Manual of
Clinical Paramedic Procedures
Pete Gregory
With thanks to Alison and Natalie Gregory for their patience and support during the writing of this book.

Ian Mursell
For Kate and Ollie.
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The *Manual of Clinical Paramedic Procedures* is unique in its extensive use of references to support the practical guidance that it offers. Evidence-based medicine is a core principle of practice in the modern UK National Health Service and in many other health providers throughout the world. Its application in pre-hospital care is, however, still under-developed, but this text goes a long way towards addressing this deficiency.

Both authors are experienced paramedics and educators, and draw on a considerable body of expertise to meet the needs of their readers. The appropriate audience for this book includes student paramedics, who will find this a rich source of material to support their studies, but also the broadest range of practitioners in pre-hospital care, resuscitation, and emergency medicine, including registered paramedics, doctors, nurses, resuscitation officers, and medical students.

Each chapter starts with a definition of the topic to be addressed. Where appropriate, the relevant anatomy and physiology are briefly but helpfully reviewed, followed by a detailed description of each clinical procedure. The use of copious colour pictures adds significantly to the utility of the clear, concise, and eminently readable text. Scenarios are used to establish the context of each chapter in true-to-life clinical settings, and break-out boxes prompt the reader to apply the principles described as they read through the material. Step-wise descriptions of each procedure are supported by detailed rationales for each sub-process and provide an important insight into the concepts behind each technique. Key points boxes emphasise particularly critical issues and summarise chapter contents, and each chapter ends with an extensive reference and further reading list. The use of this wide range of methods for presenting information means that this book will suit most readers, regardless of their preferred learning style, will aid retention, and prevent boredom.

I am naturally a lazy reader when studying, preferring to disappear into a good science fiction novel rather than a textbook. Yet I can enthusiastically recommend the *Manual of Clinical Paramedic Procedures* as the book that I wish had been available to me when I was studying to become a paramedic, and the one which I wish I
had written myself! It should take pride of place on the bookshelf of any student or experienced practitioner of pre-hospital care - but should be re-read at regular intervals to support the highest standards of clinical practice that we all aspire to.

Malcolm Woollard, PA02584, MPH, MBA, MA(ED), DipIMC (RCSED), PGCE, RN, MCPara, NFESC, FASI, FHEA, FACAP

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Clinical skills are fundamental in the day-to-day work of prehospital care providers, yet it is difficult to find a text book that not only demonstrates a step-by-step approach to clinical skills, but also provides evidence to support the approaches being advocated. At a time where pre-hospital providers are becoming ever more high-profile and public expectations are increasing, it is essential that Paramedics, Emergency Medical Technicians (EMT), and those working in the voluntary services adopt practices that are supported by the evidence. There is currently a dearth of high-quality research in prehospital care to either support or refute many of the activities carried out by prehospital providers but there is often good evidence from other disciplines that can be extrapolated to fill the void.

The Manual of Clinical Paramedic Procedures serves to review the available literature surrounding the application of key skills in prehospital care, challenges some current practices, and offers recommendations based upon the findings. The clear diagrams, pictures and supporting evidence will provide a sound reference text for those at the beginning of their health care careers through to those who are already established as competent practitioners. It will also serve the many proactive members of the voluntary ambulance organisations looking to enhance the service that they provide to their communities.

For the qualified Paramedic, the manual provides the evidence to underpin their practice and offers a ready source of information that will prove invaluable when mentoring paramedic students. It will also add to the Paramedic’s portfolio of continuing professional development by challenging current thinking and allowing the Paramedic to reflect upon how the evidence has influenced changes in their practice. Many of the clinical skills discussed within the book also fall within the remit of non-paramedic prehospital practitioners so there is plenty of value for the EMT, first responder and members of a voluntary care organisation. For the Paramedic student, the book is invaluable for learning clinical skills and has the advantage over other texts in that it clearly cites its references, which can easily be integrated into academic essays and reflections.
The application of clinical skills in emergency care is rarely straightforward, especially in the hostile prehospital environment. It is hoped that by using this manual as a basis for performing clinical skills, the practitioner will be better placed to make decisions and will have the underpinning knowledge to perform the skills safely and to greatest patient benefit.
Chapter 1
Airway management

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In emergency care, airway management is an essential first step as a means of achieving both oxygenation and ventilation. Failure to manage and maintain the airway can lead to neurological dysfunction and even death within minutes. This chapter discusses the concept of a stepwise approach to airway management and provides the rationale for the airway interventions currently available to the paramedic.

