

CHAPTER

4

Basic life support

LEARNING OBJECTIVES

In this chapter, you will learn:

- How to assess the collapsed patient and perform basic life support

4.1 INTRODUCTION

Paediatric basic life support (BLS) is not simply a scaled-down version of that provided for adults, although, where possible, guidelines are the same for all ages to aid teaching and retention. Some of the techniques employed need to be varied according to the size of the child. A somewhat artificial line is generally drawn between infants (less than 1 year old) and children (between one year and puberty), and this chapter follows that approach. The preponderance of hypoxic causes of paediatric cardiorespiratory arrest means that oxygen delivery rather than defibrillation is the critical step in children. This underlines the major differences with the adult algorithm.

By applying the basic techniques described, a single rescuer can support the vital respiratory and circulatory functions of a collapsed child with no equipment.

Basic life support is the foundation on which advanced life support is built. Therefore it is essential that all advanced life support providers are proficient at basic techniques, and that

they are capable of ensuring that basic support is provided continuously and well during resuscitation.

4.2 PRIMARY ASSESSMENT AND RESUSCITATION

Once the child has been approached safely and a simple test for unresponsiveness has been carried out, assessment and treatment follow the familiar ABC pattern. The overall sequence of basic life support in paediatric cardiopulmonary arrest is summarised in Figure 4.1.

Note: this guidance is for one or more health professionals. BLS guidance for lay people can be found in a later section.

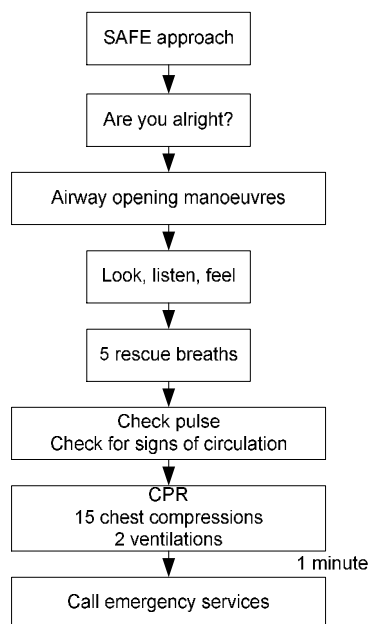


Figure 4.1. The overall sequence of basic life support in cardiopulmonary arrest (CPR = cardiopulmonary arrest)

The SAFE approach

Additional help should be summoned rapidly. Furthermore, it is essential that the rescuer does not become a second victim, and that the child is removed from continuing danger as quickly as possible. These considerations should precede the initial airway assessment. They are particularly pertinent in an unfamiliar environment. Within a health care setting the likelihood of risk is decreased. The steps are summarised in Figure 4.2.

When more than one rescuer is present one starts BLS while another activates the Emergency Medical Services (EMS) system then returns to assist in the BLS effort. If there is only one rescuer and no help has arrived after 1 minute of CPR then the rescuer must activate the EMS system himself or herself. In the case of a baby or small child the rescuer will probably be able to take the victim with him or her to a telephone whilst attempting to continue CPR on the way.

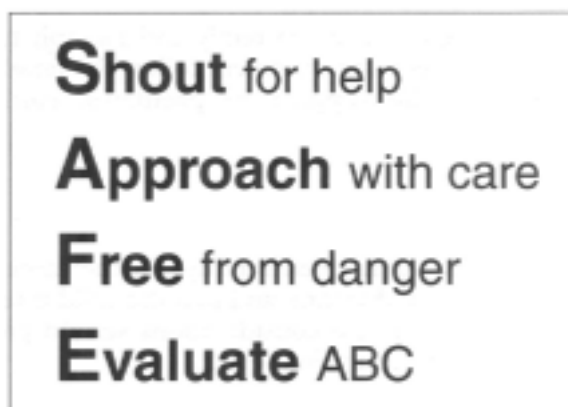


Figure 4.2. The SAFE approach

“Phone first”

In a few instances the sequence in the above paragraph is reversed. As previously described, in children, respiratory and circulatory causes of cardiac arrest predominate, and immediate respiratory and circulatory support as provided by the breaths and chest compressions of BLS can be life saving. However, there are circumstances in which early defibrillation may be life saving, i.e. cardiac arrests caused by arrhythmia. On these occasions, where there is more than one rescuer, one may start BLS and another summon the EMS as above. But if there is a lone rescuer then he or she should activate the EMS system first and then start BLS afterwards.

