspirate sample under direct scan guidance.

**SPECIMENS**

- Note appearance of fluid. Cloudy fluid often means peritonitis; uniform bloodstaining is most often found in patients who have a cancer or who have suffered trauma to abdomen; milky fluid indicates chylous ascites.

- Send samples for cytology, cell count, protein concentration, and, in selected cases, enzyme estimations and bacteriological culture.

**AFTERCARE**

- If several litres of fluid have been removed record pulse and BP hrly for 4 hr. Stop diuretics for 24 hr. Check U&E at 24 hr.

- Persistent leakage through puncture wounds is sometimes a problem. A stitch may be needed. Keep incisions in abdominal wall as small as possible and remove sufficient fluid to reduce pressure in abdominal cavity.
PRACTICAL PROCEDURES
URETHRAL CATHETERIZATION • 1/3

Remove catheter as soon as possible due to infection risk especially with extended spectrum beta-lactamase producing Gram-negative bacilli (ESBL)

Patients who have previously undergone a radical prostatectomy should be catheterised only by a urologist as urethral damage can easily occur

Temporary Catheterization:
- to relieve acute retention of urine
- to improve pelvic access during surgery
- to measure urine output after major surgery and during major illnesses

Long-term catheterization:
- male patients with urinary retention and prostatic hypertrophy who are unfit for prostatectomy
- some patients with neurological problems (e.g. multiple sclerosis, myelodysplasia, or spinal trauma, where intermittent self-catheterization is not feasible)
- as a last resort in elderly or severely incapacitated incontinent patients

Suspected urethral injury after pelvic trauma (refer to urologist)
Urinary tract infection (avoid catheter if possible)

Sterile gloves, and sheet of water-repellent paper with hole cut in centre
Dressing pack with cotton balls, gauze swabs, galley pots
Skin antiseptic
Tube of anaesthetic gel or syringe of Instillagel (lidocaine 2%, chlorhexidine 0.25%)
Appropriate urethral catheter (see Choice of catheter)
10 mL syringe filled with sterile water
Kidney dish
Measuring jug
Drainage bag

Short term (up to 14 days) use Foley
Longer term use silicone (Silastic) with inflatable balloon
To irrigate with bladder washouts – 3-way catheter (refer to urologist)
12Fr or 14Fr is suitable for women
14Fr or 16Fr is suitable for men
NB Female catheters exist which are shorter than standard catheters. They must not be used in men as the balloon will damage the urethra

Use silver-coated catheters for:
- ICU patients
- renal patients
- surgical patients who require catheters 5-7 days post op
- patients colonized with a multi-resistant organism
- patients for whom Infection Control Team has recommended this choice

Explain procedure and reassure patient
Obtain and record consent
Lie patient supine
Open sterile pack
Don sterile gloves
Assistant should open catheter, syringe, antiseptic/sodium chloride 0.9% onto pack. Doctor then draws up water into syringe and keeps sterile
Place sterile towel to protect area
Use left hand to hold penis and right hand to
Catheterization in the female

- Lie patient supine
- Place patient’s thighs apart, knees flexed and feet together
- Open sterile pack
- Don sterile gloves

Assistant should open catheter, syringe, antiseptic/sodium chloride 0.9% onto pack. Doctor draws up water into syringe and keeps sterile

- Place sterile towel to protect area
- Disinfect urethral meatus with an antiseptic swab

The female urethra is short and the need for local anaesthetic gel less

- Insert nozzle or syringe tip (Instillagel) into meatus and instil 10 mL of gel

- Allow at least 5 min to elapse before proceeding to catheterization

- Part labia to reveal meatus and insert catheter until urine clearly draining. Catheter will usually pass without difficulty

- Inflated balloon with 5-10 ml water
- Connect catheter bag

Complications

Urethral

- Failure of catheter to reach bladder - obtain specialist help. Do not persist with further attempts
- Bacteraemia or septicaemia which may be due to overmanipulation. Give broad spectrum antibiotic and fluids IV as soon as suspected

