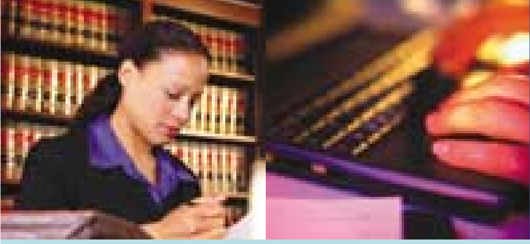


By reading this article and writing a practice profile, you can gain a certificate of learning. You have up to a year to send in your practice profile. Guidelines on how to write and submit a profile are featured at the end of this article.

The contents of the resuscitation trolley

NS250 Hand H, Banks A (2004) The contents of the resuscitation trolley. *Nursing Standard*. 18, 44, 43-52. Date of acceptance: March 19 2004.

Aim and intended learning outcomes

The aim of this article is to examine the contents of a standard resuscitation trolley in the context of basic and advanced life support. An overview of the function of each item and a rationale for its inclusion are provided. After reading this article you should be able to:

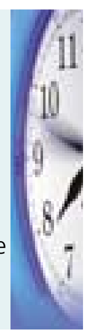
- Locate the guidelines for basic life support, advanced life support and for the contents of the standard resuscitation trolley.
- Understand the importance of standardisation of emergency equipment.
- List and describe the function of each of the items included on a resuscitation trolley.
- State the advantages and disadvantages associated with the use of a pocket mask, bag valve mask (or self-inflating bag), laryngeal mask airway (LMA) and endotracheal tube (ETT) in managing a patient's airway during cardiac arrest.
- Understand the role of the defibrillator in advanced life support and identify the safety implications associated with this item.
- List and describe the action of the major drugs used in a cardiac arrest situation.
- Know the location of and the procedure for checking and restocking the resuscitation trolley for your practice area.
- Be aware of the possible health and safety implications associated with a resuscitation attempt and how these can be avoided.

Introduction

The *CPR Guidance for Clinical Practice and Training in Hospitals* includes various recommendations from the Resuscitation Council (UK) (RCUK) relating to the provision of resuscitation services in hospitals (RCUK 2000a). One of the recommendations relates to the minimum equipment that must be available for the management of adult cardiopulmonary arrest. This article examines the recommended equipment and discusses the function of each item and its role in resuscitation. It also offers a comprehensive review of the items contained in the trolley along with relevant diagrams and a rationale for their use and inclusion, in the context of basic and advanced life support.

TIME OUT 1

It is important that the contents of the resuscitation trolley are described in the context of basic and advanced life support. Therefore, before reading any further, make sure that you are familiar with the current algorithms for basic and advanced life support. These can be accessed at www.resus.org.uk



The resuscitation trolley

The *CPR Guidance for Clinical Practice and Training in Hospitals* (RCUK 2000a) states that although the rational use of defibrillation and drugs in resuscitation has been standardised according to national and international guidelines, no attempt has been made to standardise resuscitation equipment. The guidance therefore sets out the selection of equipment that should be included for cardiopulmonary resuscitation (CPR). It suggests that the equipment be standardised throughout the hospital to aid familiarity, and that it should be stored on a standard trolley. The trolley should be located in each

In brief

Author
Helen Hand RGN, MAEd, is lecturer, and Angela Banks RGN, DPNS, BMedPsy(Hons), PGDip/Ed, is lecturer, School of Nursing and Midwifery, University of Sheffield, Rotherham. Email: h.e.hand@sheffield.ac.uk

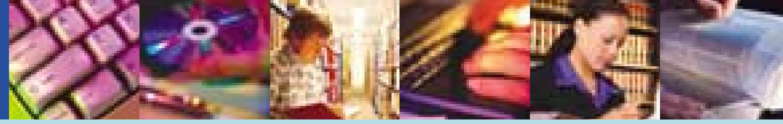
Summary
This article describes the contents of a standard hospital resuscitation trolley for cardiopulmonary resuscitation. Each item is discussed in terms of its function and the rationale for its inclusion.

Key words
- Accident and emergency nursing
- Intensive care
- Resuscitation

These key words are based on subject headings from the British Nursing Index. This article has been subject to double-blind review.

Online archive

For related articles visit our online archive at: www.nursing-standard.co.uk and search using the key words above.



ward or appropriate clinical area, with additional portable equipment to be rapidly available to all other areas of the hospital if necessary. Portable oxygen and suction devices should also be available on or adjacent to all resuscitation trolleys. However, where piped oxygen or suction is accessible, these should always be used in preference.

Wards should also have immediate access to monitoring equipment such as an electrocardiogram (ECG) machine, sphygmomanometer and stethoscope, pulse oximeter and blood gas syringes. Finally, it is imperative that each ward or department, according to local trust policy, checks the trolley contents daily.

Because it is current policy in some trusts that resuscitation trolleys are restocked at a central point and should be kept sealed at all times except for in an emergency, it may not be possible for nurses and nursing students to explore the trolley to become familiar with the contents.

It is acknowledged that some of the procedures mentioned in this article should only be performed by practitioners who have undertaken the relevant training. This training is often available in hospitals or can be accessed as part of courses such as the advanced life support course or the advanced trauma life support course. According to the guidance, the contents of the trolley can be divided into four sections: airway equipment, circulation equipment, drugs and additional items (RCUK 2000a).

TIME OUT 2

Before moving on to the next section, revise the anatomy of the upper airway. Draw a diagram that includes the following structures: oropharynx, nasopharynx, laryngopharynx, thyroid cartilage, trachea, bronchus, bronchiole and alveoli.

Airway equipment

The contents of the resuscitation trolley pertaining to airway management are listed in Box 1.

Patients requiring resuscitation usually have an obstructed airway, as a result of loss of consciousness. Sometimes, however, the obstructed airway may be the factor precipitating resuscitation by causing respiratory arrest (RCUK 2000b). Prompt assessment with airway control and provision of artificial ventilation are necessary to avoid damage to the brain and vital organs as a result of hypoxia. Airway management is, therefore, always the first priority. Once any degree of obstruction is recognised, measures must be taken to create and maintain a clear airway.

