

Nasal intubation: A comprehensive review

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Abstract

Nasal intubation technique was first described in 1902 by Kuhn. The others pioneering the nasal intubation techniques were Macewen, Rosenberg, Meltzer and Auer, and Elsberg. It is the most common method used for giving anesthesia in oral surgeries as it provides a good field for surgeons to operate. The anatomy behind nasal intubation is necessary to know as it gives an idea about the pathway of the endotracheal tube and complications encountered during nasotracheal intubation. Various techniques can be used to intubate the patient by nasal route and all of them have their own associated complications which are discussed in this article. Various complications may arise while doing nasotracheal intubation but a thorough knowledge of the anatomy and physics behind the procedure can help reduce such complications and manage appropriately. It is important for an anesthesiologist to be well versed with the basics of nasotracheal intubation and advances in the techniques. A thorough knowledge of the anatomy and the advent of newer devices have abolished the negative effect of blindness of the procedure.

Keywords: Blind nasal intubation, complications, epistaxis, fiber optic, nasotracheal intubation

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Introduction

Nasal intubation technique was first described in 1902 by Kuhn.^[1] The others pioneering the nasal intubation techniques were Macewen,^[2,3] Rosenberg,^[4] Meltzer and Auer,^[5] and Elsberg.^[6] During the World War I, Rowbotham and Magill developed and practiced the technique of “blind” nasal intubation and coined the term.^[7]

It was popularized by Magill^[8] in the 1920s. At one time, it was popular especially in Intensive Care Units for long-term ventilation, but the risk of sinusitis reduced this practice. Moreover, with the advent of muscle relaxants and rapid induction and oral intubation, the art of skillful blind nasal intubations started vanishing.

Most commonly, this technique is employed in the operating room for dental procedures and intraoral

(e.g., mandibular reconstructive procedures or mandibular osteotomies) and oropharyngeal surgeries. Some authors advocate using nasotracheal intubation for minor otolaryngologic and maxillofacial surgeries, as they believe the technique is underused in the current practice.^[9]

Other indications include securing the airway in patients with questionable cervical spine stability or severe degenerative cervical spine disease (using awake fiber-optic intubation technique), patients with intraoral mass lesions or structural abnormalities, and patients with limited mouth opening (e.g., trismus).

Occasionally, a patient might appear to be a candidate for severe respiratory obstruction for whom it might be

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prudent to intubate under topical anesthesia rather than general anesthesia.

Absolute contraindications to nasotracheal intubation are as follows:

1. Suspected epiglottitis
2. Midface instability
3. Coagulopathy
4. Suspected basilar skull fractures
5. Apnea or impending respiratory arrest.

Relative contraindications are as follows:

1. Large nasal polyps
2. Suspected nasal foreign bodies
3. Recent nasal surgery
4. Upper neck hematoma or infection
5. History of frequent episodes of epistaxis
6. Prosthetic heart valves (increased risk of bacteremia during the insertion).

Nasal Anatomy

The nasal cavity starts from the anterior nares (nostrils) extending up to the posterior part of the nasal septum. It opens into the nasopharynx through the posterior nasal apertures (choanae). The upper surface of the hard palate forms the floor of the cavity running in a horizontal plane directly backward from the anterior nares. Nasal septum forms the medial wall of the cavity which consists of cartilage part anteriorly and bony part posteriorly. Ethmoid bone and vomer bone form the perpendicular plate of bony part superiorly and inferiorly, respectively [Figure 1].

The lateral wall is formed superiorly by the medial wall of the orbit and inferiorly by the medial wall of the maxillary sinus. The three nasal conchae (turbinates)