The clinical indication for EMS activation before BLS by a lone rescuer include:

- witnessed sudden collapse with no apparent preceding morbidity
- witnessed sudden collapse in a child with a known cardiac condition and in the absence of a known or suspected respiratory or circulatory cause of arrest.

The increasingly wide availability of public access defibrillation programmes with automatic external defibrillators (AEDs) may result in a better outcome for this small group. (see section 4.3)

Are you alright?

The initial simple assessment of responsiveness consists of asking the child “Are you alright?” and *gently* applying painful stimulus to the child. Infants and very small children who cannot talk yet, and older children who are very scared, are unlikely to reply meaningfully, but may make some sound or open their eyes to the rescuer’s voice or touch. In cases associated with trauma, the neck and spine should be immobilised during this assessment. This can be achieved by a lone rescuer by placing one hand firmly on the head.

Airway (A)

An obstructed airway may be the primary problem, and correction of the obstruction can result in recovery without further intervention.

If a child is having difficulty breathing, but is conscious, then transport to hospital should be arranged as quickly as possible. A child will often find the best position to maintain his or her own airway, and should not be forced to adopt a position that may be less comfortable.

Attempts to improve a partially maintained airway in an environment where immediate advanced support is not available can be dangerous, because total obstruction may occur.

If the child is not breathing it may be because the airway has been blocked by the tongue's falling back and obstructing the pharynx. An attempt to open the airway should be made using the head tilt/chin lift manoeuvre. The rescuer places the hand nearest to the child's head on the forehead and applies pressure to tilt the head back gently. The desirable degrees of tilt are *neutral*, in the infant, and *sniffing*, in the child. These are shown in Figures 4.3 and 4.4.

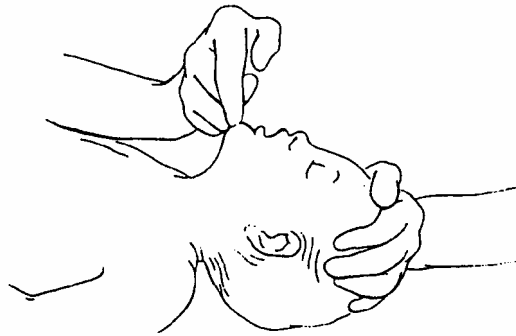


Figure 4.3. Chin lift in infants

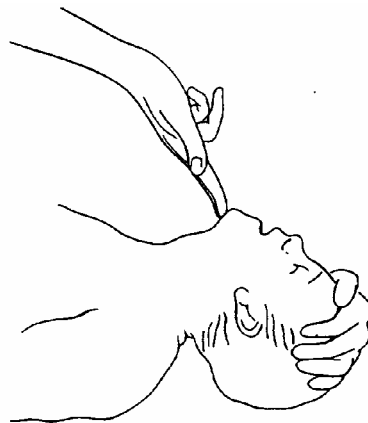


Figure 4.4. Chin lift in children

The fingers of the other hand should then be placed under the chin and the chin should be lifted upwards. Care should be taken not to injure the soft tissue by gripping too hard. As this action can close the child's mouth, it may be necessary to use the thumb of the same hand to part the lips slightly.

The patency of the airway should then be assessed. This is done by:

- LOOKing for chest and/or abdominal movement,
- LISTENing for breath sounds and
- FEELing for breath,

and is best achieved by the rescuer placing his or her face above the child's, with the ear over

the nose, the cheek over the mouth and the eyes looking along the line of the chest for up to 10 seconds.

If the head tilt/chin lift manoeuvre is not possible or is contraindicated because of suspected neck injury, then the jaw thrust manoeuvre can be performed. This is achieved by placing two or three fingers under the angle of the mandible bilaterally and lifting the jaw upwards. This technique may be easier if the rescuer's elbows are resting on the same surface as the child is lying on. A small degree of head tilt may also be applied if there is no concern about neck injury. This is shown in Figure 4.5.



Figure 4.5. Jaw thrust

As before, the success or failure of the intervention is assessed using the technique described above.