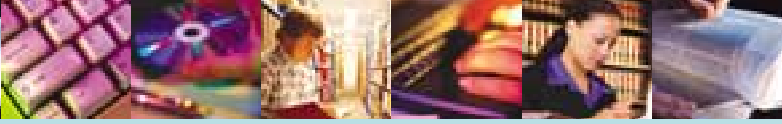
Basic airway management Airway maintenance techniques can be divided into basic and advanced. Basic techniques include the use of manoeuvres that help to open the airway. There are two manoeuvres that can be used: the chin lift and head tilt, and the jaw thrust. The chin lift and head tilt requires one hand to be placed on the forehead to provide backwards pressure, while the thumb and index finger grasp the chin and lift it upwards and open the mouth. This technique can be used to perform mouth-to-mouth ventilation, or for opening the airway of a patient with a reduced level of consciousness. Although only 5 per cent of unconscious patients have a cervical spine injury, the chin lift and head tilt technique should be avoided in trauma patients where possible (Greaves *et al* 1997). The use of a jaw thrust is advocated in some trauma patients; this involves identifying the angle of the jaw, just below the ear, and with index and forefinger use steady upward pressure to displace the jaw forward bringing the tongue with it.

Adjuncts to basic airway techniques Once the airway is opened, various adjuncts are available on the resuscitation trolley to secure or maintain it. The oropharyngeal (or Guedel) airway (Figure 1) is a curved plastic tube, designed to sit between the tongue and hard palate (Castle 1999), providing pressure on the tongue and preventing it moving backwards. It is available in various sizes; an estimate of the size may be made by selecting an airway with a length that corresponds to the distance between the corner of the patient's mouth and the angle of the jaw. The most common sizes are 2, 3 and 4 for small, medium and large adults respectively (RCUK 2000b). There are problems associated with the oropharyngeal airway. Primarily, it does not protect against aspiration of foreign matter, and as the airway is inserted, the tongue may be pushed backwards, making the obstruction worse rather than relieving it. The airway should only be used with

Box 1. Airway equipment

- Pocket mask with oxygen port
- Self-inflating resuscitation bag with oxygen reservoir and tubing
- Clear face masks size 4, 5, 6
- Oropharyngeal airways size 2, 3, 4
- Yankauer suckers x 2
- Endotracheal suction catheters x 10
- Laryngeal mask airway size 4 or Combitube™ (small)
- McGill's forceps
- Endotracheal tubes (ETT) – oral, cuffed, size 6, 7, 8
- Gum elastic bougie
- Lubricating jelly
- Laryngoscope x 2 – normal and long blades
- Spare laryngoscope bulbs and batteries
- 1" ribbon gauze
- Scissors
- Syringe – 20ml
- Clear oxygen mask with reservoir bag, for example, Hudson mask
- Oxygen cylinder x 2 (if no wall oxygen)
- Cylinder key

(RCUK 2000a)



unconscious patients as if reflexes are still present, vomiting or laryngospasm may occur (RCUK 2000b). There may also be problems inserting an airway in patients with severe facial trauma. The procedure for insertion is shown in Box 2.

After insertion of an airway, the chin lift and head tilt should be maintained and the patency of the airway checked using the look, listen and feel techniques described in the guidelines for basic life support (RCUK 2000c). If, as a result of using basic airway alignment or an airway, spontaneous breathing is restored, the patient should be placed in the recovery position and given supplemental oxygen. A Venturi mask will deliver 24-60 per cent oxygen, depending on the mask selected. A standard oxygen mask will deliver 50 per cent, provided the flow of oxygen is adequate. In these circumstances, the highest concentration available should be administered. This is best achieved by using a mask with a reservoir (commonly known as a non-rebreathe mask), which can deliver inspired oxygen concentrations of 85 per cent at flow rates of 10-15 litres per minute (RCUK 2000b). The oxygen mask and reservoir are indicated as essential components of the resuscitation trolley. There should also be an oxygen cylinder attached to the trolley in case piped oxygen is not accessible. The cylinder should be checked to ensure that it is sufficiently full to be used in the event of an emergency, and that the device for opening the cylinder is also available.

Nasopharyngeal airway Although not part of the guidance for trolley contents, a nasopharyngeal airway may also be used in airway management. This is a soft plastic tube, bevelled at one end and with a flange at the other, inserted via the nostril. The tube is secured using a safety pin to prevent it slipping back into the nasopharynx and causing an obstruction. They are usually well tolerated by patients who are not deeply unconscious, and useful in patients with facial trauma, clenched or loose teeth. Several sizes are available; the tube size is selected by choosing one that has the same diameter as the patient's little finger. A 6.5-8.0mm diameter is suitable for an average adult (Baskett *et al* 1996). They should be avoided in patients with suspected skull fracture and can cause damage to the nasal passage or induce vomiting or laryngospasm if the tube is too long. As with the oropharyngeal airway, the nasopharyngeal airway does not protect against the aspiration of foreign matter.

Box 2. Procedure for inserting an oropharyngeal airway

- Open the patient's mouth and ensure that there is no foreign material present likely to be pushed into the larynx
- Introduce the airway into the oral cavity in the 'upside-down' position
- Rotate hard through 180° as it passes below the hard palate and into the oropharynx. Rotation minimises the risk of pushing the tongue backwards and downwards
- Check for proper placement – there should now be an improvement in airway patency

(RCUK 2000b)

Ventilation Patients who are not breathing will require assisted ventilation. Mouth-to-mouth ventilation is used as part of basic life support and is most effective at providing a good seal (Brenner *et al* 1997). Mouth-to-mouth ventilation does have drawbacks: first, it may involve contact with vomit or blood, which could make rescuers reluctant to use it, and second, it involves the use of expired air. Expired air has a low oxygen concentration (16 per cent) compared with atmospheric air (21 per cent), and the prompt addition of supplemental oxygen is therefore a priority. To do this, several methods are available. The resuscitation trolley contains a pocket mask (Figure 2), a bag valve mask or self-inflating bag device (Figure 3), an LMA (Figure 4) and an ETT (Figure 5) for this purpose.

