AIRWAY MANAGEMENT WITH ENDOTRACHEAL INTUBATION (INCLUDING AWAKE INTUBATION AND BLIND INTUBATION)

Dr. Yatindra Kumar Batra 1 Dr. Preethy Mathew J. 2

Introduction

Endotracheal intubation for the purpose of providing anaesthesia was first described by William MacEwan in 1878 when he passed a tube from the mouth into the trachea, using fingers as a guide in the conscious patient. 1 Edgar Rowbotham and Ivan Magill gained wide experience of endotracheal intubation during the first world war and popularized it subsequently. 1 Endotracheal intubation provides an artificial conduit between the atmosphere and the patient’s trachea for the purpose of alveolar gas exchange or protection of the lungs from extraneous substances. The clinical situations where endotracheal intubation is indicated are listed in table 1.

Table - 1: Indications of endotracheal intubation.

<table>
<thead>
<tr>
<th>Routine</th>
<th>Emergency</th>
</tr>
</thead>
<tbody>
<tr>
<td>To provide anaesthesia</td>
<td>Airway obstruction</td>
</tr>
<tr>
<td></td>
<td>Oxygenation failure (hypoxia)</td>
</tr>
<tr>
<td></td>
<td>Mental status alteration (GCS&lt;8/15)</td>
</tr>
<tr>
<td></td>
<td>Cardiopulmonary resuscitation</td>
</tr>
<tr>
<td></td>
<td>Respiratory distress</td>
</tr>
<tr>
<td></td>
<td>Ventilation failure (hypercarbia)</td>
</tr>
<tr>
<td></td>
<td>Flat chest/Pulmonary contusion</td>
</tr>
</tbody>
</table>

I. Options

a) Nasal versus oral tracheal intubation

Oral tracheal intubation is the usual method of intubation. Nasal intubation is performed when the surgery is in the oral cavity or on the mandible and when the oral route is difficult or impossible e.g. temporomandibular joint ankylosis, trismus. In situations where visualization of larynx by direct laryngoscopy is poor, blind or fibreoptic intubation through the nasal route can be used.

The contraindications to nasal intubation are coagulopathy, severe intranasal pathology, basilar skull fracture and the presence of cerebrospinal fluid (CSF) leak. There are certain practical disadvantages of nasotracheal intubation. The inner diameter of tubes used for nasotracheal intubation is usually smaller than those for orotracheal intubation and this may increase the resistance and work of breathing. 2 The tube tends to soften and kink in the nasopharynx, which could further increase airway resistance and make passage of suction catheters more difficult. Hence, clearance of secretions could be problematic with a nasotracheal tube. There is increased risk of sinusitis and because of these concerns nasotracheal intubation is rarely used for long-term intubation. Nasal intubation may produce a bacteremia and appropriate endocarditic prophylaxis should therefore precede it. 3

b) Awake intubation versus intubation during anaesthesia

In the operating room, endotracheal intubation is usually performed after induction of general anaesthesia. The anaesthesiologist must determine whether mask ventilation and intubation will be possible after the patient is anaesthetized and paralyzed. If there is sufficient doubt regarding the patient’s airway, awake (conscious) intubation with sedation and topicalization is indicated.

The indications for awake intubation include a history of difficult intubation, findings on history or physical examination that can make intubation difficult, and severe risk of aspiration or haemodynamic instability. The reasons for conscious intubation should be explained to the patient and documented in the chart. Primary consideration of safety should be emphasized.

c) Direct versus blind

Endotracheal intubation is usually performed using direct laryngoscopy to visualize the laryngeal inlet. In conditions where mouth opening is restricted and where the larynx cannot be seen on direct laryngoscopy, the intubation may be done blindly. Blind intubation requires experience for success.

