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REVIEW ARTICLE

Anesthesia Considerations in Microlaryngoscopy or Direct Laryngoscopy

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ABSTRACT

Patients of all ages including pediatric, adult, and geriatric age groups present to anesthesiologists for microlaryngoscopy (ML scopy) or direct laryngoscopy (DL scopy). Proper preoperative evaluation, adequate intraoperative care, monitoring, and postoperative monitoring provide a successful outcome in these patients. These procedures are day care procedures. The aim of anesthesiologists while dealing with such patients is maintaining adequate depth of anesthesia, maintaining adequate ventilation to the patients, and giving enough time to the surgeon to diagnose and evaluate the definitive cause of airway disease. Anesthesiologists should share the airway or maintain the ventilation in such a way as to give the surgeon proper and good visualization of the patient's airway. The use of short-acting and potent anesthetic agents provides adequate intraoperative depth of anesthesia and speeds up postoperative recovery, i.e., awakening of the patient.

Keywords: Anesthesia, Direct laryngoscopy, Microlaryngoscopy.

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INTRODUCTION

Patients for microlaryngoscopy (ML scopy) or direct laryngoscopy (DL scopy) may be of all ages, including pediatric,[1] adult, or geriatric.[2] They are referred for the procedure for diagnostic or therapeutic purposes. They may present with hoarseness of voice, change of voice, difficulty in breathing, and inspiratory or expiratory stridor. These patients may have associated congenital and acquired conditions other than airway diseases, such as smoking-related pulmonary conditions, hypertension, ischemic heart disease, endocrinopathies including diabetes mellitus and thyroid diseases, and cardiac anomalies, especially in the pediatric age group. The main aims of anesthesiologists are as follows[3]:

- Providing adequate preoperative evaluation and optimization
- Maintaining adequate depth of anesthesia intraoperatively to maintain stable hemodynamics and still patient
- Sharing the airway in such a way to give good visualization to the surgeon to diagnose the pathological conditions
- Giving enough time to the surgeon to diagnose and treat the airway diseases
- Protecting lower airway from blood and debris
- Postoperative monitoring and early recovery of the patient

PREOPERATIVE EVALUATION

A thorough medical evaluation is necessary for all patients requiring anesthesia. These patients may present with a history of hoarseness of voice, voice change (low pitch, coarse fluttering—subglottic/high pitch, cracking voice, aphonia—glottis), and stridor (inspiratory or expiratory). Patients may present with dysphagia. The best breathing position and breathing pattern during sleep give an indication of the severity of the disease. Patients are likely to have cardiovascular system (hypertension, ischemic heart disease, and coronary artery disease) and respiratory dysfunction. History of previous endoscopic procedures and their outcome is very important. When the lesions occur in or near the airway, there is a possibility of life-threatening airway obstruction during the induction of anesthesia. Also, manipulation of the airway lesions can cause bleeding or edema, which results in airway occlusion. The difficulties may occur during the intubation of trachea; hence, oropharynx should be evaluated carefully. The range of motion of neck should be examined carefully to assess the difficulties with airway management. The radiological investigations and records, such as computed tomography (CT) scan, magnetic resonance imaging (MRI),[4,5] and X-ray help the anesthesiologists to assess the potential difficulties in securing the airway and endotracheal intubation.[6] Patients may have prolonged endotracheal intubation with intensive care unit (ICU)/neonatal ICU admission, and associated lung pathologies also should be thoroughly evaluated

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and optimized preoperatively by giving nebulization with β2 agonist and adequate hydration.

A discussion with the surgeon is necessary regarding any potential airway difficulties with anesthesia and the plan of surgery.

Before anesthesia, identify the following:

- Airway assessment: Ease of ventilation, visualization of laryngeal inlet, and tracheal intubation
- Direct or indirect laryngoscopy: Assess the severity and size of the lesions
- Chest radiography, CT, and MRI: Provide information about subglottic tracheal lesions of ventilation

PREOPERATIVE PREPARATION

- Cessation of smoking
- Continue bronchodilators
- If with tracheostomy: steam inhalation, nebulization, and suction

INDICATIONS FOR ML SCOPY

- Benign growth – nodules, polyps, cysts (as shown in Figs 1A and B)
- Granulomas
- Vocal cord dysfunction
- Obstructed tumor
- Recurrent respiratory papillomatosis
- Foreign body

PREMEDICATION

- Sedatives are avoided if any degree of airway obstruction is suspected.
- Anticholinergics are used to decrease secretions and avoid bradycardia.