LOOK LISTEN FEEL

It should be noted that, if there is a history of trauma, then the head tilt/chin lift manoeuvre may exacerbate cervical spine injury. In general, the safest airway intervention in these circumstances is jaw thrust without head tilt. However, on rare occasions, it may not be possible to control the airway with jaw thrust alone in trauma. In these circumstances, an open airway takes priority over cervical spine risk and a gradually increased degree of head tilt may be tried. Cervical spine control should be achieved by a second rescuer maintaining in-line cervical stabilisation throughout in all cases.

The blind finger sweep technique should not be used in children. The child's soft palate is easily damaged, and bleeding from within the mouth can worsen the situation. Furthermore, foreign bodies may be forced further down the airway; they can become lodged below the vocal cords (vocal folds) and be even more difficult to remove. In the child with a tracheostomy, additional procedures may be necessary. (see Chapter 20, section on management of a blocked tracheostomy)

Breathing (B)

If the airway-opening techniques described above do not result in the resumption of adequate breathing within 10 seconds, exhaled air resuscitation should be commenced. The rescuer should distinguish between adequate breathing and ineffective, gasping or obstructed breathing. If in doubt, attempt rescue breathing.

Five initial rescue breaths should be given.

While the airway is kept open as described above, the rescuer breathes in and seals his or

her mouth around the victim's mouth (for a child), or mouth and nose (for an infant as shown in Figure 4.6.) If the mouth alone is used then the nose should be pinched closed using the thumb and index fingers of the hand that is maintaining head tilt. Slow exhalation (1–1.5 seconds) by the rescuer should make the victim's chest rise. The rescuer should take a breath between rescue breaths to maximise oxygenation of the victim.

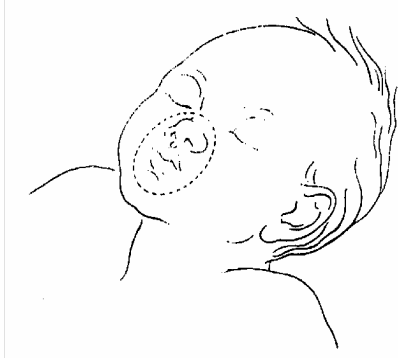


Figure 4.6. Mouth-to-mouth-and-nose in an infant

If the rescuer is unable to cover the mouth and nose in an infant he or she may attempt to seal only the infant's nose or mouth with his or her mouth and should close the infant's lips or pinch the nose to prevent air escape.

As children vary in size only general guidance can be given regarding the volume and pressure of inflation (see the box).

General guidance for exhaled air resuscitation

- The chest should be seen to rise
- Inflation pressure may be higher because the airway is small
- Slow breaths at the lowest pressure reduce gastric distension
- Firm, gentle pressure on the cricoid cartilage may reduce gastric insufflation

If the chest does not rise then the airway is not clear. The usual cause is failure to apply correctly the airway-opening techniques discussed above. Thus, the first thing to do is to readjust the head tilt/chin lift position, and try again. If this does not work jaw thrust should be tried. It is quite possible for a single rescuer to open the airway using this technique and perform exhaled air resuscitation; however, if two rescuers are present one should maintain the airway whilst the other breathes for the child. Five rescue breaths are given. While performing rescue breaths, note any gag or cough response to your action. These responses, or their absence, will form part of your assessment of “signs of circulation” described below.

Failure of both head tilt/chin lift and jaw thrust should lead to the suspicion that a foreign body is causing the obstruction, and appropriate action should be taken. (see “Choking Child”, section 4.5)

Circulation (C)

Once the rescue breaths have been given as above, attention should be turned to the circulation.

Assessment

Failure of the circulation is recognised by the absence of a central pulse for up to 10 seconds, by the presence of a pulse at an insufficient rate or by the absence of other signs of circulation, i.e. no breaths or cough in response to rescue breaths and no spontaneous movement.

In children, as in adults, the carotid artery in the neck can be palpated. In infants the neck is generally short and fat and the carotid artery may be difficult to identify. Therefore the brachial artery in the medial aspect of the antecubital fossa (Figure 4.7), or the femoral artery in the groin, should be felt.

