The first surgical choledochoscope was introduced in 1965. Murphy subsequently used this instrument to perform the first ever fibre-optic intubation in 1967. The fibre-optic bronchoscopy has now become an essential anaesthetic instrument. Awake intubation of the airway can be achieved safely with a variety of techniques using topical analgesia, regional nerve block, with or without sedation. Both oral or nasal routes can be used to achieve fibre-optic-assisted intubation.

**Awake intubation**

**Indications**

The main indication for an awake intubation is a suspected or known difficult airway. However, the role of awake intubation in a partially obstructed airway continues to be debated. Enthusiasts of fibre-optic intubation often recommend the use of awake intubation. Others adopt alternative techniques including the use of an inhalation induction followed by intubation or, if unsuccessful, an awake tracheostomy. The dangers of a full stomach are well known and a rapid sequence induction is often used under these circumstances. However, the trachea can be intubated painlessly using local anaesthesia in a very safe manner. The risk of aspiration can be minimised by close attention to detail and ensuring the patient remains conscious throughout.

Induction of anaesthesia in sick and frail patients may result in considerable cardiovascular compromise. An awake intubation may avoid the risk of cardiovascular instability. However, it should be noted that these patients may be more likely to regurgitate and aspirate. Cervical spine injury usually requires intubation during manual-in-line neck traction. This technique may make conventional laryngoscopy difficult. Awake fibre-optic intubation will reduce both flexion and extension of the neck. It will also enable accurate neurological assessment after intubation. The protection of dental caps and crowns is becoming a relative indication.

Awake intubation may be used in a patient requiring intubation but who needs to be positioned awake, for example, patients with severe rheumatoid arthritis requiring the prone position for posterior cervical disc surgery.

**Contra-indications**

Patient refusal is a contra-indication. It is almost impossible to perform the procedure in a non-compliant patient. However, if the risks of failing to secure the airway (hypoxia, awareness, CVS instability) are carefully explained to the patient, consent is obtained in most cases. Thus, preparing the patient during the pre-operative assessment and taking time to explain the importance of the procedure is crucial for success. Children are unlikely to co-operate.

Bleeding disorders may be a contra-indication to fibre-optic-assisted nasal intubation as the presence of blood and secretions in the airway makes endoscopy more difficult. The oral route provides an alternative but more difficult route.

Some tumours of the upper airway may constitute a contra-indication as they may bleed and obstruct vision through the bronchoscope. In addition, laryngospasm has been reported in these cases. The arguments against the use of this technique in patients with advanced obstruction from a periglottic tumour have been described recently in this journal (see key references). Allergy to local anaesthetic agents is another contra-indication (very rare).
Drugs used during awake intubation

Local anaesthetics

Cocaine

Cocaine penetrates the mucosa rapidly and provides effective surface anaesthesia. It is available as an oromucosal solution, nasal spray or paste in concentrations of 4%, 10% and 25%. The maximum dose recommended for topical anaesthesia is 1.5 mg kg\(^{-1}\). It has marked sympathomimetic activity and is an intense vasoconstrictor. Therefore, the addition of epinephrine is not required; it may contribute to cardiac dysrhythmias.

Lidocaine

Lidocaine is administered by subcutaneous infiltration, topically, or to produce peripheral and central nerve blockade. Local anaesthesia solutions are available as 0.5%, 1% and 2% solutions with and without epinephrine. Solutions of lidocaine 4% and 10% are available for use in sprays for laryngotracheal anaesthesia and a mixture of lidocaine 5% with phenylephrine 0.5% is available for nasal anaesthesia.

The maximum recommended dose of lidocaine is 3 mg kg\(^{-1}\) without epinephrine and 7 mg kg\(^{-1}\) with epinephrine. A good proportion of the lidocaine tends to be swallowed and the subsequent plasma concentrations are less than expected because of first-pass metabolism. Lidocaine may reduce the induction dose of thiopental and propofol.

Prilocaine

Prilocaine is available as 0.5%, 1%, 2% and 4% solutions with and without epinephrine. Although theoretically safer than lidocaine, it is rarely used, possibly because of lack of availability and concerns about methaemoglobin production.

Sedatives

The use of sedation is generally accepted in a non-obstructed airway. Some argue that it should not be used as it is essential to maintain lower airway reflexes to avoid aspiration. However, it is also accepted that, as long as there is verbal contact with the patient, it assists with patient compliance and improves the chances of successful intubation. Intravenous midazolam is used most commonly. Propofol (intermittent bolus or target controlled infusion) is an alternative. Sedation should not normally be used in patients with an obstructed airway. However, it is occasionally used with extreme caution by those very experienced in the technique.