The pocket mask is a clear plastic mask that covers the patient's mouth and nose. It has a unidirectional valve that can be attached to direct the patient's expired air away from the rescuer, thus reducing the risk of transmission of infection. Blood and vomit can be observed, as the mask is transparent. Ventilation using a pocket mask also uses expired air, but if the technique is appropriate and supplemental oxygen is added, can increase the percentage of oxygen administered to around 50 per cent.

The pocket mask is the preferred method of ventilation when only one rescuer is available (Driscoll *et al* 2000). The main problem that has been identified is obtaining an airtight seal. The amount of air that should be used with a pocket mask is in the region of 400-600ml (RCUK 2000b). Introducing too much air can result in high airway pressure, which often leads to gastric inflation. This in turn may result in vomiting and subsequent pulmonary aspiration.

It is acknowledged that it is difficult to judge the amount of air that is being administered and the practitioner should observe for signs of visible chest movement with each inflation. Jevon (2002) also suggests that the breaths should be delivered slowly over two to three seconds. The procedure for using the pocket mask is given in Box 3.

The bag valve mask The bag valve mask or self-inflating bag device will be familiar to most healthcare professionals. It can be connected to a facemask, LMA or ETT, or it can be used independently to provide assisted ventilation and deliver high-inspired oxygen concentrations. As the bag is squeezed, the contents are delivered to the lungs; when the bag is released, the expired gas is diverted to the atmosphere and the bag then refills. Used alone, the device delivers ambient oxygen only. With oxygen added at a rate of 5-6 litres per minute (RCUK 2000b), the device can deliver up to 45 per cent

Figure 1. Guedel airways

Figure 2. Pocket mask

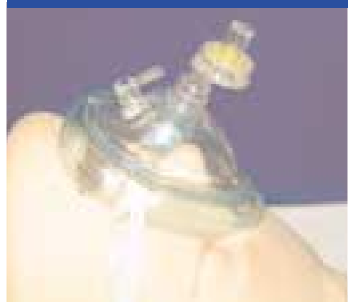


Figure 3. Bag valve mask

Figure 4. Laryngeal mask airway

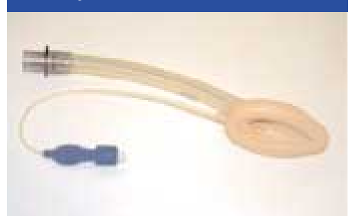
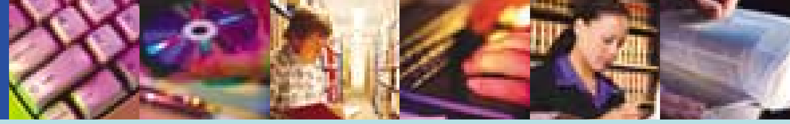


Figure 5. Endotracheal tube



oxygen. This can be increased up to 85 per cent with the addition of an oxygen reservoir and increasing the oxygen flow to 10 litres. It is, however, dependent on the skill of the user and the lungs of the majority of people managed in this way are inadequately ventilated (Baskett *et al* 1994). In addition, the patient is exposed to gastric inflation, regurgitation and pulmonary aspiration. Use by a single person requires great skill. When used with a facemask, it is difficult to obtain an airtight seal and squeeze the bag while maintaining the patient's head and neck alignment. This may result in hypoventilation and the use of two people is, therefore, recommended. One person holds the mask in place while maintaining the patient's airway and the second person squeezes the bag, paying particular attention not to overinflate and thus increase the risk of regurgitation and aspiration (Roberts *et al* 1997). Initial ventilation in cardiac or respiratory arrest is usually performed by nurses using the bag valve mask method, before the insertion of another device that will provide definitive airway security, such as a laryngeal mask airway or an endotracheal tube.

Laryngeal mask airway The LMA was invented by Dr Archie Brain in 1981 using plastercasts of a human cadaver's pharynx as a structure on which to model the mask (O'Meara 1995). It was introduced into anaesthetic practice in the mid-1980s and has been shown to be reliable and safe (O'Meara 1995). The LMA is composed of a silicone rubber and is reusable up to 40 times (although single-use versions are available), being sterilised by autoclaving. It consists of a flexible curved tube opening at the distal end into the lumen of a small elliptical mask that has an inflatable rim. The LMA should only be inserted in deeply unconscious unresponsive patients, and those in need of an artificial airway, such as in cardiac arrest. When inserted correctly, the LMA occupies the entire laryngopharynx

Box 3. Procedure for using the pocket mask

- Remove the pocket mask and assemble correctly
- Connect the oxygen, if available, to the nipple
- Select a flow rate of 10 litres per minute. This will allow delivery of up to 50 per cent oxygen
- Apply the mask to the patient's face; press on the lateral edges of the mask to achieve a seal
- At the same time as positioning the mask, apply a jaw thrust: lift the jaw into the mask by exerting pressure behind the angles of the jaw with the remaining fingers
- Take a breath; blow steadily into the mouthpiece for two seconds and watch for the chest to rise
- Stop inflation and observe for the chest to fall
- If the chest does not rise, check the patient's mouth for obstruction. Ensure that the airway is open by maintaining a chin lift and head tilt and make sure that there is a good seal between the mask and the patient's face
- Repeat the procedure

(RCUK 2000b)

