Comparison of Success Rate and Safety of Nasotracheal Intubation by Conventional and Finger-Guided Method in Patients Undergoing Maxillofacial Surgery

Seyed Jalal Hashemi[1], Hamidreza Shetabi[1], Reihanak Talakoub[1], Avishan Aminizad[2]

[1]Anesthesiology and Critical Care Research Center, Isfahan University of Medical Sciences, Isfahan, Iran, [2]Student Research Committee, Isfahan University of Medical Sciences, Isfahan, Iran

Abstract

Background: Different techniques have been introduced to reduce the complications of nasotracheal intubation. The aim of this study was to compare the incidence of nasotracheal intubation complications in finger-guided and conventional methods.

Materials and Methods: In this double-blind randomized trial study, 70 patients who were candidates for oral and maxillofacial surgery who required nasal intubation were included in the study finally of which 33 patients with conventional method and 35 patients with finger-guided tubes in the nasopharynx were analyzed at the end of the study. Variables such as success rate, hemodynamic response, and complications of intubation were compared between the two groups.

Results: There was no significant difference between the two groups in terms of hemodynamic response to intubation ($P > 0.05$). There was a significant difference between the two groups in terms of success in tracheal intubation ($P < 0.05$). There was a significant difference between the two groups in terms of epistaxis immediately after intubation ($P < 0.05$). There was no significant difference between the two groups in terms of nasal turbine fractures ($P > 0.05$). However, the frequency of submucosal intubation in the conventional method was significantly higher than the other group ($P = 0.02$).

Conclusion: Nasotracheal intubation using the finger guiding technique in the nasopharynx is associated with a higher success rate and less complications after intubation such as epistaxis and submucosal intubation compared to the conventional method.

Keywords: Airway management, maxillofacial surgery, nasotracheal intubation

Address for correspondence: Dr. Hamidreza Shetabi, Alzahra Hospital, Anesthesiology and Critical Care Research Center, Isfahan University of Medical Sciences, Isfahan, Iran.
E-mail: hamidshetabi@med.mui.ac.ir
Submitted: 15-Aug-2021; **Revised:** 29-Dec-2021; **Accepted:** 31-Jan-2022; **Published:** 25-Feb-2023

Introduction

Oral and maxillofacial surgery focuses on reconstructive facial surgery, facial trauma surgery, head and neck, jaws, oral cavity, and also cosmetic facial surgery.[1]

Tracheal intubation is one of the most common methods of airway management.[2] In nasotracheal intubation due to the passage of the tube through the narrow path of the nasal duct, the risk of tissue trauma, is higher than the orotracheal intubation.[3,4] Especially when passing through the nasopharynx with maneuver, nasal mucosa, and turbine may be damaged.[5] However, in oral and maxillofacial surgeries, nasotracheal intubation is widely used.[6] The most common complication following this method of intubation is epistaxis,[7] which often occurs due to damage to the nasopharyngeal mucosa or traumatic fractures.[8] The prevalence of epistaxis

Access this article online	
Quick Response Code:	**Website:** www.advbiores.net
	DOI: 10.4103/abr.abr_255_21

How to cite this article: Hashemi SJ, Shetabi H, Talakoub R, Aminizad A. Comparison of success rate and safety of nasotracheal intubation by conventional and finger-guided method in patients undergoing maxillofacial surgery. Adv Biomed Res 2023;12:35.

in different studies has been reported in different numbers from 12% to 66% and even up to 77% in another study. Which ranges from blood-soaked mucus to large and extensive hemorrhages.[4,9] Although the amount of bleeding usually is not problematic for the patient or the surgical procedure, sometimes life-threatening bleeding has been reported.[10] Blood in the airways will interfere with the doctor's vision and there is even the possibility of aspiration of blood into the lungs.[1] According to the above, several techniques have been recommended to reduce nasopharyngeal airway trauma and thus reduce the incidence and severity of epistaxis.[4]

