

Focus on cardiopulmonary resuscitation techniques for victims of cardiac arrest

In the first of two articles within this cardiovascular special section Bhavisha Pattani reviews the current adult cardiopulmonary resuscitation guidelines in the United Kingdom. She describes the key changes that have taken place in recent years and helps us to refresh our memory about basic — and advanced — life-support measures. At the end of this *Learning points* style article Bhavisha poses 10 multiple-choice questions taken from the text to enable you to reflect on your reading.

Introduction

Cardiac arrest is the sudden loss of cardiac output, which is potentially reversible with prompt restoration of circulation and oxygen delivery. There are approximately 700,000 sudden cardiac arrests in Europe each year.¹ It is most commonly caused by ventricular fibrillation (VF). VF effectively stops the ventricles pumping blood into the systemic circulation. The victim in VF cardiac arrest needs cardiopulmonary resuscitation (CPR) and defibrillation. Defibrillation is not effective for all forms of cardiac arrest but is effective to treat VF if delivered promptly.

CPR is a combination of rescue breathing and chest compressions delivered to victims who are thought to be in cardiac arrest. CPR can support a small amount of blood flow to the heart and brain to 'buy time' until normal heart function is restored. CPR effectively restores haemodynamic stability in 40% to 60% of arrests.²

Guidelines

The first international sets of guidelines for cardiopulmonary resuscitation and for emergency cardiovascular care were published simultaneously in 2000. These guidelines were reviewed in 2004/2005 and amended treatment recommendations made at the American Heart Association Conference — the *2005 International Consensus on Cardiopulmonary Resuscitation*

and *Emergency Cardiovascular Care Science with Treatment Recommendation (COSTR)*.³ This document formed the basis for the European Resuscitation Council (ERC) *Guidelines for Resuscitation 2005*, and the Resuscitation Council (UK) guidelines 2005 are an abbreviated version of the ERC guidelines. Full texts and algorithms are available at www.resus.org.uk.

The Resuscitation Council UK guidelines 2005 also include treatment of choking and the resuscitation of victims of drowning. More recently, in January 2008, the guidelines for the emergency treatment of anaphylactic reactions have been updated and are on the website. The use of intravenous adrenaline in such situations has been clarified and doses simplified.¹

Adult basic life-support

Basic life-support (BLS) implies that no equipment is employed other than a protective device. Before approaching a victim, you should always check that it is safe to approach. If the victim is unresponsive, you should shout for help and then check the airway. The sequence of BLS, taken from the *Resuscitation guidelines UK* is summarised in Figure 1 and involves the following stages:

- Making sure the victim, any bystanders and yourself are safe (a).
- Turning the victim onto his back

and then opening the airway using head tilt and chin tilt. Then looking, listening and feeling for no more than 10 seconds to determine if victim is breathing normally. If you have any doubt whether breathing is normal you should act as if it is not normal (b).

- Starting chest compressions by placing the heel of one hand in the centre of the chest with the other hand on top (c).
- Combining chest compressions with rescue breaths (d). Stop to recheck the victim only if he starts breathing normally, otherwise do not interrupt resuscitation. If you are not able, or are unwilling to give rescue breaths, give chest compressions only.

Figure 1. Basic adult life-support measures¹

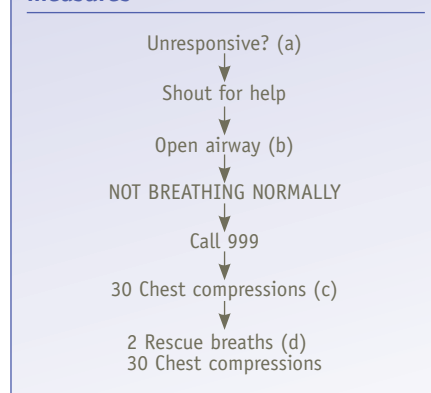


Figure 1. Adult basic life-support measures — taken from Resuscitation Guidelines UK¹