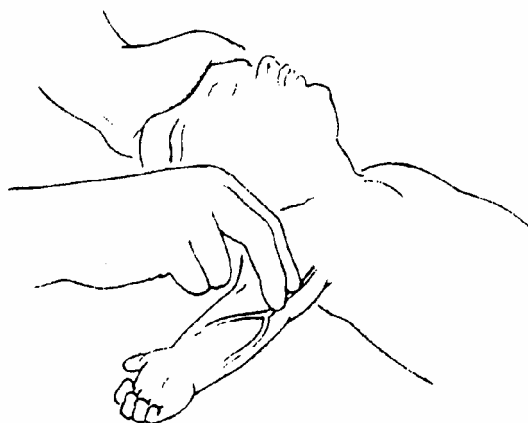


Figure 4.7. Feeling for the brachial pulse

If the pulse is absent for up to 10 seconds or is inadequate (less than 60 beats per minute, with signs of poor perfusion) then cardiac compression is required. Signs of poor perfusion include pallor, lack of responsiveness and poor muscle tone. Even experienced health professionals can find it difficult to be certain that the pulse is absent within 10 seconds so the absence of “signs of circulation” are an indication to start chest compressions also. Signs of a circulation include: movement, coughing or normal breathing (not agonal gasps - these are irregular, infrequent breaths).

Start chest compressions if

- no pulse
- slow pulse (less than 60 per minute with poor perfusion)
- no signs of circulation

“Unnecessary” chest compressions are almost never damaging and it is important not to waste vital seconds before starting them. If the pulse is present – and has an adequate rate, with good perfusion – but apnoea persists, exhaled air resuscitation must be continued until spontaneous breathing resumes.

Chest compressions

For the best effect the child must be placed lying flat on his or her back, on a hard surface.

Children vary in size, and the exact nature of the compressions given should reflect this. In general, infants (less than 1 year) require a technique different from children up to puberty in whom the method used in adults can be applied with appropriate modifications for their size. Compressions should be approximately one third of the depth of the child's or infant's chest.

Position for chest compressions

Chest compressions should compress the lower third of the sternum. The finger/thumb or hand position for all ages is found by finding the angle where the lowest ribs join in the middle and placing the finger/thumb or hand one finger's breadth above this.

Infants Infant chest compression can be more effectively achieved using the hand-encircling technique: the infant is held with both the rescuer's hands encircling or partially encircling the chest. The thumbs are placed over the correct part of the sternum (as detailed above) and compression carried out, as shown in Figure 4.9. This method is only possible when there are two rescuers, as the time needed to reposition the airway precludes its use by a single rescuer if the recommended rates of compression and ventilation are to be achieved. The single rescuer should use the two-finger method, employing the other hand to maintain the airway position as shown in Figure 4.8.

Children Place the heel of one hand over the lower third of the sternum one finger's breadth above the angle of the junction of the ribs. Lift the fingers to ensure that pressure is not applied over the child's ribs. Position yourself vertically above the child's chest and, with your arm straight, compress the sternum to depress it by approximately one third of the depth of the chest (Figure 4.10). For larger children, or for small rescuers, this may be achieved most easily by using both hands with the fingers interlocked (Figure 4.11). The rescuer may choose one or two hands to achieve the desired compression of one third of the depth of the chest.



Figure 4.8. Infant chest compression: two-finger technique

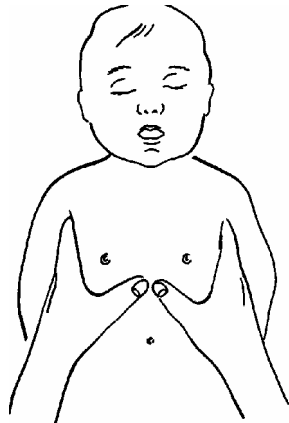


Figure 4.9. Infant chest compression: hand-encircling technique

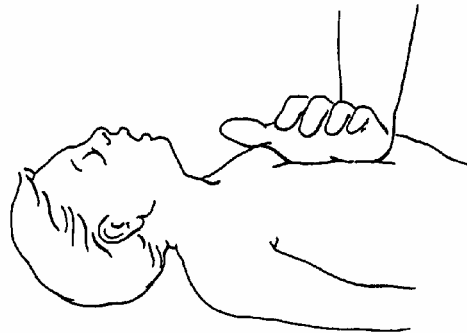


Figure 4.10. Chest compression: one-handed technique

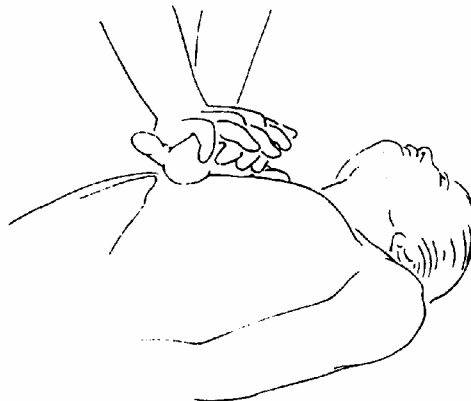


Figure 4.11. Chest compression: two-handed technique

Once the correct technique has been chosen and the area for compression identified, fifteen compressions should be given to two ventilations.