These include: using smaller tubes, heating the tube before intubation, using lubricants such as saline or water-soluble gel on the surface of the tube, and even using topical vasoconstrictors such as cocaine-lidocaine-phenylephrine and oxymetazoline. However, the effectiveness of these methods is controversial, and in addition to the above drugs, for example, sympathomimetics may be associated with life-threatening complications such as severe hypertension, dysrhythmia, myocardial infarction, and even heart failure. As a result, the use of these drugs should be limited, especially in people with coronary heart disease.[11] In a study by Lim *et al*., The use of a nasogastric tube as a guide to facilitate the passage of the nasal endotracheal tube reduced the incidence and severity of epistaxis.[8] In another study conducted by Hosseinzadeh *et al*. In 2013, it was found that heating the nasal endotracheal tube with hot water before intubation reduces the incidence and severity of epistaxis.[11] A study by Kwon *et al*. In 2016 found that the use of a fiberoptic laryngoscope for nasal intubation was associated with a reduction in epistaxis.[6] Furthermore, Earle and colleagues in another study conducted in 2016 showed that the use of Parker Flex-Tip nasal endotracheal tube was not significantly different in terms of epistaxis compared to standard (Ring-Adair-Elwyn) endotracheal tubes.[5] Also in another study by Hsu *et al*., in 2011. It was found that the use of glove finger cover on the cuff of the nasal endotracheal tube reduced the trauma of the cuff and nasopharynx in cases of nasotracheal intubation.[12] In another article published in 2017 by Dr. Taheri talesh and colleagues on the effect of 2% nasal mupirocin ointment on the side effects of endotracheal intubation, it was finally concluded that the use of this ointment before intubation will reduce the complications of intubation such as comfortable extubation (removal of the tube after surgery), easier breathing following extubation and less severe bleeding following extubation. However, in terms of the frequency of bleeding during intubation, the difference There was no significant difference between the two groups but after extubation (tube extraction) the severity of epistaxis was higher in the group that did not use the ointment and there was a significant difference.[13]

Given that most of the methods mentioned above are complex, time-consuming, or even ineffective in reducing the incidence and severity of epistaxis[5] and the existence of simple, inexpensive, and effective methods for clinical anesthesia is felt[7] Considering the lack of a similar study in this field, the present study was designed and performed with the aim of determining the incidence and severity of epistaxis in endotracheal intubation with the help of finger guidance in the nasopharynx and comparing it with conventional methods. Another study, conducted in 2017, compared the effect of epinephrine and xylometazoline on epistaxis during nasal intubation and concluded that, in the xylometazoline group, epistaxis levels were significantly higher. It was less during intubation but there was no significant difference between the two groups in terms of bleeding rate at 5 min after intubation and in general after surgery.[14] It should be noted that a relatively new article conducted in 2018 by Özkan and colleagues compared the effect of North Polar Tube and Spiral Tube on the risk of epistaxis, and finally, it was found that the degree of epistaxis and manipulations such as pressure on The larynx by tube was clearly lower in the NPT group than in the other group, but there was no significant difference between the two groups in terms of mean arterial pressure and heart rate (HR).[15] Given that most of the methods mentioned above are complex, time-consuming, or even ineffective in reducing the incidence and severity of epistaxis[5] and the existence of simple, inexpensive, and effective methods for clinical anesthesia is felt.[7] Considering the lack of a similar study in this field, the present study was designed and performed with the aim of determining the incidence and severity of epistaxis in endotracheal intubation with the help of finger guidance in the nasopharynx and comparing it with conventional methods.

Materials and Methods

This is a double-blind randomized trial study that was performed after the approval of the Research Ethics Committee of Isfahan University of Medical Sciences with the code (IR.MUI.RE3.1396.3.558) and registers in Clinical Trial Center with ID IRCT20180416039326N15 from January to August 2019 on 70 candidates for maxillofacial surgeries requiring nasotracheal intubation at Al-Zahra University Hospital in Isfahan, Iran

Inclusion criteria include

Patients aged 15–70 years who were candidates for maxillofacial surgery, American Society of Anesthesiologists I, II and having the consent to participate in the study.