- Bleeding can occur, particularly if catheter inflated in the urethra. Remove catheter, obtain specialist help

SPECIMENS

- Record volume of urine that drains after catheter inserted. Send aliquot for culture

AFTERCARE

- Connect catheter to a closed drainage bag that is emptied as necessary. If system has to be opened (e.g. to change bag or to wash out clots occluding catheter), full sterile precautions are essential

insert catheter

- Clean penis with swab soaked in sodium chloride 0.9% or antiseptic. Retract prepuce as necessary and clean glans

- Insert syringe with instillagel into urethra

- Massage gel carefully down urethra to sphincter. Gently compress distal urethra to prevent gel escaping

- Allow at least 5 min to elapse before proceeding to catheterization

- Hold penis vertically at commencement of catheterization

- Gradually pull penis downwards to straighten the urethra and to align catheter with prostatic urethra as catheter is advanced into bladder. Urine will begin to drain if present

- If procedure difficult or painful or bleeding occurs, abandon procedure

- Advance catheter another 4 cm after urine starts to drain

- Inflate catheter balloon with 5-10ml water. This should not cause any pain or bleeding

- Connect catheter bag

- Gently withdraw catheter until there is resistance

- Replace prepuce to avoid danger of paraphimosis
An indwelling catheter almost always leads to bacteriuria within two weeks. Minimize risk by regular bladder washouts with sodium chloride 0.9%. When bacteriuria is established even the most intensive antibiotic treatment is unlikely to make urine sterile until catheter is removed or replaced.

Bladder irritation can produce severe and painful bladder spasms, and may cause bypassing of urine alongside the catheter. Try reducing amount of fluid in balloon, or use a smaller or less rigid catheter.

If there is leakage around catheter it is futile to replace with a larger one. This simply commits patient to a spiral of increasing catheter size. The urethra becomes steadily more dilated until it can retain no catheter.

Frequent bladder washouts and application of antiseptic solutions may inhibit infection, which seems to be associated with post-meatal strictures that sometimes follow catheterization.

Bacteriuria associated with an indwelling catheter without clinical evidence of infection does not require antibiotic treatment.

Removal of catheter

If catheter balloon fails to deflate when the time comes to remove it, do not try to burst it by overdistension, as bladder may burst first. Refer to urologist.

Do not cut the catheter.
INDEX

ACE inhibitor 47, 142, 170
Acid Base 196, 192, 218
Acute abdominal aortic aneurysms 35-36
Acute pancreatitis 37-38
Acute renal failure 178-179, 38, 118, 143
Acute right iliac fossa pain 30
Acute severe asthma in adults 175-177, 46, 197, 210
Acute upper abdominal pain 31
Acute upper gastrointestinal haemorrhage 180-185
Acute retention of urine 42, 113, 122, 233, 235
Acute limb ischaemia 39-41
Acutely painful testis 43
Administration of blood and blood components 146-152
Admissions policy 12
Aminophylline 197-198
Anaemia (see Chronic anaemia)
Anaesthetic assessment 46
Aneurysm 12, 31, 35, 36, 37, 39 40, 154, 155, 223, 226
Angina 48, 50, 51, 75, 79, 170
Antibacterial prophylaxis 90-91, 48, 49, 72
Antibacterial prophylaxis for gastroenterology, biliary and general surgery 94-95
Antibacterial prophylaxis for ophthalmology 98
Antibacterial prophylaxis for orthopaedic surgery 96-97
Antibacterial prophylaxis for patients at risk of endocarditis 92-93
Antibacterial prophylaxis in ear, nose and throat surgery 99-100
Antihypertensive medication 47, 170, 182
APTT 32, 35, 52, 84, 85, 86, 87, 123, 158, 159, 160, 161, 164, 167, 168, 192, 204, 205, 207, 213
Arterial puncture 218-220
Arranging a theatre list 13
Arterial occlusion 223
Arteriovenous fistula 219, 221
Asthma 46, 53, 118, 165, 175-177, 197, 210
Atrial fibrillation 39, 41, 48, 88, 199, 215