Continuing cardiopulmonary resuscitation

The compression rate at all ages is 100 per minute. A ratio of fifteen compressions to two ventilations is maintained whatever the number of rescuers. If no help has arrived the

emergency services must be contacted after 1 minute of cardiopulmonary resuscitation. With pauses for ventilation there will be less than 100 compressions per minute although the *rate* is 100 per minute. Compressions can be recommenced at the end of inspiration and may augment exhalation. *Apart from this interruption to summon help, basic life support must not be interrupted unless the child moves or takes a breath.*

Any time spent readjusting the airway or re-establishing the correct position for compressions will seriously decrease the number of cycles given per minute. This can be a very real problem for the solo rescuer, and there is no easy solution. In the infant and small child, the free hand can maintain the head position. The correct position for compressions does not need to be remeasured after each ventilation.

The cardiopulmonary resuscitation manoeuvres recommended for infants and children are summarised in Table 4.1.

Table 4.1. Summary of basic life support techniques in infants and children

	Infant (<1 yr)	Child (1 yr to puberty)
Airway		
Head-tilt position	Neutral	Sniffing
Breathing		
Initial slow breaths	Five	Five
Circulation		
Pulse check	Brachial or femoral	Carotid
Landmark	One finger-breadth above xiphisternum	One finger-breadth above xiphisternum
Technique	Two fingers or two thumbs	One or two hands
CPR ratio	15:2	15:2

Automatic external defibrillators (AEDs) in children

The use of the AED is now included in basic life support teaching for adults because early defibrillation is the most effective intervention for the large majority of unpredicted cardiac arrests in adults. As has been stated, in children and young people circulatory or respiratory causes of cardiac arrest predominate. However, in certain circumstances (described in section 4.2) children may suffer a primary cardiac cause for cardiac arrest, and the use of an AED may be life saving. Recently there has been a large increase in the number of AEDs, together with trained operators, made available in public places such as airports, places of entertainment and shops, so the opportunity for their use will correspondingly increase.

In this text the discussion of the use of AEDs with regard to children will be found in the chapter on The Management of Cardiac Arrest (Chapter 6).

Recovery position

No specific recovery position has been identified for children. The child should be placed in a stable, lateral position that ensures maintenance of an open airway with free drainage of fluid from the mouth, ability to monitor and gain access to the patient, security of the cervical spine and attention to pressure points.

Age definitions

As the techniques of CPR have been simplified there is now no need to distinguish between different ages of children but only between infants (under one year) and children (from one year to puberty). It is clearly inappropriate and also unnecessary to establish the physical evidence for puberty at CPR. The rescuer should use paediatric guidelines if he or she believes the victim to be a child. If the victim is, in fact, a young adult, no harm will be caused as the aetiology of cardiac arrest is, in general, similar in this age group to that in childhood, i.e. hypoxic/ischaemic rather than cardiac in origin.

Compression: ventilation ratios

Experimental work has shown that coronary perfusion pressure in resuscitation increases if sequences of compressions are prolonged rather than curtailed. Equally, ventilations are a vital part of all resuscitation and are needed early especially in the hypoxic/ischaemic arrests characteristic of childhood. There is no experimental evidence to support any particular ratio in childhood but a 15:2 ratio has been validated by experimental and mathematical studies and is the recommended ratio for health care professionals.

Lay rescuers

It has become clear that bystanders often do not undertake BLS because they are afraid to do it wrongly and because of an anxiety about performing mouth-to-mouth resuscitation on strangers. For lay rescuers, therefore, the adult compression/ventilation ratio of 30 compressions to 2 ventilations is recommended for children as well as adults thus simplifying the guidance. To increase the appropriateness for children, lay rescuers can be advised to precede their efforts by 5 rescue breaths if the victim is a child. Single health care professional rescuers are also enabled to perform a ratio of 30 compressions to 2 ventilations for children if they find difficulty in the transition from compressions to ventilations.