Noninclusion criteria were: history of bleeding disorders, a history of nasopharyngeal masses, history of head and face trauma and fracture, use of any anticoagulants, and history of any surgery on maxillofacial.

Exclusion criteria, in cases where we could not pass the tracheal tube through the nasopharynx with three times attempts (failure in intubation) or either a systolic or diastolic blood pressure drop of more than 30% occurred during intubation, patients were excluded from the study.

70 patients who were candidates for oral and maxillofacial surgery who required nasal intubation were included in the study finally of which 33 patients with conventional method and 35 patients with finger-guided intubation method were

analyzed at the end of the study. Due to the lack of data in the analysis stage, two patients of the conventional method group were excluded from the study.

The patient and the observer who collected the information were unaware of the patient grouping. The first anesthesiologist who performed the intubation had no role in the study and collecting data.

and the intubating conditions were assessed by second anesthesiologist who was unaware of the study groups and intubation method.

After obtaining the written consent of the patients who were eligible to participate in the study, using the table of random numbers, generated from the randomization allocation software, they were randomly divided into two groups of routine and finger-guided nasotracheal intubation.

After being placed on the operating table, all patients underwent continuous monitoring including electrocardiography, pulse oximetry, capnography, and noninvasive intermittent blood pressure. HR, systolic and diastolic blood pressure, as well as blood oxygen saturation, were measured and recorded before induction of anesthesia in patients. The dominant or more open nostril (patent) was selected by alternating finger pressure on the left and right nasal fins and asking the patient to take a slow breath.

In more patent nostril, phenylalanine 0.5% drop was used as vasoconstrictor and 2 ml 2% lignocaine jelly to lubricate the nasopharyngeal pathway.[16] Induction of anesthesia was performed with fentanyl 2 μg/kg, thiopental 5 mg/kg, and atracurium 0.5 mg/kg. After 3 min' ventilation with oxygen 100%. Tracheal intubation was performed by standard tracheal tube (HENAN INDUSTRIAL CO, China) 7.5 mm in males and 7.0 mm in females patients, respectively, and the tracheal tube cuff was inflated with air and according to previous studies, the appropriate pressure of the endotracheal tube cuff was considered as 20-30 cm H2O. and controlled using handheld aneroid manometer.[17] According to the previous study, the average depth of the tube from the nostril in women 26.6 ± 1.5 cm and in men 28.9 ± 1.3 was considered.[18] Maintenance of anesthesia was with isoflurane with Mac 0.8-1.2.

After wearing gloves on both hands, the endotracheal tube was inserted through the dominant (open) nostril and directed to the pharynx. In the first group (conventional method), the tube was moved blindly forward until the endotracheal tube was placed. In the second group, as the endotracheal tube enters the dominant (more open) nostril and moves toward the nasopharynx, the index finger of the nondominant hand entered the mouth and was placed behind the soft palate in the nasopharyngeal area, after contacting the tip of the endotracheal tube with the finger, the tip of the finger was inserted into the bevel of the tracheal tube, then the endotracheal tube moved forward with the guidance of finger until the endotracheal tube enters the oropharyngeal space. After the endotracheal tube entered the throat, laryngoscopy was performed in both groups with Macintosh laryngoscope. If necessary, Magill forceps were used to insert the nasal endotracheal tube into the patient's trachea. After ensuring the accuracy of the tube location, the tube was fixed. Immediately after tracheal intubation and also 5 min after intubation, the second anesthesiologist, who was unaware of the intubation method, was asked to perform a laryngoscopic evaluation of the local complications of intubation.