Vasoconstrictors

The addition of a vasoconstrictor (e.g. epinephrine, phenylephrine, xylometazoline, ephedrine) decreases local blood flow, slows the rate of absorption of the local anaesthetic and prolongs its effect. It is recommended that the concentration of epinephrine should not be > 1:200 000.

Antisialogogues

Antisialogogues reduce secretions enabling local anaesthetic agents to act more effectively and improving the fibre-optic view. Glycopyrronium 4–8 \(\mu\)g kg\(^{-1}\) is often used. It is more effective intramuscularly 1 h before intubation rather than intravenously in the anaesthetic room. Atropine 0.3–0.6 mg i.m. and hyoscine 0.2 mg i.m. are less frequently used.

Methods of anaesthetising the upper airway

The nose, pharynx and larynx need to be anaesthetised to provide satisfactory intubating conditions.

The nose

Sensory fibres of the nasal mucosa arise from the middle division of the trigeminal nerve via the sphenopalatine ganglion. This lies under the nasal mucosa posterior to the middle turbinate (Fig. 1). Fibres from the sphenopalatine ganglion also provide sensory innervations for the superior portion of the pharynx, uvula and tonsils.

The nasal mucosa can be anaesthetised using two or three cotton pledgets soaked in 4% cocaine. This provides surface anaesthesia and vasoconstriction thereby minimising nasal bleeding. Lidocaine solution is also used as a spray. The time to maximum...
effect of lidocaine is 2–3 min. Vasoconstrictors may also be used with lidocaine to decrease nasal bleeding. Lidocaine can also be inhaled through a nebuliser, usually 4–6 ml of a 4% solution. This technique requires supplementary anaesthesia of the larynx.

The pharynx

The major nerve supply of the pharynx is via the glossopharyngeal nerve which contains both sensory and motor fibres. This nerve emerges from the upper part of the medulla and leaves the skull through the jugular foramen. It enters the pharynx between the superior and middle constrictor muscles of the pharynx. It subsequently divides into its terminal branches supplying sensory fibres to the pharynx, tonsillar region and the posterior third of the tongue.

It is useful to calculate the number of sprays of lidocaine that can be used beforehand – it is very easy to administer more than the recommended dose. The tongue and the oropharynx can be sprayed directly with 10% lidocaine spray. Benzocaine lozenges can also be used for this purpose.

The larynx

The sensory innervation of the larynx is derived from branches of the vagus nerve (Fig. 2). The superior laryngeal branch of the vagus leaves the vagal trunk in the carotid sheath and pierces the thyrohyoid membrane. As it does so, it gives sensory branches to the vocal cords, the epiglottis and the arytenoids. This nerve provides the sensory supply of the larynx above the vocal cords. The sensory supply below the cords comes from the recurrent laryngeal branches of the vagus.

Cricothyroid puncture (translaryngeal block)

A cricothyroid puncture (translaryngeal block) can be used to anaesthetise the larynx. The cricothyroid membrane is identified and fixed between the index finger and the middle finger of the operator’s non-dominant hand. A small weal is raised with 1% lidocaine. A 20-G cannula attached to a 5 ml syringe containing normal saline is passed through the weal. After piercing the cricothyroid membrane, air is aspirated (bubbles) and 2–3 ml of 2% lidocaine is injected. This causes coughing which helps to disperse the local anaesthetic solution. This technique will anaesthetise most of the laryngeal surface.

Superior laryngeal nerve block

The patient is placed either in the sitting or semirecumbent supine position. A 24-G needle is introduced through a wheal raised 1 cm below and 2 cm in front of the extremity of the prominent cornu of the hyoid. The needle is advanced in a caudal direction and ‘walked’ over the lower border of the hyoid to pierce the thyrohyoid membrane. Alternatively, it can be walked off the superior cornua of the thyroid cartilage in a cephalad direction to pierce the thyrohyoid membrane. A third method is to place the needle equidistant between the hyoid and thyroid cartilages and inject medially in a fan-like fashion. A total of 1–2 ml of 2% lidocaine is injected following negative aspiration with all these methods. The same procedure is repeated on the other side.

An awake intubation technique

Technique

A technique of awake intubation that has been successfully used in over 300 cases is described. All the equipment (Table 1) is stored in a labelled box in the anaesthetic room with a summary of the technique printed on the inside of the lid.

