Basic and advanced life support in adults

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Key points

Basic life support is an essential skill for all healthcare providers

Early defibrillation is important in determining survival from cardiac arrest

The 2000 guidelines represent an international concensus on the best available evidence

Potentially reversible causes of cardiac arrest must be sought as part of resuscitation.

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Cardiopulmonary resuscitation (CPR) is a core professional skill for anaesthetists. This is reflected in the large numbers of anaesthetists involved in the practice of resuscitation and in training at a local level and on nationally recognised courses. The publication of *Guidelines 2000 for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care*, following co-operation between international resuscitation councils, marks a step towards the application of these skills in the era of evidence-based medicine. Most of these recommendations have been adopted by the European Resuscitation Council and the Resuscitation Council (UK) and have been incorporated in the fourth edition of the *Advanced Life Support Manual*.

At the centre of a successful resuscitation event is the chain of survival; early access to the emergency services, early CPR, early defibrillation, and early advanced care. In adult ventricular fibrillation, the time from collapse to defibrillation is the single greatest determinant of survival. Each minute of delay to defibrillation results in a 7–10% fall in survival and, after 12 min, the survival rate is as low as 2–5%.

Basic life support

Basic life support (BLS) is an essential link in the chain of survival. The rapid recognition of cardiac or respiratory arrest and delivery of effective BLS are vital to preserve heart and brain function. BLS slows the deterioration from VF to asystole, may improve the probability of defibrillation, and leads to significantly increased survival.

The sequence of actions taken in BLS are summarised in the BLS algorithm (Fig. 1). Before commencing resuscitation, the rescuer must check that it is safe to approach the casualty. The level of response of the casualty is assessed by gently shaking the casualty and shouting 'are you all right?' Unnecessary movement of the casualty at this stage should be avoided, especially when trauma is considered as the cause of collapse. A shout for help, at this time, may activate local assistance.

The head tilt with chin lift or the jaw thrust manoeuvre are the mainstays of basic airway management. Any foreign body should be removed if visible in the airway but a blind finger sweep is not recommended. Once the rescuer has assessed the casualty's breathing for 10 sec and confirmed apnoea, two effective rescue breaths should be given. Mouth-to-mouth ventilation is used in BLS but a pocket mask or a self-inflating bag and mask can be used if the rescuer has been trained in their use. Up to five attempts at achieving two effective ventilations can be made, aiming to provide visible chest movement that approximately corresponds to 10 ml kg^{-1} tidal volume delivered over 2 sec.

The recovery position should be used if the casualty is breathing spontaneously and effectively. There has been much controversy over the recovery position and no single position is perfect for all casualties. However, the following six key principles must considered:

1. The casualty should be in as near a true lateral position as possible, with head dependent to allow free drainage of fluid.
2. The position should be stable.
3. Avoid any pressure on the chest that impairs breathing.
4. It should be possible to turn the casualty on his or her side and to return to the supine position easily and safely, with concern for possible cervical spine injury.
5. Good observation of, and access to, the airway should be possible.
6. The position itself should not cause injury to the victim.