INTRAOPERATIVE MONITORING

Routine monitoring

- Electrocardiography for heart rate and rhythm
- Noninvasive blood pressure (NIBP) monitoring
- Pulse oximetry
- End-tidal carbon dioxide monitoring ($ETCO_2$)
- Temperature

Additional observations:

- Airway pressures
- Invasive monitoring

ANESTHETIC TECHNIQUES FOR ML SCOPY

Intubation techniques: Advanced airway with ML scopy endotracheal tube

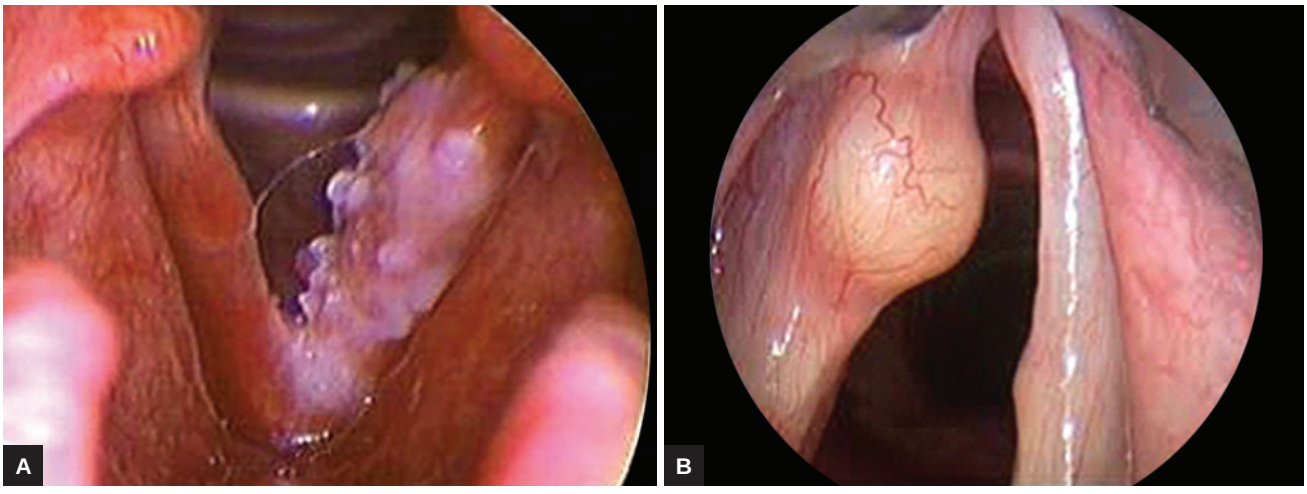
Nonintubation techniques

- Intermittent apnea
- Insufflation technique
- Spontaneous ventilation
- Jet ventilation

INDUCTION OF ANESTHESIA

Patients who are not at risk of respiratory obstruction can have anesthesia induced in a straightforward manner following preoxygenation.[3] The minimum monitory equipments suggested are NIBP monitoring, pulse oximetry, electrocardiography, a precordial stethoscope, an oxygen analyzer, and capnogram. When the obstruction of the airway is anticipated, a full array of anesthesia equipment is mandatory. Different sizes of laryngoscope blades, oral and nasal airway, rigid bronchoscope, and tracheostomy tray should be available.

Anesthesia is induced with barbiturates, such as sodium thiopental [5 mg/kg intravenous (IV)] and muscle relaxants, such as succinylcholine (2 mg/kg IV) with oxygen on intermittent positive pressure ventilation, and endotracheal intubation is performed. Anesthesia is maintained with oxygen, sevoflurane, and intermittent nondepolarizing muscle relaxants (NDMRs), such as vecuronium bromide.



Figs 1A and B: Lesions at vocal cords

The surgeon should be present at the time of anesthetic induction. Many a times, awake intubation of the trachea using topical anesthesia is the technique recommended. Transtracheal instillation of local anesthetics and superior laryngeal nerve blocks may be useful. In difficult cases, fiberoptic laryngoscope should be considered.[7] Intravenous anesthetics should be used carefully in order that adequate and unobstructed respirations are maintained.