Box 4. Procedure for inserting a laryngeal mask airway

- Select an appropriate size airway and inflate to check the condition of the laryngeal mask airway (LMA)
- Place the patient in a supine position with the head and neck in alignment
- Lubricate the back and sides of the LMA but not the aperture
- Wearing a glove, hold the tube like a pen and introduce the LMA into the mouth, with the distal aperture facing towards the patient's feet, and the introducer's index finger placed anteriorly at the junction of the tube and the cuff
- With the tip of the airway pressed against the hard palate, advance the airway in one fluid movement through the oropharynx
- When resistance is felt, withdraw the finger while holding the tube in place with the other hand
- Using the syringe, inflate the cuff with the appropriate volume of air
- As the cuff is inflated, the mask may rise up slightly 1-2cm as the cuff finds its correct position
- Once successfully inflated, a bite block or oropharyngeal airway is inserted to guard against tube compression. The tube should then be secured using the ribbon gauze
- A standard bag valve device can now be attached to the LMA, which, with an attached oxygen reservoir, will deliver an oxygen concentration of more than 90 per cent
- The position of the LMA can be confirmed by listening over the chest during inflation and noting bilateral chest movement. A small leak is acceptable provided chest movement is adequate (RCUK 2000b)
- If after 30 seconds, the LMA has not been inserted correctly, remove and oxygenate using a bag valve mask or pocket mask before attempting reinsertion

(RCUK 2000b)

and rests against the upper oesophageal sphincter behind the cricoid cartilage. The cuff is inflated to form an airtight seal around the larynx. The major advantage of the LMA is that it can be inserted by nurses (following a short period of training), which means that the patient's airway can be protected shortly after the onset of cardiac or respiratory arrest. The LMA has three adult sizes: size 3 for a small adult, requiring approximately 20ml of air to inflate the cuff, size 4 for a medium adult, requiring 30ml of air for inflation, and size 5 for a large adult requiring 40ml of air for inflation.

The importance of early airway protection has been highlighted by research comparing the use of the bag valve mask and the LMA. Stone *et al* (1998) undertook a study comparing the incidence of gastric regurgitation using both methods. They studied 256 patients who had had an LMA inserted during a resuscitation attempt, 170 of whom had been ventilated with a bag valve mask before LMA insertion. They discovered that, of the 86 patients who were ventilated with a LMA only, three regurgitated afterwards. Of the 170 ventilated using the bag valve mask before LMA insertion, 20 patients regurgitated during CPR and eight regurgitated afterwards.

Roberts *et al* (1997) suggest that, when positioned correctly, the LMA provides a clear airway with a reduced risk of gastric overinflation, and Stone *et al* (1998) state that the LMA remains stable during cardiac compressions. Although absolute protection of the airway is not guaranteed, the device is particularly useful where there is a possibility of an unstable neck injury or where access with a laryngoscope is limited.

Other advantages include ease of insertion and good retention of the skill by nurses (Leach *et al* 1993), and the fact that once inserted, ventilation only requires one operator, thus making more efficient use of personnel. The equipment required for the insertion of the LMA includes: the appropriate size LMA, a 50ml syringe, lubricating jelly, the bag valve device (without the mask), a bite block or oropharyngeal airway and tape to hold the LMA in place. The procedure for inserting the LMA is shown in Box 4. Difficulties associated with insertion include the epiglottis folding down to cover the laryngeal inlet causing airway obstruction (O'Meara 1995). Should this occur, the tube should be withdrawn and reinsertion attempted.

TIME OUT 3

Summarise the advantages and disadvantages of the pocket mask, bag valve mask and laryngeal mask airway as methods of ventilating a patient.

Endotracheal tube Tracheal intubation is still considered to be the optimal method of securing an airway. It is, however, a highly skilled procedure and one that few nurses are certified to perform. Its superiority stems from the fact that the airway is reliably isolated from foreign matter in the oropharynx (RCUK 2000b). Ventilation via an ETT can be achieved generally without leaks, even in the presence of high airway resistance such as in pulmonary oedema or bronchospasm. Tracheal intubation also allows suction of the trachea and lower airways to take place, along with the delivery of high concentrations of oxygen, and the delivery of some emergency drugs such as adrenaline (epinephrine).

The procedure does require expertise and is not a skill easily retained without practice (Gabbott and Baskett 1997). Multiple attempts at intubation by inexperienced practitioners may adversely affect the outcome of CPR (RCUK 2000b). Because of this, the Resuscitation Council (UK) recommends that no longer than 30 seconds is taken to attempt intubation.

The ETT is a hollow plastic tube with an inflatable balloon or cuff at the distal end. Ranges of tube sizes are available. The RCUK (2000b) recommends an 8.00mm diameter tube for an adult male and a 7.0-7.5mm internal diameter tube for a female.

Intubation requires the use of the following items, all of which are available on the resuscitation trolley:

- *Laryngoscope* There are two types: a straight (Millar) blade and a curved (Macintosh) blade (Figure 6), the latter being the most popular. The RCUK (2000b) recommends the inclusion of both normal (size 3) and long-bladed (size 4) laryngoscopes. The longer blade, if available, is suitable for very large, longer-necked patients (RCUK 2000b). It is essential that the laryngoscope is in good working order; the bulb and batteries must be checked and replaced if necessary. Spares must be immediately available.
- *Cuffed ETT* A selection of tubes should be available on the resuscitation trolley; one appropriate to the size of the patient should be selected. This must be fitted with standard connectors.
- *Syringe* This is required to inflate the cuff once the tube has been inserted.
- *Other items* These include water-soluble lubricating jelly and ribbon gauze to secure the tube in place once the correct position has been confirmed. A stethoscope will be used to confirm the position by listening over both lungs and observing for equal air entry. Introducers such as a gum elastic bougie or semi-rigid stylet should also be available and are used in difficult intubations. A bougie is a long, thin, flexible, plastic-coated wire that is easier to insert than an ETT. Once in place, the ETT can be inserted over the top of the bougie. A stylet is inserted into the ETT providing stiffness to the tracheal tube, thereby facilitating better manipulation during intubation (Jevon 2002). It must be lubricated before insertion and must not protrude from the end of the ETT, as damage may be caused when the tube is inserted.