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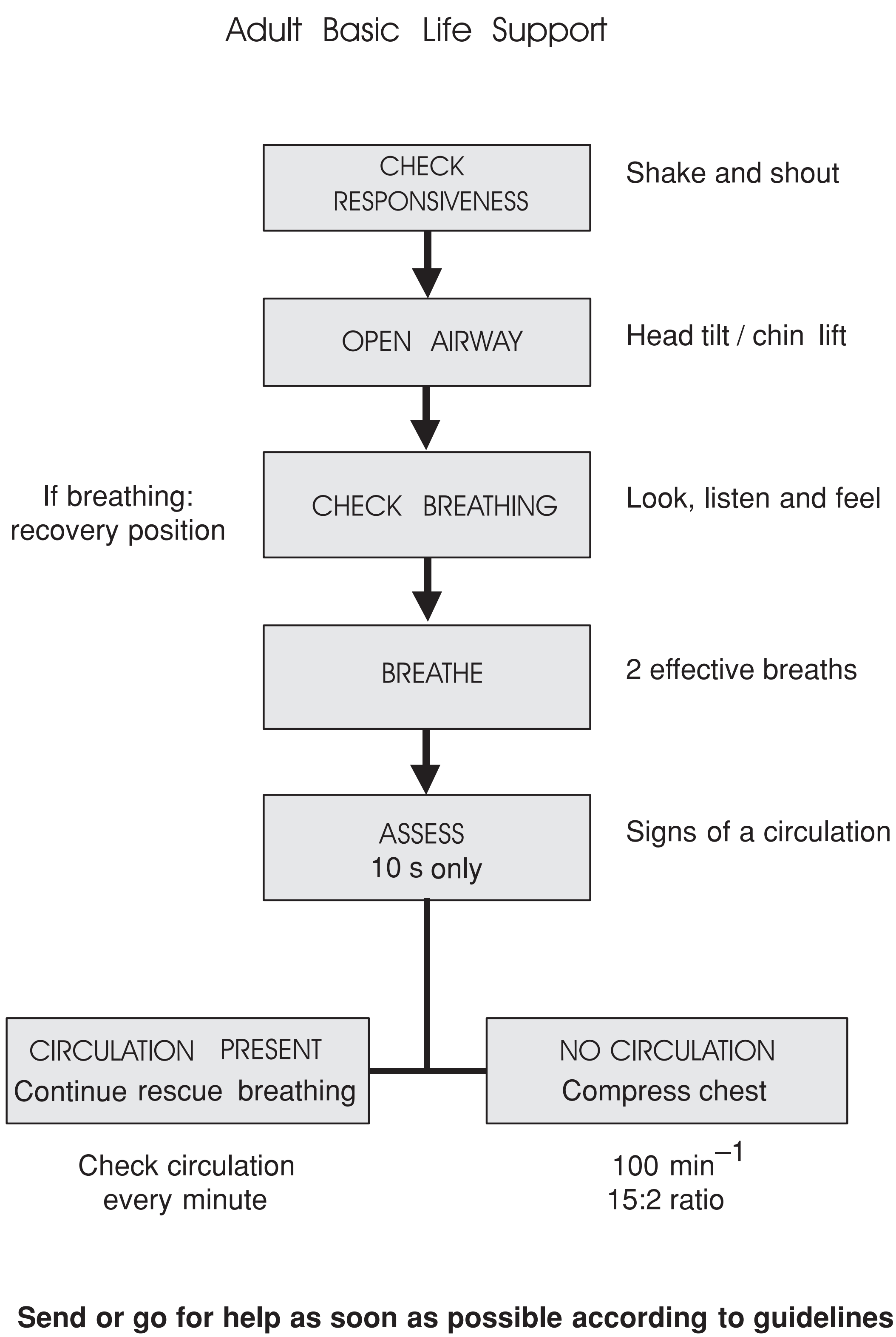

Fig. 1 The basic life support algorithm.

Early defibrillation is one of the keys to survival. To ensure early defibrillation, the emergency medical services or cardiac arrest team must be summoned early and, if the rescuer is alone, then it may be necessary to leave the unresponsive apnoeic patient to call for help. Therefore, it is recommended that the lone rescuer leaves the scene to summon help before giving rescue breaths. Adult victims of drowning, trauma and drug intoxication are the exceptions and resuscitation should be commenced before leaving to call for the emergency services if no help is immediately available. Similarly for children, who rarely arrest from a primary cardiac event, the rescuer should start rescue breathing before leaving to call the emergency services.

Following the rescue breaths, the rescuer should assess for signs of a circulation or a pulse for no more than 10 sec. Research has demonstrated that 45% of lay-persons reported a pulse present when it was absent and a further 10% reported it absent when it was present, thereby denying or delaying potentially life-saving treatment. Lay rescuers are no longer advised to perform a pulse check but to check for 'signs of a circulation' to confirm arrest. Healthcare personnel must still carry out a carotid pulse check. If no signs of a circulation or a pulse are present, chest compressions at a rate of 100 min^{-1} should be started. The chest should be compressed by 4–5 cm of its anterior-posterior diameter. The ratio of compression to ventilation is 15:2 for both one and two rescuers. The advantage of the 15:2 ratio is the sustained coronary blood flow achieved by the compression sequence, rather than the poor interrupted flow achieved during shorter compression-ventilation sequences.

