The 2015 advanced life support guidelines: a summary and evidence for the updates

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ABSTRACT

The International Liaison Committee on Resuscitation recently released updated 2015 recommendations for resuscitation. The guidelines form the basis for all levels of resuscitation training, now from first aid to advanced life support (ALS), and for trainees of varying medical skills, from schoolchildren to medical students and consultants. We highlight major updates relating to intra-arrest and postarrest care, and the evidence for their recommendation. We also summarise areas of uncertainty in the evidence for ALS, and highlight current discussions that will likely inform the next round of recommendations.

The International Liaison Committee on Resuscitation (ILCOR) recently released updated 2015 recommendations for resuscitation, expanding the evidence basis for resuscitation.[1–11] The guidelines form the basis for all levels of resuscitation training, now from first aid to advanced life support (ALS), and for trainees of varying medical skills, from schoolchildren to medical students and consultants. With each new release, national resuscitation councils around the world use these ILCOR recommendations to update their own resuscitation guidelines.

While the 2015 update emphasises the importance of ensuring quality in the provision of cardiopulmonary resuscitation (CPR) there are multiple modifications to the intra-arrest treatment and postarrest management of the patient with cardiac arrest. Here, we highlight relevant 2015 guideline changes relating to intra-arrest and postarrest care. We also address areas of uncertainty in the evidence for ALS and highlight current clinical trials that will likely inform the next round of recommendations.

GETTING THE FUNDAMENTALS RIGHT

The current update continues to emphasise the importance of performing high-quality CPR during resuscitation. We can achieve high-quality CPR if we focus on the fundamental skills taught in basic life support and ALS.

Uninterrupted chest compressions: interruptions in chest compressions are associated with worse outcomes.[12 13] The updated guidelines reaffirm the importance to healthcare professionals of providing high-quality chest compressions and ventilation while minimising interruptions. Notably, for non-healthcare professionals, the guidelines recommend to provide compressions at the expense of ventilation.

Rate and depth matter: ILCOR recommendations now support a maximum upper limit of chest compressions, advising compressions to remain between 100 and 120 compressions per minute. This follows recent evidence suggesting that maintaining a compression rate above 120 per minute compromises compression depth in a dose-dependent manner.[14] Introducing an upper limit is thought to promote full recoil of the chest between compressions ensuring appropriate coronary filling. The recommendations now also identify an upper limit for the depth of compressions of 5–6 cm, citing evidence that middle-range compression depth is associated with better outcomes.[15] This is a difficult recommendation to put into practice for many doctors, particularly medical students or those at the beginning of their career, who when attending their first arrest calls will be nervous about controlling the force they use in CPR. While too deep compressions certainly can cause unnecessary harm, it is important for rescuers to know that chest compression depth is more often too shallow than too deep (table 1).[16]

Mechanical compression devices: the routine use of mechanical compression devices is not recommended in most CPR scenarios. Several publications, including an updated meta-analysis, found no significant benefit, or harm to be associated with the use of mechanical compression devices compared with manual chest compressions in neurologically intact patients, although evaluating a number of different outcomes.[17–19] For this reason, manual chest compressions remain the standard of care and the use of mechanical compression devices is only recommended for situations in which high-quality manual chest compressions may not be possible, such as prolonged CPR with limited number of rescuers. However, while mechanical compression devices may aid in providing CPR in situations where adequate compressions would be hard to maintain, the recently published PARAMEDIC trial suggested that there was no difference in 30-day survival between patients who received manual or mechanical compression in ambulances across four centres in the UK.[20] This same study found significantly higher rates of chest wall injury in the cohort receiving mechanical compressions.

ADVANCED CARE DURING RESUSCITATION

Ultrasound (US) imaging: the 2015 ALS guidelines suggest that US imaging can be used both to identify sufficient cardiac motion, cardiac output or peripheral blood flow and to determine reversible causes of cardiac arrest during an arrest. Sonography-determined cardiac kinetic movement is associated with increased reoccurrence of spontaneous circulation (ROSC), and survival to hospital admission.[21 22] The guidelines suggest that

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Table 1 Summary of key updates in the 2015 guidelines that are of particular relevance for medical students, and the comparison with the previous 2010 guidelines