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Two of the changes to the 2000 guidelines for BLS are the ratio of compressions to ventilations, which is now recommended as 30:2 and — for adult victims — the omission of the initial two breaths, so that 30 compressions should be given immediately after cardiac arrest is established. These changes were made to reflect the greater importance placed upon chest compression and an attempt to reduce the number and duration of pauses. In March 2007 the SOS-KANTO (Cardiopulmonary resuscitation by bystanders with chest compression only) group did an observational study of patients who had an out-of-hospital cardiac arrest. The group concluded that bystander cardiac-only resuscitation (i.e. chest compressions only) is the preferred approach to resuscitation for adult patients with witnessed out-of-hospital cardiac arrest.⁴ More recently, in March 2008, the American Heart Association published a statement 'Hands-only (compression-only) CPR'. This is reflected in the UK guidance and although the UK guidance has not been amended the Resuscitation Council UK strongly supports any initiative to increase bystander CPR for out-of-hospital cardiac arrest.⁵

Adult advanced life-support

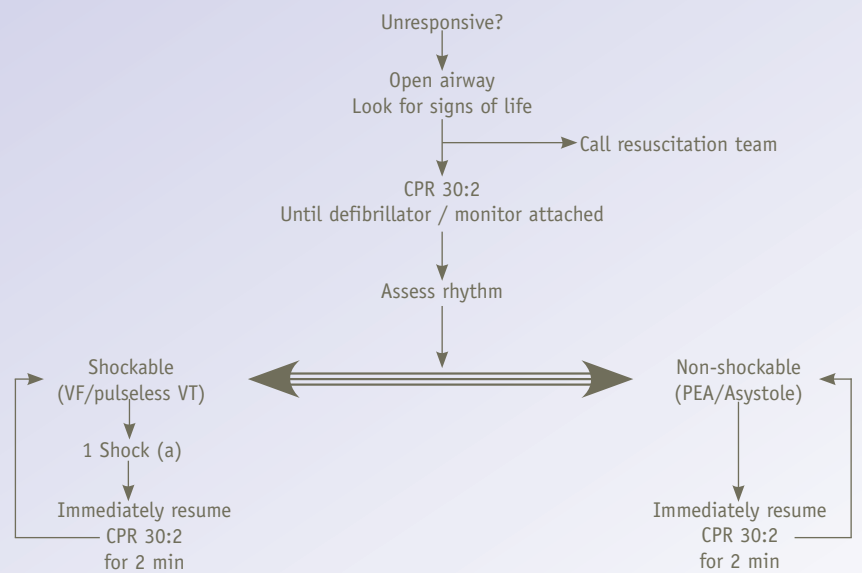
Adult advanced life-support (ALS) starts when medical personnel arrive. Arrhythmias associated with cardiac arrest are divided into two groups: shockable rhythms — VF or ventricular tachycardia (VT) — and non-shockable rhythms (asystole and

pulseless electrical activity — or PEA). The key difference between these is the need for attempted defibrillation in patients with VF/VT. Subsequent actions — including chest compressions, airway management and ventilation, venous access, administration

of adrenaline, and the identification and correction of reversible factors — are common to both groups. The sequence of ALS is summarised in Figure 2.

It is important to note that the revised guidelines now suggest that after a shock has been delivered to treat VF/VT there should be immediate resumption of CPR (30 compressions to 2 ventilations). This is to minimise the 'no flow' time. The rhythm should be checked after two minutes of CPR and another shock given if indicated. The recommended initial energy for biphasic defibrillation is 150–200J with second and subsequent shocks at 150–360J. For a monophasic defibrillator this is 360J for both the initial and subsequent shocks (Figure 2 — a). The revised guidelines recommend that if there is doubt whether a rhythm is asystole or fine VF do not attempt defibrillation and instead continue chest compressions and ventilation.¹ During

Figure 2. Advanced life-support measures



During CPR:

- Correct reversible causes (hypoxia, hypovolaemia, hypo/hyperkalaemia, hypothermia, tension pneumothorax, tamponade (cardiac), toxins, thrombosis (coronary or pulmonary))
- Check electrode position and contact
- Attempt or verify : IV access, airway and oxygen
- Give uninterrupted compressions when airway secure
- Give adrenaline every 3–5 minutes (b)
- Consider: amiodarone, atropine, magnesium

Figure 2. Adult advanced life-support (ALS) — taken from Resuscitation Guidelines UK¹

It is important to note that the revised guidelines now suggest that after a shock has been delivered to treat VF/VT there should be immediate resumption of CPR (30 compressions to 2 ventilations). This is to minimise the 'no flow' time.

CPR the reversible causes of cardiac arrest can be addressed and adrenaline 1mg iv can be given (Figure 2 — b) immediately before alternative shocks; this is approximately every 3–5 minutes.