Beta blocker 47, 48
Bone profile 53
Bowel preparation 55
Cardiac failure 47, 73, 118, 139, 143, 170, 213, 215
Cardiac surgery 10, 50, 52
Cardiopulmonary resuscitation 186
Cardiopulmonary resuscitation – clinical justification 185
Cerebral thrombosis 223
Chest X-ray 13, 31, 34, 37, 40, 50, 165, 166, 170, 175, 178, 179, 187, 188, 192, 224, 225, 229, 230
Chronic renal failure 49, 51, 68, 123
Clotting screen 40, 51, 52
Codeine and dihydrocodeine 110
Congenital heart disease 48, 50
Consent 14-16, 13, 17, 25, 30, 51, 53, 55, 134, 146, 171, 185, 218, 222, 224, 229-231, 233
Coroner – when to inform 27, 193
Crossmatch 20, 35, 36, 75, 146, 147, 153, 171, 180, 199, 216
CVP 37, 170, 171, 179, 182, 229
Cyanosis 162, 175

Deep venous thrombosis 158-163
Diabetes mellitus 52, 68, 123
Diabetic Ketoacidosis 188, 191, 143
Diathermy 48
Dietician 57, 58, 59, 60
Digoxin 199, 19, 42, 141
Distal ischaemia 223
Diuretics 52, 139, 141, 142, 150, 165, 167, 170, 182, 232
Drug history 46, 178
Dyspnoea 46, 47, 49, 149, 151, 165, 231
ECG 12, 13, 23, 35, 37, 39, 48, 50, 141, 142, 156, 166, 170, 187, 188
Electrolyte disturbances 138-142
Entonox 126-127
Epidural analgesia 119-124

Flowswitch cannula 222
Gelofusine 170, 179, 182
Gentamicin 200-202, 67, 92-99, 140, 193, 194, 197, 199
Glasgow Coma Scale 203
Glucose 35, 37, 52, 58-60, 62-66, 138, 140-142, 144, 187-192, 198, 200, 210, 211
Goitre 49
Group & Save 19, 40, 73, 146, 149, 150, 151, 153-156, 180
Haemodialysis 49
Haemoglobin 49, 50, 51, 54, 67, 73, 152, 180
Haemoglobinopathies 51
Hand hygiene 131, 130
Heart block 48
Heparin induced thrombocytopenia 205-207, 51, 68, 158-161, 163, 167, 168
Hickman line 60
Hydrocortisone 81, 82, 146, 151, 175
Hypertension 39, 41, 47, 50, 110, 231
Hyperthyroidism 48, 49
Hypotension 170, 42, 47, 73, 95, 97, 98, 100, 107-109, 120, 122, 143, 149-151, 164, 175, 178, 180, 181, 188
Hypothalmic-pituitary-adrenocortical axis (HPA) 81, 82
Hypothyroidism 49
Hypovolaemia 119, 121, 122, 140, 170, 186

Inotropes 179, 221
INR 19, 31, 32, 35, 41, 52, 69, 84-88, 123, 158-161, 163, 167, 168, 171, 180, 192, 204, 205, 207, 213-216, 231
Insertion of arterial lines 221-223

SURGICAL GUIDELINES

Issue 03
Issued: June 2006
Expires: June 2007
INDEX

Intercostal tube drainage 224-225, 120, 230
Internal defibrillators 48
Ischaemic heart disease 26, 48, 50, 210
IV unfractionated heparin 204, 87, 164, 165

Jehovah’s Witnesses 16, 146
Joint replacement 10, 52
JVP 143, 144, 165, 167, 170, 178