II. Technique

The key to success in intubation is a calm, collected approach with efficient but complete preparation. During the learning process, mental rehearsals of the steps of laryngoscopy and intubation help in acquiring the skill faster.
Preparation

i) Equipment: All the necessary equipments for intubation including drugs should be readily available at hand. A list of suggested items are given in table 2. The equipments should be in good working condition. The light of the direct laryngoscope should be bright. The integrity of the endotracheal tube cuff and pilot balloon should be tested by attaching a 10 ml syringe to the one-way valve of the pilot balloon and then briefly inflating the cuff with approximately 10 ml of air.

| Table - 2 : Suggested items to be ready for intubation. |
|--------------|-------------|
| Equipment    | Drugs       |
| Intravenous catheters (16-22 gauge) | Atropine   |
| Direct laryngoscope with blades | Glycopyrrolate |
| Macintosh 2, 3, 4. | Lignocaine 1%, 4% |
| Miller 0, 1, 2, 3. | Lignocaine jelly, aerosol, viscous |
| Endotracheal tubes (3-8 mm ID) | Midazolam |
| Syringes (5 ml, 10 ml) | Propofol |
| Magill forceps | Saline |
| End tidal CO₂ detector | Suxamethonium |
| Nasal/ oral airways | Thiopentone |
| Suction catheters | Non depolarizing muscle relaxant |
| Tube changer | Morphine/ Fentanyl |
| Guide wire |          |
| Nasogastric tubes |                |
| Tape |                  |

ii) Patient’s history and airway assessment: Apart from the airway, the patient’s cardiac and respiratory status should be assessed. History of prior difficulty in intubation needs to be enquired. Also the potential for aspiration of gastric contents into the lung is to be assessed.

iii) Suction: A functioning suction is a must prior to the attempt at laryngoscopy. Suction catheters of various diameters should be available.

iv) Oxygen source: In the operating room, anaesthesia machine and breathing circuits must be checked for leaks. In a peripheral setting, adequate oxygen source has to be confirmed before attempting intubation. 100% oxygen is to be administered via a tight fitting mask and reservoir bag prior to any attempt at intubation.

v) Position of the patient: In the supine position, the pharyngeal and laryngeal axes of the patient are offset, making a good view of the glottis extremely difficult during direct laryngoscopy. Flexion at the lower cervical joints aligns the pharyngeal and laryngeal axes. In adults, a small foam pillow or several folded sheets are often employed to achieve this. The extension of the head at atlanto-occipital joint brings the oral axis more in alignment to the laryngeal axis. The alignment of the oral, pharyngeal and laryngeal axes makes the pathway from the lips to the glottis nearly a straight line. This position of head and neck to facilitate intubation is classically described as “sniffing the morning air” position.

In suspected cervical spine injuries, an assistant should stabilize the head and neck in a neutral position by maintaining in-line cervical traction during airway manipulations. The greatest cervical displacement appears to occur during bag and mask ventilation.

The height of the bed/trolley should be adjusted so that the patient’s head is at the operator’s midchest level.

Procedure

Direct laryngoscopy

The Macintosh and Miller blades are commonly used. The tip of the macintosh blade is inserted into the vallecula (the space between the base of the tongue and the pharyngeal surface of the epiglottis). Pressure against the hypoepiglottic ligament elevates the epiglottis to expose the larynx. The macintosh blade provides good room for passage of the endotracheal tube with minimum epiglottic trauma. Size ranges vary from 0 to 4 with most adults requiring a macintosh # 3 blade. The miller blade is passed to include the epiglottis and the tip lies beneath the laryngeal surface of the epiglottis; the epiglottis is then lifted to expose the vocal cords. The miller blade provides a better exposure of the glottic opening but provides a smaller room through the oro and hypopharynx. Size ranges vary from 0 to 4, with most adults requiring a miller no. 2 or 3 blade.

