Nasotracheal Intubation: An Overview

Deepak Prasanna · Sonia Bhat

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Abstract

Introduction Nasotracheal intubation is the commonest method used to induce anaesthesia in oral surgery patients. It has a distinct advantage of providing good accessibility for oral surgical procedures.

Anatomy and procedure One must know the anatomy involved, the pathway and procedure of intubation, the pre-anaesthetic medication and complications which may be seen at the time of intubation. The surgeon must have the knowhow of the tube and the procedure which are explained in detail in the article.

Complications Several complications can arise while performing the procedure which may be operator induced or arising due to anatomical variations.

Conclusion It is prudent for the oral surgeon to know the basics of nasotracheal intubation in order to form a useful team member for management of complications arising from anaesthesia. Recent years have seen improvement in the armamentarium. These help negate the blindness of the procedure.

Keywords Nasotracheal intubation · Epistaxis · Fibreoptic endoscopy · Bacteremia

Introduction

Anaesthesiology is an integral part of every surgical subject. It is imperative for the operating oral surgeon to have in depth knowledge of the same. Nasotracheal intubation (NTI) is one of the commonest methods used to induce anaesthesia for surgeries of the head and neck region. NTI involves the tracheal tube to pass through nose hence allowing better isolation and good surgical access for intraoral procedures. The knowledge of NTI empowers the surgeon to become a part of the team involved in managing anaesthetic complications involving the NTI.

The Basic Anatomy

To understand NTI the understanding of the basic anatomical structures involved is paramount. The nasal cavity is a potential space situated above the oral cavity and hard palate and below the skull base and intracranial compartment. It is separated in the midline by the cartilaginous nasal septum into a right and left side. The left and right nasal cavities become continuous in the back of the nose via the opening to the nasopharynx, termed the choana. The lateral nasal walls include three structures called turbinates. Beneath each turbinate is a meatus, named according to the turbinate just above it. The inferior turbinate is the largest of the three paired turbinates, and runs along the entire length of the lateral nasal wall, adjacent to the nasal floor. The middle turbinate projects into the central nasal cavity and resides next to the nasal septum. The superior turbinate is the smallest of the turbinates. It resides just above and behind the middle

D. Prasanna (✉)
Department of Oral and Maxillofacial Surgery, Rishiraj College
of Dental Sciences and Research Centre, Gandhinagar,
Bhopal 462036, Madhya Pradesh, India
e-mail: deepsmyle@yahoo.com

S. Bhat
Department of Prosthodontics, Rishiraj College of Dental
Sciences and Research Centre, Gandhinagar, Bhopal 462036,
Madhya Pradesh, India

turbinate, and also attaches to the skull base superiorly and nasal wall laterally [1].

There are two pathways along which a tube can be introduced through the nasal cavity namely the lower and upper pathway (Figs. 1, 2). Lower pathway lies along the floor of the nose and is safer. The upper pathway lies between the inferior turbinate and middle turbinate. The lower pathway is a preferred pathway. We are well versed with the nasal anatomy but not with the anomalies. Intranasal abnormalities are seen in 2/3rd of oral surgery patients [2]. Anatomical variations like concha bullosa, septal deviations, spur, nasal polyps which can cause unilateral obstructions and thereby affect intubation, are common [3]. Deviated nasal septum changes the airflow dynamics. These variations must be diagnosed during pre-anaesthetic evaluation to prevent complications.

Indications of NTI [4, 5]

1. Intraoral and oropharyngeal surgery.
2. Oral route of intubation not possible due to trismus
3. In ICU as an alternative to tracheostomy for longer ventilation periods
4. Surgery of maxillofacial cases needing better surgical access
5. Tonsillectomies
6. Rigid laryngoscopy and microlaryngeal surgery

Its contraindications include

1. Previous history of old or new skull base fractures
2. Bleeding disorders predisposing NTI to epistaxis.

Fig. 1 Upper and lower pathways for NTI in sagittal view

Fig. 2 Upper and lower pathways for NTI in coronal view

Armamentarium

Tube Type

Tubes used in intubation are classically of two types, namely oral tubes and nasal tubes. The nasal tubes are longer than the oral tubes. The proximal end of these tubes is placed either in the nasal or oral cavity and the distal end of the tube enters the trachea. NTI involves usage of nasal tube. This allows the oral field to be left free and unimpeded for surgery. The proximal end is connected to the anaesthetic circuit. The tube normally comes with an attached cuff. This cuff (*pilot balloon*) in the tube when inflated seals the tube against the tracheal wall [6]. This helps in preventing aspiration of fluids into the lungs and ensures that tidal volume ventilates lungs rather than allowing escape of air and gases. The cuff is usually inflated to 25 mm of Hg which is also called “*just seal volume*”. Increased cuff pressure can cause sore throat, tracheal damage and vocal cord dysfunction [7]. Smaller diameter nasotracheal tubes as compared to orotracheal tubes are preferred to reduce the chances of sore throat and hoarseness. Thermo softening of the tube is recommended prior to intubation to reduce the incidence of trauma to nasal mucosa [8].