It is unlikely that BLS alone will restore a circulation and, therefore, resuscitation should continue uninterrupted until advanced life support measures are commenced or the patient shows signs of a circulation. If the rescuer is reluctant or unable to provide mouth-to-mouth ventilation, the rescuer should provide chest compressions alone as there is evidence that compression only CPR is better than no CPR at all.

Advanced life support

The advanced life support (ALS) algorithm divides into two limbs (Fig. 2):

1. Ventricular fibrillation (VF) or pulseless ventricular tachycardia (VT).
2. Non-ventricular fibrillation or tachycardia (non-VF or non-VT) but including asystole and pulseless electrical activity (PEA).

Defibrillation is indicated for VF or VT only, all other measures are common to both pathways. If the arrest is monitored or witnessed, a precordial thump (low energy attempt at defibrillation) should be administered immediately.

If the patient's rhythm is confirmed as VF or pulseless VT, then defibrillation with a monophasic defibrillator should be attempted at energies of 200 J, 200 J and 360 J. The aim is to deliver the three defibrillation shocks without interruption within 1 min and to repeat the defibrillation cycle every 3 min. Having reached 360 J, all subsequent attempts at defibrillation should remain at 360 J unless there is the return of a perfusing rhythm when the sequence should begin again at 200 J. Following each set of three defibrillation attempts, BLS is continued.

Recent advances in technology have enabled the introduction of the new biphasic defibrillator. Biphasic defibrillators reverse the current flow during defibrillation and appear to be as, or more, effective in terminating ventricular fibrillation than monophasic defibrillators. Biphasic defibrillators are effective at lower energy levels (200 J), use smaller modern technology batteries and, when combined with analysis software, allows the manufacture of small, portable automatic devices that use voice prompts to guide the responder. These automated external defibrillators (AED) have provided the tool for early defibrillation in the pre-hospital environment by allowing non-healthcare providers access to defibrillation. In North America, implementation of public access defibrillation (PAD) schemes has led to significant improvements in immediate survival. In the UK, the pilot phase of 'Defibrillators in Public Places' is now complete and a national programme of AED installation and first responder training is continuing.

After three attempts at defibrillation, the airway should be secured, venous access achieved and epinephrine 1 mg administered. If defibrillation results in a change in rhythm, the pulse is checked. If no pulse is felt but the defibrillator monitor continues to indicate an electrocardiogram consistent with a pulsatile flow, a further minute of CPR is carried out and the pulse re-assessed before giving epinephrine. This is to allow the myocardium time to recover, contract effectively and produce a palpable cardiac output (myocardial stunning).

The defibrillation sequences are bypassed for non-VF/VT rhythms, either asystole or pulseless electrical activity. Basic life support is continued, the airway secured and venous access achieved.

The airway is secured by intubation of the trachea with a tracheal tube, the gold standard for airway management.