The severity of epistaxis was assessed by second anesthesiologist based on the Sugiyama criteria.[7]

Without epistaxis

no blood should be seen on the endotracheal tube or posterior wall of the throat.

Mild epistaxis

blood is seen on the endotracheal tube or posterior wall of the throat.

Moderate epistaxis

accumulation of blood in the posterior wall of the throat

Severe epistaxis

accumulation of a large amount of blood in the throat in a way that interferes with nasal intubation and requires immediate intubation of the trachea through the mouth.

Fractures of the nasal turbines were performed based on a nasal examination by a maxillofacial surgeon present in the operating room. In direct laryngoscopy, if there was blood in the supraglottis and oropharynx, the patient's oropharynx was suctioned, if there was a submucosal bulge in retropharyngeal space, we asked the surgeon to see the place and give his opinion about Submucosal intubation. Submucosal intubation means placing the tube below the surface of the mucosa instead of the lumen, in other words, when the tube is accompanied by resistance and bleeding on its way to the trachea. The tube will be accompanied by resistance and bleeding on its way to the trachea, and by touching it with a finger, the tip of the tube will be felt below the mucosal surface, and eventually, the tube will need to be moved or even removed.

In case of failure in the patient's intubation, another patient was replaced.

An observer who was no member of the study team record information including time spent for the entire intubation process (from the moment the tip of the tube enters the nostril to the moment it is placed in the trachea) or failure in the intubation process, cardiovascular response, and arterial oxygen saturation in study times periods (0 and 5 min after intubation) and also possible complications.

Consort diagrams of patients at each stage of the study are shown in Figure 1.

Sample size with $Z\alpha$ =1.96 and $Z\beta$ =0.84, also S1 = S2 = 0.5 and mean changes of 0.4, 35 people in each group were considered.(Confidence interval: 95%, power of the test 80%).

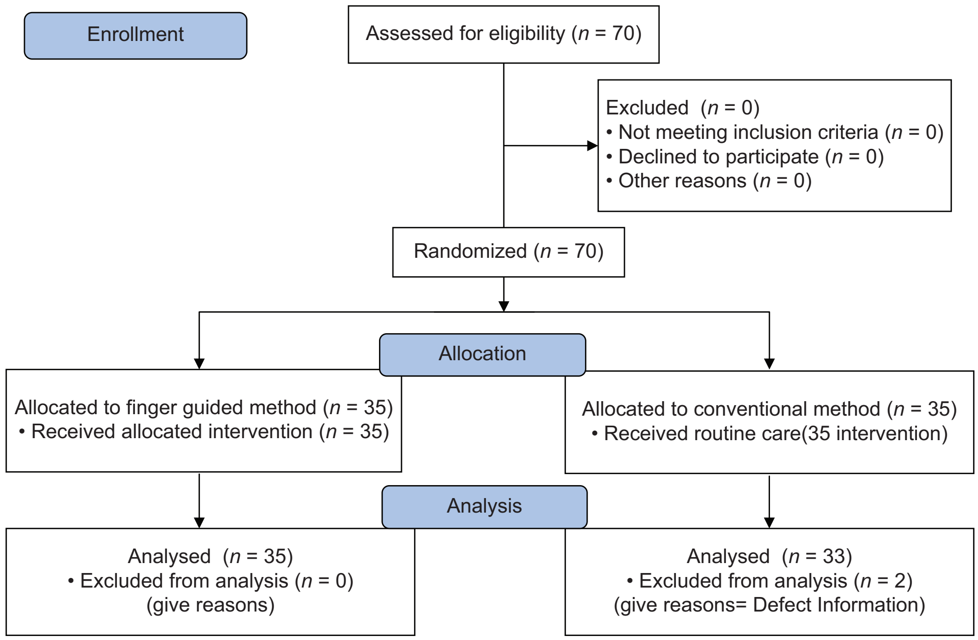

Figure 1: Consort diagram of study

Data were entered into SPSS software (version 23; SPSS Inc., Chicago, Ill., USA) and analyzed using descriptive statistics and Mann–Whitney-Chi-square and *t*-test.

