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Review Article

Internal Medicine Section

A Narrative Review of Different Nasotracheal Intubation Techniques with Recent Advancements in Clinical Practice

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ABSTRACT

Nasotracheal intubation is commonly used in clinical practice for procedures requiring general anaesthesia, mechanical ventilation, and emergency treatment of critically ill patients. It presents a new good surgical field and operating space for maxillofacial surgeries, offers an artificial airway for long-term mechanically ventilated patients in the Intensive Care Unit (ICU), and provides a method for emergency and difficult airway intubations. Compared to orotracheal intubations, nasotracheal intubation has advantages such as minimal stimulation to the throat, good patient tolerance, easy fixation, facilitation of oral care, and longer duration of placement. However, it requires higher level of technical skill from the operator and carries a higher incidence of complications like epistaxis and sinusitis, which have restricted its widespread application. From the early blind intubation method to the current direct laryngoscopy, video laryngoscopy, and fibreoptic bronchoscopy, the success rate of nasotracheal intubation has increased, while the incidence of complications has decreased. This review summarises the common methods, advantages and disadvantages of nasotracheal intubation, as well as the research progress on related complications and coping strategies, aiming to enhance the application of this technology in clinical practice.

Keywords: Complications, Epistaxis, Fiberoptic bronchoscopy, Nasal pressure injury, Sinusitis, Tracheal intubation, Video laryngoscopy

INTRODUCTION

Tracheal intubation is a routine procedure for rescuing critically ill patients and for use under general anaesthesia, with the main purpose of maintaining a clear airway, preventing reflux and aspiration, as well as connecting to a ventilator for mechanical ventilation. Tracheal intubation can be performed by the oral or the nasal route. Orotracheal intubation is characterised by a simple and convenient operation, but patients may find it uncomfortable, and it is not conducive to oral care. Nasotracheal intubation is more in line with the physiological characteristics of the patient's airway, with advantages such as minimal stimulation to the pharynx, good patient tolerance, easy fixation, convenient oral care, and longer indwelling time. However, it requires a high level of technical expertise from the operator and carries risks of nasal and nasopharyngeal injury, epistaxis, and sinusitis. In recent years, with the development of clinical medicine and advancements in research, especially the application of technologies such as video laryngoscopy and fibreoptic bronchoscopy in nasotracheal intubation, the success rate of nasotracheal intubation has significantly improved while lowering associated complications [1]. This article provides a comprehensive review of the research progress on the application of nasotracheal intubation in clinical practice.

Nasotracheal intubation is a frequently utilised technique in patients undergoing oral and maxillofacial surgery, offering improved surgical visibility and operational space compared with orotracheal intubation [2,3]. For anterior cervical surgery, nasotracheal intubation obviates the need for excessive neck extension, with the mandibular-cervical angle increased by 7.3°, thereby improving the surgical field [4]. In the ICU, tracheal intubation is predominantly conducted through the oral route, as opposed to the nasotracheal approach. This preference is largely attributable to complications associated with nasotracheal intubation, including epistaxis and infections such as sinusitis and ventilator-associated pneumonia. Consequently, orotracheal intubation is increasingly being utilised as a replacement for nasotracheal intubation [5].

However, in the ICU, patients requiring prolonged airway management are common, prognosis is often poor, and family members are often unwilling to let them undergo tracheostomy. Nasotracheal intubation can be considered for such patients as the duration of orotracheal intubation should not be prolonged. For some awake patients in the ICU, nasotracheal intubation can reduce the dosage of sedatives, and some patients can eat on their own without the need for a feeding tube. Furthermore, in patients with respiratory infectious diseases, nasotracheal intubation can reduce the risk of infection for healthcare workers during intubation. In the Paediatric ICU (PICU), the proportion of nasotracheal intubation seems to be higher than in adult patients, to reported rates in PICU children being 5.6% and 3.8%, respectively [6,7]. A study in the context of cardiac surgery indicated that the proportion of neonates undergoing nasotracheal intubation was 41%, while the corresponding figure for infants was 38%. These findings reinforce the notion that nasotracheal intubation in paediatric patients is safe and does not significantly elevate the risk of severe complications. Compared with orotracheal intubation, there is a marked reduction in the rate of unplanned extubation, and the incidence of sinusitis and ventilator-associated pneumonia remains statistically unchanged [8].