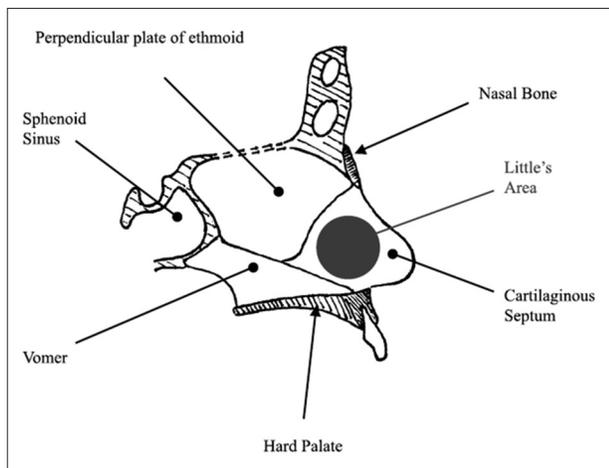


Figure 1: Structures forming medial wall of the nasal cavity

formed from three downward facing scrolls of bone form the lateral wall, which is covered by thick respiratory mucosa [Figure 2].^[10]

Superiorly, the nasal cavity is separated from the anterior cranial fossa by cribriform plate which is joined by the lateral wall and the septum. The whole cavity is covered by pseudostratified columnar epithelium and a highly vascular mucosal stroma. They provide protection by trapping the inspired particulate matter and also help in humidification of inspired air.

Maxillary artery by its branch of sphenopalatine artery provides blood supply to the nasal cavity. In the anterior part of the nasal septum (Little's area), the ascending branch of the greater palatine artery and the superior labial artery form an anastomosis known as Kiesselbach's plexus. Due to high vascularity of the whole nasal cavity, trauma to any part of the nasal cavity, especially Little's area, can lead to epistaxis and brisk bleeding.

Anatomical Anomalies

Wide variations have been observed in the internal structures of the nasal cavity and are rarely symmetrical. The deviated nasal septum (DNS) is the most common anatomical anomaly, affecting the anterior cartilaginous part or rarely the posterior bony part. The deviation in the nasal septum is attributed to a previous insult. Many patients do not give any history of nasal trauma. Intrauterine insults such as molding or trauma during parturition is considered as a cause.^[11] Congenital cause cannot be denied in view of the presence of intrauterine DNS.^[12]

Change in the anatomy of the nasal cavity changes the airflow dynamics within the cavity which further causes changes in mucosal lining. On the convex side of the nasal septum, there occurs ulcerations and drying, whereas the concave side shows compensatory inferior turbinate hypertrophy eventually leading to an

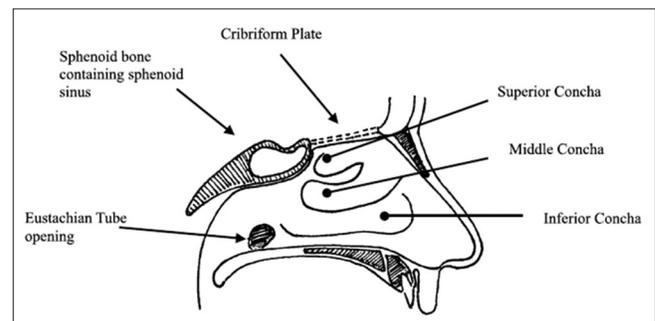


Figure 2: Structures forming lateral wall of the nasal cavity

overall narrowing of the airway. More severe form of narrowing is seen in severe trauma or surgery. Closure of airway (choanal atresia) is very uncommon and is diagnosed in early life.

There are two main anatomical pathways through which the endotracheal tube (ETT) is passed through the nasal cavity [Figure 3].^[13] The lower pathway which lies along the floor of the cavity and the upper pathway which lies below the middle turbinate, both are separated by the inferior turbinate. Once the tube has established its path in the nose, it is difficult to change the track as the medial border of the inferior turbinate lies close to the nasal septum. The middle turbinate is attached to the base of the cranium formed by cribriform plate by a thin lamella and it is highly vascular. Any trauma leading to avulsion of the middle turbinate can lead to massive epistaxis or cerebrospinal fluid rhinorrhea or injury to olfactory nerve secondary to damage to the cribriform plate;^[14-17] this is very commonly seen with middle turbinate hypertrophy or concha bullosa.^[18] Traditionally, it was also taught that lower pathway for nasal intubation is safer by advancing the ETT caudally along the floor of the nasal cavity away from the middle turbinate and cribriform plate to avoid trauma, thus supporting the thought.^[9,19-21]

Technique of Blind Nasal Intubation

The patient is premedicated in the usual fashion, and a narcotic and drying agent are given.