Large bowel obstruction 34
Latex allergy 46

Malignant hyperpyrexia 46
Management of patients with Clostridium difficile 135
Management of patients with ESBL 134
Management of patients with MRSA 133
Management of perioperative pain 103
Management of the aggressive patient 24
Management of the diabetic patient in the perioperative period 62
Maximum blood ordering schedule 153
Mechanical prosthetic heart valve 87
Medical Records 17
Medical emergencies 173
Menorrhagia 50
Mental capacity 24, 25
Modified early warning scoring system for patient monitoring 22
Myeloproliferative disease 51
Naloxone 125, 112-114, 116, 119, 224
Necrosis 37-39, 178, 205, 223
Neurosurgery 10, 52, 155
NG 57, 58
NJ 57, 58

Obesity 35, 49, 67, 109, 164, 172
On-call pathology 19
On-call radiology 21

Opioids 111-115, 106-109, 116-119, 122, 125, 209
Oxygen 22, 34, 35, 40, 52, 68, 112, 113, 114, 119, 126, 127, 151, 170, 175, 178, 186, 218, 220

Pacemaker 48, 69, 71
Pain control in palliative care 208
Paracetamol and NSAIDs 118
Patent ductus arteriosus 49, 91
Patient controlled opioid analgesia 116
Patients taking aspirin 79
Patients taking clopidogrel 80
Patients taking corticosteroids 81
Patients taking oral contraceptive and hormone replacement therapy 83
Patients taking warfarin 84
PEG 57, 58
Percutaneous central venous cannulation 226-229
Perioperative drugs policy 77
Platelet count 51, 68, 159, 160, 161, 163, 167, 168, 204-207

Polyuria 52, 170, 188
Post-operative haemorrhage 171
Post-operative nausea and vomiting 109, 46
Practical Procedures 217
Prednisolone 74, 81, 82, 175
Pre-operative assessment 46-49, 62, 104
Pre-operative assessment and administration 104
Pre-operative fasting 56
Pre-operative investigations (see Routine pre-operative investigations)
Prescribing regimens and nomograms 195
Prevention of infection in patients with absent / dysfunctional spleen or sickle cell disease 101
Prophylactic heart valve 48, 87, 216
Pulmonary embolism 164-168, 170, 31, 84, 192

Rheumatoid arthritis 50, 51, 208
Salbutamol 210, 46, 151, 175
Screening for MRSA 69
Serosanguineous discharge 172
Sickle Cell anaemia 51, 52
Small bowel obstruction 32-33, 34
Sepsis, severe sepsis & septic shock 192-194

Spontaneous pneumothorax – see Medical guidelines
Standard infection control 130, 133, 135
Surgical emergencies 169
Surgical jejunostomy 57
Suxamethonium apnoea 46

Tapping ascites/paracentesis 231-232
Thoracic surgery 50, 52, 53, 154, 218
Thrombocytopenia 20, 51, 68, 152, 158, 159-161, 163, 167, 168, 204-207
Thromboprophylaxis 67-68, 83, 85-88
Thrombosis 21, 32, 61, 158-163, 167, 186, 205-207, 213, 216, 223
Tracheal compression 49, 50
Transfusion 16, 17, 19, 20, 49, 51, 52, 54, 73-75, 146-153, 180, 182, 183, 221

Transfusion flowchart 75

Unfractionated heparin – see IV unfractionated heparin
Urethral catheterization 233-235, 42, 188, 192
Use of personal protective equipment 132

Vancomycin 211-212
Valvular heart disease 48, 50
VYGON Leadercath 222

Warfarin 213-216, 41, 48, 84-88, 123, 159, 160, 162, 163, 165, 166, 168, 206, 207

White blood cell count (WBC) 49, 30, 37, 50, 51, 192, 231

Wound infection and dehiscence 172
If you notice an error or omission PLEASE let us know as soon as possible.

Please complete and return any comments or suggestions to:

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Any discrepancies with the enclosed information

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Suggestions for future topics

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