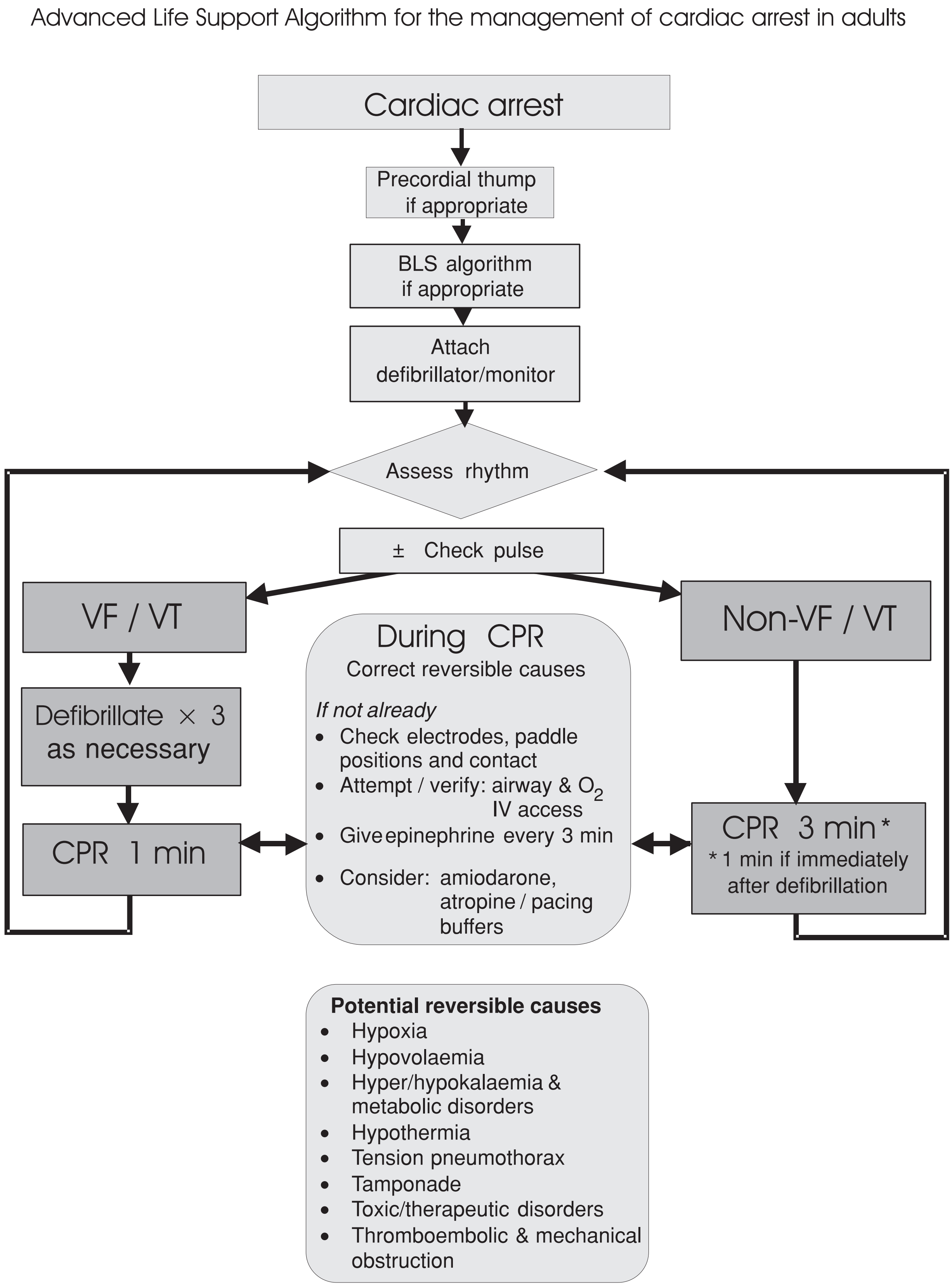

Fig. 2 The universal advanced life support algorithm.

Confirmation of tracheal tube placement by the measurement of expired carbon dioxide is complicated due to the lack of a spontaneous circulation. However, expired carbon dioxide can be detected when chest compressions are generating an adequate blood flow. An alternative airway management strategy is the insertion of a Laryngeal Mask Airway or a Combitube and these techniques have been taught to healthcare staff that have not gained the skill of tracheal intubation. Any attempt to secure the airway must not delay defibrillation and oxygenation can be maintained by manual ventilation using a self-inflating resuscitation bag, valve and face-mask, with supplemental oxygen and an oxygen reservoir, until a definitive airway is provided. Once the airway has been secured, CPR is continued using asynchronous ventilation with continuous chest compressions at a rate of 100 min^{-1}. This avoids the fall in coronary perfusion associated with the interruption of compressions to allow for ventilation.

Intravenous access should be obtained without undue delay. If rapid access to the central circulation can be obtained it will allow effective drug delivery. However, attempts to access a central vein can result in the interruption of BLS and, in unskilled hands, may be associated with potentially life-threatening complications. Peripheral access is usually preferred as it is quicker to achieve and safer. However, drugs given via a peripheral vein must be followed by a 20 ml of 0.9% saline flush to aid delivery of drugs to the central circulation.