The patient is assessed and the technique explained. We obtain verbal consent but there is an increasing trend to obtain written consent. The adult patient is premedicated with temazepam 10–20 mg (provided there is no risk of airway obstruction) and glycopyrrolate 0.4 mg i.m. about 1 h before the procedure. In the anaesthetic room, an ECG, pulse oximeter and NIBP machine are attached and intravenous access secured. A capnograph is connected to the breathing filter attached to the mask. Providing

Fig. 2 Nerve supply of the larynx.
Anaesthesia for awake intubation

Table 1 Contents of awake intubation box

<table>
<thead>
<tr>
<th>Contents of awake intubation box</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nose</strong></td>
</tr>
<tr>
<td>Cotton-tipped buds</td>
</tr>
<tr>
<td>Lidocaine 4% ampoules</td>
</tr>
<tr>
<td>Xylometazoline nasal drops (Otrivine)</td>
</tr>
<tr>
<td><strong>Pharynx</strong></td>
</tr>
<tr>
<td>10% lidocaine spray</td>
</tr>
<tr>
<td><strong>Larynx</strong></td>
</tr>
<tr>
<td>2% lidocaine</td>
</tr>
<tr>
<td><strong>Syringes</strong></td>
</tr>
<tr>
<td>5 ml, 2 ml</td>
</tr>
<tr>
<td><strong>Tracheal tube</strong></td>
</tr>
<tr>
<td>6.0 re-inforced</td>
</tr>
<tr>
<td>7.0 re-inforced</td>
</tr>
<tr>
<td><strong>Drugs</strong></td>
</tr>
<tr>
<td>Succinylcholine 100 mg</td>
</tr>
<tr>
<td>1% propofol 20 ml</td>
</tr>
<tr>
<td>Midazolam 10 mg for dilution with 10 ml of normal saline</td>
</tr>
<tr>
<td>Fentanyl 100 µg</td>
</tr>
<tr>
<td><strong>Others</strong></td>
</tr>
<tr>
<td>Suction catheter</td>
</tr>
<tr>
<td>Yankauer sucker</td>
</tr>
<tr>
<td>Lidocaine 4% (Laryngojet)</td>
</tr>
<tr>
<td>Mucosal atomisation device</td>
</tr>
</tbody>
</table>

there is no risk of airway obstruction, fentanyl 25–50 µg is given intravenously. An epidural catheter is inserted into the fibrescope via the suction port.

The patient is placed in the semirecumbent position and xylometazoline (vasoconstrictor) 2 drops are applied to each nostril. This is followed by 0.5 ml of 4% lidocaine injected with a 2 ml syringe into each nostril. Cotton-tipped buds soaked in 4% lidocaine are passed along the floor of the nose. The tip of the tongue is sprayed once with 10% lidocaine spray. The tongue is extruded and held by the operator so that the oropharynx can be sprayed 6 times with the 10% spray. A second set of 6 sprays are squirted further down the pharynx. (It is recognised that much of this is either expired or swallowed.) The patient usually coughs and midazolam 1 mg is given intravenously. If necessary, secretions are removed from the mouth by a Yankauer sucker – the fibrescope suction channel is not an effective suction device.

The fibrescope, preloaded with a size 6 re-inforced tracheal tube, is passed under direct vision through the nose and into the pharynx. When the larynx is identified, the epidural catheter is threaded out of the end of the fibrescope and an assistant injects 2 ml of 2% lidocaine onto the vocal cords as the patient takes a deep breath. A further 1 mg of midazolam is injected intravenously. As the patient usually coughs, it is prudent to wait until the view clears. The epidural catheter is then advanced between the cords and a second dose of 2 ml of 2% lidocaine is injected via the epidural catheter. The epidural catheter is withdrawn and the patient takes another deep breath as the scope is passed through the vocal cords. On the final deep breath, a well-lubricated tracheal tube at the entrance to the nose is rotated through the nose and into the trachea. The patient is informed that this may be uncomfortable. Once tube position is confirmed (using a stethoscope and capnography), the patient is anaesthetised using sevoflurane, paralysed and the cuff of the tracheal tube inflated.

Complications
Over-sedation should be avoided, especially in those who have a difficult airway. It should be remembered that local anaesthetic agents decrease the requirements for sedative agents. Hyper-reactive airways can cause upper airway obstruction or bronchospasm. Bleeding or haematoma formation or both can occur.

The procedure may fail because of inadequate operator skills, technical failure and patient complications such as airway obstruction. Adequate training is, therefore, essential. The operator should be able to diagnose and deal with the toxic side-effects of local anaesthetics; great care should be taken not to exceed the recommended doses. An early sign of overdose is cerebral irritation which is preceded by a prodromal phase of peri-oral tingling and/or isolated neuromuscular twitching. Cardiovascular symptoms and signs include tachycardia, ECG changes and cardiac arrest. Peak absorption of topical anaesthesia occurs 15–60 min after administration. The need for continued monitoring in the operating theatre and the recovery room is emphasised. The duration of topical anaesthesia may be greater than the duration of surgery. Therefore, oral intake should only be allowed after ensuring that the cough and swallowing reflexes have returned to normal.

Key references
Mason RA, Fielder CP. The obstructed airway in head and neck surgery. Anaesthesia 1999; 54: 625

See multiple choice questions 88–90.