**Definition of airway management**

Airway management may be defined as the provision of a free and clear passage-way for airflow. Obstruction of the airway may be partial or complete and may occur at any level from the nose to the trachea. In the unconscious patient, the most common site of airway obstruction is at the level of the pharynx and this obstruction has usually been attributed to posterior displacement of the tongue caused by reduced muscle tone. However, the cause of airway obstruction is often the soft palate and the epiglottis rather than the tongue. Obstruction may also be caused by vomit or blood, swelling of the airway (e.g. anaphylaxis), a foreign body, or laryngeal spasm.

**Concept of a stepwise approach**

Airway management techniques range from basic manual manoeuvres to the more complex techniques of tracheal intubation and cricothyroidotomy. Each technique comes with its own inherent risks and it is essential that the paramedic is aware of the problems and limitations of each technique. It is advocated that a stepwise approach that leads from the least invasive to the most invasive technique be adopted. The paramedic may choose to miss out certain steps based upon the needs of the patient, but a risk-benefit analysis should be undertaken to ensure that the most appropriate airway management technique is employed. It should be noted that measurement of airway adjuncts only provides a starting point for deciding on the appropriate size; it is essential to assess the effectiveness of any airway manoeuvre once undertaken.

**Scenario**

You are called to attend a 37-year-old female patient in cardiopulmonary arrest. On arrival you find that the patient is in the third trimester of pregnancy lying supine on the floor. What anatomical and physiological changes occur during pregnancy that may affect your airway management strategy? How would you manage the patient’s airway?
Basic anatomy of the airway

See Figure 1.1.

Safe airway management requires sound knowledge of the relevant anatomy. This section provides an overview of the nose, pharynx, larynx, trachea and main bronchi; the practitioner is advised to refer to an appropriate anatomy textbook for a deeper description of the airway.

Nose

The nose can be divided into external and internal portions. The external portion provides a supporting structure of bone and cartilage for the overlying muscle and skin; it is lined with a mucous membrane. The bony framework of the external nose is formed by the frontal bone, nasal bones and maxillae.

The internal portion lies inferior to the nasal bone and superior to the mouth and contains both muscle and a mucous membrane. It is worth remembering that the internal nares extend in an anterior-posterior direction, especially when inserting a nasopharyngeal airway.

Mouth

The mouth is not strictly a part of the airway, but as many airway management interventions involve the mouth, it is worth reviewing basic anatomy. The mouth is formed by the cheeks, hard and soft palates, and the tongue. The lips surround the opening to the mouth and each lip is attached to its respective gum by the labial frenulum. The vestibule is the space between the cheeks or lips, and the teeth. The roof is formed by the hard and soft palates, whilst the tongue dominates the floor. The anterior portion of the tongue is free but connected to the underlying epithelium.

Figure 1.1 Lateral wall of nasal cavity. Reproduced from Faiz, O. and Moffat, D. Anatomy at a Glance, 2nd edn, copyright 2006, with permission of Blackwell Publishing.
by the lingual frenulum. The border between the mouth and the oropharynx extends from the dangling uvula to the base of the tongue.\footnote{6}

**Pharynx**

The pharynx is divided into three anatomical sections; the nasopharynx (extending from the internal nares to the posterior edge of the soft palate), the oropharynx (extending to the base of the tongue at the level of the hyoid bone) and the laryngopharynx (extending to the opening of the oesophagus).

**Larynx**

See Figures 1.2 and 1.3. This is a very important structure in terms of airway management and it is essential to know the anatomy in depth. Basic anatomy is outlined here but it is recommended that revision should be undertaken with an appropriate anatomy text (see reference\footnote{5}).

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**Figure 1.2** Cartilages of the larynx. Reproduced from Faiz, O. and Moffat, D. *Anatomy at a Glance*, 2nd edn, copyright 2006, with permission of Blackwell Publishing.