Tube Material and Bevel

Tubes used for intubation are available in several materials and come in various designs. Tubes may be made of poly vinyl chloride (PVC), rubber, poly urethane or silicone. The tip design can be classified into Magill tip and Murphy's tip. Tip of Magill tracheal tube has a simple bevel and a shorter end. Whereas, the tip of Murphy tube have a more acute bevel and the presence of Murphy's eye makes it longer than the Magill tube. Murphy's eye is an aperture in the tube wall opposite the bevel. It allows a continuous passage of air in the event of obstruction at the level of bevel. Covering the nasotracheal tube with soft materials

[9, 10] is an important modification. Sheathing of tube reduces trauma to the nasal mucosa and prevents impaction of foreign objects into the tube. This technique is suitable in patients with bleeding disorders or high risk of epistaxis or nasopharyngeal trauma [11].

Methodology

Pre-anaesthetic Evaluation [12, 13]

A pre-anaesthesia evaluation must be performed for each patient, procedure requiring anaesthesia, by a person qualified to administer anaesthesia. It includes:

1. Review of the medical history, including anaesthesia, drug and allergy history
2. Interview and examination of the patient
3. Notation of anaesthesia risk according to established standards of practice (e.g., ASA classification of risk)
4. Identification of potential anaesthesia problems, particularly those that may suggest potential complications or contraindications to the planned procedure (e.g., difficult airway, ongoing infection, limited intravascular access)
5. Additional pre-anaesthesia evaluation, if applicable and as required in accordance with standard practice prior to administering anaesthesia (e.g., stress tests, additional specialist consultation)
6. Development of the plan for the patient's anaesthesia care, including the type of medications for induction, maintenance and post-operative care and discussion with the patient (or patient's representative) of the risks and benefits of the delivery of anaesthesia.

The patient evaluation must be performed and documented within 48 h prior to the surgery.

Pre-anaesthetic Preparation [14]

i. *Preparation for awake intubation:* The process of intubating an awake patient requires careful preparation. The anaesthesiologist must evaluate each patient's needs on an individual basis. Nearly every patient experiences some degree of anxiety associated with the surgery, anaesthesia, and perhaps outcome. For this reason, most patients require some degree of sedation and analgesia. For this purpose, it is best to use short-acting or reversible agents for sedation or agents that do not cause a considerable degree of respiratory depression. Some examples of commonly used medication for awake intubation include midazolam, alfentanil, and fentanyl. These sedatives/analgesics are particularly useful in this setting because of their easy titratability to effect easy reversal with flumazenil or

naloxone. Similarly, dexmedetomidine does not cause respiratory depression and is suitable in this setting.

ii. Antisialagogues should be used before any airway instrumentation. Secretions may make visualization difficult and may serve as a barrier to effective penetration of local anaesthetic into the mucosa. Glycopyrrolate 0.4 mg given intramuscularly or intravenously helps to diminish secretions. Alternatively, atropine 0.5–1 mg may be used intramuscularly or intravenously to similar effect.

iii. Topicalization can also be accomplished by the use of local anaesthetic-soaked cotton pledgets or swabs. These are soaked in either viscous or aqueous solutions of local anaesthetic and then left for 5–15 min on the region of mucosa that requires anaesthesia. The cotton acts as a reservoir for the anaesthetic agent, producing a dense block. This technique is especially effective in the nasal passages. Most clinicians have used the technique of adding small concentrations of epinephrine (1:200,000 or less) or phenylephrine (0.05 %) to lidocaine. Alternatively, a vasoconstricting nasal spray (oxymetazoline) can be applied before application of the local anaesthetic. This approach results in dry mucosa, which then can be more easily anesthetized with local anaesthetic because the local anaesthetic does not get diluted with nasal secretions or saliva. The resulting vasoconstriction is nearly as effective as that of cocaine and offsets lidocaine's powerful vasodilatation.

iv. Pre-warming of the tube is performed by the anaesthetist to soften the tube and advance its movement with minimum force into the nasal cavity. However, it may distort the tube and obstruct the tube where the inflation lumen opens in the cuff [8, 15].