4.2 BASIC LIFE SUPPORT AND INFECTION RISK

There have been a few reports of transmission of infectious diseases from casualties to rescuers during mouth-to-mouth resuscitation. The most serious concern in children is meningococcus, and rescuers involved in the resuscitation of the airway in such patients should take standard prophylactic antibiotics (rifampicin or ciprofloxacin).

There have been no reported cases of transmission of either hepatitis B or human immunodeficiency virus (HIV) through mouth-to-mouth ventilation. Blood-to-blood contact is the single most important route of transmission of these viruses, and in non-trauma resuscitations the risks are negligible. Sputum, saliva, sweat, tears, urine and vomit are low-risk fluids. Precautions should be taken, if possible, in cases where there might be contact with blood, semen, vaginal secretions, cerebrospinal fluid, pleural and peritoneal fluids and amniotic fluid. Precautions are also recommended if any bodily secretion contains visible blood. Devices that prevent direct contact between the rescuer and the victim (such as

resuscitation masks) can be used to lower risk; gauze swabs or any other porous material placed over the victim's mouth is of no benefit in this regard.

The number of children in the UK with AIDS or HIV-1 infection is less than the number of adults similarly affected. If transmission of HIV-1 does occur in the UK, it is therefore much more likely to be from adult rescuer to child rather than the other way around.

In countries where HIV/AIDS is more prevalent the risk to the rescuer will be greater. In South Africa, in a medical ward 25–40% of children may be HIV-positive but the prevalence is lower in trauma cases. In the Caribbean, HIV prevalence is second only to sub-Saharan Africa. The situation may change, as effective anti-retroviral agents are made available to poor countries.

Although practice manikins have not been shown to be a source of infection, regular cleaning is recommended and should be carried out as shown in the manufacturer's instructions. Infection rates vary from country to country and rescuers must be aware of the local risk.

4.3 THE CHOKING CHILD

Introduction

The vast majority of deaths from foreign body airway obstruction (FBAO) occur in pre-school children. Virtually anything may be inhaled, foodstuffs predominating. The diagnosis may not be clear-cut, but should be suspected if the onset of respiratory compromise is sudden and is associated with coughing, gagging and stridor.

Airway obstruction also occurs with infections such as acute epiglottitis and croup. In these cases, attempts to relieve the obstruction using the methods described below are dangerous. Children with known or suspected infectious causes of obstruction, and those who are still breathing and in whom the cause of obstruction is unclear, should be taken to hospital urgently. The treatment of these children is dealt with in Chapter 8.

If a foreign body is easily visible and accessible in the mouth then remove it but while attempting that, take great care not to push it further into the airway. Do not perform blind finger sweeps of the mouth or upper airway as these may further impact a foreign body and damage tissues without removing the object.

The physical methods of clearing the airway, described below, should therefore only be performed if:

1. The diagnosis of FBAO is clear-cut (witnessed or strongly suspected) and ineffective coughing and increasing dyspnoea, loss of consciousness or apnoea have occurred.
2. Head tilt/chin lift and jaw thrust have failed to open the airway of an apnoeic child. (The sequence of instructions is shown in Figure 4.12.)