Visualization of airway structures is easier if a sufficient distance is maintained between the operator’s eyes and the patient’s airway. Crouching too close to the mouth results in a narrowed visual depth of field.4

After positioning the patient, the laryngoscope is held in the left hand and the fingers of the right hand are used to open the mouth gently. A scissoring motion of the right thumb and index finger is described to open the mouth. The clinician should wear gloves because of the likelihood of entry of fingers into the patient’s mouth. The laryngoscope blade is introduced along the right corner of the patient’s mouth avoiding the teeth and to enable the flange of the blade to keep the tongue to the left. The laryngoscope blade is advanced to expose the right tonsillar pillar and then advanced in the midline until the epiglottis comes in view.
The tongue and pharyngeal soft tissues are lifted to expose the glottic opening (fig. 1). The direction of force is along the axis of the laryngoscope handle to pull it forward and upward. The blade should never be used as a lever, using the upper teeth or maxilla as the fulcrum. External pressure on the cricoid and/or thyroid cartilages may aid in visualization of the glottis.5

Adequate mask ventilation and the administration of a neuromuscular blocking agent followed by direct laryngoscopy and intubation. Suxamethonium is a widely used relaxant for intubation because it produces rapid and excellent intubating conditions. The intermediate acting non-depolarizing muscle relaxants—rocuronium, atracurium and vecuronium when used in large doses produce rapid onset of acceptable intubating conditions. Hence, these agents are also used to facilitate intubation. Adequate mask ventilation is a must before administering any muscle relaxant. Pre-oxygenation is recommended as it provides an added margin of safety.

Laryngoscopy and intubation being powerful noxious stimuli require deep levels of anaesthesia to blunt the deleterious patient response. In high-risk population (coronary artery disease, cerebral aneurysm etc.), additional pharmacological agents like i.v lignocaine, esmolol, fentanyl etc. may be used to blunt the haemodynamic perturbations.

In "full stomach" situation or when there is propensity for aspiration, and there is reasonable certainty that intubation should not be difficult, a "rapid sequence" intubation is chosen. If there is sufficient doubt about the ability to intubate the patient, awake intubation with topical anaesthesia of the airway should be considered. Before rapid sequence induction, the patient is pre oxygenated. After pre oxygenation, an intravenous anaesthetic and muscle relaxant are administered together and mask ventilation is not provided until intubation. Proper cricoid pressure is not applied until after the patient is unconscious. Gentle downward pressure is given by the thumb and first finger on the cricoid cartilage to occlude the oesophageal area behind the cricoid. This will prevent regurgitation and should greatly decrease the risk aspiration.8 Suxamethonium is the relaxant of choice during rapid sequence induction due to rapid onset. Rocuronium 1-1.2 mgkg⁻¹ also provides intubating conditions in 60-90 seconds.

When the initial attempt at intubation fails, mask ventilation should be resumed while the situation is reassessed. As long as mask ventilation is maintained, the problem is not emergent. Cricoid pressure should be maintained in full stomach situations. Head position and laryngoscopy technique may be re-examined during the next attempt.

Verification of endotracheal tube placement

Oesophageal intubation remains one of the most common mistakes in airway management associated with a fatal outcome9 and no verification technique is entirely foolproof.10 The usual standard of care for verification of proper endotracheal position includes the persistent detection
of carbon dioxide (CO₂) in the end tidal samples of exhaled gas and auscultation over the stomach and both the lung fields. Small concentrations of CO₂ may be detected after an oesophageal intubation, especially if bag and mask ventilation has insufflated previously exhaled air into the stomach.11 However, the end tidal value decreases progressively with ventilation and should raise the suspicion of oesophageal tube placement.

Listening for breath sounds high in each axilla may decrease the chances of being misled by transmitted breath sounds from the opposite lung. If the breath sounds are heard over only one side of the thorax, and endobronchial intubation should be suspected, and the endotracheal tube should be withdrawn until breath sounds are heard bilaterally. If the breath sounds are not heard over the thorax or are heard over the epigastrium, an oesophageal intubation should be suspected.

