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Update on cardiopulmonary resuscitation

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ABSTRACT Adult cardiopulmonary resuscitation (CPR) has been shown to improve survival for individuals suffering cardiac arrest. Despite this, the delivery of basic life support to victims outside the clinical environment remains poor, particularly as only a minority receive resuscitation. In addition, research continues to examine the optimal techniques for CPR and guidelines have been modified to reflect the latest developments. These guidelines are a compromise between simplicity and effectiveness. While the core of the guidelines remains unchanged, the latest recommendations focus on minimising any delay in the assessment of the collapsed patient and the initiation of CPR. They also address the recent body of opinion promoting compression-only CPR as an alternative to the combined technique of compression and mouth-to-mouth ventilation. Throughout the guidelines a more pragmatic approach to resuscitation is adopted to try to encourage all individuals, whether trained healthcare professionals or lay people, to initiate resuscitation. An acknowledgement of the reasons why individuals may be reluctant to start resuscitation through fear or anxiety will hopefully help to encourage the instigation of these techniques. This overview will summarise the guidelines and highlight alterations or alternatives where appropriate.

KEYWORDS Cardiopulmonary resuscitation, chest compression, defibrillation, guidelines, ventilation

DECLARATION OF INTERESTS No conflict of interests declared.

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INTRODUCTION

Cardiopulmonary resuscitation (CPR) is the emergency support of the respiratory and circulatory systems. It has been shown to improve survival in patients suffering sudden cardiac or respiratory arrest and now forms an integral part in the training of medical, nursing and auxiliary healthcare professionals while also being widely promoted among the general population.

Since the development of the combined techniques of artificial respiration and external chest compressions in the 1960s, guidelines have been introduced and revised to optimise the initiation and delivery of CPR. While clearly facilitating the co-ordinated delivery of CPR, these guidelines have been burdened with the need to encompass a wide range of scenarios ranging from out-of-hospital, unwitnessed arrests with a single lay person attendee, to monitored arrests in the setting of the coronary care unit with a full emergency medical team present.

Perhaps as a result of this, and despite the widespread promotion of modern techniques, bystander-initiated CPR is only delivered in between 15–35% of cases and survival from out-of-hospital arrest to discharge remains very low (5–10%). New alterations to CPR technique in light of ongoing research continue to try and improve these figures, but considerable challenges remain. This article will remind readers of the latest algorithms (based on the European Resuscitation Council guidelines and Resuscitation Council (UK) guidelines) for the delivery of CPR while also introducing some more recent developments in the field with reference to the supporting evidence. For the purpose of this article we will focus on the out-of-hospital cardiac arrest scenario, although the majority is applicable to first responders in the hospital setting.

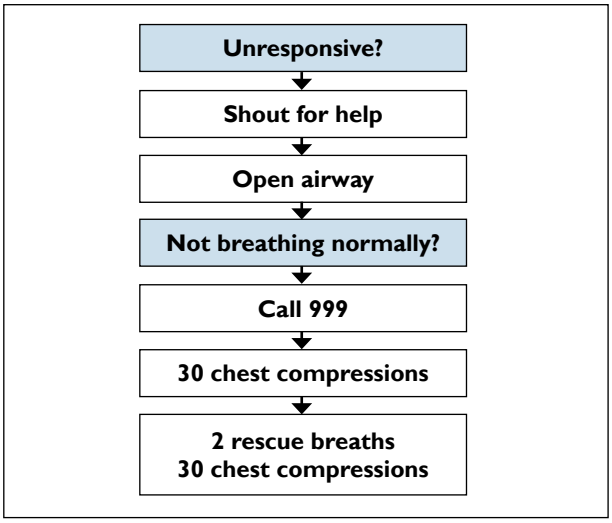

FIGURE 1 The Adult Basic Life Support Algorithm

CURRENT GUIDELINES

Figure 1 summarises the Adult Basic Life Support Algorithm. There have been a number of alterations to this algorithm since 2005. The main aim of these alterations is to minimise any delay to the delivery of CPR and to emphasise the importance of chest

compression during resuscitation. Details and the rationale behind the current guideline with a discussion of more specific changes follow.

1. Ensure the victim, any bystanders and you are safe

Before approaching the sudden cardiac arrest (SCA) victim, it is vital to ensure that the environment is safe and that, wherever possible, risk to yourself and any bystanders is minimised; for example, in the case of an individual collapsed due to suspected electrocution.

2. Check the victim for a response: 'shake and shout'

If the victim does not respond, shout for help, turn the victim onto his or her back and open the airway using the head tilt and chin lift manoeuvre (see Figure 2).