Nostril Selection

Choosing the correct nostril for intubation is very important. Anterior rhinoscopy during pre-anaesthetic evaluation gives accurate indication of most patent nostril. However, it fails to determine posterior nasal abnormality. Hence anterior rhinoscopy can be used as a provisional method for selection of nostril [2]. Nasal endoscopy is also helpful in choosing the nostril for intubation and assessing intranasal abnormality. Pre-existing nasal pathology and various degree nasal obstructions render the nose susceptible to trauma during nasal intubation. Flexible endoscope may be used to perform detailed examination of the entire nasal cavity for the selection of nostril [5, 16].

Force

Anaesthetists with experience develop a sense of threshold pressure to be applied for intubation. Any excessive force may increase significant risk of damage to nasal structures

[2]. Ahmed Nusrath noticed that 43 % tubes met with resistance and tube had to be manipulated more than once [3].

Method of Insertion [12]

Stepwise Intubation Technique

1. Examine both nostrils to determine which is larger.
2. Spray the nasal passages and back of the throat with an appropriate topical anaesthetic and vasoconstrictor (neosynephrine) in order to numb the mucosa and reduce bleeding. Use of xylocaine jelly and/or a nasal airway prior to intubation may increase anaesthesia and reduce bleeding. Dilate the selected nostril with a #32 nasal airway. If significant resistance is felt, try the other side. Remove the airway prior to intubation.
3. Pre-oxygenate the patient at 100 % and keep the patient on oxygen by a cannula in the mouth during the entire procedure.
4. Check the balloon on an appropriately sized nasotracheal tube (same or 2 size smaller than ETT). Firmly seat the 15 mm adapter in the proximal end of the tube and lubricate the distal 4 cm with xylocaine jelly.
5. Position the patients head in midline neutral position if possible
6. With gentle, steady pressure, insert the tube directed towards the occipital protuberance on the back of the skull with the bevel turned towards the nasal septum. If the tube will not pass on one side, try the other. Some resistance may be encountered when the tube reaches the posterior nasopharynx. At this point some gentle manipulation may ease passage past the resistance. Turn the tube 1/4 turn after reaching the nasopharynx. Do not force it.
7. When the tube has reached the oropharynx, manipulation of the tube with Magill's forcep and laryngoscope is done to facilitate its movement into the trachea. Listen at the end of the tube for air moving in and out with each respiration. Do not force the tube down as structures in the larynx may be torn. If properly positioned, the tube will easily slip into the trachea (Fig. 3). Keep your other hand on the cricoid cartilage to palpate and assist tube passage (Sellick manoeuvre).

Fibreoptic Nasal Intubation

The mainstay of difficult airway management remains flexible fibreoptic laryngobronchoscopic intubation. Fibreoptic intubation can be performed under a variety of

Fig. 3 NTI tube in position

conditions. Fibreoptic nasal intubation has a definite advantage over the conventional NTI. It simplifies intubation in Grades 3 and 4 direct laryngoscopy as described by Cormack and Lehane [17] and avoids dental damage. Fibreoptic should not be used only as an intubating device but also as diagnostic and therapeutic tool [18, 19]. However, it is a time consuming and expensive procedure not indicated for minor procedures.

Complications of Nasotracheal Intubation

Complication of NTI is one of the many causes for anaesthesia related mortality [20]. The various complications are:

1. *Epistaxis*: This is a common complication of NTI which can be managed by external pressure on the nares. Life threatening bleeding has been reported during intubation [8, 21]. Blood in the airway can deteriorate conditions obscuring view and aspiration of blood into the lungs is possible. Severe epistaxis can be managed by tamponade of the turbinates using various materials [22, 23]. If epistaxis occurs, then tilting the head downward will keep blood away from the glottis till throat pack is placed [24]. The severity of haemorrhage is reduced with thermo softening of tube prior to intubation as it causes lesser trauma [25, 26].

2. *Bacteremia*: It has been observed that dental procedures under general anaesthesia demonstrate a higher incidence of bacteremia compared to procedures under local anaesthesia [27]. The most common species of bacteria in the nasal cavity are alpha haemolytic streptococcus

and cornibacterium species. Pre-existing respiratory diseases have higher incidences of bacteremia with nasal intubation.

The etiology of bacteremia may be from two places:

- (a) Trauma to nasal mucosa during NTI can occur due to difference in size of the tube to nostril size and increased force used, during intubation. Hence, presence of bacteria in the nasal cavity and trauma during intubation predispose to bacteremia.
- (b) Transfer of bacteria from nasal cavity or mucosa into trachea via the tube can occur. Highly vascularised trachea is prone to bacteremia through bacteria carried by the tube via the nasal cavity. If NTI is indicated then higher dose of antibiotic is necessary to prevent bacteremia.

