1 Let's Start at the Very Beginning . . .

If you are starting as a trainee in anaesthesia with little knowledge of how operating theatres work, read this. If you understand the theatre environment, go to Chapter 1.

What You Need

You will need your ID badge, two black pens (one invariably runs out of ink or is borrowed), a stethoscope and a copy of this book. You may also need a card to log on to the hospital IT system with associated passwords.

Where to Go

You need to find the correct changing room, male or female, and change into theatre scrubs, hat and suitable footwear. Do not leave anything valuable in your clothes; lock it away or take it with you. A combination padlock is useful to have. Do not enter the wrong changing room 'by mistake' more than once. Do not borrow theatre shoes: the pair you take will belong to one of the senior surgeons, who will make your life a misery for the next few months when (s)he finds that they are missing. Face masks are usually unnecessary except in theatres in which a prosthesis is inserted, such as orthopaedics.

You will see staff wandering round the hospital and even local shops in theatre scrubs. One author even saw a person wearing theatre scrubs in an international airport. This is inappropriate, and you should change each time you leave the operating theatre.

How to Behave

You should be punctual, polite and pleasant to all theatre staff. As a new anaesthetic trainee you may feel near the bottom of the theatre hierarchy.

Key People in Theatres

In each operating theatre there is a scrub nurse and a runner, who is not scrubbed, who fetches instruments for the surgical team. There is usually a theatre sister in overall charge. In the United Kingdom, the anaesthetist always works with a trained assistant. They may be called an operating department practitioner (ODP), operating department assistant (ODA) or anaesthetic nurse. They will have undergone at least two years of training and are often skilled in resuscitation and trauma assessment. Watch carefully how they prepare for cases and listen to any advice they may give. Very few ODPs are unhelpful to new trainees and the best are outstanding. We have learnt much from experienced ODPs and value their knowledge, commitment and friendship.

The theatre manager is an important person, so introduce yourself and try to gain their support (see How to Behave). The theatre receptionist/secretary has to deal with the running of the theatres and is often very knowledgeable about the likes and dislikes of senior staff. Time spent in idle chat is usually time well spent.

Key People in Anaesthetic Departments

The most important person in the anaesthetic department is the secretary/administrator/rota organiser. You must not upset them – they can make your life miserable. Other people in the department, who think that they are important, include the college tutor, educational supervisors, module supervisors, clinical supervisors, mentors and the head of department. It is very difficult to find any consultant without a label. The longer the title, the less important the position.

You should not need to bother these people in the first few weeks. In many departments you will work with a few senior staff who will guide you gently through the basics of anaesthesia. They are chosen for their kindness, imperturbability and good humour in the presence of the chaos of your initial attempts at anaesthesia. It is their job to imprint safe anaesthetic practice into your receptive brain. You will remember them long after you have forgotten the name of the head of department.

Cleanliness and Sterility

Cleanliness is important for all theatre staff. Hands must be washed, or an alcohol handrub used, before and after touching patients. This boring ritual is necessary to minimise infections acquired in theatres.

The patient's skin should be cleaned with chlorhexidine 2% in isopropyl alcohol 70 per cent before the insertion of needles and cannulae. For central venous cannulation and neuraxial blockade the anaesthetist should adopt surgical sterility: gown, gloves, hat and mask (GGHM).

Controlled Drugs (CDs)

The supply and use of drugs that can cause dependency or abuse, such as opioids, benzodiazepines, ketamine and cocaine, is tightly controlled by law under The Misuse of Drugs Act. These drugs are kept in a locked cupboard, and when they are used you must:

- Sign the controlled drug register. This is countersigned by another qualified person (nurse/qualified ODP). Your signature confirms that the number of remaining ampoules is correct. The register requires you to sign for the doses supplied, administered and wasted.
- Record the amount of drug given to the patient on the anaesthetic chart.
- Return unopened ampoules to the locked cupboard.
- Not use the contents of an ampoule for more than one patient.
- Discard any drug not used, ideally in the presence of a third party.

Although these regulations may appear onerous, it is the law and it protects both you and others in the department, making misuse of these drugs difficult (but not impossible). Pharmacies perform audits to ensure that the CD book tallies with the drugs administered in theatres and will hold the anaesthetist accountable for any discrepancies. Rarely (but not impossibly), the police can be involved.

Consent/WHO Checklist

Anaesthesia is not overburdened with paperwork but there are two key documents that must be checked before surgery starts. The consent form, which gives details of the surgical procedure, must have been signed by the patient and witnessed by a member of the surgical team. The identity of the patient must be determined on the patient's name band to ensure that the right patient is in the right place for the right operation. If the operation has a left or right choice (e.g., limb surgery) the side should be marked by the surgeon on the ward.