3. Keeping the airway open, look, listen and feel for normal breathing

While maintaining the head tilt and chin lift, place your cheek above the victim's mouth facing caudally, look for chest movement and listen for breath sounds while feeling for expired air on your cheek (see Figure 3). Rescuers should perform this assessment for no more than 10 seconds. The guidelines highlight that rescuers should be confident of normal breathing and not confuse this with infrequent agonal gasps that can occur in the early stages of cardiac arrest. If there is any doubt about normality, assume that breathing is not normal.

Once abnormal breathing is confirmed, expert help should be called either by yourself (which may involve leaving the victim) or by another bystander. Chest compressions should then be started.

4. Chest compressions

From a kneeling position, place the heel of one hand in the centre of the chest. The heel of the other hand is then placed on top of the first and fingers interlocked. The chest should be compressed 4–5 cm at a rate of 100 beats per minute (bpm) with equal time for compression and release (Figure 4).

Those familiar with previous guidelines will notice several changes in this area of the algorithm. Palpation of the carotid pulse as part of the initial assessment has been removed. Evidence suggests that accurate determination of carotid pulsation in the circumstances of a cardiac arrest is difficult, unreliable and may delay the initiation of CPR. An absence of normal breathing and a lack of response are now deemed sufficient for the confirmation of cardiac arrest. Rescuers with experience in the assessment of sick patients may wish to simultaneously assess the carotid pulse and breathing, but the same rationale and instruction applies as for the less experienced rescuer.

The positioning of the hands on the sternum of the victim was previously guided by locating the lower edge of the sternum and moving two finger breadths above. Again,

FIGURE 2 Head tilt and chin lift technique to open the airway (with kind permission of Charles Bloe Training/Novartis Vaccines, © Novartis Vaccines).

FIGURE 3 Assessment of normal breathing (with kind permission of Charles Bloe Training/Novartis Vaccines, © Novartis Vaccines).

FIGURE 4 Adult chest compression (with kind permission of Charles Bloe Training/Novartis Vaccines, © Novartis Vaccines).

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this has been deemed an unnecessary manoeuvre which does not enhance positioning and may add further delay to the initiation and resumption of chest compressions.

Finally, the initial step was to deliver two rescue breaths prior to seeking expert help or commencing CPR. However, immediately following non-asphyxial cardiac arrest blood oxygen levels remain high and the suggestion is that early supplementation of the circulation through chest compressions is more important than delivering rescue breaths at this stage.

Combine chest compressions with rescue breaths

After 30 initial chest compressions, reinstate head tilt and chin lift, pinch the soft part of the victim's nose and deliver two rescue breaths. If a pocket mask is available, and the rescuer is trained in its application, then this should be used. Each breath should cause a rise of the victim's chest and take about one second. The chest should fall again when the seal over the mouth is removed. If the chest fails to rise appropriately with the initial breath, check for any visible obstruction in the victim's mouth and ensure adequate head tilt and chin lift. Do not attempt more than two rescue breaths between compressions. Once the two breaths have been attempted, and without delay, hands should be returned to the sternum and a further 30 chest compressions delivered as before. This cycle should continue in a ratio of 30:2.

Resuscitation should continue in this manner until further help arrives, the victim starts breathing normally or the rescuer becomes exhausted.

Chest compression-only CPR

If the rescuer is unwilling or unable to deliver rescue breaths then continuous chest compressions are an appropriate alternative approach.

It is well recognised that rescuers, including trained healthcare workers, are often unwilling to deliver mouth-to-mouth resuscitation. This most likely reflects a dislike of the intimate contact required, particularly in circumstances where there may be blood or gastric contents present. There is also a fear of infection. There are isolated case reports of tuberculosis and severe adult respiratory distress syndrome transmission but, as yet, no cases of human immunodeficiency virus transmission through resuscitation. These issues may be an important reason why the instigation of bystander CPR is so low.

In addition, the delivery of rescue breaths carries a significant delay to the delivery of chest compression. Evidence examining the delivery of rescue breaths by recently trained lay persons suggests an average time of 16 seconds to deliver two rescue breaths. There is a growing body of opinion that, in the context of sudden cardiac arrest where the circulation is critically compromised, the detrimental effect of this delay on organ perfusion outweighs any potential benefit of increased oxygen delivery to the lungs. There are also concerns that haemodynamic changes induced by rescue breaths may be detrimental. An increase in intrathoracic pressure during rescue breathing may reduce venous return to the heart, thereby limiting cardiac output during chest compressions.

Finally, rescue breathing is also associated with significant gastric air entry. As a consequence there appears to be a significant increase in the regurgitation of gastric contents in patients receiving mouth-to-mouth resuscitation, with a concomitant increase in pulmonary aspiration and associated difficulties in establishing a definitive airway later in the resuscitation.

On the positive side, chest compression-only CPR is clearly simpler, more appealing and hopefully more likely to be initiated. The chest compression itself will cause a degree of ventilation which may be equivalent to rescue breathing. Victims of recent cardiac arrest, as already discussed, tend to have intermittent agonal respirations or gasping which will contribute to lung ventilation. The resumption of gasping respiration following the commencement of early chest compression is also recognised and may again be of more benefit than rescue breaths themselves.