**Figure 1.3** Larynx as viewed through a laryngoscope. Reproduced from Faiz, O. and Moffat, D. *Anatomy at a Glance*, 2nd edn, copyright 2006, with permission of Blackwell Publishing.
The larynx consists of nine cartilages; three paired and three single, as described below.

The epiglottis projects above the glottis and protects the larynx during swallowing. The thyroid cartilage forms most of the anterior and lateral surfaces of the larynx and tends to be more prominent in men. The cricoid cartilage is the ring-shaped cartilage that connects the larynx to the trachea. The three paired cartilages are found within the interior structure of the larynx and are the arytenoids, corniculate and cuneiform cartilages.

**Trachea**

See Figure 1.4.

The trachea is approximately 11-12 cm long and 2.5 cm in diameter. It is held open by ‘C’ shape cartilage, which is open posteriorly to allow for extension of the oesophagus during swallowing. The trachea bifurcates into the left and right main bronchi around the level of the 5th thoracic vertebra. The right main bronchus is

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**Figure 1.4** Trachea and main bronchi. Reproduced from Faiz, O. and Moffat, D., *Anatomy at a Glance* 2nd edn, copyright 2006, with permission of Blackwell Publishing.
larger in diameter than the left and extends at a steeper angle - an endotracheal tube that has been inserted too far is most likely to locate itself in the right side, as are foreign body obstructions.

**Basic airway management manoeuvres**

**Head tilt and chin lift**

This manoeuvre has been the mainstay of basic airway management for nearly 50 years with few changes advocated since the early 1960s. The rescuer’s hand is placed on the patient’s forehead and the head gently tilted back; the fingertips of the other hand are placed under the point of the patient’s chin, which is gently lifted to stretch the anterior neck structures (Figure 1.5).

**Jaw thrust**

The jaw thrust is recommended where there is a risk of cervical spine injury but it may be used electively on any patient. Where there is no risk of spinal injury, the manoeuvre may be applied on its own or in conjunction with a head tilt manoeuvre.

The jaw thrust brings the mandible forwards and relieves obstruction by the soft palate and epiglottis. The practitioner places their index and other fingers behind the angle of the mandible and their thumbs on the mandible itself (Figure 1.6). The thumbs gently open the mouth whilst the fingers are used to apply pressure upwards and forwards. This movement causes the condyles of the mandible to sublux anteriorly in the temporomandibular joints. This displaces the mandible and tongue anteriorly, thereby clearing the airway.7

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**Figure 1.5** Head-tilt, chin-lift.
Figure 1.6 Jaw thrust.

**THINK**

Is there any circumstance where it would be permissible to perform a head tilt and chin lift manoeuvre in a patient with suspected cervical spine injury?

**Basic airway adjuncts**

**Nasopharyngeal airway**

See Figure 1.7.

The nasopharyngeal airway (NPA) is a simple airway adjunct that is used by a number of different healthcare disciplines. It has advantages over the oropharyngeal airway (OPA) in that it can be used in the presence of trismus, an intact gag reflex, or oral trauma.8 Despite these advantages, the NPA is used less frequently than the OPA.9,10
Figure 1.7 Nasopharyngeal airways.

Figure 1.8 Bevel of NPA against the septum.

The NPA is designed to relieve soft tissue upper airway obstruction in a patient requiring airway support. The tube follows the natural curvature of the nasopharynx and extends to the posterior pharynx below the base of the tongue where it separates the soft palate from the pharynx. The distal end is bevelled to facilitate placing of the tube; the bevel should be placed against the nasal septum (Figure 1.8).
Sizing of an NPA

Traditional methods of sizing have tended to compare the NPA with the patients little finger or the size of their external nares; these methods are based on anecdote rather than evidence and are likely to be flawed. Both methods place emphasis on the diameter of the tube rather than the length despite an earlier study clearly showing that the length of the tube was more important than the diameter.11 This study suggested that the tube should lie within 1 cm of the epiglottis. If too short the airway would not separate the soft palate from the posterior wall of the pharynx and if too long would enter either the larynx and stimulate laryngeal reflexes, or enter the vallecula with the inherent risk of obstructing the airway.