Nasopharyngeal anesthesia

Usually, lignocaine spray or jelly is used. As the spray is inserted deeper into the pharynx, the patient is instructed to inspire deeply and the mist is sucked into the glottis.

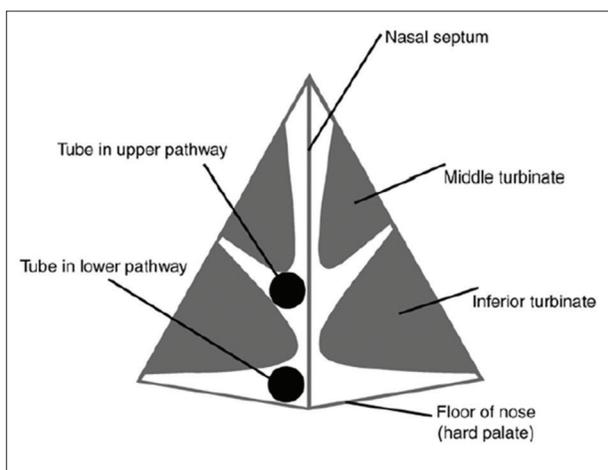


Figure 3: Coronal section through midnose showing the two main pathways of endotracheal tube for nasal intubation

Translaryngeal anesthesia

Usually, it is provided with 2 cc of 2% lignocaine (1:100,000 epinephrine) using sterile precautions. The left index finger palpates the depression between thyroid and cricoid cartilages, i.e., cricothyroid membrane. A 21-gauge needle attached to a 2 cc syringe held in the right hand is inserted through the skin and cricothyroid membrane and into the lumen of the larynx. After aspiration of air, the injection is made and the needle is withdrawn rapidly. As the patient coughs, the anesthetic is nebulized and the region from carina to epiglottis is sprayed topically.

Blind nasal intubation

A thin-walled, cuffed ETT of appropriate size is well lubricated. Patient is reassured and the anesthesiologist grasps the chin with his/her left hand, occluding the unanesthetized nostrils and lips. His/her left hand slowly but progressively moves the tube inferiorly and posteriorly, following the floor of the nose. The breath sounds are observed, and when the tube is in the pharynx, the patient is instructed to breathe deeply. If the tube is in the midline, it enters the larynx below an immobile epiglottis and between areflexic vocal cords. Since the gag reflex is obtund, involuntary swallowing and subsequent closure of glottis are prevented.

It has been suggested that pharyngeal muscle tone in the conscious patient usually aids intubation because a trough is formed along which the tube is guided into the space below the epiglottis and between the cords. If the cords are viewed after translaryngeal anesthesia, they resemble the flaccid cords seen after succinylcholine administration.

Nowadays, blind nasal intubation is reserved for situations where direct laryngoscopy is difficult or impossible and where induction of general anesthesia along with neuromuscular blockade for intubation can be hazardous. The advent of fiber-optic endoscopy for cases of difficult intubation as a gold standard technique and the need for extensive training to master this specialized technique may further relegate the blind skill.^[22]

The blind nasal intubation has an advantage over direct vision advancement using laryngoscope for routine intubation in a way that it can be rapidly achieved and is devoid of the stimulation of rigid instrumentation. The pressure response secondary to laryngoscopy and intubation is attributed mainly to the duration of laryngoscopy with an increase in the heart rate as a delayed response.^[23,24] The hemodynamic changes

during nasotracheal intubation assisted with direct laryngoscopy last significantly longer than that for oral intubation and can be attributed to the longer duration of laryngoscopy during nasotracheal intubation.^[25]

Nasal Intubation Techniques

Once beyond the nasal cavity, there are various techniques available to advance the ETT into the trachea.