Figure 6. Laryngoscope (curved)

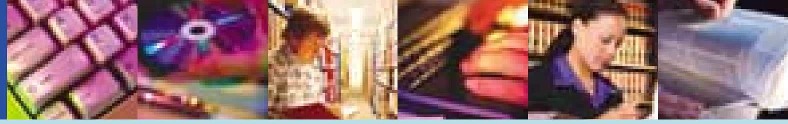


Figure 7. McGill's forceps

Figure 8. Catheter mount and swivel connector

- *McGill's forceps* These are long, bent forceps, occasionally used to assist with placement of the tube, or to remove foreign matter from the airway (Figure 7) (Eltz *et al* 2002).
- *Catheter mount* This is attached to the ETT and is used to give added flexibility to the device (Figure 8).
- *Bag valve device* This self-inflating bag with oxygen reservoir is attached to the catheter mount and used to provide ventilation.
- *Suction equipment* (See below).

The technique for intubation is described in Box 5.

Suction The resuscitation trolley guidance recommends the inclusion of endotracheal suction catheters and Yankauer suckers (RCUK 2000a). The Yankauer sucker is a wide-bore rigid sucker that can be used to remove liquid, blood, saliva and gastric contents from the upper airway. This is attached to a portable suction machine or to the static wall-mounted equipment available at the patient's bedspace.

The thinner, longer endotracheal suction catheters are designed for removing secretions from the trachea. Suction may be performed before and after intubation. This is best done under direct vision during intubation but should not result in any delay in achieving a definitive airway. If tracheal suction is necessary, it should be as brief as possible and preceded and followed by ventilation with 100 per cent oxygen.

TIME OUT 4

Return to the airway equipment items listed in Box 1. Give a brief description of each item and summarise how each item is used in the context of cardiac/respiratory arrest.

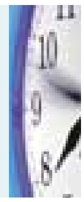
Circulation equipment

The equipment required for management of the circulation is shown in Box 6. All the procedures described in this section require further training before they can be undertaken.

Once airway and ventilatory management have been achieved, attention should then be given to the circulatory status of the patient. According to the RCUK (2000b), patients who require resuscitation often have underlying cardiovascular disease, which accounts for approximately 40 per cent of all deaths in Europe in people below the age of 75. Circulatory assessment and related interventions are, therefore, the cornerstone of emergency interventions for emergency patients, regardless of their complaint or symptoms (Koran and Newberry 1998).

TIME OUT 5

Before proceeding, refer to the guidelines for basic life support (RCUK 2000c) and describe how an assessment of circulation is performed.



Prompt assessment of the circulatory status must be performed and an artificial circulation established so that coronary and neurological perfusion are maintained. The RCUK (2000b) advocates that this is achieved when chest compressions are delivered at a rate of 100 per minute uninterrupted except for pulse checks when indicated, and ventilation occurs at approximately 12 breaths per minute. If a pause in chest compressions occurs, coronary perfusion falls dramatically with the mean perfusion pressure taking time to resume its former level, even when chest compressions are resumed.

Box 5. Technique for orotracheal intubation

- The patient must be pre-oxygenated before commencing intubation. The RCUK (2000b) recommends that intubation should take no longer than 30 seconds and should be preceded by ventilation with a high concentration of oxygen for a minimum of 15 seconds
- The patient is positioned with the head extended and neck flexed. This is often referred to as the 'sniffing the morning air position'. If spinal injury is suspected, this position is avoided and the head and neck maintained in neutral alignment
- The laryngoscope is inserted and the mouth briefly checked for loose teeth and foreign matter. Suction may be required. Once the larynx has been identified, the tube is advanced through the right side of the mouth keeping the larynx in view until the proximal limit of the cuff is positioned just below the chords
- If successful, the tube is connected to a catheter mount and then to a ventilation device such as the self-inflating bag (bag valve device). The highest concentration of oxygen available should be administered
- The cuff of the tube should be inflated sufficiently to prevent an air leak during inspiration
- The position of the tube must be checked by observing that both lungs expand equally and by listening at the sides of the chest for breath sounds. If the right side only is ventilating, the tube may have been inserted too far and has entered the right main bronchus. The cuff should be deflated and the tube withdrawn 1-2cm, reinflated and checked again
- Secure the tube with the ribbon gauze tie and insert a bite block or oropharyngeal airway to prevent damage from biting when consciousness returns

(RCUK 2000b)

Box 6. Circulation equipment

- Intravenous cannulae 18 gauge x 3, 14 gauge x 3
- Hypodermic needles 21 gauge x 10
- Syringes 2ml x 6, 5ml x 6, 10ml x 6, 20ml x 6
- Cannula fixing dressings and tapes x 4
- Seldinger wire central line kits x 2
- 12 gauge non-Seldinger central venous cannulae x 2
- Intravenous giving sets x 3
- 0.9% sodium chloride – 1,000ml x 2

(RCUK 2000a)

Circulatory access and intravenous cannulation During CPR, if access to the circulatory system is not already established, it must be promptly acquired. This is done for several reasons including the administration of drugs, giving intravenous (IV) fluid, taking blood samples and inserting cardiac-pacing wires if required. Three routes can achieve access to the circulation. The route most commonly used during cardiac arrest is the IV route, although the tracheal and intraosseous routes can be considered as alternatives if access to the IV route fails. Intracardiac injection, although previously popular, is no longer recommended because of the considerable risk of complications such as pneumothorax, cardiac tamponade or laceration of a coronary artery (Colquhoun *et al* 1999).

The intravenous route To achieve venous access, a variety of IV cannulae are available on the trolley. IV cannulae are either hollow metal needles or the more commonly used plastic cannulae. Hollow metal needles are not recommended during resuscitation events, as they can easily become dislodged, allowing extravasation of fluids and drugs (RCUK 2000b).

Cannula over needle This is the device most commonly used. It consists of a plastic tube mounted over a metal needle, the bevel of which protrudes from the plastic tube (Figure 9). The metal needle is introduced into the vein and then removed, leaving the plastic tube in place. This is then secured using the fixing device found on the trolley. All cannulae have a standard Luer-Lok aperture for attaching to a giving set. Some cannulae have wings to aid attachment to the skin and a valved injection port through which drugs can be administered. The size of the cannula depends on the urgency of the patient's condition, the patient's size, age and condition of the vasculature. In a cardiac arrest situation, large-sized cannulae are usually selected to achieve a fast flow; the trolley contains sizes 14 and 18 gauge for this purpose.