The scientific evidence to support early defibrillation is overwhelming; the delay from collapse to delivery of the first shock is the single most determinant of survival. The Resuscitation Council UK strongly recommends a policy of early attempted defibrillation and gives guidance on the use of automated external defibrillators (AEDs) by lay people, first responders and health care professionals.

The national defibrillator programme

The Department of Health has a national defibrillator programme that since February 2000 has put nearly 700 AEDs in 110 locations across England. More than 6000 volunteers have been trained in BLS skills and use of AEDs at the sites where the AEDs have been located. Current evidence suggests that 74 lives have been saved as a direct result of the work of the programme. The programme is in its third phase and has a target of placing 3000 AEDs in the community.^{6,7}

Drug therapy

During cardiac arrest, basic CPR and early defibrillation are of primary importance and drug administration is of secondary importance.³ Drugs may be administered to support cardiac output, and especially to support blood flow to the heart and brain. Drugs may be selected to improve heart rate, myocardial contractility or arterial pressure or to reduce afterload. Afterload is the resistance that the heart meets in

contracting and doing work to drive blood through the arteries.

Central line access is not needed in most resuscitation attempts and drugs can be administered peripherally. Peripheral access does not interrupt CPR. When drugs are administered peripherally they typically require 1–2 minutes to reach the central circulation. It is common practice to administer a flush with 20ml sodium chloride 0.9% to enhance passage from peripheral to central circulation.

Some resuscitation drugs may be administered by the endotracheal route if intravenous access cannot be established. Higher doses (up to two or three times a normal dose) are required, but drug delivery and pharmacological effects are unpredictable.³



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Most trusts will have some form of resuscitation box available for use during an arrest. Contents may vary, but the idea of having the necessary agents to hand as soon as possible is critical, and should be reviewed locally by the trust's resuscitation committee.⁸ Some agents have a short shelf-life and there should be a stock rotation system in place to cover this.

1. Adrenaline (epinephrine)

Adrenaline is the primary drug used in ALS to increase myocardial and cerebral blood flow.² It does this through its alpha-adrenergic effects.³ The current UK guidelines recommend to give 1mg intravenously if VF/VT persists after a second shock and to repeat 1mg every 3–5 minutes thereafter if VF/VT persists. For asystole and pulseless electrical activity give 1mg adrenaline as soon as intravenous access is achieved and repeat every 3–5 minutes. Higher doses of adrenaline are not recommended unless treating a specific problem. In the UK adrenaline is available as a 'minijet®' at a dose of 1 in 10,000 (100micrograms/ml). At our trust the resuscitation box contains six of these. Adrenaline is one of the agents recommended by the Resuscitation Council UK that should also be available in the primary care setting as a minimum requirement.

2. Antiarrhythmics

There is no evidence that giving any antiarrhythmic drug routinely during human cardiac arrest increases survival to hospital discharge.¹ The Resuscitation Council UK recommend amiodarone as the antiarrhythmic of choice over lidocaine. It is recommended that if VF/VT persists after three shocks, then a bolus dose of 300mg should be given by injection during the brief rhythm analysis before delivery of the fourth shock. A further dose of 150mg may be given for recurrent refractory VF/VT followed by an infusion of 900mg over 24 hours. This is above the licensed maximum dose of amiodarone, which is 1.2g/24 hours.¹ Our resuscitation boxes contain one prefilled syringe of amiodarone 300mg and one ampoule of 150mg/3ml to support this recommendation. Lidocaine 1mg/kg may be used as an alternative if amiodarone is not available, but do not give lidocaine if amiodarone has already been given.¹

3. Atropine

Atropine has an established role in the treatment of bradycardia, asystole and PEA at a slow rate, by blockade of parasympathetic activity at both sinoatrial and atrioventricular nodes. The recommended dose is 3mg



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given as a single dose, although lower doses may be given for bradycardia. Higher doses of atropine are not recommended. Our trust resuscitation box contains one prefilled syringe of 3mg.¹

4. Magnesium

The use of magnesium during or early after resuscitation remains controversial.⁹ The Resuscitation Council UK guidelines recommend a dose of 8mmol (in our trust a 50% solution of magnesium is made up with sodium chloride 0.9% to give 8mmol in a 20ml volume for administration) for refractory VF if there is any suspicion of hypomagnesaemia (for example, if a patient is taking diuretics) and also if torsade de pointes is diagnosed.¹