Microlaryngeal tube can be used as an advanced airway technique when endotracheal intubation is planned.

MICROLARYNGEAL TUBES OR MALLINCKRODT CRITICAL CARE TUBE

Microlaryngeal tubes (shown in Fig. 2) have the following characteristics:

- Small internal and external diameter
- Can be used orally or nasally
- 4 to 6 mm internal diameter and 30 cm long with standard cuff
- Low-pressure high-volume cuff
- When inflated, the cuff lies between arytenoid cartilages, leaving at least anterior two-third of glottis unobscured

Advantages of Microlaryngeal Tube

- Routine technique for all anesthesiologists
- Protection of lower airway
- Control of ventilation
- Control of airway
- Minimal pollution by volatile agents
- Monitor $ETCO_2$

Disadvantages of Microlaryngeal Tube

- Surgical access and visibility of lesion may be limited
- High inflation pressure may be required through small tube
- Higher resistance, difficulty in suctioning, and increased chances of occlusion and kinking
- Tube-related damage to vocal cords during intubation
- Risk of laser airway fire

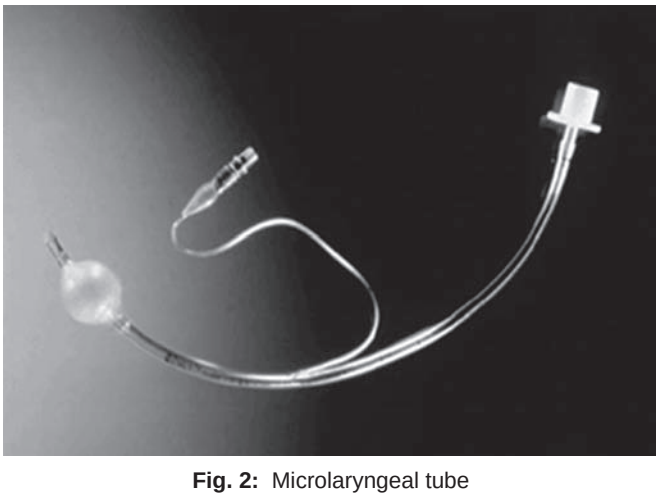


Fig. 2: Microlaryngeal tube

NONINTUBATION TECHNIQUES OF ANESTHESIA IN DIFFICULT ML SCOPY PROCEDURES[8-10]

Spontaneous Ventilation

Most of the time when there is anticipated difficult intubation and ventilation, spontaneous ventilation technique using inhalational induction with sevoflurane or halothane in oxygen is used. In this technique, laryngoscopy is performed, topical local anesthetic is instilled on and above vocal cords, and mask ventilation with 100% oxygen is given. When suitable depth of anesthesia is achieved, rigid laryngoscopy or bronchoscopy is performed. It has its own advantages as there is excellent visualization of the surgical field and ability to evaluate vocal cord function. Also, it is good for otherwise stable patients with compromised airway. Spontaneous ventilation has disadvantages, such as oxygenation, and ventilation is more difficult to assess, surgical field is not still, there is a risk of aspiration, and depth of anesthesia is not consistent.

Insufflation Technique

Insufflation technique incorporates the following routes:

- A small catheter in the nasopharynx placed above the laryngeal opening
- A tracheal tube cut short and placed through the nasopharynx emerging just beyond the soft palate
- A nasopharyngeal airway
- Side arm or channel of the laryngoscope

The technique for insufflation is shown in Figure 3.

It has some potential disadvantages, such as no control over ventilation, loss of protective airway reflexes, and the potential for airway soiling. It also causes gastric distention and theater pollution. It is not suitable for soft floppy lesion.