As these devices are available in a variety of lengths, they can be used for peripheral or central venous insertion. A large vein, usually in the antecubital fossa is the site of choice, the external jugular and femoral vein providing useful alternatives giving faster drug delivery but with greater risk of complications. Where peripheral venous cannulation is used for drug administration, either a flush of 20ml sodium chloride or an IV infusion is required. Two litres of 0.9% sodium chloride is provided on the resuscitation trolley for this purpose. The arm should also be raised to expedite drug entry into the circulation (RCUK 2000b).

Figure 9. Cannulae

The cannula over needle is the device most often preferred in a cardiac arrest as it is easier to insert than the Seldinger device (Skinner and Vincent 1997).

Central venous cannulation Central venous access cannulae are made of silicone or polyurethane having a radiopaque strip. The most commonly used is the Seldinger type, the name Seldinger refers to the technique used during insertion. The equipment required for the cannulation of a central vein includes a Seldinger wire central venous catheter kit and a relatively small cannula. Two kits and two size 12G cannulae are provided on the trolley. The chosen vein is entered with a pilot needle attached to a syringe. When blood is aspirated freely, the syringe is removed and the flexible end of the wire is inserted through the needle 5-6cm into the vein. The needle is then removed leaving the wire behind. The cannula is then loaded onto the wire ensuring that the distal end of the wire protrudes through the cannula. The wire and cannula are then advanced into the vein, the wire is removed and a syringe is attached to the cannula to remove blood, thus confirming that the cannula is in a vein (RCUK 2000b).

Box 7. Complications of central venous catheter insertion

- Hydrothorax
- Haemothorax
- Pneumothorax
- Cardiac arrhythmias
- Cardiac tamponade
- Thoracic duct trauma
- Brachial plexus injury
- Air embolism
- Catheter embolism
- Haemorrhage
- Misdirection or kinking

(Dougherty 2000)

There are a number of complications associated with insertion of a central venous access device (Box 7). Evidence suggests that the more experienced a practitioner is at inserting the device, the lower the complication rates, especially of pneumothorax (Nightingale 1997).

The sites most often chosen for central access include the internal jugular and the subclavian vein. The internal jugular is preferred, as cannulation does not interfere with external cardiac massage (RCUK 2000b). Woodrow (2002) suggests that the femoral site might also be useful during a cardiac arrest should access elsewhere prove difficult.

Central versus peripheral routes Kuhn *et al* (1981) demonstrated during research into peripheral versus central circulation times, that a delay was experienced in the arrival of dye in the femoral artery following the use of a peripheral device in people who had had a cardiac arrest. The arrival time of the dye when centrally administered was 30 seconds as opposed to not being detected within 90 seconds when peripherally administered. The preferred site for access is therefore a central vein, as drugs will reach their site of action more rapidly.

In reality, the choice of route will be determined by the skill and experience of the people in attendance at the arrest. Peripheral cannulation is safe, easily learnt and does not require interruption of CPR (Colquhoun *et al* 1999). Central cannulation requires resuscitation to be interrupted (Colquhoun *et al* 1999) and greater skill, more training and practice. Since more and more nurses are adding peripheral venous cannulation to their repertoire of skills, this is an aspect of advanced life support that can usually be accomplished by nursing staff.

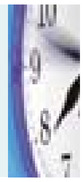
The endotracheal route This route may be used when access to the circulation by cannulation proves difficult. It is often used in patients who are profoundly hypovolaemic, hypothermic or are IV drug users (RCUK 2000b). It is also used during cardiac arrest situations (RCUK 2000c).

Conflicting evidence regarding the efficiency of drug administration using this method has been reported from clinical studies. Bray *et al* (1987) showed an encouraging response in the administration of endotracheal atropine, while Quinton *et al* (1987) showed that there was no rise in arterial adrenaline levels following administration. It cannot, therefore, be the route of choice. A further disadvantage is that the route is not appropriate for all drugs: calcium salts, sodium bicarbonate and amiodarone fall into this category (RCUK 2000b). When this route has been used, it has been recommended that the dose of the drug should be increased to two to three times the IV dose. Administration should be followed by five ventilations to disperse the drug into the peripheral bronchial tree to aid absorption (RCUK 2000c).

The drug should thus be diluted into a volume of 10-20ml of sterile water and delivered as a jet or spray to take advantage of the larger surface area of the bronchioles and alveoli (RCUK 2000b).

TIME OUT 6

Before moving on, summarise the advantages and disadvantages of intravenous cannulae and central venous catheters.

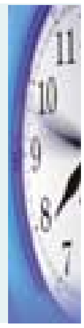


Drugs

As you will be aware, a small selection of drugs is indicated for use in advanced life support. These drugs are shown in Box 8 and are discussed in detail in this article. All the drugs should be available in a pre-filled syringe or 'mini-jet' system ready for immediate use. The guidance indicates a further selection of drugs that should be available but are not discussed here (Box 9). Appropriate training in accordance with local trust policy must be undertaken before taking on the role of drug administration.

TIME OUT 7

Before commencing the next section, refer to the advanced life support algorithms that you located on the www.resus.org.uk website. Make a note of the drugs that are indicated, looking in particular at the dose and route of the drugs and where in the algorithm they are given.



