



## PRACTICE

## PRACTICE POINTER

# Primary care management of chest pain after coronary artery bypass surgery

Damian Gimpel *unaccredited cardiothoracic registrar*<sup>1 2</sup>, Raewyn Fisher *cardiologist*<sup>3</sup>, Zahoor Khan *general practitioner*<sup>4</sup>, David J McCormack *consultant cardiothoracic surgeon*<sup>1 2</sup>

<sup>1</sup>Waikato Cardiothoracic Unit, Waikato Hospital, Hamilton, New Zealand; <sup>2</sup>Faculty of Medical and Health Sciences, The University of Auckland, New Zealand; <sup>3</sup>Department of Cardiology, Waikato Hospital, Hamilton, New Zealand; <sup>4</sup>General Practice, Roodlane Medical, London, UK

## What you need to know

- Investigate any chest pain after coronary artery bypass grafting by requesting an electrocardiogram, chest x ray, and tests such as troponin assay and complete blood count
- Chest pain of sudden onset or of increasing severity may be due to ischaemic heart disease or aortic dissection. Urgently refer the patient to specialist cardiology or emergency services
- Suspect sternal wound infection if the pain is localised to the surgical scar and is accompanied by erythema or discharge at the site, fever, or malaise
- Persistent pain after surgery with normal findings on assessment and investigations may be attributed to musculoskeletal cause or chronic postoperative pain
- There is no evidence based treatment for chronic postoperative pain, but a combination of analgesics for pain relief, patient education and counselling to address lifestyle risk factors, behavioural therapy, and follow-up may be offered

Coronary artery bypass grafting (CABG) is increasingly common and accounts for over half of all adult cardiac surgeries globally.<sup>1</sup> Over 16 000 operations were performed in the UK in 2015.<sup>2</sup> Recurrent or chronic chest pain after CABG can be extremely worrying for the patient and affect their quality of life.<sup>3</sup> In a prospective cohort study (183 patients), a third of patients reported chronic chest pain on movement and 17% reported chest pain at rest at one year after CABG.<sup>4</sup> This presents a diagnostic challenge in primary care and requires prompt investigation.<sup>5</sup>

This article presents a practical approach for non-specialists to evaluate chest pain in patients after a CABG with a median sternotomy (see [box 1](#)). We focus on chest pain in the medium to long term after surgery, when the patient has been discharged from postoperative services and is under the care of their general practitioner in the community. The approach can be relevant in patients with post-sternotomy chest pain after other cardiac procedures.

## Box 1: Overview of coronary artery bypass grafting (CABG)

CABG is a surgical procedure in which autologous arterial or venous conduits are harvested in order to bypass atherosclerotic coronary arteries. Traditionally, a midline sternotomy is performed for surgical exposure. The procedure can be performed minimally invasively. The common sources of conduit for CABG include the internal thoracic or mammary artery, the radial artery, and the great saphenous vein. Depending on the extent and anatomical position of the coronary artery disease, a combination of grafting between arterial and venous conduit can be done. The procedure is completed with closure of the sternum with sternal wires, plates, or sutures and closure of the subcutaneous tissue and skin.

## What are possible causes?

Patients may report that their pain that has failed to subside after surgery, has changed in nature, is escalating in severity, or is new in onset. The infographic lists common causes to consider and features that can help in making a diagnosis. Broadly, it is important to distinguish pain of cardiac origin from that related to the surgery, and from pain that is musculoskeletal or chronic in nature.

## Coronary artery disease

Ischaemic heart disease after CABG can be due to new coronary artery disease or unsuccessful revascularisation of the CABG. Early graft failure is the major reason for resistant or recurrent chest pain after surgical revascularisation. This can result from acute thrombosis or technical errors during surgery.<sup>5</sup>

## Aortic dissection

Aortic dissection after CABG is rare but life threatening. Acute chest pain radiating to the back and increasing in severity should raise suspicion.

## Post-cardiac injury syndrome

This encompasses inflammatory processes that include post-cardiotomy syndrome, Dressler's pericarditis, and post-cardiac trauma.<sup>6</sup> At least two of the following five criteria must be present to diagnose post-cardiac injury syndrome:

- Fever without alternative causes
- Pericarditis or pleuritic chest pain that is sharp in nature
- Pericardial or pleural rub
- Pericardial effusion
- Pleural effusion on imaging and a raised C reactive protein level.<sup>6</sup>

## Sternal wound infection

This can occur as a complication of sternotomy. According to the Centre for Disease Control guidelines,<sup>7</sup> it is diagnosed by one or more of the following:

- Isolation of an organism from mediastinal tissue or fluid
- Evidence of mediastinitis at operation
- Presence of chest pain, sternal instability, fever, and purulent discharge from the mediastinum
- A positive blood or tissue culture from the mediastinum.

## Chronic postoperative pain

This is usually diagnosed when the patient has persistent pain after surgery and other causes have been excluded. It is usually localised to the surgical field or has a specific neurological distribution. It is either a continuation of post-surgical pain or develops after an asymptomatic period. Pain can last for months or years and can considerably affect quality of life.<sup>8</sup>

## What to cover on initial assessment?

### History

A good history about the presenting complaints can provide important diagnostic clues.