The repeated measure analysis of variance (ANOVA) test was also used to examine the changes in variables.

$P < 0.05$ was considered as a significant level.

Results

In this study, 70 patients were divided into two groups: Nasal intubation by conventional method and finger guidance. There was no significant difference between the two groups in terms of age, sex, Body mass index and duration of intubation ($P > 0.05$) [Table 1].

Table 1: Demographic variables studied between the two groups

Variables	Finger guided method (*n*=35)	Conventional method (*n*=33)	*P*
Age (years)*	27.03±11.63	27.3±7.67	0.43
Sex, *n* (%)**			
Male	19 (54.3)	18 (54.5)	0.58
Female	16 (45.7)	15 (45.5)	
BMI* (kg/m^2)	22.776±3.89	22.05±3.17	0.43
Intubation time*	35.47±34.73	28.25±25.61	0.34

* Independent t-test, **Chi-Square test. SD: Standard deviation

Systolic blood pressure at the time immediately after intubation and HR at 5 min after intubation were significantly lower in the finger-guided group ($P < 0.05$).

There was no significant difference between the two groups based on systolic and diastolic blood pressure, HR, and oxygen saturation at other times ($P > 0.05$) [Table 2] According to repeated measure ANOVA test, changes in hemodynamic variables at different time intervals were statistically significant ($P < 0.001$).

Immediately after intubation the rate of mild epistaxis, in the finger guidance group was in 12 patients (36.4%) and in the conventional intubation group in was 20 patients (51.7%), and severe bleeding was seen only in 4 patients (12.1%) in the conventional method, and there was a significant difference between the two groups ($P = 0.04$). 5 min after intubation the rate mild epistaxis in the finger guidance group was 15 patients (45%) and in the conventional intubation group was 7 patients (21.1%), moderate epistaxis in 2 patients (6.1%), and severe epistaxis in 7 patients (21.2%) was seen only in the conventional method ($P = 0.07$).

Furthermore, six cases of nasal turbine fractures, 5 cases of submucosal intubation, and 4 cases of intubation failure were reported. There was no significant difference between the two groups based on nasal turbine fracture and intubation failure ($P > 0.05$), but the frequency of submucosal intubation in the conventional method was significantly higher than the other group ($P = 0.02$) [Table 3].

The following diagram compares the frequency distribution of epistaxis severity between the two groups [Figure 2].

Discussion

Based on the results of this study, the use of both endotracheal intubation methods (finger-guided method and conventional method) are useful in patients undergoing maxillofacial surgery.

However, the use of the finger-guided method had advantages over the conventional method, which included more

Table 2: Hemodynamic variables studied in two groups

Variables	Finger guided method (*n*=35)	Conventional method (*n*=33)	*P**
Systolic blood pressure (mmHg)			
Before intubation	107.97±33.91	114.4±17.15	0.33
Immediately after completion of intubation	111.4±18.91	124.54±20.01	0.007
5 min after intubation	103.15±14.94	109.09±20.14	0.18
Diastolic blood pressure (mmHg)			
Before intubation	69.82±15.27	70.83±10.16	0.75
Immediately after completion of intubation	71.68±17.87	71.69±14.55	0.43
5 min after intubation	67.26±13.92	68.25±15.26	0.78
Heart rate			
Before intubation	97.08±19.51	94.27±17.1	0.470
Immediately after completion of intubation	96.51±18.8	104.01±18.55	0.10
5 min after intubation	80.54±12.75	94.16±18.71	0.001
Arterial oxygen saturation			
Before intubation	96.09±1.69	94.36±1.6	0.51
Immediately after completion of intubation	95.9±3.33	94.74±4.82	0.27
5 min after intubation	98.38±3.343	98.7±1.62	0.64

