saturation with a pulse oximeter (if available). Ensure that you have a resuscitation bag and mask available (and oxygen).

Restraining children for procedures
Restrain is important both for the child and for the clinician who is undertaking the procedure. Clearly, the procedure will be undertaken more quickly, safely and accurately if the child is kept still. However, to prevent a child with a chronic condition who will experience many such procedures being made fearful of further attempts, sedation should be strongly considered if facilities are available for this.

If facilities do not allow or if the procedure is unlikely to require repetition, physical restraint can be used. Ideally a parent or trusted friend or relative can actually hold the child. It is also very helpful to use distraction techniques such as singing a song, telling a story or using a glove puppet. Blowing soap bubbles is a very useful distraction for children, and it costs very little to bend a piece of wire into a loop and make up some strong soap solution.

First explain to the child in an age-appropriate manner what is going to happen. Never say ‘This won’t hurt when you know it will’. Always use local analgesia if at all possible (see Section 1.15). Explain why they are to be wrapped up (a ‘big cuddle’), what is to happen and what will happen afterwards. Give plenty of praise before, during and after the procedure.

Restraining a child for examination does not usually require wrapping, but it is wise to leave examination of the ears, nose and throat until the end of the examination.

8.2 Airway procedures

Oropharyngeal airway
For adjunct-free airway opening and airway positions, see Section 1.12.

The oropharyngeal or Guedel airway is used in the unconscious or obtunded patient to provide an open airway channel between the tongue and the posterior pharyngeal wall. In the conscious patient with an intact gag reflex, it may not be tolerated and may induce vomiting. It is especially useful in the convulsing and post-ictal patient.

The oropharyngeal airway is available in a variety of sizes. A correctly sized airway when placed with its flange at the centre of the incisors, and then curved around the face, will reach the angle of the mandible. Too small an airway may be ineffective, and too large an airway may cause laryngospasm. Either may cause mucosal trauma or may worsen airway obstruction. Reassessment following placement is therefore a vital part of safe insertion of an airway device.

There are two methods for inserting the oropharyngeal airway in a child, depending on whether the child is small or large. However, there is no set age for switching from one to the other, as the choice of method depends on practicality and the skills of the operator. The important thing is not to push the tongue back, as that will obstruct the airway instead of keeping it open.

The twist technique is used for the larger child and in pregnancy, and means that the convex side of the airway is used to depress the tongue as the airway is pushed into the mouth. Insert the airway upside down until the tip has passed the soft palate, and then rotate it through 180 degrees so that the natural curve of the Guedel airway follows the curve of the tongue and pharynx.

However, in the infant and small child, as the tongue is larger relative to the size of the mouth, the airway cannot be rotated in the mouth without causing trauma. Therefore

FIGURE 8.2.1 Oropharyngeal airway, showing sizing technique (correct size is illustrated).

FIGURE 8.2.2 Oropharyngeal airway, showing position when inserted.
the tongue is depressed with a spatula and not by the reversed airway.

Ensure that insertion of one of these devices results in improvement in the patient’s airway and breathing. If it does not improve the airway as shown by improved breathing, a reappraisal of the choice or size of airway is urgently required (see also Section 1.13).

Tracheal intubation

Aims
These are as follows:
- to secure the airway
- to protect the airway
- to facilitate prolonged and intra-operative ventilation
- for tracheo-bronchial toilet
- in the application of high airway pressures and positive end-expiratory pressure (PEEP)
- during cardiopulmonary resuscitation to improve ventilation and allow uninterrupted chest compressions.

Choice of tube
An uncuffed tube is often recommended in children who weigh less than 25kg, as the larynx is narrowest below the glottis at the circular non-distensible cricoid ring, and inexperienced use of the cuffed tube may cause damage at that point, although the cuffed tube gives better airway protection. The choice ultimately depends on the experience of the practitioner (see also Section 1.13).

The correctly sized tube is one that passes easily through the glottis and subglottic area with a small air leak detectable at 20 cmH₂O (sustained gentle positive pressure).

Size of tube
The correct size of tube is:
- one that can just fit into the nostril or
- in preterm neonates, 2.5–3.5 mm internal diameter or
- in full-term neonates, 3.0–4.0 mm internal diameter or
- in infants after the neonatal period, 3.5–4.5 mm internal diameter or
- in children over 1 year:
  - the internal diameter (in mm) is age/4 + 4
  - the length of tube (in cm) is age/2 plus 12 for an oral tube, and age/2 plus 15 for a nasal tube.