### Where is the pain localised?

Ask the patient to point to the site of the pain. Pain localised to the surgical site is usually due to surgical site infection, sternal instability, or sternal wires. Pain overlying the chest and not specific to the sternotomy scar can indicate underlying cardiac disease or intercostal nerve damage after harvesting of the internal thoracic or mammary artery for surgery.<sup>9 10</sup> Isolated inferior chest wall pain can suggest gastro-oesophageal reflux disease.

### Is the pain similar to what they experienced before surgery?

Patients will often be able to distinguish between new onset pain and recurrent pain based on preoperative symptoms. Suspect underlying heart disease if the pain is similar to preoperative anginal symptoms. Constant sharp pain can be due to anterior intercostal nerve irritation, which is common when the left internal mammary artery has been harvested.<sup>9 10</sup> Sharp pain that increases on inspiration could suggest underlying respiratory pathology.

### How did it start?

Abrupt onset of chest pain can indicate life threatening cardiac disease such as aortic dissection or ischaemic heart disease.

Persistent pain since the operation is commonly described as chest pain with movement<sup>4</sup> and is often musculoskeletal in origin.

### Does the pain radiate to other sites?

Central chest pain that radiates to the neck or down either arm should raise suspicion of ischaemic heart disease. If pain radiates to the back, consider aortic dissection as a possible cause. Pain can radiate or be arising from a radial artery harvest site. Severe hand ischaemia after radial artery harvesting is a rare complication, and claudication pain is typically provoked by repetitive fist clenching. In contrast, chest pain radiating to the arm is characterised by generalised cardiorespiratory exertion, such as walking uphill.

### What pain medications are you taking?

Ascertain the patient's postoperative pain medication regimen. Pain regimens on discharge will vary by institution and even treating surgeon. There is a lack of guidelines or consensus on an optimal pain control regimen on discharge after CABG. Most centres will follow an analgesic multimodal approach—that is, offering two or more drugs with different mechanisms of action for pain relief to minimise the need for opioids. Recent US guidelines recommend oral therapy with paracetamol (acetaminophen), non-steroidal anti-inflammatory drugs, oral opioids, and gabapentin or pregabalin for outpatients after surgery.<sup>11</sup>

### Do you currently smoke?

Observational studies have shown that ongoing smoking is closely linked to recurrent angina.<sup>12</sup>

### Other symptoms

**Fever**—Fever in the immediate postoperative period should raise clinical suspicion of an underlying inflammatory or infectious process such as post-cardiac injury syndrome or sternal wound infection.

**Shortness of breath**—Dyspnoea can indicate underlying respiratory pathology in conjunction with other signs of infection suggesting pneumonia. Dyspnoea, along with fatigue or nausea, can also indicate acute coronary syndrome.<sup>13</sup>

**Discharge from the sternotomy wound site**—Erythema, discharge, or malodour from the surgical site points to sternal wound infection. The patient may have associated systemic symptoms of malaise, fever, nausea, and vomiting.

## Examination

Assess the patient's vital signs, including blood pressure, heart rate and rhythm, oxygen saturation, respiratory rate, and temperature. Auscultate the chest to assess systolic and diastolic cardiac valvular function and all lung fields for normal air entry. Examine the sternotomy site with the patient sitting. Feel the sternotomy scar with your index and middle fingers (fig 1 and the media on page ?). If the patient complains of pain on palpation of the entire sternotomy site and is otherwise well, it is likely of neuro-musculoskeletal origin. Pinpoint palpation that causes an increase in pain only at that site could be due to a broken sternal wire. Place your thumb and index fingers on either side of the sternotomy site and ask the patient to take a deep breath and cough (fig 2, the media on page ?). In mechanical non-union of the sternum, there will be presence of pain or clicking on doing this in the absence of infection.<sup>14</sup> To assess for musculoskeletal pain, ask the patient to flex forward,

extend backwards and rotate their thorax. Musculoskeletal pain will increase with these movements (the media on page ?).

## What investigations are required?

Promptly investigate any chest pain in a postoperative CABG patient before attributing a neuro-musculoskeletal cause. [Figure 3](#) represents an algorithm for diagnosis of chest pain following CABG.<sup>6 13 15-17</sup>

## Electrocardiogram

Request an electrocardiogram in all patients with chest pain after CABG at initial assessment. ST depression or elevation, T wave inversion, or new axis deviation can point to coronary artery ischaemia. If a previous electrocardiogram taken after surgery is available, compare this with the latest electrocardiogram to look for new changes. Widespread ST upwardly concaved elevation is more suggestive of post-cardiotomy syndrome.

## Laboratory tests

In patients with pain suggestive of ischaemic heart disease, prompt referral to emergency services is recommended. Before transfer, it would be reasonable to perform venepuncture and acquire blood for baseline testing. A blood test for cardiac troponins T and I can be ordered if the pain is suggestive of an acute coronary syndrome. This should not, however, delay transfer to emergency services. If the pain has resolved 24 hours before examination, it is still advisable to request a troponin assay.<sup>18</sup> In clinically stable patients, ask for a complete blood count to detect anaemia (low haemoglobin) and possible infection (raised white cell count or C reactive protein). Microscopy and culture of blood or fluid from the sternal site may be required if sternal wound infection is suspected.