1. The method of picking up ETT and catheters in the oropharynx with the help of a forceps and guiding them into the trachea under direct vision by laryngoscopy was first described by Magill in 1920^[26]
2. Various aids to blind nasal intubation have been employed including:
 - a. Listening to breath sounds directly through the ETT or using an extension tube and earpiece^[27]
 - b. Inflating the tracheal cuff (the cuff of the ETT is inflated in the oropharynx to help guide the tip of the tube into the trachea)^[28,29]
 - c. Monitoring the end tidal carbon dioxide levels^[30]
 - d. Technique of gently identifying the right pyriform fossa. With the tip of the ETT, the right pyriform fossa is identified as a bulge in the skin. Pulling the ETT back slightly and rotating it counterclockwise through 90° and then advancing toward the midline give access to the trachea. Depending on the curvature of the ETT, a minor adjustment in the degree of atlantooccipital joint extension has to be made. Sometimes, the tube is abutting the anterior commissure, in such conditions flexion of the head helps. If the tube enters the esophagus, withdrawing the tube and reinserting it with head in hyperextended state achieves intubation
3. Stylet-facilitated nasotracheal intubation
In this technique, curved stylet is used to flex the tip of the ETT anteriorly and is removed immediately once the tube is in the nasal cavity. This helps in smoother insertion of the tube through the nasal cavity, and the chances of bleeding are minimal
4. With the use of a light wand
The more commonly used technique describes the use of a light wand alone. After adequately preparing the patient with topical anesthesia, the patient is counseled and prepared psychologically. An appropriate-sized ETT is inserted till it is in the oral cavity (appreciated by a loss of resistance). The theater lighting is dimmed, and the light wand is inserted in the ETT till the fixer touches the top of the ETT
Further, the light wand is manipulated and guided by the light glow that shows through the neck, till it is visible in the midline of the neck just above the

cricothyroid membrane. The light wand is then fixed with one hand and the ETT is glided into the trachea with the other hand

Iseki *et al.*^[31] described a technique where a string was attached to the tip of the light wand (Trachlight; Laerdal Medical, Armonk, NY) and this modified wand was inserted inside the ETT into the nasal cavity, thereby helping maneuver the tip of the ETT during intubation

5. Technique of using the Endotrol ETT and a light wand
This is a different method which uses the Trachlight and Endotrol tube (Mallinckrodt, Athlone, Ireland). The inner metal stylet is removed from the Trachlight, and the light wand is placed in the Endotrol tube till the tip of the light wand and the tip of the ETT are aligned. The Endotrol tube has a wire hook with which the curve of the tube can be controlled
6. A modified nasal trumpet (MNT) to facilitate fiber-optic intubation
The MNT is a functionally similar device to both the laryngeal mask airway (LMA)^[32] and the cuffed oropharyngeal airway (COPA).^[33] The MNT establishes a patent airway and may substitute for mask ventilation in the unintubated patient. It permits positive pressure ventilation. It is placed blindly. Evidence suggests that when used as a tool for facilitating intubation, MNT is most likely more efficient and safer as compared to both the LMA and the COPA. The MNT may be inserted in a spontaneously breathing patient, who can either be awake or anesthetized. The MNT permits fiber-optic intubation, both oral and nasal, while it is in place
The MNT is ideal for maintaining a patent airway during both spontaneous ventilation and while delivering general anesthesia for fiber-optic intubations. It is especially useful in patients who needed awake intubation, but refused
7. Nasotracheal intubation with the Bonfils retromolar fiberscope
The Bonfils retromolar fiberscope, usually referred to as the "Bonfils," is one of the devices developed for managing the difficult airway.^[34] It was initially used for the management of patients with an anticipated difficult airway around the 1990s and as of today, it continues to be a very useful device for the management of the unexpected difficult airway^[35-37]
With the patient under general anesthesia and under the appropriate level of anesthesia, relaxed as for any intubation procedure, the tube is introduced into the selected and prepared nasal cavity; the ETT is advanced till it reaches the oropharynx. Then, an assistant is required to perform an upward mandibular traction, and the Bonfils retromolar

fiberscope is inserted from the right lip commissure and a “retromolar bonfiloscopy” is performed. The Bonfils is advanced until the epiglottis and the vocal cords are identified. Then, the Bonfils is slightly withdrawn, and a panoramic view of the oropharynx is sought and the tracheal tube is identified. The person doing the intubation maneuvers the Bonfils and the ETT, and a skilled and trained person maintains the upward mandibular traction, which helps improve the visibility of the vocal cords. The tube is advanced up to the field of observation of the Bonfils and immediately the tube is guided up to the trachea under direct vision with the Bonfils