Tracheal drug administration has been recommended in previous guidelines but it is now regarded as inferior to the intravenous or intra-osseous route. Drugs that can be given via the tracheal tube are lidocaine, epinephrine, atropine and naloxone (LEAN). The tracheal drug dose is 2–2.5 times the intravenous dose and this should be diluted in 10 ml of 0.9% saline or sterile water to aid absorption. Although the intra-osseous route is recommended for use in children, its efficacy is still being investigated in adults.

Drugs in resuscitation

Epinephrine

Epinephrine (adrenaline) is used primarily in resuscitation for its α-adrenergic effect, providing peripheral vasoconstriction and thus improving coronary and cerebral perfusion. Epinephrine is given in a dose of 1 mg, intravenously every 3 min throughout the resuscitation sequence. It can also be given by the intra-osseous route or via the tracheal tube. The dose of epinephrine given via the tracheal route is 2–3 mg diluted in 10 ml of sterile water. High dose epinephrine (5–10 mg i.v.) is no longer recommended as there is no evidence that it improves long-term survival.

Vasopressin

Vasopressin, in non-physiological doses, acts as a non-adrenergic peripheral vasoconstrictor. In a dose of 40 units, it directly stimulates the V_1 receptors of smooth muscle and has been shown to be efficacious in resuscitation. Vasopressin may be recommended when further evidence on its efficacy and its effects on long-term survival rates are available.

Amiodarone

Amiodarone (class III anti-arrhythmic) is now recommended for 'shock resistant VF' and may be considered for administration as early as the fourth defibrillation shock. An i.v. bolus dose of 300 mg diluted in 20 ml of 5% dextrose is given with additional doses of 150 mg in refractory VF. This should be followed by an infusion of 1 mg min^{-1} for 6 h and then 0.5 mg min^{-1}, up to a total dose of 2.2 g in 24 h. Amiodarone does cause bradycardia and hypotension and patient long-term survival rates following its use are still under review.

Lidocaine

Lidocaine (lignocaine) 100 mg i.v. has returned to the resuscitation algorithm for use in VF or VT. It should not be given in addition to amiodarone.

Magnesium sulphate

Magnesium sulphate 1–2 mg i.v. has been recommended in polymorphic VT.

Bretylium

Bretylium has been removed from the guidelines because of the high incidence of side-effects associated with its use.

Atropine

Atropine 1 mg i.v., repeated every 3–5 min (to a total dose of 3 mg), is still recommended for use in asystole and in pulseless electrical activity when the ventricular rate is less than 60 min^{-1}.

Sodium bicarbonate

Sodium bicarbonate administration may be considered if the arrest is prolonged or the patient has a severe acidosis on

Table 1 The four 'H's and four 'T's of resuscitation

Hypoxia	Tension pneumothorax
Hypokalaemia/electrolyte disturbances	Thromboembolism
Hypothermia	Toxic/therapeutic disturbances
Hypovolaemia	Tamponade (cardiac)

blood gas analysis. It does not improve the ability to defibrillate or improve survival rates in animals, can increase intracellular acidosis, has a negative inotropic effect on the heart, may induce hyperosmolarity and hypernatraemia and causes a left shift of the oxygen dissociation curve. When it is used, it should be titrated against a calculated base deficit following blood gas analysis.

Treatment of underlying cause

During the resuscitation process, the underlying causes of the arrest should be sought and treated appropriately. They are easily remembered as the four 'H's and four 'T's of resuscitation (Table 1).

The prognosis of patients who suffer a cardiac arrest in hospital remains poor and the prevention of an avoidable cardiac arrest is an important strategy. The establishment of hospital Emergency Medical Teams and Intensive Care Outreach Services has prioritised the identification of the pre-arrest patient and of those who would benefit from early referrals to high-dependency and intensive-care.

Importance of audit

The Guidelines 2000 document was developed on an evidence-based strategy and further development in resuscitation depends on the careful and meticulous audit of resuscitation procedures. The Utstein templates for in-hospital, out-of-hospital and paediatric resuscitation are the recommended format for the audit of resuscitation events. It remains to be seen whether patient outcomes will be significantly altered in the UK with the adoption of the new guidelines, improved technology, and the 'Defibrillators in Public Places' campaign.

Key references

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Web sites

European Resuscitation Council www.erc.edu

Resuscitation Council (UK) www.resus.org.uk

See multiple choice questions 67–69.