## Chest x ray

A chest x ray can help diagnose respiratory pathology such as effusion or pneumonia. A widened mediastinum with acute onset chest pain raises suspicion of aortic pathology. A pericardial or pleural effusion is seen in post-cardiotomy syndrome. Isolated pain at the sternotomy site in conjunction with findings of pinpoint pain on palpation, possibly over a raised area of skin, could be due to a sternal wire. A fractured sternal wire can be seen on the chest x ray ([fig 4](#)).

## Who to refer?

Urgently refer patients to specialist cardiology services or the closest emergency department if they have:

- Sudden onset pain or pain that escalates in severity (may indicate ischaemic heart disease or aortic dissection)<sup>15</sup>
- Signs of sternal wound infection such as chest pain, sternal instability, fever, and purulent discharge from the mediastinum. Deep sternal wound infection has a mortality of up to 40%<sup>16</sup>
- A raised troponin level and electrocardiogram findings consistent with an acute myocardial infarction
- A widened mediastinum on chest x ray suggesting aortic dissection
- Pain with ambiguity over the diagnosis.

## How to manage chronic postoperative pain?

Clinically stable patients with persistent pain since surgery and normal investigations can be managed in primary care. Reassure the patient that their examination and investigations do not suggest a cardiac pathology. Pain on movement may be musculoskeletal in origin. Chronic postoperative pain does not increase on movement but has similar characteristics.

Not enough evidence is available on its treatment.<sup>19</sup> A small retrospective study (48 patients) found that 32 patients (94%) experienced improvement after sternal wire removal for chronic pain with no identifiable organic cause.<sup>20</sup> Preoperative anxiety has been linked to higher postoperative pain.<sup>21</sup> There is, however, very limited evidence on the effect of cognitive behavioural therapy to improve postoperative pain. A randomised control trial (53 patients) found that cognitive behavioural therapy for depression improved control and severity of pain after cardiac surgery.<sup>22</sup>

Regularly review the patient's postoperative pain medication regimen.<sup>23</sup> Consult their cardiac team to discuss modifications. With any dose increase, review patients every four weeks.<sup>24</sup> Patients are unlikely to experience adequate pain relief in the long term if there is no response to opioids within three months.<sup>24</sup> Of note, there is a dose-dependent relation between opioid use and development of chronic neuropathic pain.<sup>25</sup> Discuss tapering and discontinuing opioids if there is no improvement.<sup>26</sup> Offer referral to a chronic pain specialist if the pain does not improve. At follow-up visits discuss lifestyle modifications such as diet, physical activity, and smoking. Advise patients to stop smoking and offer adequate support services to help them quit.

## What investigations can patients expect when referred to specialist cardiac care?

On referral to a cardiologist, one or more imaging modalities will be ordered. A transthoracic echocardiogram is an ultrasound scan of the heart and can indicate pathology, including a pericardial effusion, new motion wall abnormalities indicating ischaemic heart disease, aortic pathology, and valvular disease. A stress test is unlikely: these are often equivocal because of local perfusion abnormalities or partial collateral filling of ischaemic zones, especially in functionally adequate but anatomically incomplete revascularisation.<sup>5</sup> A computed tomography angiogram is a non-invasive method to ascertain the coronary anatomy, or an invasive coronary angiogram will be undertaken with potential treatment of the underlying coronary pathology concurrently. Depending on these findings, a consultation with a cardiac surgeon may be arranged.

### Sources and selection criteria

We searched PubMed and Scopus using the terms (coronary artery bypass surgery OR CABG surgery) AND (pain/dysfunction/syndrome) AND (post-operative). We selected papers that represented the best available evidence (systematic reviews and randomised controlled trials where possible). We also drew from our experience in chest pain after CABG especially for the sections with limited evidence (red flags, investigations, and diagnostic algorithm).

### Education into practice

- What causes will you consider in a patient who has undergone a CABG and who now complains of chest pain or discomfort?
- What findings on assessment would prompt you to refer the patient to specialist cardiology or emergency services?
- In patients with no clear cause of chest pain and normal findings on examination and investigations, how will you discuss chronic postoperative pain and its management?

### How patients were involved in the creation of this article

A patient who had undergone coronary artery bypass surgery reviewed this article for *The BMJ*. He shared that patients may be very apprehensive about chest pain after surgery and that an algorithm for clinicians on how to identify the cause will be useful. He said it was important to consider anxiety in patients and to address it. As a result, we expanded our discussion of chronic postoperative pain and management strategies. We are grateful for his input.

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## Figures



**Fig 1** Examination of postoperative sternotomy for pain



**Fig 2** Examination of postoperative sternotomy for sternal instability

**Fig 3** Clinical algorithm for management of chest pain after CABG



**Fig 4** Chest radiograph with evidence of broken sternal wires after CABG