8. Fiber-optic nasal intubation

The frequency of a difficult intubation due to inability of passing an ETT over an orally inserted fiberscope varies between studies, ranging from 0% to 90%.^[38] Fiber-optic intubation when performed nasally can be as difficult as oral fiber-optic intubation. The primary cause of difficulty while the ETT is being advanced over the fiber-optic bronchoscope is considered to be due to the deviation in the course of the ETT from that of the fiberscope. This is because of a gap present between the two. The ETT usually deviates toward the epiglottis, arytenoids cartilage, pyriform fossa, or esophagus.^[39-42] Marfin *et al.* showed that the sites of impingement of the ETT during fiber-optic nasal intubation are usually the posterior structures of the laryngeal inlet and suggested rotating the tube counterclockwise as a solution^[38]

9. Single-hand maneuver for flexible fiber-optic bronchoscope-guided nasotracheal intubation (FNI)^[43]

The single-hand maneuver is applied to maintain airway patency during the process of performing FNI in anesthetized patients. The little finger is placed below the angle of the mandible; the ring finger is placed below the body of the mandible, and the middle finger under the mentum. With the fingers in this position, manipulation of the degree of chin lift can be adjusted according to the quality of the bronchoscopic view. The bronchoscope is held by the thumb and index finger of the same hand

10. Nasal intubation in the sitting position

Sitting endotracheal intubation has been proven to be more successful when compared to conventional intubation^[44]

11. Using a dual bougie for nasotracheal intubation^[45]

When it is anticipated that the nasotracheal intubation would be difficult, but at the same time conventional orotracheal intubation could be done through conventional laryngoscopy, this technique is used. A cuffed tracheal tube is placed into the trachea.

The position of the tube is confirmed as usual through auscultation and capnography. This is followed by inserting an appropriate size cuffed tracheal tube nasally which is then guided into the oropharynx. An Eschmann bougie is passed through this nasal tube to the glottic aperture guided with the aid of a Magill forceps by direct laryngoscopy

The cuff of the orotracheal tube is then deflated, and the Eschmann bougie is advanced into the trachea to lie alongside the orotracheal tube. A second Eschmann bougie is now passed through the orotracheal tube. This is followed by removing the orotracheal tube, while leaving the oral bougie *in situ*. The nasal tracheal tube can now be advanced into the trachea over the previously placed nasal Eschmann bougie. The nasal Eschmann bougie can now be removed, and the position of the tube can be confirmed by auscultation and capnography.

Choice of Tube

Modern nasotracheal tubes are preformed and are made from various synthetic materials which are of varying stiffness. Warming the tube can make it a little suppler but this is at the expense of losing the curve provided by the manufacturer. Cuffed tubes have high-volume, low-pressure cuffs which are likely to scratch the naris and cause bleeding when deflated than the now outdated but streamlined red rubber-cuffed tube. Many experienced anesthetists thus continue to use uncuffed tubes. Among the polyvinyl chloride tubes that are available, the ivory tube is a cuffed tube by Portex, it is the most malleable, and is thus suitable for the nasal passage, yet it retains its original overall curvature which is essential for the ease of laryngeal intubation.^[46] The uncuffed version of this ETT, which is made from polyurethane, is associated with a lower incidence of severe nasal bleeding.^[47]

Conclusion

Nasotracheal intubation is an effective and safe technique that is underused in the current practice. The pros of a patient that is intubated by the nasal route to the head and neck surgeon can potentially outweigh the few cons to the patient. The skill of fiber-optic intubation has become essential for a practicing anesthetist today to safely manage patients in whom orotracheal intubation is anatomically difficult; this has made the use of blind techniques fall out of favor. FNI is expensive in terms of time and equipment required. In this setting, careful intubation with the aid of forceps or blind nasotracheal intubation provides a quick and relatively safe alternative while providing improved operating conditions for the surgeon.

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Conflicts of interest

There are no conflicts of interest.

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