NTI poses a higher risk of bacteremia in patients with prosthetic heart valves, requiring antibiotic prophylaxis [28]. Sheathing of the tube tip with soft materials prevents bacteremia and nasal contamination into the trachea or bronchus [11, 25].

3. *Partial or complete obstruction of tube:* Obstruction of the NTI with local and foreign objects [29] have been reported with avulsed polyp [30], avulsed inferior turbinate [31, 32], tooth [33], micropore tape [34] and blood clot [35]. In partial obstruction the onset of symptoms of obstruction may be delayed. These events can be avoided with use of monitoring with end tidal CO₂ [36]. If visualization of trachea is difficult due to collected fluid in the nasopharynx then, CO₂ monitoring may be used to confirm correct endotracheal intubation. Except CO₂ no other signal can document the status of both ventilator and metabolic systems so readily.

4. *Other complications:*

- A. Topography of the naso pharynx forces the advancing ET tube to bend sharply thus increasing the risk of sub mucosal laceration [37]. Indiscriminate removal of turbinate during elective nasal surgery results in atrophic mucosa, loss of ciliary function, dry crusty and functionless airway [38]. Prolonged nasal intubation can cause inferior turbinate ulceration [39].
- B. Perforation of pyriform fossa can occur during NTI which may cause subcutaneous/mediastinal emphysema [40]. Inadvertent intra cranial placement of nasotracheal tube can cause hemiparesis, blindness, anosmia and CSF fistula. Tube in anterior cranial fossa has a high mortality rate [4]. NTI may also be followed by sinusitis. Excessive force application during intubation may cause olfactory nerve injury [41] or cribriform plate fracture causing CSF rhinorrhoea. Damage to the middle turbinate during NTI may cause fracture of the cribriform plate of ethmoid

resulting in CSF rhinorrhoea or damage to the olfactory nerves.

- C. Retropharyngeal perforation [38] may be a more common complication of nasotracheal intubation than realized. The major technical error is failure to appreciate that loss of flow of air from the tube, once the tube has passed the turbinates, means that the lumen of the tube is abutting the pharyngeal mucosa. Even slight pressure at this point can lead to retropharyngeal perforation.

Risk Factors for Intubation Complications [42]

Patient factors

1. Unfavourable anatomy
2. Abnormal anatomy (eg: facial skeletal abnormality)
3. Pre-existing medical condition (eg: Gastro esophageal reflux disorder)

Tube factors

1. Too large a tube size selected
2. Cuff pressure too high
3. Co-existing naso-gastric tube

Technical factors

1. Forceful intubation
2. Poor visualization of larynx
3. Numerous intubation attempt

Knuth and Rick [32], Murray and Modell [36] suggested various preventive measures for tube obstruction such as:

- Choosing appropriate tube size
- Using most patent nostril
- The bevel of the tube tip lies on the right side of the tube. Hence, use right nostril first as the bevel at the tip will point away from nasal turbinate so less possibility of shearing or avulsion exists.
- When left nostril is used pass the tube upside down.
- Never force the tube, retreat and re-entry.
- Visual inspection of the tube lumen before lifting the tube into glottic fold is advised.

Recent Innovations in NTI

There are special tubes available now which are preformed, adjustable in shape, softer and reinforced. Silicon based wire reinforced tracheal tube reduces nasal morbidity. This tube requires fewer attempts at intubation compared to regular PVC tube [43]. Tube modified for maxillofacial

surgery retains curvature, is malleable for nasal curvature and allows easy laryngeal intubation [44]. In maxillofacial surgical cases involving adults, armoured flexo metallic nasal tube are used to allow for head manipulation and prevent kinking of the tube during surgery. Preformed tubes however, are difficult to pass through in the lower pathway as they take a cephalad direction and may cause damage to middle turbinate [3].

Tracheal intubation using a laryngoscope is a commonly practiced technique today to secure the respiratory passage in instances where the trachea is blocked or constricted. The Pentax Airway Scope [45] a rigid video laryngoscope for intubation and features a scope with a tip-mounted imaging CCD is a recent innovation. The operator can perform intubation while watching the LCD monitor. The built-in monitor screen has a wide viewing angle and is readily visible from behind and from the side of the airway scope, allowing staff other than the operator to verify the tracheal intubation status. There are several reported cases of use of airway scope for NTI where the conventional technique or the fiberoptic endoscopy have failed [46–48].

Conclusion

Today anaesthesiology has come a long way from its original days of trial and error. We are far better equipped in terms of knowledge and instruments to make it a more predictable science. A surgeon needs to know the various aspects of nasotracheal intubation in smaller details as he encounters this procedure very often. This prepares him better for any emergency that may occur in the operation theatre originating from anaesthesia.

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