The other methods for verifying the placement of the endotracheal tube include visual observation of the endotracheal tube passing through the vocal cords, observation of chest and abdominal movement with ventilation and palpation of trachea as the tube is passed.12,13 Gurgling sounds over the stomach and absence of noticeable chest wall expansion are signs of oesophageal intubation. The exhaled tidal volume may be measured and is reduced with oesophageal intubation.14 Water vapour may be observed to coat the endotracheal tube upon expiration and disappear upon inspiration after proper placement. Fibreoptic endoscopy can be used to confirm endotracheal tube placement.15

**Nasotracheal intubation**

Most of the basic techniques for nasotracheal intubation are similar to those used for orotracheal intubation. Assessment of patency and preparation of the nasal passage is an additional step during preparation. Vasocostriction of nasal mucosa is critical to reduce mucosal oedema and the chance of epistaxis during intubation. Vasocostriction is usually accomplished with a topical solution such as oxymetazoline. Both nostrils should be treated. If both nares are equally patent, the right nostril may be preferable because the bevel of endotracheal tube will face the flat nasal septum when introduced through the right nostril, reducing damage to the turbinates. The inferior turbinates limit the size of the endotracheal tube. A 6.0 to 6.5 mm ID endotracheal tube for women and 7.0 to 7.5 mm ID endotracheal tube for men are suitable for nasotracheal route. Insertion to a depth of 26 cm, measured at the naris in women and 28 cm in men has been reported to result in proper position within the trachea.16 The tube should be advanced in a direction that is perpendicular to the face and parallel to the hard palate. As the tube is passed into the nasopharynx, it may impact against the posterior nasopharyngeal wall. The tube should then be retracted slightly, the patient’s neck extended, and the tube readvanced. Forcible advancement of the tube risks tearing the mucosa and creating a false passage. After the tip reaches the pharynx, the tube is advanced through the glottic opening. This may be accomplished with direct laryngoscopy and Magill forceps to guide the tip of the tube anteriorly through the glottis. The forceps should grasp the tube proximal to the endotracheal tube cuff. This reduces the chance of damaging the endotracheal tube cuff during insertion. An assistant must then advance the tube as it is directed with the forceps.

**Blind nasal intubation**

Blind intubation is easier to describe than to perform. Patient may be intubated either awake or asleep, without visualizing the larynx. Once the endotracheal tube has passed into the nasopharynx, the monitoring of breath sounds becomes the key for successful intubation. At each inspiratory effort, the tube should be advanced while constantly monitoring breath sounds. If advancing the tube results in loss of or reduction in breath sounds, then the tube should be withdrawn to the point at which the breath sounds are maximally heard. The endotracheal tube then can be turned slightly and readvanced with each inspiratory effort. Successful tracheal intubation will be detected by continued auscultation of distant breath sounds, some resistance as the tube passes through the vocal cords, the patient coughing, and the capnography reading and waveform. If repeated insertions of the endotracheal tube fail to enter the trachea, then the tube should be withdrawn to the point when the breath sounds are heard loudest. At this point, 10 ml of air can be introduced into the tube cuff (this directing the tube tip anteriorly away from the posterior pharyngeal wall) and the endotracheal tube can be advanced a further 2 cm without loss of breath sounds. The cuff is then deflated and the tube advanced further into the trachea. Most commonly, the tube tends to enter the oesophagus. Extending the patient’s neck or providing cricoid pressure tends to align the tube with the glottis and may increase the chances the success.

Blind nasal intubation is an important skill for the anaesthesiologist, as it remains an important adjunct in the management of difficult airway. Indications for this technique include potentially difficult orotracheal intubation and patients in whom muscle relaxants or a surgical airway are undesirable or contraindicated. The former situation may include patients with dental fractures, arthritis or dislocations of the temporomandibular joints, a small mouth, a short
neck, a large tongue, a history of previous head and neck surgery, or cervical spine immobility. This technique is often performed with the patient sitting upright in bed and so is useful when the patient cannot or should not be placed supine. Contraindications include acute epiglottitis, apnoea, basilar skull fractures with or without cerebrospinal fluid rhinorrhoea, bleeding diathesis, upper airway foreign body, large bilateral nasal polyps, abscesses and severe laryngeal trauma. Complications are rarely serious, but can include nasopharyngeal haemorrhage, laryngeal trauma, retropharyngeal perforation, and paranasal sinusitis.