It is crucial to note that bilateral nasal obstruction constitutes an absolute contraindication for nasotracheal intubation. Therefore, a thorough assessment of the nasal cavity's patency should be conducted prior to the procedure [6]. Additionally, certain conditions, such as nasopharyngeal haemangioma, severe laryngeal oedema, coagulation disorders, skull base fractures, and the possibility of elevated intracranial pressure, are considered relative contraindications. Patients presenting with these conditions should avoid nasotracheal intubation whenever possible.

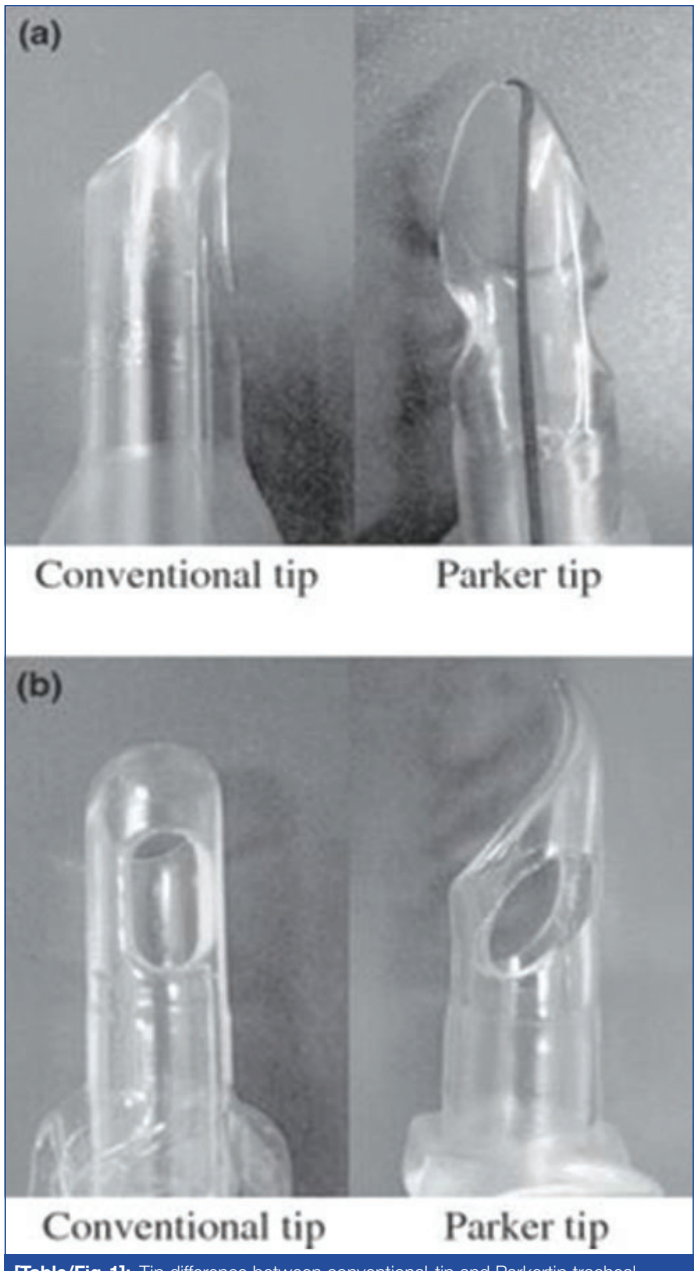
The Choice of Nostril

When nasotracheal intubation is performed, if both nasal cavities are clear, intubation can be done through either nostril. A study reported that the success rates of intubation through the left nostril and the right nostril were similar {Group L 96% (24/25), Group R 96%

(24/25)}, with no difference in the incidence and severity of epistaxis during intubation [9]. However, the most current available evidence suggests that intubation through the right nostril is safer and faster, with a lower incidence and severity of epistaxis [10,11]. Research has shown that for intubation through the left nostril, angling the tip of the endotracheal tube towards the nasal septum can reduce the incidence of epistaxis [12]. A study of 390 patients undergoing nasotracheal intubation found that among 94 patients with nasal septum deviation identified by X-ray, complications occurred more frequently when nasal septum deviation was present (35.0% vs 18.5%) [13].