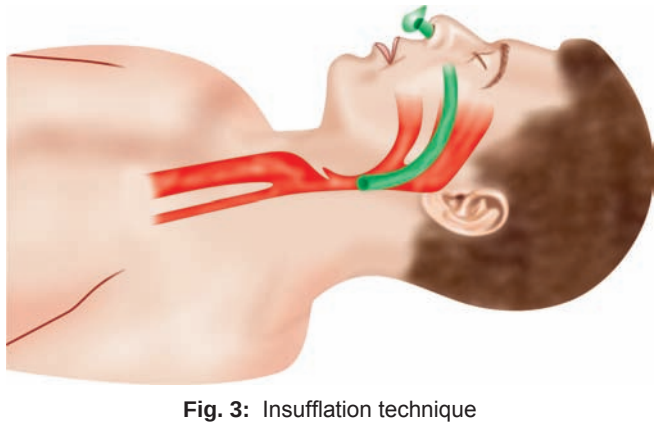


Fig. 3: Insufflation technique

Intermittent Apnea Technique

Standard anesthesia induction with induction agents, such as sodium thiopental (4–5 mg/kg IV) and muscle relaxants, such as vecuronium bromide is given, and the patient is intubated. Anesthesia is maintained with intermittent NDMRs and inhalational agents, such as sevoflurane. The patient is handed over to the surgeon after adequate ventilation and the surgeon performs diagnostic and therapeutic ML scopy procedure on the patient's airway. Meanwhile, oxygen saturation and other vital parameters are monitored. As the oxygen saturation goes below 97%, the patient is reintubated and ventilated till oxygenation improves. At the end of the procedure, the patient is reintubated and hyperventilated. Anesthesia is reversed with standard anticholinesterases, such as neostigmine and anticholinergics, such as glycopyrrolate.

Intermittent apnea technique has excellent visibility of surgical field and safety in the use of laser. It has certain disadvantages, as there is a limitation of surgical time, inadequate ventilation, aspiration risk, varying levels of anesthesia, and potential trauma through multiple reintubations.

DIRECT LARYNGOSCOPY

Definition and Introduction

Direct laryngoscopy[11] is the procedure that is used to obtain a view of the vocal folds and the glottis. Laryngoscopy may be performed to facilitate tracheal intubation during general anesthesia or to secure airway in cardiopulmonary resuscitation or for procedures on the larynx or other parts of the upper tracheobronchial tree.

History

Alfred Kirstein (1863–1922), Chevalier Jackson (1865–1958), and Gustav Killian (1898–1912) are the contributors to the introduction of the handheld laryngoscopy.

Manuel Garcia (1805–1868) introduced indirect laryngoscopy.

Indications

Diagnostic indications for laryngoscopy include
- Stridor, either congenital or acquired
- Subglottic stenosis
- Cysts or masses causing airway obstruction
- Vocal cord palsy
- Foreign bodies

Therapeutic indications for laryngoscopy include
- Subglottic stenosis
- Aspiration/injection of mucous cysts and cystic hygromas
- Papillomas
- Lingual thyroid
- Webs
- Intubation

Instruments/Equipment

Laryngoscopy can be performed by using rigid or flexible instruments.

Rigid laryngoscopy: A rigid laryngoscopy may be performed by using the indirect or direct method.

- *Indirect laryngoscopy*
  It is performed by using specially designed laryngeal mirrors in combination with a headlight. This enables the larynx and the nasopharynx to be visualized. Frequently used in adults, it is often difficult to carry out this procedure in children.
- *Direct laryngoscopy*[11]
  It is performed with handheld curved or straight blade instruments or by using a suspension laryngoscope, which leaves both hands free to manipulate instruments. The curved Macintosh blade and the straight Miller blade laryngoscopes are routinely used.

Equipment for Laryngoscopy[12]

- Oxygen source and self-inflating ventilation bag (e.g., Ambu bag)
- Face mask
- Oropharyngeal and nasopharyngeal airways
- Tracheal tubes
- Tracheal tube stylet[13]
- Syringe for tracheal tube cuff inflation
- Suction apparatus
- Laryngoscope handle (two)
- Laryngoscope blades: Common blades include the curved (Macintosh) and straight (Miller) (shown in Figs 4 and 5 respectively)
- Stethoscope

Technique

Sniffing position[14-16]: The sniffing position, shown in Figure 6, is the best starting position for laryngoscopy. In the sniffing position, the cervical spine below C5 is relatively straight, there is increasing flexion from C4 to C2, and the head is fully extended (occipitoatlantoaxial complex).[4,17] Neck flexion between C2 and C4 is achieved by elevating the head.[5,18,19]

- Flexion at the cervical spine
- Extension at atlanto-occipital joint
- Goal: Alignment of the three axes: oral axis, pharyngeal axis, and laryngeal axis