**Blind oral intubation**

During direct laryngoscopy, if the laryngeal inlet is not visualized, a bougie can be passed blindly below the epiglottis followed by threading the endotracheal tube over the bougie. The placement of the endotracheal tube is confirmed as described in the previous section.

Blind intubation with the aid of light wand is another option. It has a malleable stylet with a light source at the tip. The handle containing the battery for the light source is attached to the proximal end of the stylet. The endotracheal tube is threaded over the lighted stylet in the conventional fashion and introduced into the oropharynx blindly following the curve of the tongue. It is helpful to bend the stylet anteriorly close to the tip. The glow visible over the anterior neck—bright glow in the midline—guides tracheal intubation. Darkening the surroundings enhances appreciation of the glow. The endotracheal tube can be slid off the light wand as if it were a standard malleable stylet.

**Awake intubation**

Instrumentation of the airway is uncomfortable and distressing to a conscious patient. An informed and reassured patient adds to the success of awake intubation. A struggling patient markedly reduces the chances of successful intubation. A reasonable patient, however, is vital during awake intubation. In those patients at severe risk of aspiration, narcotics and other sedatives must be used sparingly. When awake intubation is planned, a dose of anticholinergic, such as glycopyrrolate 0.2 mg IV is recommended.

Local anaesthetic agents are rapidly absorbed by the mucous membrane of the respiratory tract to effectively eliminate pharyngeal, laryngeal and tracheobronchial reflexes. These agents are less effective on topical application due to diminished buffering capacity of mucous membranes, limiting release of anaesthetic base and presence of cilia and secretions on the mucous membrane acting as barriers to the penetration of drugs. To compensate for these, a higher concentration of drug must be used. The commonly used agents are lignocaine, benzoicaine and tetracaine. Lignocaine is available as 2%, 4% solutions, 2% viscous solution, 10% aerosol preparation and 5% ointment. Local anaesthetics can be applied to mucous membranes with cotton-tipped applicators or pledgets or sprayed over the mucosa directly or via aerosol inhalation. Nares may be anaesthetised by pledgets soaked in 4% lignocaine. The nasopharynx may be instilled through a 16 or 18 gauge catheter inserted deeply into the nose. The tongue and oropharynx can be anaesthetized with 10 % lignocaine spray using the laryngoscope blade or a tongue depressor. Alternatively, the patient can gargle and expectorate viscous lignocaine to produce topical anaesthesia of the pharynx. The larynx can be sprayed with lignocaine directly onto the visualized glottis. The trachea can be anaesthetized with a translaryngeal application of 2 to 3 ml of 1% lignocaine. A 22-gauge catheter or a 23-gauge needle is inserted through the cricothyroid membrane in the midline, air is aspirated to confirm the location of the needle tip and lignocaine is quickly injected and the needle removed. The cough induced provides excellent spread of the anaesthetic in the larynx below the vocal cords. The superior laryngeal nerve may be blocked by an external approach using a 23-gauge needle to inject 2-3 ml of 1% lignocaine between the greater cornu of the hyoid bone and the thyroid cartilage. This nerve may also be blocked by the application of lignocaine soaked pledgets with Krause forceps held in the pyriform fossa. Nebulization of lignocaine can also be employed to anaesthetise the nasal passage, pharynx, larynx and tracheobronchial tree.
Techniques for awake intubation: The choice of technique depends on the preference for oral versus nasal tube placement, experience and availability of equipment. If one technique fails, another is usually tried. The various options are oral intubation with direct laryngoscopy, blind oral intubation, blind nasal intubation, retrograde intubation and fibreoptic bronchoscopy guided intubation.

Conclusion

Airway management is the most important skill required of an anaesthesiologist and one of the first ones to be taught during training. Endotracheal intubation is a skill based on the knowledge of airway anatomy, equipments for airway manipulation, aided by judicious use of pharmacological agents and enhanced by experience.

References