Nasotracheal Intubation Methods

Nasotracheal intubation does not require specialised tracheal tubes, but opting for a smaller endotracheal tube compared with oral intubation enhances ease of use and reduces complications. The Parker Flex-TipTM tracheal tube, featuring a soft, flexible tip, minimises nasal mucosal damage during insertion [Table/Fig-1] [14]. Additionally, it helps regulate haemodynamic responses, with minimal effects on heart rate and diastolic pressure [15]. Preheating and softening the tube prior to intubation can further reduce nasal mucosal injury and lower the incidence of epistaxis [16]. A study on 140 patients found significantly reduced epistaxis severity in the heat-softened group (7% vs. 51%) compared to the control group [17]. However, excessive softening may compromise tracheal tube patency, potentially affecting intubation success.



[Table/Fig-1]: Tip difference between conventional-tip and Parkertip tracheal tubes: a) Top view; b) Lateral view [14].
Image source: [14]

Blind Nasotracheal Intubation (BNTI): Blind probing was initially utilised for nasotracheal intubation due to equipment constraints, without any auxiliary measures, requiring a high level of technical proficiency from the operator. Trained operators can also achieve a higher success rate. In 1993, van Elstraete AC et al., reported a success rate of 75% for blind nasotracheal intubation using cuff-inflation method, with an overall success rate of 95% [18]. The specific procedure involved inserting the endotracheal tube through the right nostril, positioning the tube tip at the oropharynx, inflating the cuff with 15 mL of gas, gently advancing the tube until encountering slight resistance when the cuff touched the vocal cords, deflating the cuff, and inserting the endotracheal tube into the trachea. Another method is the suction catheter-guided blind nasal intubation, where a suction catheter is first inserted through the nasal cavity into the trachea, followed by sliding the endotracheal tube over the suction catheter and slowly advancing it into the trachea before removing the suction catheter [19,20]. Training operator providers in blind nasotracheal intubation is crucial, with proficient individuals achieving success rates comparable to fibreoptic bronchoscope nasotracheal intubation [21]. Despite being considered outdated, this technique remains a critical option when dealing with special patients such as severe cervical deformities, burns, and those with limited or impossible mouth opening [22].

Direct Laryngoscopy Nasotracheal Intubation (DLNTI): Direct laryngoscopy has been the standard method for tracheal intubation since its development in the early 20th century. It enables visualisation of the vocal cords, improving intubation success over blind techniques. Magill forceps assist in guiding the tube into the trachea, reducing difficulty and increasing success rates. Using a disposable tube core can replace Magill forceps, significantly reducing intubation time in patients without difficult airways [23]. However, DLNTI requires sedation and anaesthesia, poses cardiovascular risks, and is gradually being replaced by video laryngoscopy [24].

Video Laryngoscopy Nasotracheal Intubation (VLNTI): Video laryngoscopy has improved intubation success rates and efficiency. Unlike direct laryngoscopy, it does not require excessive head extension, making positioning easier [25]. In ICU and emergency settings, it enhances intubation success and reduces procedural difficulty [26,27]. It also improves first-pass success and lowers complication rates compared to direct laryngoscopy [28,29]. Paediatric patients benefit from HugeMed® video laryngoscopy, which enhances vocal cord visualisation and minimises tissue trauma [30]. Studies confirm faster intubation times and reduced use of Magill forceps with video laryngoscopy [31]. McGrath and C-MAC® video laryngoscopes provide superior vocal cord visualisation, reduced airway trauma, and stable haemodynamics [32,33]. C-MAC's adjustable blade angle aids nasotracheal intubation in cervical injury patients [34]. For awake intubation, video laryngoscopy is faster and safer than fibreoptic bronchoscopy, reducing oxygen desaturation risks [35].