Adrenaline (epinephrine) Adrenaline is a potent catecholamine and is the first drug used in a cardiac arrest of any cause (RCUK 2000c). As you will have noted, it is included in the advanced life support algorithm for use after every three minutes of CPR. It is also used in the treatment of anaphylaxis and as second-line treatment for cardiogenic shock (RCUK 2000b). Adrenaline acts by stimulating both alpha- and beta-adrenergic receptors in the sympathetic nervous system, the part of the nervous system responsible for the 'fight or flight' phenomenon. The drug is used primarily in cardiac arrest for its effect on the alpha-1 and alpha-2 receptors in the cardiac muscle conduction system (Hinchliff *et al* 1996), stimulation of which produces arterial and arteriolar vasoconstriction. This action ensures that systemic vascular resistance is maintained during CPR, thus producing an increase in coronary and cerebral perfusion (RCUK 2000b). The

Box 8. Drugs indicated for use in advanced life support

Immediately available pre-filled syringes containing:

- Adrenaline (epinephrine) 1mg (1:10,000) x 4
- Atropine 3mg x 1
- Amiodarone 300mg x 1

(RCUK 2000a)

Box 9. Other readily available drugs not discussed in this article

- Adrenaline (epinephrine) 1mg (1:10,000) x 4
- Sodium bicarbonate 8.4% – 50ml x 1
- Calcium chloride 13.24% – 10ml x 2
- Lidocaine 100mg x 2
- Atropine 1mg x 2
- Normal saline 10ml ampoules x 10
- Naloxone 400mcg x 2
- Adrenaline (epinephrine) 1:1,000 x 2
- Amiodarone 150mg x 4
- Magnesium sulphate 50% solution 2g (4ml) x 1
- Potassium chloride 40mmol x 1
- Adenosine 6mg x 10
- Midazolam 10mg x 1
- Hydrocortisone 200mg x 1
- Glucose 10% 500ml x 1

(RCUK 20000a)

main effects of stimulation of the beta-1 receptors in the cardiac muscle conduction system include an increase in the heart rate (known as a positive chronotropic effect) and the force of contractility (positive inotropic effect), both of which are potentially harmful as they raise the demand for oxygen by the myocardium (positive inotropic effect).

There are two strengths of adrenaline: 1:1,000 (1ml contains 1mg of the drug), for intramuscular administration in anaphylaxis and 1:10,000 (10ml of this solution contains 1mg of the drug), ten times weaker, for use in cardiac arrest via IV administration (Harrison and Daly 2001). In a cardiac arrest, if venous access is delayed, or cannot be obtained, 2-3mg of 1:10,000 solution diluted into a volume of 10ml sterile water may be given via the ETT (RCUK 2000b).

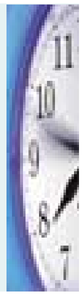
Atropine Atropine is indicated after adrenaline in asystole and pulseless electrical activity (PEA) with a heart rate of less than 60 beats per minute (bpm) (RCUK 2000b). It is also used in sinus, atrial or nodal bradycardia when the haemodynamic condition of the patient is poor (RCUK 2000b). Atropine is an anticholinergic drug that blocks the action of the vagus nerve on the sinoatrial (SA) and atrioventricular (AV) nodes, thereby increasing their conduction velocity (Eltz *et al* 2002). It also increases the SA node discharge rate, and decreases the effective refractory period of the AV node. The end result is an increase in heart rate. The recommended adult dose for patients in asystole or PEA with a rate less than 60bpm, is 3mg intravenously in a single dose. According to the RCUK (2000b), there is no conclusive proof that the drug is of any value for use in asystolic cardiac arrest, however, as this represents a 'grave prognosis' and anecdotal accounts of success do exist, the RCUK suggests that it is unlikely to be harmful in a cardiac arrest situation.

Amiodarone Amiodarone is an anti-arrhythmic drug, widely used because of its efficacy and safety record (Landowski *et al* 2002). It works on the conducting tissue of the heart and affects all phases of the action potential. It is particularly associated with inhibiting the outflow potassium channels and hence prolonging polarisation. It is generally accepted as the most effective anti-arrhythmic drug. In cardiac arrest it is used in the treatment of refractory ventricular fibrillation (VF) and pulseless ventricular tachycardia (VT). It is also indicated for use in haemodynamically stable VT and other resistant tachycardias.

In cardiac arrest, an initial IV dose of 300mg amiodarone diluted in 5% dextrose to 20ml, or via a pre-filled syringe, should be considered if VF or pulseless VT persists after the first three shocks (RCUK 2000b). This can be given as a bolus injection into a peripheral vein, but is best administered via a central venous catheter if one is available.

TIME OUT 8

The other drugs that may be used in cardiac arrest have not been discussed in detail. You may, however, need to use these drugs in practice. Take some time now to make notes on the use, action and recommended dosage of the drugs listed in Box 9.



Additional items

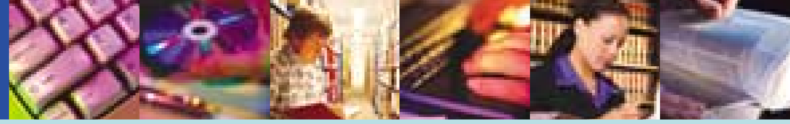
Additional items are recommended for inclusion on the standard resuscitation trolley (Box 10). In accordance with the advanced life support algorithm, following the onset of VF or pulseless VT, cardiac output ceases and cerebral hypoxia commences within three minutes. Defibrillation must be attempted (by appropriately trained personnel) as soon as possible in these circumstances in a bid to prevent or limit neurological damage. Defibrillation is defined as the 'termination of fibrillation' or 'the absence of VF/VT at 5 seconds after shock delivery' (RCUK 2000b).

The defibrillator sends a current of electricity across the myocardium to depolarise a critical mass of the cardiac muscle simultaneously, thus allowing the natural pacemaker to resume control of the heart. Factors that affect the success of the shock include transthoracic impedance. This is influenced by the paddle size, paddle-skin coupling material, number and time interval between shocks, phase of ventilation

Box 10. Additional items on the standard resuscitation trolley

- Electrocardiogram (ECG) electrodes
- Defibrillation gel pads
- Clock
- Gloves, goggles, aprons
- A sliding sheet or similar device should be available for safer patient handling

(RCUK 2000a)



and paddle pressure (RCUK 2000b). Impedance between the paddle and the skin is reduced by the use of gel pads that are found on the standard trolley. The pads vary according to the manufacturer; they are for single patient use only but can be used a number of times during the same resuscitation attempt, before requiring replacement, again according to manufacturer's instructions. The packet containing the gel pads should be checked to ensure that it has not been opened, as this will allow the pads to dry out and become unusable. Not only do the pads limit transthoracic impedance, they also protect the patient from burns as a result of the electricity (RCUK 2000b).