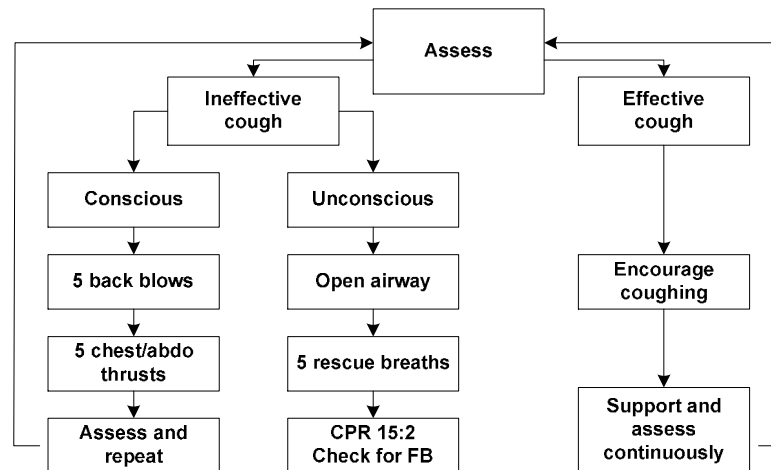


Figure 4.12. The sequence of actions in a choking child

If the child is coughing he should be encouraged. A spontaneous cough is more effective at relieving an obstruction than any externally imposed manoeuvre. An effective cough is recognised by the victim's ability to speak or cry and to take a breath between coughs. The child should be continually assessed and not left alone at this stage. No intervention should be made unless the cough becomes ineffective that is quieter or silent, and the victim cannot cry, speak or take a breath or if he becomes cyanosed or starts to lose consciousness. Then call for help and start the intervention.

These manoeuvres are then alternated with each other and with examination of the mouth and attempted breaths as shown in the diagram.

Infants

Abdominal thrusts may cause intra-abdominal injury in infants. Therefore a combination of back blows and chest thrusts is recommended for the relief of foreign body obstruction in this age group.

The baby is placed along one of the rescuer's arms in a head-down position, with the rescuer's hand supporting the infant's jaw in such a way as to keep it open, in the neutral position. The rescuer then rests his or her arm along the thigh, and delivers five back blows with the heel of the free hand.

If the obstruction is not relieved the baby is turned over and laid along the rescuer's thigh, still in a head-down position. Five chest thrusts are given – using the same landmarks as for cardiac compression but at a rate of one per second. If an infant is too large to allow use of the single-arm technique described above, then the same manoeuvres can be performed by laying the baby across the rescuer's lap. These techniques are shown in Figures 4.13 and 4.14.

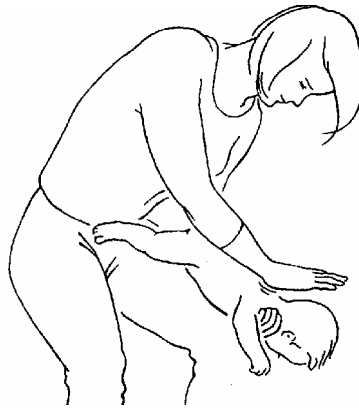


Figure 4.13. Back blows in infant

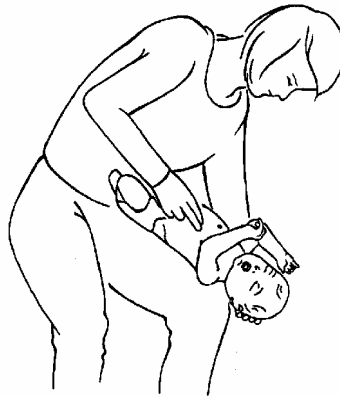


Figure 4.14. Chest thrusts in an infant

Children

Back blows can be used as in infants (Figure 4.15) or in the case of a larger child, with child supported in a forward leaning position. In the child the abdominal thrust (Heimlich manoeuvre) can also be used. This can be performed with the victim either standing or lying but the former is usually more appropriate.

If this is to be attempted with the child standing, the rescuer moves behind the victim and passes his or her arms around the victim's body. Owing to the short height of children, it may be necessary for an adult to raise the child or kneel behind them to carry out the standing manoeuvre effectively. One hand is formed into a fist and placed against the child's abdomen above the umbilicus and below the xiphisternum. The other hand is placed over the fist, and both hands are thrust sharply upwards into the abdomen. This is repeated five times unless the object causing the obstruction is expelled before then. This technique is shown in Figure 4.16.

To carry out the Heimlich manoeuvre in a supine child, the rescuer kneels at his or her feet. If the child is large it may be necessary to kneel astride him or her. The heel of one hand is placed against the child's abdomen above the umbilicus and below the xiphisternum. The other hand is placed on top of the first, and both hands are thrust sharply upwards into the abdomen, with care being taken to direct the thrust in the midline. This is repeated five times unless the object causing the obstruction is expelled before that.

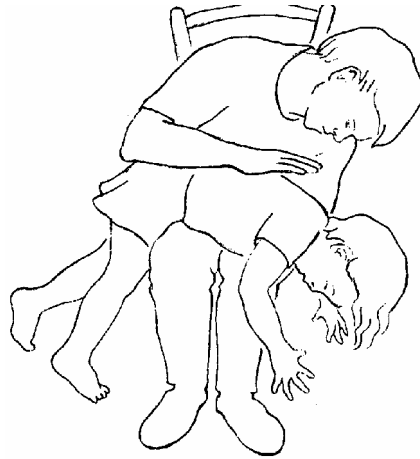


Figure 4.15. Back blows in a small child

Following successful relief of the obstructed airway, assess the child clinically. There may be still some part of the foreign material in the respiratory tract. If abdominal thrusts have been performed the child should be assessed for possible abdominal injuries.