Fiberoptic Bronchoscope Nasotracheal Intubation (FBNTI): FBNTI involves inserting a fiberoptic bronchoscope through the nasal cavity to guide the tracheal tube into the trachea. This technique offers direct visualisation, ensuring proper tube placement and minimizing misplacement risks. It significantly lowers epistaxis incidence of epistaxis compared with blind techniques and direct laryngoscopy intubation [36]. In paediatric dental procedures, FBNTI is safe and yields higher success rates with fewer complications than direct laryngoscopy [37]. Traditional bronchoscopes are rigid, but flexible models reduce complications, especially in awake patients [38]. Oral secretions and bleeding can hinder success, requiring mitigation efforts [39]. Despite its advantages, FBNTI involves extensive preparation, limiting its use in emergency intubation.

Each technique has specific benefits and limitations, with video laryngoscopy emerging as the preferred method in various clinical settings.

Other Nasotracheal Intubation Methods

Lightwand-guided nasotracheal intubation: This method utilises a light source at the tip of a flexible lightwand to guide tracheal tube placement. Compared blind intubation, it offers higher success rates, fewer complications, and shorter intubation times [40]. The process involves inserting the tracheal tube through the nose into the oropharynx, followed by inserting the lightwand into the tube. The light's positioning just above the cricoid cartilage helps ensure proper placement before advancing the tube into the trachea and removing the lightwand. However, repeated adjustments may risk injury to the nasal cavity, epiglottis, or airway.

Ultrasound-Guided Tracheal Intubation (UGTI): UGTI is a newer approach beneficial for patients with restricted mouth opening who cannot undergo laryngoscopy. Unlike traditional methods, it is unaffected by oral secretions or bleeding [41]. While widely applied for orotracheal intubation, reports on its nasotracheal use remain limited.

Comparison of Intubation Methods and Process Flowchart

Various nasotracheal intubation methods are used clinically, each with its advantages, disadvantages, and indications. Operators should select the most appropriate technique based on patient-specific factors. A comparative analysis of these methods is provided in [Table/Fig-2] [18,22,24,26,28-34,36-38], while the step-by-step nasotracheal intubation procedure is outlined in [Table/Fig-3] [1].

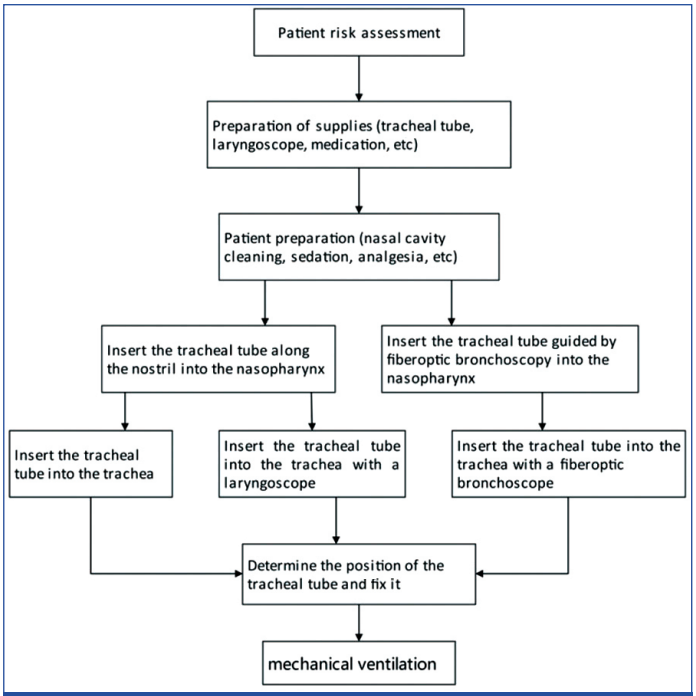
Intubation methods	Advantages	Disadvantages	Success rates	Optimal indications
BNTI	No special equipment required [18]	High failure rate [18]	Low [18]	severe cervical deformities; burns, and patients with limited or impossible mouth opening [22]
DLNTI	Fast speed [24]	Need sedation and analgesia	High [24]	patients without difficult airways [24]
VLNTI	Easy to operate, fast speed [26,28-32,34]	Need video laryngoscope	High [26,28-32,34]	Widely used (Emergency, Anaesthesiology, ICU) [26,28,29,31-34]
FBNTI	High success rate [37,38]	Cumbersome preparation before intubation [36,37,38]	High [37,38]	Surgery patients undergoing preoperative anaesthesia intubation [37,38]