ECG electrodes are also recommended as standard contents of the trolley. As can be seen from the advanced life support algorithm, diagnosis of the cardiac rhythm is vital so that the appropriate action may be taken. The patient, therefore, requires a cardiac monitor, or monitoring via the defibrillator, which necessitates the use of monitoring electrodes. As with the gel pads, these have a tendency to dry out and must be checked before use, as this will affect the quality of the ECG trace.

Universal precautions should always be used; the inclusion of goggles, gloves and aprons is a reminder of the need for care even in an emergency. A slide sheet or similar device is also recommended as health and safety are also important considerations whatever the situation. The final suggested item is a clock. This is started at the beginning of a resuscitation attempt and has several purposes. First, it allows the team to keep track of how long the resuscitation attempt has been under way. This will provide useful information in the decision to suspend resuscitation. The clock is also useful for the timing of drug administration during resuscitation. You will remember from the discussion on the role of drugs in the algorithms that adrenaline is administered after each three minutes of CPR.

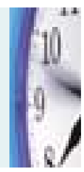
Conclusion

It is important that all hospitals provide appropriate equipment to enable resuscitation to be attempted and to maintain patient and staff safety while doing so. This also includes the provision of services for adequate training and regular updating of all appropriate staff.

It is also the responsibility of each member of the healthcare team to ensure that their practice is current and that they understand the role and function of each item on the resuscitation trolley to maximise the effectiveness of resuscitation and, therefore, improve patient outcomes. Having worked through this article, you should have a greater understanding of why each item is included and an appropriate evidence-based rationale for use in an emergency situation

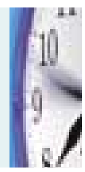
TIME OUT 9

Review the complete list of contents and write down a description of each item and its use in a cardiorespiratory arrest.



TIME OUT 10

Now that you have finished the article, you might like to write a practice profile. Guidelines to help you are on page 55.



REFERENCES

Baskett P *et al* (1996) Guidelines for the advanced management of the airway and ventilation during resuscitation. *Resuscitation*. 31, 3, 201-230.

Baskett P *et al* (1994) The use of the LMA by nurses during CPR: a multicentre trial. *Anaesthesia*. 49, 8, 731-732.

Bray B *et al* (1987) Tracheal versus intravenous atropine. *Anaesthesia*. 42, 11, 1188-1190.

Brenner B *et al* (1997) Determinants of reluctance to perform CPR among residents and applicants: the impact of experience on helping behavior. *Resuscitation*. 35, 3, 203-211.

Castle N (1999) The airway and the A&E nurse. *Emergency Nurse*. 6, 10, 29-35.

Colquhoun M *et al* (1999) *ABC of Resuscitation*. Fourth edition. London, BMJ Books.

Dougherty L (2000) Central venous access devices. *Nursing Standard*. 14, 43, 45-50.

Driscoll P *et al* (2000) *ABC of Major Trauma*. London, BMJ Books.

Eltz P *et al* (2002) *Mastering ACLS*. Philadelphia PA, Springhouse.

Gabbott D, Baskett P (1997) Management of the airway and ventilation during resuscitation. *British Journal of Anaesthesia*. 79, 2, 159-171.

Greaves I *et al* (1997) *Emergency Care: A Textbook for Paramedics*. London, WB Saunders.

Harrison R, Daly L (2001) *Acute Medical Emergencies*. London, Churchill Livingstone.

Hinchliff S *et al* (1996) *Physiology for Nursing Practice*. London, Baillière Tindall.

Jevon P (2002) Mouth to mask ventilation. *Nursing Times*. 98, 13, 45-46.

Koran Z, Newberry L (1998) Vascular access and fluid replacement. In Newberry L (Ed) *Sheehy's Emergency Medicine: Principles and Practice*. St Louis MO, ENA Books, Mosby.

Kuhn G *et al* (1981) Peripheral versus central circulation times during CPR. *Annals of Emergency Medicine*. 10, 8, 417-419.

Landowski R *et al* (2002) Drugs used in the heart: pharmacology part 1. *Nursing Times*. 98, 18, 43-46.

Leach A *et al* (1993) The laryngeal mask airway in cardiopulmonary resuscitation in a district general hospital: a preliminary communication. *Resuscitation*. 25, 3, 245-248.

Nightingale C (1997) A prospective analysis of 949 long-term central venous access catheters for ambulatory chemotherapy in patients with gastrointestinal malignancy. *European Journal of Cancer*. 33, 3, 398-403.

O'Meara M (1995) The laryngeal mask airway. *Anaesthesiology*. 9, 2, 305.

Quinton D *et al* (1987) Comparison of endotracheal and peripheral IV adrenaline in cardiac arrest. *Lancet*. 1, 8537, 828-829.

Resuscitation Council UK (2000a) *CPR Guidance for Clinical Practice and Training in Hospitals*. (Appendix revised 2001). www.resus.org.uk/pages/standard.htm (Last accessed: June 7 2004.)

Resuscitation Council UK (2000b) *Advanced Life Support Provider Manual*. Fourth edition. London, RCUK.

Resuscitation Council UK (2000c) *Adult Basic and Advanced Life Support Guidelines*. www.resus.org.uk (Last accessed: June 30 2004.)

Roberts I *et al* (1997) Airway management training using an LMA: a comparison of two different training programmes. *Resuscitation*. 33, 3, 211-214.

Skinner D, Vincent R (1997) *Cardiopulmonary Resuscitation*. Oxford, Oxford University Press.

Stone B *et al* (1998) The incidence of regurgitation during CPR: a comparison between the bag valve mask and the LMA. *Resuscitation*. 38, 1, 3-6.

Woodrow P (2002) Central venous catheters and central venous pressure. *Nursing Standard*. 16, 26, 45-51.