Aids to intubation
- Laryngoscope: blade (straight for neonates and infants because of long, floppy epiglottis, curved for older children), bulb and handle.
Magill's forceps.
- Introducer (not further than the end of the tube itself).
- Syringe (cuffed tube).
- Gum elastic bougie (over which the tube can pass).
- Cricoid pressure (can aid visualisation of larynx).
- Suction apparatus (this must be available).

Predicting difficulty
- Difficulty in opening mouth.
- Reduced neck mobility.
- Laryngeal/pharyngeal lesions.
- Acquired: burns, trauma.

If on viewing the infant’s face from the side, the chin is unusually small (micrognathia), the intubation will be difficult, and senior help is required (but see below).

Complications
- Displacement: oesophageal, endobronchial, out of larynx!
- Obstruction: kinking, secretions.
- Trauma: lips to larynx.
- Hypertensive response.
- Spasm: laryngeal, pharyngeal.
- Aspiration: gastric contents.

Procedure
Prepare and check the equipment.
- Choose an appropriate tube size, with one size above and one size below it available.
- Get the tape ready to fix the tube.
- Suction must be available.
- Induce anaesthesia and give a muscle relaxant unless the patient is completely obtunded.
- Do not attempt the procedure in a semi-conscious child.

Position the child.
- Children over 3–4 years of age: the ‘sniffing morning air’ position (head extended on the shoulders, and flexed at the neck).
- Children under 3 years of age (especially neonates and infants): a neutral position (large occiput).
- Keep the child in a neutral position with in-line immobilisation in the case of unstable cervical spine (e.g. trauma, Down’s syndrome).

Oxygenate the child using a face mask and reservoir (if patient is breathing) or bag and mask ventilation to provide high flow oxygen.
- Introduce the laryngoscope into the right side of the mouth.
- Sweep the tongue to the left.
- Advance the blade until the epiglottis is seen.
  - Curved blade: advance the blade anterior to the epiglottis. Lift the epiglottis forward by moving the blade away from your own body.
  - Straight blade: advance the blade beneath the epiglottis, into the oesophagus. Pull back, and the glottis will ‘flip’ into view.

Recognise the glottis.
- Insert the endotracheal tube gently through the vocal cords.
- Stop at a predetermined length.

Confirm the correct placement.
- The chest moves up and down with ventilation.
- Listen to breath sounds in the axillae and anterior chest wall.
- Confirm that there are no breath sounds in the stomach.
- Oxygen saturations do not go down.
- Carbon dioxide is measured from expired gases.

Secure the tube.
Secure with tape around the tracheal tube and on to the patient’s face (see below).

Nasal intubation.
Although oral intubation is quicker and more reliable in an emergency, for prolonged ventilation nasal intubation is preferable, if a skilled operator is available, as the tracheal tube is more securely fixed. The technique is similar, but with the additional use of the Magill’s forceps to grasp and guide the tracheal tube as it emerges into the posterior pharynx downward into the trachea through the vocal cords.

Intubation of the newborn infant without a laryngoscope
It is possible to intubate a newborn baby using a finger rather than a laryngoscope. This can be very helpful if you do not have a functioning laryngoscope, or if the child has facial or oral deformities that interfere with your ability to insert a laryngoscope or to see the larynx (e.g. severe micrognathia).

Procedure
- Insert the index finger of the left hand into the baby’s mouth, with its palmar surface sliding along the tongue. Use the little finger if the baby is small.
Slide the finger along the tongue until it meets the epiglottis. This feels like a small band running across the root of the tongue.

Slide the finger a little further until the tip lies behind and superior to the larynx and the nail touches the posterior pharyngeal wall.

Slide the tube into the mouth between the finger and the tongue until the tip lies in the midline at the root of the distal phalanx of the finger.

At this point place the left thumb on the baby’s neck just below the cricoid cartilage in order to grasp the larynx between the thumb on the outside and the fingertip on the inside.

While the thumb and finger steady the larynx against side-to-side motion, the right hand advances the tube a short distance (about 1–2 cm).

A slight ‘give’ can sometimes be felt as the tube passes into the larynx, but no force is needed for insertion.