2015 guidelines	2010 guidelines
Chest compressions	
▶ Perform chest compressions at a rate of 100–120 compressions/min· Perform chest compressions to a depth of 5–6 cm maximum depth and avoid excessive chest compression depth	▶ > 100 compressions/min ▶ Chest compressions with a minimum of 5 cm depth
Adrenaline	
▶ Deliver adrenaline as early as feasible for patients with non-shockable rhythms	▶ For patients with non-shockable rhythms deliver adrenaline every 3–5 min ▶ For patients with shockable rhythms administer after third round of CPR
Waveform capnography	
▶ Use end-expiratory CO_2 to monitor quality of CPR, correct endotracheal tube placement and early signs of ROSC	▶ Consider waveform capnography for additional monitoring
Intra-arrest USS	
▶ Ultrasound may be considered during the management of cardiac arrest, although its usefulness has not been established	▶ New recommendation
Temperature management	
▶ Cool to a core temperature between 33°C and 36°C for at least 24 h ▶ Prevent hyperthermia beyond 24 h of targeted temperature management	▶ For comatose survivors of cardiac arrest with VF rhythm aim for core temperature of 33°C for 24 h and consider induced hypothermia in comatose patients with a non-shockable initial rhythm
Coronary angiography	
▶ Emergent coronary angiography is recommended in all patients suffering cardiac arrest with ST-segment elevation on ECG ▶ Coronary angiography may be suitable for patients who remain comatose after suffering cardiac arrest without ST-segment changes	▶ Primary percutaneous coronary intervention may be reasonable in patients resuscitation from cardiac arrest even in the absence of ST-segment elevation

CPR, cardiopulmonary resuscitation; ROSC, reoccurrence of spontaneous circulation; VF; ventricular fibrillation.

when all reversible causes of arrest have been identified and corrected, but there is still no ROSC, motionless cardiac US is an indicator to stop CPR.

US is a quick, low-risk method for identifying the causes of reversible cardiac arrest. Protocols using US have been described for pericardial effusion leading to cardiac tamponade,[23] hypovolaemia,[24] pneumothorax[25] and pulmonary embolism[26] (although with a poor specificity).[27] Using US within an arrest protocol has been shown to change clinical management.[28] However, the guidelines recognise that no study has shown US intervention to improve cardiac arrest outcome, and that adding US into an intra-arrest sequence, without the presence of adequately trained individuals present, may delay CPR.

Use of adrenaline: one of the more highly debated aspects of ALS guidelines is the use of adrenaline during resuscitation. The recommendations continue to distinguish between the use of adrenaline in shockable rhythms (ventricular fibrillation and pulseless ventricular tachycardia) and non-shockable rhythms (pulseless electrical activity and asystole).

The guidance states that it is reasonable to administer adrenaline as soon as feasible in patients with non-shockable cardiac arrests. For patients with shockable rhythms the guidelines state that 1 mg intravenous/IO adrenaline should be administered after chest compressions have resumed following the third defibrillation shock. Adrenaline administration should then continue every 3–5 min until ROSC is achieved.

Monitoring with waveform capnography: ILCOR recommends the use of waveform capnography during the intra-arrest period to reduce potential failures in ventilation as it may help to identify otherwise unrecognised oesophageal intubation. Similarly, End-tidal CO2 (ETCO2) (or the absence thereof) may also be used as one component to assess ROSC, or to inform decisions to terminate resuscitation efforts, as low ETCO2 measurements for extended durations may be associated with poor outcomes in patients with cardiac arrest.[29 30]

ADVANCED CARE AFTER RESUSCITATION

Coronary intervention: the updated guidelines recommend that coronary angiography be performed emergently following ROSC in patients with ST-elevation on ECG. Coronary angiography may also be considered in select patients who remain comatose after ROSC and without evidence of ST-segment elevation on ECG. While no randomised control trial has been conducted to date, multiple observational studies have demonstrated a favourable relationship between early coronary angiography and survival as well as favourable neurological outcomes in postarrest patients.[31 32] The recommendation for coronary angiography for patients with ST-segment elevation myocardial infarction (STEMI) remains in concordance with emergency management for patients with Acute Coronary Syndrome (ACS) and STEMI. For patients without STEMI but who remain comatose following ROSC, coronary angiography may help to improve cardiac dysfunction and aid in recovery from coma [33]