5. Sodium bicarbonate

Routine use of sodium bicarbonate during

cardiac arrest and CPR is not recommended although it may be considered after a prolonged arrest. It may be useful if arrest is associated with hyperkalaemia or tricyclic antidepressant overdose. Administration should be guided by blood gas analysis.¹

6. Calcium

Calcium is indicated during resuscitation from PEA if it is thought to be caused by hyperkalaemia, hypocalcaemia, overdose of calcium-channel-blocking drugs, or overdose of magnesium.¹

Conclusions

Cardiac arrest outcomes could be improved by public education and early commencement of resuscitation. The Resuscitation Council UK has updated guidelines,¹ which should be visited by pharmacists. Ideally all pharmacists should

be trained to BLS standards. All health professionals need to stay current with the latest guidelines through literature reviews and regular validation of BLS.¹⁰ If a victim is unconscious or unresponsive and not breathing normally CPR should commence at a ratio of 30:2. ❖

Declarations of interest

The author has no interests to declare.

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References

1. Resuscitation Council (UK). *Resuscitation Council (UK) guidelines 2005*. Available at www.resus.org.uk (accessed 5 May 2008).
2. Thel M, O'Connor C. Cardiopulmonary resuscitation: historical perspective to recent investigations. *American Heart Journal* 1999; **137**(1): 39–48.
3. 2005 American Heart Association guidelines for cardiopulmonary resuscitation and emergency cardiovascular care. *Circulation* 2005; **112**: Issue 24 Supplement.
4. SOS-KANTO study group. Cardiopulmonary resuscitation by bystanders with chest compression only (SOS-KANTO): an observational study. *Lancet* 2007; **369**: 920–6.
5. Sayre M, Berg R, Cave D *et al.* Hands-only (compression-only) cardiopulmonary resuscitation: A call to action for bystander response to adults who experience out-of-hospital sudden cardiac arrest. *Circulation* 2008; **117**: 2162–7.
6. Davies S, Colquhoun M, Graham S *et al.* Defibrillators in public places: the introduction of a national scheme for public access defibrillation in England. *Resuscitation* 2002; **52**: 13–21.
7. Department of Health. National Defibrillator Programme. Available at www.dh.gov.uk (accessed 5 May 2008).
8. Lynch R, Williams H. Cardiopulmonary resuscitation. *The Pharmaceutical Journal* 2003; **271**: 581–3.
9. Reis A, Paiva E, Schwartsman C, [initial?] Zaritsky. Magnesium in cardiopulmonary resuscitation: Critical review. *Resuscitation* 2008; **77**: 21–5.
10. Cooper J, Cooper J. New strategies for cardiopulmonary resuscitation. *Current Treatment Options in Cardiovascular Medicine* 2008; **10**: 49–58.

Questions

	True	False
1. For adult BLS the ratio of compressions to ventilations is 30:2?	<input type="checkbox"/>	<input type="checkbox"/>
2. Arrhythmias associated with cardiac arrest can be either shockable or non-shockable ?	<input type="checkbox"/>	<input type="checkbox"/>
3. The recommended initial energy for the first shock from a monophasic defibrillator is 150J?	<input type="checkbox"/>	<input type="checkbox"/>
4. Central line access is always required to administer drugs?	<input type="checkbox"/>	<input type="checkbox"/>
5. Some resus drugs may be administered via the endotracheal route at higher doses?	<input type="checkbox"/>	<input type="checkbox"/>
6. The recommended dose of adrenaline is 1mg in the adult ALS algorithm?	<input type="checkbox"/>	<input type="checkbox"/>
7. Lidocaine is the antiarrhythmic of choice in an arrest situation?	<input type="checkbox"/>	<input type="checkbox"/>
8. Atropine has an established role in the treatment of bradycardia, asystole and PEA at a dose of 3mg?	<input type="checkbox"/>	<input type="checkbox"/>
9. There is no point in doing chest compressions if you don't want to give mouth-to-mouth ventilation?	<input type="checkbox"/>	<input type="checkbox"/>
10. Automated external defibrillators can be used by lay people?	<input type="checkbox"/>	<input type="checkbox"/>

Answers

Having read through the text why not try to answer the questions opposite? They are designed to help you reflect upon your reading, so just answer true or false to each question then turn the page upside down and see how you fared.

Answers: 1. True, 2. True, 3. True, 4. False, 5. True, 6. True, 7. False, 8. True, 9. False, 10. True.