When the tube is in the trachea the laryngeal cartilages can be felt to encircle it. If it has passed into the oesophagus it can be felt between the finger and the larynx.

**Fixation of endotracheal tubes**

Two people should be available to do this, one of whom should hold the tube at all times.

Cut two strips of sticky zinc oxide tape (see below); they should reach from just in front of the ear across the cheek and above the upper lip to the opposite ear.

**Procedure**

- Attach a cricothyroidotomy cannula-over-needle (or if this is not available, an IV cannula and needle) of appropriate size to a 5-mL syringe.
- Place the patient in a supine position.
- If there is no risk of cervical spine injury, extend the neck, perhaps with a sandbag under the shoulders.
- Identify the cricothyroid membrane by palpation between the thyroid and cricoid cartilages.
  - Prepare the neck with antiseptic swabs.
  - Place your left hand on the neck to identify and stabilise the cricothyroid membrane, and to protect the lateral vascular structures from needle injury.

**Cricothyroidotomy**

Cricothyroidotomy is indicated if a patent airway cannot be achieved by other means. It must be performed promptly and decisively when necessary.

**Call a surgeon and an anaesthetist (if available).**

In children under the age of 12 years, needle cricothyroidotomy can be performed rather than a full surgical cricothyroidotomy. In adolescents, either technique can be used, but the surgical technique allows better protection of the airway. The relevant anatomy is shown in Figure 8.2.10.

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In comparison, wall oxygen is provided at a pressure of 4.41 kPa (45 cmH₂O) (the blow-off valve pressure), and this is insufficient to drive gas through a narrow cannula. The maximum pressure from a bag is approximately 392 kPa or 4000 cmH₂O. The second misconception is that expiration can occur through the cricothyroid membrane. This is not possible. The intratracheal pressure during expiration is usually less than 2.9 kPa (30 cmH₂O) (less than 1% of the driving pressure in inspiration). Expiration must occur via the upper airway, even in situations of partial upper airway obstruction. Should upper airway obstruction be complete, it is necessary to reduce the gas flow to 1–2 litres/minute. This provides some oxygenation but little ventilation.

Nevertheless, insufflation buys a few minutes in which to attempt a surgical airway.

**Surgical cricothyroidotomy**

1. Place the patient in a supine position.
2. If there is no risk of neck injury, consider extending the neck to improve access. Otherwise, maintain a neutral alignment.
3. Identify the cricothyroid membrane in the following manner. Place your finger over the most prominent part of the thyroid cartilage (the Adam’s apple). Move the finger downwards (i.e. towards the chest), keeping strictly in the midline. The first dip felt is the area of cricothyroid membrane.
4. Prepare the skin and, if the patient is conscious, infiltrate with local anaesthetic.
5. Place the index and middle fingers of your left hand on each side of the midline of the neck to stabilise the cricothyroid membrane, and to protect the lateral vascular structures from injury.
6. Make a small vertical incision in the skin, and press the lateral edges of the incision outwards, to minimise bleeding.
7. Make a transverse incision through the cricothyroid membrane, being careful not to damage the cricoid cartilage.
8. Insert a tracheal spreader, or use the handle of the scalpel by inserting it through the incision and twisting it through 90 degrees to open the airway.
9. Insert an appropriately sized endotracheal or tracheostomy tube. It is advisable to use a slightly smaller size than would have been used for an oral or nasal tube (e.g. size 6.0 mm internal diameter for age 12–16 years).
10. Ventilate the patient and check that this is effective.
11. Secure the tube to prevent dislodgement.

**Complications of cricothyroidotomy**

These include the following:

- asphyxia
- aspiration of blood or secretions
- haemorrhage or haematoma
- creation of a false passage into the tissues
- surgical emphysema (subcutaneous or mediastinal)
- pulmonary barotrauma
- subglottic oedema or stenosis
- oesophageal perforation
- cellulitis.

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**Emergency needle thoracocentesis**

This procedure is used for the rapidly deteriorating patient who has a life-threatening tension pneumothorax (see Section 7.3.A). If this technique is used in a patient who does not have a tension pneumothorax, there is a 10–20% risk of producing a pneumothorax or causing damage to the lung, or both. In such cases, immediate insertion of a chest drain is mandatory. Patients who have undergone...