*Independent *t*-test

Table 3: Frequency of complications after intubation in both groups

Variables	Guide the tube with finger (*n*=35), *n* (%)	Conventional method (*n*=33), *n* (%)	*P***
Epistaxis			
Immediately after intubation			
No	17 (51.5)	15 (42.9)	0.04
Mild	12 (36.4)	20 (57.1)	
Moderate	0	4 (12.1)	
5 min after intubation			
No	18 (51.4)	9 (27.3)	0.07
Mild	15 (45.5)	17 (48.6)	
Moderate	0	7 (21.2)	
Sever	0	2 (6.1)	
Fractures of nasal turbines	2 (5.7)	4 (12.1)	0.30
Submucosal intubation	0	5 (15.2)	0.02
Failure in intubation	0	4 (12.1)	0.05

**Chi-Square test

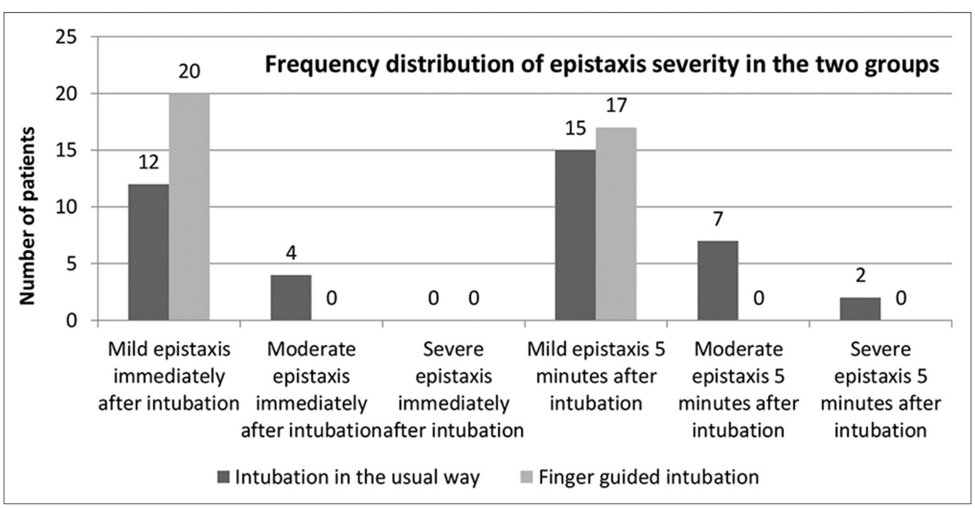

Figure 2: Frequency distribution of epistaxis severity in the two groups

stable hemodynamic variables, and fewer postintubation complications (such as epistaxis and intubation failure).

By guiding the nasotracheal tube into the throat, the rate of epistaxis and hemodynamic complications were reduced as soon as it was observed.

In fact, the reason for the reduction of complications in nasal intubation in the finger-guided method is that the anesthesiologist, after touching the tip of the endotracheal tube inside the nasopharynx with the index finger, inserts the tip of the finger into the bevel, guiding the finger moves the tube toward the throat.

This maneuver prevents the tip of the endotracheal tube from colliding with the anatomical elements in the path and prevents it from colliding with the mucosa and causing bleeding or submucosal intubation. In a study, Hsu et al. used a modified gloved finger technique during nasotracheal intubation, which successfully protected the cuff from being cut by the sharp nasal cristae and also moved the tip of the tube away from the posterior pharyngeal wall.[19] Another study by Watanabe *et al*., in which 66 patients were examined, used the tracheal tube technique containing an air cushion on the head, and it was finally found that this technique also reduces the rate of epistaxis after intubation and can perform better than conventional methods.[20]

The results of the above study were consistent with our study because, as in our study, the rate of bleeding was reduced in the group for whom intubation was performed in a way other than the normal method and these people experienced fewer episodes of epistaxis. Another complication that has been reported following blind nasal intubation is trauma like as avulsion of the middle turbinate may cause massive epistaxis.[21]