One small study has shown that neither of the traditional methods for measuring the NPA correlated with the nasal anatomy of the subject, so are unreliable.12 A clear correlation between patient height and their nares–epiglottis length has been demonstrated11 so it is perhaps more sensible to base NPA size on the patient’s height and sex. In the absence of a more accurate measurement, it is recommended that a size 6 (130 mm length) be used for an average female and a size 7 (150 mm length) for an average male.8,12 Longer or shorter lengths may be considered for patients who are taller or shorter than average.

Once the initial choice has been made the NPA should be measured to ensure that only the correct length is inserted. A reasonable way of ascertaining this is to measure from the tip of the nose to the tragus of the ear. There is sufficient anatomical correlation for this to prove reliable although checks to ensure correct placement should be undertaken afterwards. When the length has been ascertained, the safety pin should be inserted into the proximal end of the NPA at the maximum point of insertion; this will prevent the NPA from being inserted too far into the pharynx and possibly into the oesophagus. For example, if a size 7 (150 mm) had been selected and the measure from the tip of the nose to the tragus was 145 mm, the pin should be placed 5 mm distal to the flange of the NPA. The safety pin is not there to prevent loss of the NPA into the external nares. When inserting the safety pin, place to the side of the NPA to allow free passage for suction catheters if required.

Contraindications

A commonly taught contraindication to the use of an NPA is a potential or known basal skull fracture. Two published case reports of an NPA being inserted through a fractured cribiform plate into the cranial vault13,14 may have been responsible for the development of this contraindication and it has been propagated by the Advanced Trauma Life Support Manual and courses. It is difficult to know whether these were isolated occurrences or whether further reports are less likely as it is no longer a novel complication, plus there may be a tendency to under report clinical errors.15 The consensus appears to be that NPA placement may be necessary, even where relative contraindications exist, to avoid sub-standard airway management in patients with suspected or apparent base of skull fracture.

Complications

The most common complication is bleeding, which may cause serious airway obstruction if not managed. Blood tends to coagulate in the trachea and will form a solid
occlusion to the passage of air. Patient positioning may help if bleeding does occur and suctioning will also be of benefit, although it is possible that suctioning may not be sufficient to maintain a clear airway.

If the bleeding is in the anterior portion of the nose, consider use of a tampon to stem the flow. If in the posterior portion of the nose, it may be necessary to insert a device such as a urinary catheter so that the balloon can be inflated to prevent aspiration of blood. Any practitioner who inserts an NPA must have a contingency plan for managing haemorrhage should it occur.

Necrosis of the anterior aspect of the nose may also occur if the diameter of the NPA is too large. If there is evidence of blanching around the external nares the NPA should be removed and a smaller one inserted. Necrosis will commence within about 20 minutes of the occlusion of blood supply and it is very difficult to cosmetically alter any damage.

Equipment required

- Range of nasopharyngeal airways
- Water-based lubricant
- Devices to arrest haemorrhage in both anterior and posterior portion of nose should it occur.

Technique for insertion

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<th>Procedure</th>
<th>Additional information/rationale</th>
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</thead>
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<td>1. Select appropriate size, 7.0 as a starting point for an average adult male and 6.0 for an average adult female.</td>
<td></td>
</tr>
<tr>
<td>2. Once the selection has been made, measure from the tip of the nose to the tragus of the ear. Insert safety pin to mark the maximum depth of insertion (this should be at the proximal end of the NPA).</td>
<td>If too short the airway would not separate the soft palate from the posterior wall of the pharynx; if too long may enter either the larynx or vallecula where the airway could become obstructed.</td>
</tr>
<tr>
<td>3. Where no risk of cervical spine injury exists, hyperextend the head and neck.</td>
<td>Stretches the anterior neck structures to relieve obstruction of the soft palate and epiglottis.</td>
</tr>
<tr>
<td>4. Lubricate the exterior of the tube with a water-soluble gel.</td>
<td>Minimises trauma during insertion.</td>
</tr>
<tr>
<td>5. If there is no obvious nasal deformity, it is recommended that the right nostril be used.</td>
<td>The bevel of the NPA is designed to cause less trauma to the mucosa when inserted into the right nostril.</td>
</tr>
<tr>
<td>6. Where deformity exists, the most patent nostril should be selected.</td>
<td></td>
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</tbody>
</table>
Airway management  

Procedure | Additional information/rationale
---|---
7. If inserting into the left nostril the bevel is placed alongside the septum and the airway rotated through 180° when it enters the nasopharynx. | To minimise trauma to the internal nares.