Each time breaths are attempted, look in the mouth for the foreign body and remove it if visible. Take care not to push the object further down and avoid damaging the tissues. If the obstruction is relieved the victim may still require either continued ventilations if not breathing but is moving or gagging or both ventilations and chest compressions if there are no signs of a circulation. Advanced life support may also be needed.

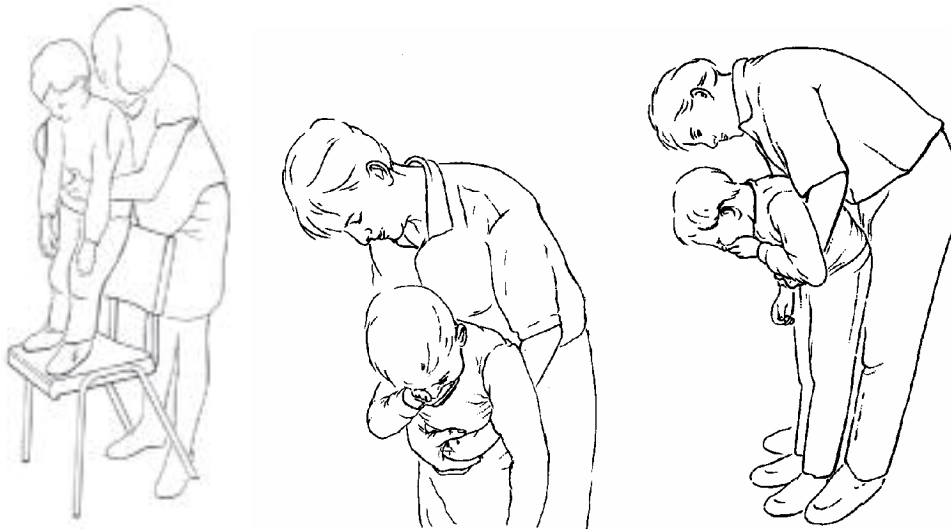


Figure 4.16 & 4.17. Heimlich manoeuvre in a standing child

If the child breathes effectively then place him in the recovery position and continue to monitor him.

Unconscious infant or child with foreign body airway obstruction

Call for help

Place the child supine on a flat surface

Open the mouth and attempt to remove any visible object.

Open the airway and attempt 5 rescue breaths, repositioning the airway with each breath if the chest does not rise

Start chest compressions even if the rescue breaths were ineffective

Continue the sequence for single rescuer CPR for about a minute then summon help again if none is forthcoming.

Each time breaths are attempted, look in the mouth for the foreign body and remove it if visible. Take care not to push the object further down and avoid damaging the tissues. .

If the obstruction is relieved the victim may still require either continued ventilations if not breathing but is moving or gagging or both ventilations and chest compressions if there are no signs of a circulation. Advanced life support may also be needed.

If the child breathes effectively then place him in the recovery position and continue to monitor him.

4.4 SUMMARY

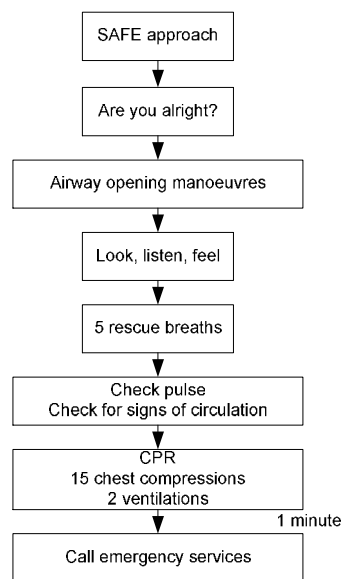


Figure 4.18. The overall sequence of basic life support in cardiopulmonary arrest

The teaching in this chapter is consistent with the ILCOR guidelines, Resuscitation 2005, and there are an enormous number of references which have informed this process. These are available on the ALSG Web site. See details on the “Contact Details and Further Information” page.