Epistaxis is the most common complication of nasotracheal intubation, which is seen to some extent in about every intubation.[22] Other recent techniques for reducing postintubation bleeding include the use of Parker Flex-Tip tubes. In a 2017 study by Earle *et al*., in a study of 60 patients, they concluded that the use of Parker tubes had no advantage over conventional tubes (RAE) for intubation and that results showed no difference.[5] A comprehensive study conducted in 2016, criticized blind procedures for nasal intubation, stating that conventional methods can lead to epistaxis and other complications and it is better to use techniques such as the use of fiber optic guides for nasal intubation to reduce epistaxis.[2] It should be noted that a relatively new article conducted in 2018 by Özkan and colleagues compared the effect of North Polar Tube and Spiral Tube on the risk of epistaxis, and finally, it was found that the rate of epistaxis and manipulations such as pressure on The larynx by tube was clearly lower in the NPT group than in the other group, but there was no significant difference between the two groups in terms of mean arterial pressure and HR.[15] In another study, the researchers investigated the anatomical conditions of the nostril to prevent complications during nasotracheal intubation and concluded that the occurrence of epistaxis and its severity in intubation through the right nostril is far less than that of the left nostril.[23] The results of these studies are consistent with our study because we also showed that the use of a technique other than the conventional and blind technique for nasal intubation of patients, reduces bleeding.

In another study conducted in 2016, examining the rate of epistaxis after nasotracheal intubation among 44 patients, it was reported that the use of new methods such as fiber optics reduces the rate of epistaxis in intubation.[3] The results of this study were also consistent with our study in which people who were routinely intubated had more epistaxis.

Conclusion

The present study showed that nasal intubation with tube guided by finger, compared to conventional intubation, it is a safe method with higher success, more stable hemodynamics, and less complications (epistaxis, submucosal intubation, etc.). One of the strengths of this study is that its subject is new and that it is the first study that examines the novel method of nasotracheal intubation and compares it with a conventional method.

Limitations

Our study had some limitations. First, the study was performed on a small group of patients, and all the results of the present study may not be generalizable to other races or countries. Second, different results may be observed in patients with difficult airways. Third, in this study, the assessment of epistaxis was subjective, therefore, a blind observer assess bleeding during and after Nasotracheal intubation, which improved the validity of this evaluation.

Acknowledgments

This article is derived from the MD thesis of Dr. *****. This research was supported by the Medical Faculty Research Council of Isfahan University of Medical Sciences.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. Gigliotti J, Makhoul N. Demographics, training satisfaction, and career plans of Canadian oral and maxillofacial surgery residents. J Oral Maxillof Surg 2015;73:e32-3.
2. Prasanna D, Bhat S. Nasotracheal intubation: An overview. J Maxillofac Oral Surg 2014;13:366-72.
3. Chauhan V, Acharya G. Nasal intubation: A comprehensive review. Indian J Crit Care Med 2016;20:662-7.
4. Kumar R, Gupta E, Kumar S, Rani Sharma K, Rani Gupta N. Cuff inflation-supplemented laryngoscope-guided nasal intubation: A comparison of three endotracheal tubes. Anesth Analg 2013;116:619-24.
5. Earle R, Shanahan E, Vaghadia H, Sawka A, Tang R. Epistaxis during