[Table/Fig-2]: Comparative analysis of various intubation methods [18,22,24,26,28-34,36-38].
BNTI: Blind nasotracheal intubation; DLNTI: Direct laryngoscopy nasotracheal intubation; VLNTI: Video laryngoscopy nasotracheal intubation; FBNTI: Fiberoptic bronchoscope nasotracheal intubation

Complications of Nasotracheal Intubation

Epistaxis: Epistaxis, a frequent and severe complication of nasotracheal intubation, results from damage to the nasal mucosa and vascular damage. Excessive bleeding can be life-threatening, necessitating preventive measures. Guidelines recommend local nasal vasoconstrictors pre-intubation [42]. Pre-emptive epinephrine nebulisation and xylometazoline spray effectively reduce epistaxis rates [43,44]. Xylometazoline drops have been shown to further decrease severe epistaxis during intubation and extubation [45]. Studies indicate that cocaine and xylometazoline offer comparable efficacy in preventing epistaxis [46]. Nasal packing with bupivacaine effectively minimises bleeding [47], while softer North Polar Tubes further lower the epistaxis incidence [48]. Gentle intubation technique and careful tube adjustments are crucial for prevention.

Nasal pressure injury: Nasal pressure injuries are common after nasotracheal intubation but can be mitigated with



[Table/Fig-3]: Flowchart of nasotracheal intubation steps.

protective strategies. Hydroactive dressings significantly reduce nasal wing skin damage [49,50], while hydrocolloid dressings help paediatric patients by reducing pressure and absorbing exudates [51]. A 3M Microfoam™ surgical tape offers effective nasal protection [52].

Sinusitis: Prolonged nasotracheal intubation increases the risk of sinusitis due to mucosal damage and ostial obstruction. Patients intubated for over five days face a higher likelihood of developing sinusitis [53]. Late-onset sinusitis is more common with nasotracheal versus oral intubation [54]. 2% nasal mupirocin ointment may lower infection rates by reducing Staphylococcus aureus colonisation [55].

Other complications: Postoperative sore throat is prevalent, affecting 74.6% of patients following oral and maxillofacial surgery [56]. Fiberoptic bronchoscope intubation reduces sore throat compared with Macintosh laryngoscopy [57]. Cardiac arrest, triggered by nasal mucosal stimulation and the rhino-cardiac reflex, requires immediate intubation cessation and emergency drug intervention with atropine or epinephrine [58]. Rare complications include internal carotid artery injury, submucosal retropharyngeal dissection, pyriform sinus perforation, and cervicothoracic emphysema.

Given the potential severity of these complications, careful patient assessment is essential before intubation. Gentle handling minimises epistaxis risk, proper nasal protection prevents pressure injuries, and timely extubation mitigates sinusitis. Close monitoring during intubation ensures early detection of serious complications such as cardiac arrest.

Techniques to Improve the Success Rate of Nasotracheal Intubation

The primary concerns with nasotracheal intubation are success rates and complications. A study of 86 patients showed that the nasal tip-lifting method significantly improved the success rate (79.1% vs 51.2%). This technique involves selecting the appropriate nostril, lifting the nasal tip upwards with one hand, and inserting the tracheal tube with the other [59].

While the incidence of epistaxis was similar in both groups (18.6% vs 32.6%), nasal tip lifting helps the tube pass more smoothly through the nasal cavity. Research indicates that directing the tube toward the patient's head rather than the left side reduces nasal bleeding during jaw surgery [60]. Additionally, expanding the nasal cavity before intubation aids in guiding the tube into the pharynx and minimises

trauma and epistaxis. Placing a nasopharyngeal airway beforehand increases stability and space, making tube insertion easier.

Finally, standardised training, selecting appropriate intubation methods, and avoiding excessive force are essential for improving intubation success and reducing complications.

CONCLUSION(S)

In clinical practice, nasotracheal intubation is a valuable airway management technique that offers advantages in specific situations. Operators must have a comprehensive understanding of indications, complications, and the latest advances in airway management to ensure the safety and effectiveness. Various nasotracheal intubation methods have their pros and cons, and healthcare providers should be proficient in one or more techniques to perform nasotracheal intubation successfully when necessary, ensuring patient safety and meeting surgical requirements.

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