Temperature management: therapeutic hypothermia (cooling the core temperature to 32°C –33°C) has, for nearly a decade, been the standard of care for all comatose cardiac arrest patients. One recent large randomised clinical trial compared temperature management at 36°C versus 33°C and found no difference in outcomes.[34] The updated guidelines suggest cooling between these targets for a minimum duration of 24 h and not necessarily requiring cooling to 33°C. The guidelines also encourage the prevention of fever, which a number of studies have associated with poorer outcomes following cardiac arrest.[35]

THE ETHICS OF ALS

While the physical manifestations of arrest are taken care of, the holistic requirements of modern care may be sidelined unintentionally. The 2015 guidelines highlight the need to equip members of the resuscitation team to make decisions about the ethical implications of their resuscitation efforts. These decisions should take into account the pillars of medical ethics, available

scientific evidence and should also reflect relevant legal and cultural considerations. As the strategies for resuscitation continue to improve, healthcare professionals will likely be faced with mounting challenges with respect to the ethics of resuscitation. In particular, the use of intra-arrest prognosis or use of extracorporeal CPR devices may modify decisions to initiate or terminate resuscitation efforts. Although a detailed discussion is outside the scope of this current report we remind healthcare professionals of patient autonomy, non-maleficence, beneficence and justice as the pillars of medical decision-making.

To maintain patients' autonomy, doctors must discuss decisions around resuscitation and CPR with patients and their families. In the UK, this has only recently become recognised in case law.[36] Although the decision to withhold CPR is a medical decision, the patient and family must be consulted. Patients and family members often have unrealistic expectations of CPR,[37] and without adequate counselling on the risks of CPR and likelihood of survival for that particular patient, patients and their family can come to misleading conclusions about decisions to not attempt CPR, including feelings of abandonment or neglect. Misunderstandings around the meaning of Do Not Attempt Resuscitation (DNAR) also prevail within the medical team, with some studies suggesting that supportive care has been withheld from patients with DNAR because of confusion about resuscitation and the degree of clinical intervention.[38]

AREAS OF UNCERTAINTY AND FUTURE DIRECTIONS

The updated guidelines highlight areas for ongoing research and investigation for patients with cardiac arrest. Adrenaline continues to be a highly debated topic and we are likely to see additional advice on this in the near future. While their use has been shown to increase survival to hospital admission and to increase the incidence of ROSC, placebo-controlled trials have shown no increased survival to hospital discharge.[39] This has been corroborated by observational trials of adrenaline use,[40] and systematic reviews of adrenaline use in out-of hospital cardiac arrest.[41 42]

Administration of adrenaline has also been associated with reduced neurological outcomes.[43] Concerns about the neurological effects of adrenaline stem from its widespread α-adrenergic, vasoconstrictive effect, which while increasing macrocirculatory and cerebral perfusion pressures is thought to limit cerebral microcirculation[44] and overall cerebral perfusion.[45] There are also concerns about adrenaline increasing the risk of arrhythmias and conversion of shockable to non-shockable rhythms.[46] One ongoing large-scale clinical trial in the UK (PARAMEDIC2: The Adrenaline Trial, ISRCTN734 85024) purports to answer some of these remaining questions about the use of adrenaline in out-of-hospital cardiac arrest.

Uncertainty also exists around the use of extracorporeal cardiopulmonary resuscitation (ECPR). There is increasing evidence to suggest that the use of ECPR can restore spontaneous circulation in a select group of patients.[47] The current guidelines indicate that ECPR may be used in patients who have not responded to conventional CPR. Although ECPR is resource-intensive and highly specialised, we are likely to see a drive for capable EDs and hospitals to perform ECPR in specific circumstances in the coming years.

SUMMARY

This overview of the 2015 ILCOR guidelines has highlighted important updates to resuscitation practice in the UK, and given explanations for the changes. Effective ALS requires highly skilled CPR, employing knowledge of the fundamental principles of ALS to deliver the best care for patients. Effective ALS also requires an active knowledge of the research behind the recommendations, the patient cohorts used and the ambiguities that remain in our practice. The technical feat of cardiac resuscitation must be married with the experiences of patients, both during an arrest and care delivered postarrest. Doctors' knowledge of the guidelines must extend beyond memory aids, as being confident with new guidelines will make them more competent at CPR, and therefore ALS. We also raise areas demanding continuing research and discussion that may affect the next guideline update.

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