8. Insert the tube into the selected nostril and follow the nasal floor parallel to the mouth. It is imperative that the airway is not pushed in a cephalad direction. | This ensures correct location and reduces risk of cranial insertion where basal skull fracture exists.

9. Avoid pushing against any resistance. If resistance is felt, remove the airway, review technique and reinsert using the other nostril. | Pushing against resistance may cause bleeding and kinking of the NPA.

10. Verify appropriate position by listening for clear breath sounds and looking for chest rise and fall. Air may also be felt at the proximal end of the airway in the spontaneously breathing patient. | Ensures correct placement.

11. Check to make sure there is no blanching of the patient’s nostrils. If there is, remove NPA and select a smaller diameter. | Prevents necrosis of the tissues.

### Oropharyngeal airway

See Figure 1.9.

Oropharyngeal airways (OPA) are available in sizes suitable for neonate (00) to large adult (4). It is a curved plastic device designed to follow the curvature of the palate. It works to keep the tongue away from the posterior pharynx and to separate the soft palate from the pharyngeal wall. The OPA is designed to be used in unconscious patients requiring airway support and should only be inserted in those patients who have absent laryngeal and glossopharyngeal reflexes. Use of an OPA in patients with these reflexes intact may cause vomiting or laryngospasm.

The oropharyngeal airway can become obstructed at three possible sites: part of the tongue can occlude the end of the airway; the airway can lodge in the vallecula; and the airway can be obstructed by the epiglottis.

#### Sizing of an OPA

There is little evidence to support or contradict the traditional methods of sizing an OPA. Current teaching suggests that the length of the OPA should correspond with the vertical distance between the patient’s incisors and the angle of the jaw (Figure 1.10). This measurement is achieved by placing the flange of the OPA against the
Figure 1.9 Oropharyngeal airways.

Figure 1.10 Measuring an OP airway.

The patient’s cheek, parallel to the front of the incisors and viewing the tip at the angle of the jaw. If the airway is too long it may occlude the airway by locating within the vallecula and displacing the epiglottis; if too short it will not separate the soft palate or tongue from the posterior wall of the pharynx.
Contraindications

The OPA should not be used in any patient with an intact gag reflex.

Equipment required

Range of oropharyngeal airways.

Techniques for insertion

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Additional information/rationale</th>
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<tbody>
<tr>
<td>1. Select appropriate size.</td>
<td>If too short the airway would not separate the soft palate from the posterior wall of the pharynx; too long may displace the epiglottis.</td>
</tr>
<tr>
<td>2. Where no risk of cervical spine injury exists, hyperextend the head and neck. Grasp the patient’s jaw and lift anteriorly.</td>
<td>Stretches the anterior neck structures to relieve obstruction of the soft palate and epiglottis.</td>
</tr>
<tr>
<td>3. Using other hand, hold the OPA at its proximal end and insert it into the patient’s mouth with the tip pointing towards the roof of the mouth.</td>
<td>Avoids unnecessary trauma to the delicate tissues in the mouth and inadvertent blocking of the airway by pushing the tongue back.</td>
</tr>
<tr>
<td>4. Once the tip reaches the level of the soft palate, gently rotate the airway 180° until it comes to rest over the tongue.</td>
<td>Brings the OPA into the alignment required for use.</td>
</tr>
<tr>
<td>5. The flattened, reinforced section of a correctly sized OPA should lie between the patient’s teeth/dentures or gums. The lips should not be pulled over the flange of the OPA as this may cause damage to the labial frenulum.</td>
<td>Acts as a bite block.</td>
</tr>
<tr>
<td>6. Verify appropriate position by listening for clear breath sounds and looking for chest rise and fall.</td>
<td>Ensures correct placement.</td>
</tr>
</tbody>
</table>

See also Figures 1.11–1.14.

In small children the above technique should not be used due to the friable nature of the hard palate. Instead a tongue depressor should be employed and the OPA should be inserted ‘right side up’ with the tip pointing towards the tongue rather than the roof of the mouth. This technique may also be utilised for adult patients where a tongue depressor is available.
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Figure 1.11 Insertion of an OPA.

Figure 1.12 Insertion of an OPA.