nasotracheal intubation: A randomized trial of the Parker Flex-Tip™ nasal endotracheal tube with a posterior facing bevel versus a standard nasal RAE endotracheal tube. Can J Anesth J Can Anesth 2017;64:370-5.
6. Kwon MA, Song J, Kim S, Ji SM, Bae J. Inspection of the nasopharynx prior to fiberoptic-guided nasotracheal intubation reduces the risk epistaxis. J Clin Anesth 2016;32:7-11.
7. Sugiyama K, Manabe Y, Kohjitani A. A styletted tracheal tube with a posterior-facing bevel reduces epistaxis during nasal intubation: A randomized trial. Can J Anaesth 2014;61:417-22.
8. Lim CW, Min SW, Kim CS, Chang JE, Park JE, Hwang JY. The use of a nasogastric tube to facilitate nasotracheal intubation: A randomised controlled trial. Anaesthesia 2014;69:591-7.
9. Shohara K, Goto T, Kuwahara G, Isakari Y, Moriya T, Yamamuro T. Validity of rhinometry in measuring nasal patency for nasotracheal intubtion. J Anesth 2017;31:1-4.
10. Sanuki T, Hirokane M, Kotani J. Epistaxis during nasotracheal intubation: A comparison of nostril sides. J Oral Maxillofac Surg 2010;68:618-21.
11. Hosseinzadeh H, Taheri Talesh K, Golzari SE, Gholizadeh H, Lotfi A, Hosseinzadeh P. Warming endotracheal tube in blind nasotracheal intubation throughout maxillofacial surgeries. J Cardiovasc Thorac Res 2013;5:147-51.
12. Hsu CT, Shih CK, Chau SW, Tseng KY, Chen MK, Cheng KI. Modified glove fingers as an aid for safely navigating endotracheal tube through the nasal cavity and nasopharynx in difficult nasotracheal intubation. Acta Anaesthesiol Taiwan 2011;49:119-21.
13. Talesh KT, Gargary RM, Arta SA, Yazdani J, Roshandel M, Ghanizadeh M, *et al.* Effect of 2% nasal mupirocin ointment on decreasing complications of nasotracheal intubation: A randomized controlled trial. J Clin Diagn Res 2017;11:C08-12.
14. Song J. A comparison of the effects of epinephrine and xylometazoline in decreasing nasal bleeding during nasotracheal intubation. J Dent Anesth Pain Med 2017;17:281-7.
15. Özkan AS, Akbas S, Toy E, Durmus M. North polar tube reduces the risk of epistaxis during nasotracheal intubation: A prospective, randomized clinical trial. Curr Ther Res Clin Exp 2019;90:21-6.
16. Dhakate VR, Singam AP, Bharadwaj HS. Evaluation of nasopharyngeal airway to facilitate nasotracheal intubation. Ann Maxillofac Surg 2020;10:57-60.
17. Khan MU, Khokar R, Qureshi S, Al Zahrani T, Aqil M, Shiraz M. Measurement of endotracheal tube cuff pressure: Instrumental versus conventional method. Saudi J Anaesth 2016;10:428-31.
18. Ji SM. Estimation of optimal nasotracheal tube depth in adult patients. J Dent Anesth Pain Med 2017;17:307-12.
19. Hsu CT, Shih CK, Chau SW, Tseng KY, Chen MK, Cheng KI. Modified glove fingers as an aid for safely navigating endotracheal tube through the nasal cavity and nasopharynx in difficult nasotracheal intubation. Acta Anaesthesiologica Taiwanica 2011;49:119-21.
20. Watanabe S, Yaguchi Y, Suga A, Asakura N. A "bubble-tip" (Airguide) tracheal tube system: Its effects on incidence of epistaxis and ease of tube advancement in the subglottic region during nasotracheal intubation. Anesth Analg 1994;78:1140-3.
21. Ahmed-Nusrath A, Tong JL, Smith JE. Pathways through the nose for nasal intubation: A comparison of three endotracheal tubes. Br J Anaesth 2008;100:269-74.
22. Folino TB, Mckean G, Parks LJ. Nasotracheal Intubation. In: StatPearls. Treasure Island (FL): StatPearls Publishing; 2021.
23. Shetabi H, Hashemi SJ, Fatouni Y. The effect of right or left nostril selection for nasotracheal intubation on the incidence of complications in the patients under maxillofacial surgery. J Isfahan Med School 2019;37:816-23.