It should be noted that the current guidelines still recommend combined compression and ventilation resuscitation where possible. In particular, it should be emphasised that where the victim is thought to have suffered primarily a respiratory arrest leading to a cardiac arrest, then there is added need to improve ventilation. In this circumstance (for example, choking, drowning, drug overdose or intoxication) circulating blood will be hypoxic compared with the primary cardiac arrest scenario. Attempts through rescue breathing to improve blood oxygenation are therefore more likely to be of benefit.

ADVANCED LIFE SUPPORT

The complexities of advanced life support lie outside the remit of this article. However, for a sudden cardiac arrest, early defibrillation remains a critical intervention and should be applied, where appropriate, as soon as possible. Only a single shock should be delivered before CPR is recommenced for two minutes prior to assessing for rhythm and response.

ADDITIONAL NOTES

Suspected cervical spine injury

In circumstances where the victim may have suffered cervical spine injury, caution should be used in performing the head tilt and chin lift manoeuvre. Rescuers may prefer to attempt the jaw thrust technique in order to establish an airway.

Airway adjuncts

In the clinical environment, additional resuscitation equipment should be readily available to assist with CPR. Clearly, bag and mask ventilation, with high-flow oxygen, should replace any mouth-to-mouth techniques. Airway adjuncts such as oropharyngeal and nasopharyngeal airways should be considered if available.

The oropharyngeal airway is inserted 'upside-down' into the oral cavity to the junction of the soft and hard palate and then rotated through 180 degrees. This minimises the risk of pushing the tongue back and down, which might worsen any airway obstruction. Appropriate sizes for adults are 2 (small), 3 (medium) and 4 (large).

The nasopharyngeal airway is made of more malleable material and often better tolerated in patients who are not deeply unconscious. After lubrication with water-soluble jelly, it is usually inserted through the right nostril along the floor of the nasal cavity. The natural curve should direct the airway caudally. Appropriate sizes are 6 or 7 mm for adults. The diameter of the small finger is no longer considered an appropriate sizing reference. If there is any difficulty with the right nostril then the left should be tried.

KEY POINTS

- Bystander-initiated CPR is only delivered in 15–35% of out-of-hospital cardiac arrests and survival to hospital discharge is poor.
- The initial assessment of the collapsed patient should focus on the presence or absence of a response and normal breathing (maximum 10 seconds).
- Adult resuscitation should begin with 30 chest compressions rather than rescue breaths.
- Compression-only cardiopulmonary resuscitation at 100 beats per minute is a suitable alternative where the rescuer is unable or unwilling to deliver artificial respirations.
- Early defibrillation, for ventricular fibrillation or ventricular tachycardia, is critically important.

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FURTHER READING

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SELF-ASSESSMENT QUESTIONS

1. Which one of the following is the most important first step in dealing with a witnessed collapse?

A. Shake and shout.
B. Call for help.
C. Ensure you and any bystanders are safe.
D. Chest compressions.
E. Rescue breathing.

2. Which one of the following is true regarding cardiopulmonary resuscitation (CPR) in an adult who is not breathing normally?

A. Cardiopulmonary resuscitation should begin immediately with two rescue breaths.
B. Cardiopulmonary resuscitation is thought to be delivered in 70% of out-of-hospital cardiac arrests.
C. Combined compression and ventilation should be delivered in a ratio of 15:2.
D. Chest compressions should be delivered at a rate of 100 beats per minute (bpm).
E. Rescue breathing is often associated with transmission of respiratory tract infections.

3. Which one of the following statements is correct with regard to adjunctive management during cardiac arrest?

A. Size 6 or 7 oropharyngeal airway may be used.
B. Size 3 or 4 nasopharygeal airway may be used.
C. Mouth-to-mouth ventilation is more effective than bag and mask.
D. Three consecutive shocks should be delivered in the presence of ventricular tachycardia or ventricular fibrillation.
E. Cardiopulmonary resuscitation may stop when the patient starts breathing normally.

4. Which one of the following is true with regard to compression-only CPR?

A. Interlocking hands should be placed two finger breadths from the lower edge of the sternum.
B. It is more likely to cause gastric air entry.
C. It may be less beneficial in victims of a respiratory arrest.
D. It should be delivered at a rate of 80 bpm.
E. It is preferential to defibrillation in sudden ventricular fibrillation.

5. Which one of the following is recommended for the rapid assessment of the collapsed patient?

A. Assess for a response by shaking and shouting.
B. Feel for the carotid pulse.
C. Look, listen and feel for normal breathing for 15 seconds.
D. In the presence of agonal respiration the victim should be placed in the recovery position.
E. The jaw thrust, to maintain airway patency, should be avoided in suspected cervical spine injury.

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