The consent form must be signed by a competent person. Almost always, this is the patient including children once they reach the age of 16, when they are presumed in law to be competent – their parents cannot override consent or refusal from a competent 16/17-year-old. This is called Form 1. Sometimes Form 4 is used if the patient's capacity to consent to the proposed procedure or treatment is in doubt (e.g., dementia or confusion). This form should be used when the patient lacks capacity and should be completed by the professional doing the procedure, and the decision to proceed is in the patient's best interest.

All hospitals have adopted the WHO Surgical Safety Checklist, which aims to prevent wrong-site surgery and decrease surgical complications. Although most of the details are surgical, the anaesthetist is asked for the American Society of Anaesthesiologists (ASA) status of the patient (see Chapter 22) and if they have any concerns. The latter refers to medical, not personal, concerns so it is inappropriate to mention your doubts about the possible health hazards of your recent social life. All members of the theatre team are introduced by name and role, which is a rapid way of integrating new trainees.

Anaesthetic Charts

The anaesthetic chart is a contemporaneous record of what happened to the patient while they were your responsibility. It is a very important document that must be completed legibly, accurately and in appropriate detail. The chart may be analysed very closely in the future by the legal profession, who will emphasise any omissions, errors and illegibility. A scruffy chart with coffee stains creates a bad impression. Anaesthetic charts vary slightly from hospital to hospital but contain the following basic information:

- patient details
- preoperative assessment
- intraoperative management
- postoperative instructions

The chart should contain enough information so that another anaesthetist could give an identical anaesthetic from the information recorded. The advent of the electronic patient record (EPR) still requires detailed documentation, which in many cases is easier to undertake.

Enthusiasts

The senior anaesthetists who supervise your initial training will protect you from the more eccentric members of the profession. However, you will encounter enthusiasts who believe passionately that their anaesthetic techniques are superior to those of others. Three groups are easily recognised: regional anaesthesia enthusiasts (always needing the ultrasound machine), infusion enthusiasts (the more infusion pumps the better the anaesthetic) and technology enthusiasts (always using the latest equipment with many totally unnecessary

functions). They all have useful knowledge to impart but should be avoided until you can give a safe simple anaesthetic.

. . . When you read you begin with A-B-C (airway-breathing-circulation) so read on

(with apologies to *The Sound of Music*).

Section 1

Nuts and Bolts

The first section of this book deals with two fundamental aspects of anaesthetic practice: the airway and vascular access.

General anaesthesia has been summarised by the simple phrase: put up a drip, put down a tube and give plenty of oxygen. Although many anaesthetists resent this glib description of their work, it does have the virtue of emphasising the importance of venous cannulation and control of the airway, which are essential for the safe conduct of anaesthesia. Difficulties arise in anaesthesia when one of these fundamental areas is not secure, and if both fail then disaster is close at hand.

Therefore, in the first 10 chapters we concentrate on evaluation and control of the airway, the anaesthetic machine and circuits, basic anaesthetic monitoring, vascular access and the choice of intravenous fluids. We have not given detailed instructions on how to undertake the practical procedures.

There is no substitute for careful instruction from a senior anaesthetist as part of the anaesthetic procedure. At the start of training the application of physiology and pharmacology to anaesthesia is exciting, and knowledge of the equipment may seem mundane and even boring. It is imperative that you have a basic understanding of the equipment you use – failure to do so will put the patient at risk.

Chapter 1

Evaluation of the Airway

Experienced anaesthetists teach that there are three fundamental aspects to safe anaesthetic practice: the airway, the airway and the airway. Unanticipated airway problems account for about 40 per cent of overall anaesthetic morbidity and mortality. Therefore, before embarking upon anaesthesia, the anaesthetist must attempt to answer several key questions.

- Can I ventilate the patient with an airway and mask?
- Can I use a laryngoscope easily and safely on this patient?
- Can I intubate this patient safely without hypoxia or aspiration of stomach contents occurring?
- If I predict difficulties, have I got all the equipment and help available to assist me to secure the airway and oxygenate the patient?

Tracheal intubation is now undertaken less often, mainly because of the advent of supraglottic airways. However, tracheal intubation remains the gold standard for airway management, control and protection. It may be required during the course of an anaesthetic or for the management of an unconscious patient. Careful airway assessment must be undertaken. This is carried out logically, as summarised in Box 1.1.