Fig. 4: Different sizes of Macintosh laryngoscope blades

Fig. 5: Different sizes of Miller laryngoscope blades

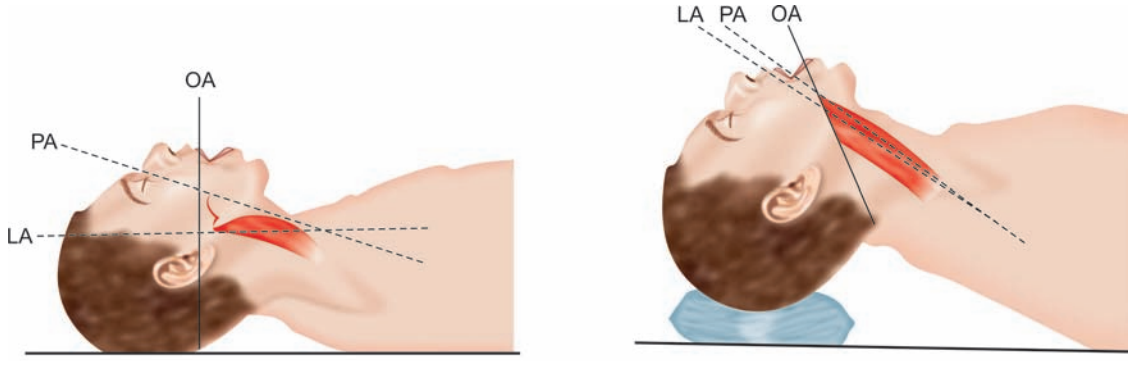


Fig. 6: Airway axes alignment and exposure of the glottic opening; OA: oral axis; PA: phryngeal axis; LA: laryngeal axis

Suspension Laryngoscopy

- Frequently carried out by ear, nose, and throat surgeons, as this arrangement leaves the surgeon's hands free to use instruments and even to position an operating microscope for precise surgery.
- The surgical procedures that can be done with the suspension laryngoscope include the following:
  - Aspiration/marsupialization of cysts
  - Excision of nodules
  - Laser vaporization of papilloma
  - Injection of bleomycin in cystic hygromas with laryngeal involvement

Technique of DL scopy and sharing of airway by surgeons and anesthesiologists are shown in Figure 7.

Fig. 7: Direct laryngoscopy

Anesthesia Management

- The requirements of anesthesia for laryngoscopy must be compatible with maximum safety and minimum patient discomfort.
- Premedication should be performed with anticholinergics (glycopyrrolate), benzodiazepines, and opioids.
- Anesthesia should be induced using sodium thiopental (5mg/kg)/propofol (2 mg/kg).

- Only after confirming that the patient can be ventilated by mask (100% oxygen given for 2–3 minutes) a long-acting muscle relaxant is administered.
- Four minutes after the injection of NDMRs or after the patient is adequately under the inhalational anesthesia, intubation will be attempted by performing DL scopy.

Laryngoscopy Response

- DL scopy is a noxious stimulus that can provoke adverse responses in the cardiovascular, respiratory, and other physiological systems.
- The magnitude of the response is greater with increasing force and duration of laryngoscopy.
- Elevation in arterial pressure typically starts within 5 sec of laryngoscopy, peaks in 1 to 2 min, and returns to control levels within 5 min. Such hemodynamic changes are undesirable in patients with cardiac diseases.

Many techniques have been tried in an effort to attenuate adverse hemodynamic responses to intubation, but none is ideal.

- Prevention by the use of an increased depth of anesthesia
- Use of N_2O with a volatile agent may be beneficial
- Large doses of narcotics (other than morphine), such as fentanyl (2–3 μg/kg), suppress the hemodynamic response but risk prolonged respiratory depression.
- Aerosol or other applications of topical anesthetics may be beneficial with a low risk of adverse effects.
- Awake flexible fiberoptic intubation with effective topical anesthesia almost eliminates the hemodynamic response to tracheal intubation.

CONCLUSION

Different anesthesia techniques have their own advantages and disadvantages. The choice of anesthesia for a given procedure should be decided based on the extent of airway disease in the patient, comorbidities in the patient, and available equipment and resources.

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