History

Any previous anaesthetic history must be obtained. Information about difficulties with tracheal intubation may be found in old anaesthetic records. Previous successful intubation is not an indicator of current ease (e.g., tumours may have progressed, or radiotherapy may have been administered). Some patients carry letters or wear MedicAlert

Box 1.1 Assessment of the airway

- History
- Symptoms
- Examination
  - anatomy and variants
  - medical conditions
  - specific assessment
  - Mallampati scoring system
  - thyromental distance
  - sternomental distance
  - other tests

Box 1.2 Medical features of difficult airway intubation

- Congenital: rare
- Acquired
  - trauma: fractures of mandible and cervical spine
  - infection: epiglottitis, dental or facial abscess
  - endocrine: thyroid enlargement, acromegaly, obesity
  - neoplasia: tongue, neck, mouth, radiotherapy
  - inflammatory: ankylosing spondylitis, rheumatoid arthritis, scarring from burns
  - pregnancy
  - other: obstructive sleep apnoea (OSA), difficult dentition, recent intubation (swelling)

bracelets stating their anaesthetic difficulties, while others with major problems know nothing about them. Ascertain whether the airway is potentially difficult by checking whether the patient has any of the medical and surgical conditions listed in Box 1.2.

Whenever possible, you will also want to review any previous anaesthetic charts.

Symptoms

Upper airway obstruction may be found in patients with stridor, dysphagia and hoarseness.

Examination and Clinical Tests

Normal Anatomy and Its Variants

Some patients appear anatomically normal and yet are difficult, or impossible, to intubate. These patients cause anaesthetists unexpected problems. We have had the occasional experience of casually starting an apparently normal laryngoscopy, only to have the sinking feeling associated with complete failure to see the larynx. It is much better to anticipate a difficulty than encounter one unexpectedly. Some anatomical factors that make airway control and intubation difficult are listed in Box 1.3.

Box 1.3 Anatomical features of difficult airway control and intubation

- Short immobile neck
- Full set of teeth, buck teeth, edentulous
- High arch palate
- Poor mouth opening – less than three fingers gap between upper and lower teeth
- Small mouth
- Receding mandible (may be hidden by a beard)
- Inability to sublux the jaw (forward protrusion of the lower incisors beyond the upper incisors)

Specific Assessment

Several clinical tests to assess the airway are in common use. None are reliable in predicting a difficult airway or intubation, and all should be used in combination as this provides a better overall assessment of the airway.

Modified Mallampati Scoring System

This predicts about 50 per cent of difficult intubations. The test can be performed with the patient in the upright or supine position. It is based upon the visibility of the pharyngeal structures with the mouth open as wide as possible (Figure 1.1). Patients are classified as follows:

- Grade 1: faucial pillars, soft palate and uvula visible
- Grade 2: faucial pillars, soft palate visible, but uvula masked by the base of the tongue
- Grade 3: soft palate only visible
- Grade 4: soft palate not visible

Patients in grades 3 and 4 are considered difficult to intubate, and those in grades 1 and 2 are considered feasible intubations. It is important to realise that this system is not infallible, and patients in grade 2 sometimes cannot be intubated. The use of this test as a single predictor has been shown to have a high sensitivity and negative predictive value. However, its sensitivity remains low. It is therefore important to utilise a combination of tests when performing an airway assessment.

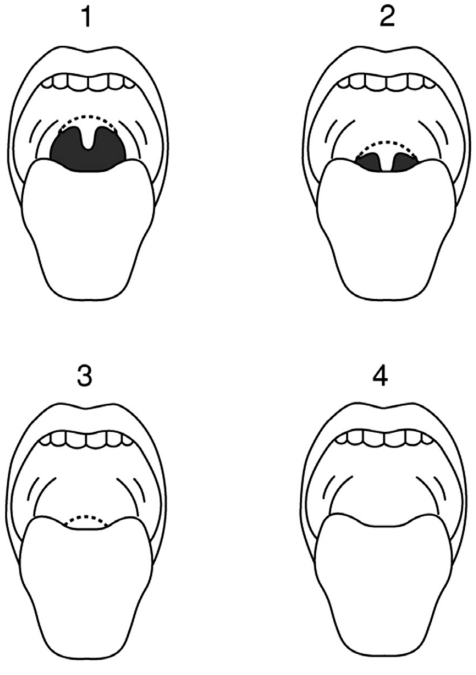

Figure 1.1 Structures seen on opening of mouth for Mallampati grades 1–4.

Head and Neck Movement

Flexion and extension are greater than 90° in normal people.

Jaw Movement and Mandible

Check that the patient's mouth opens normally. It should have an interincisor gap of greater than 5 cm (about three finger breadths). Check that the patient does not have buck teeth or a receding mandible. Ideally, the lower incisors should be able to be protruded beyond the upper incisors. If these simple tests cannot be performed the airway may be difficult to manage.

Thyromental Distance

The thyromental distance (Patil test) is the distance from the thyroid cartilage to the mental prominence when the neck is extended fully (Figure 1.2). In the absence of other anatomical factors, if the distance is more than 6.5 cm, problems should not occur with intubation. A distance of less than 6 cm suggests laryngoscopy will be impossible, and for distances of 6–6.5 cm laryngoscopy is considered difficult, but possible. This measurement may predict up to 75 per cent of difficult intubations.

Sternomental Distance

The distance from the upper border of the manubrium sterni to the tip of the chin, with the mouth closed and the head fully extended, is measured. A distance of less than 12.5 cm indicates a difficult intubation.

Upper Lip Bite Test (ULBT)

In this test, the patient is asked to bite his or her upper lip with the lower incisors. It has been shown to have good specificity and positive predictive value.

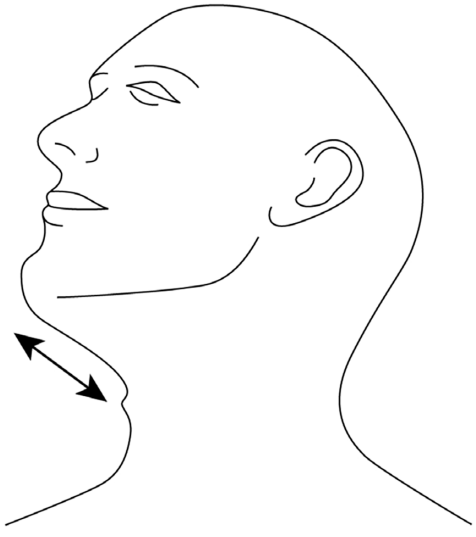

Figure 1.2 Line shows the thyromental distance from the thyroid cartilage to the tip of the chin.

Other Tests

Airways can be further assessed by using indirect laryngoscopy or imaging. Nasal endoscopy is frequently used to assess and grade difficult airways by passing a flexible scope via the nose to gain view of the glottis. This procedure is done in consented fully awake patients and the airway may be topicalised with local anaesthetic. Similarly, another approach includes the use of awake laryngoscopy also using a flexible scope or a videolaryngoscope. These methods have the benefit of allowing visualisation and dynamic assessment of the glottis and vocal cords.

Imaging methods include the use of lateral X-rays, which are less commonly used nowadays, computed tomography (CT), magnetic resonance imaging (MRI) and ultrasound.

Using X-rays, the effective mandibular length is compared with the posterior depth of the mandible; a ratio of more than 3.6 may be associated with a difficult intubation. A decreased distance between the occiput and the spinous process of C1 is also reported as associated with difficulties with laryngoscopy. We have found these tests to be of limited value.

Computed tomography imaging produces high-resolution views of the head, neck and chest, allowing a detailed assessment also including lower airway pathologies. The direct internal diameter of the tracheal lumen can be measured in the transverse plane and is particularly useful for stenotic tracheal lesions. Dynamic CT images (including inspiratory and expiratory phase) can be used to assess conditions that may cause dynamic airway collapse, such as tracheomalacia.

Ultrasound has become more widely accessible as a tool to detect the cricothyroid membrane used for front-of-neck access and also to predict difficult intubation and laryngoscopy.

To detect the cricothyroid membrane, a linear high-frequency transducer can be used in the transverse plane to determine the position of the trachea. This is then followed by a sagittal view scanning down from the hyoid bone to determine the location of the cricothyroid membrane. Moreover, the distance to the space can be noted and the patient's neck may be marked in case of an emergency. Sublingual ultrasound has been used to predict difficult intubation by visualising the hyoid bone. Similarly, the distances from the anterior skin to the epiglottis or hyoid bone have been used as predictors.

However, it must be remembered that clinical and radiological assessment modalities have limitations, as they do not account for dynamic airway changes related to posture and breathing.

Conclusion

The airway must be assessed before any anaesthetic procedure is embarked upon. Airway control and tracheal intubation is occasionally difficult, or even impossible, in anatomically normal people. An assessment of the patient's history, symptoms and medical conditions, combined with careful clinical examination, will help avoid many, but not all, unexpectedly difficult intubations. In addition, an airway may be physiologically difficult in a patient with physiological derangement or reduced oxygen reserve. This may lead to higher risk of hypoxaemia and complications and when combined with an anatomically difficult airway can easily become an anaesthetist's nightmare! A detailed preoperative assessment, preoxygenation and a well-prepared airway management plan are therefore a must.