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Comparison of Conventional Nasotracheal Intubation with Nasogastric Tube Guided Nasotracheal Intubation via Standard and Parker Flex Tip Tube

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Abstract

Nasotracheal intubation is an established airway management technique used in various intra-oral and oropharyngeal surgical procedures. Nasal trauma is the chief complication associated with it. In order to overcome nasal trauma we conducted a randomized controlled study over 90 adult patients undergoing elective surgery under general anaesthesia using nasogastric tube as a pathfinder to facilitate the passage of nasal endotracheal tube till it reaches oropharynx (Group B and C) compared with the conventional technique (Group A) i.e blind insertion of tracheal tube into nasal cavity, insert further till it is visible in oropharynx and then attempt direct laryngoscopy followed by nasotracheal intubation. We concluded that in group A, 43.3 % patients had easy insertion of nasotracheal tube compared to 86.7% in group B and 86.7% in group C ($p < 0.001$). Nasogastric tube decreases incidence of nasal trauma ($p < 0.001$), increased passage of nasotracheal tube via lower nasal pathway ($p < 0.001$) as well as decreased number of attempts for nasotracheal intubation ($p = 0.018$).

Keywords: Epistaxis, Nasotracheal Intubation, Nasogastric Tube

Introduction

Nasotracheal intubation is an established way of securing the airway of the patient during general anaesthesia for head and neck surgeries. It involves insertion of an endotracheal tube through the nose into the trachea.[1] This technique was first described by Kuhn in 1902 but was popularised by Magill in 1920s.[2] There are two main anatomical pathways in the nostril through which the endotracheal tube may pass. The lower pathway lies along the floor of nose underneath the inferior turbinate. The upper pathway lies above the inferior turbinate just below the middle turbinate. The nasotracheal tube may take any of the above two pathways. The lower pathway is considered to be the safer route for nasotracheal intubation, as it is located away from the cribriform plate and middle turbinate which is a very fragile, porous and vascular structure.[2,3] There are various techniques of nasal intubation which may be a blind procedure or under direct laryngoscopic view. Moreover nasotracheal intubation can be aided

i.e. helping the nasal tube to be placed into the trachea, but we understand that the major resistance felt in the path, as well as maximum nasal trauma occurs until the nasal tube crosses the posterior nares to reach the oropharynx. The smooth transit of the tracheal tube through the nasal passage is essential to reduce the incidence of nasal trauma. The Parker Flex Tip (PFT)-tube has a curved, flexible tip with a posterior facing bevel which causes less impingement on the mucosal surface while passing through the nasal passage and the laryngeal structures.[4] Thus parker flex tip tube may reduce the trauma associated with tip of endotracheal tube while passing through nasopharynx.

A nasogastric tube, an easily available tool in the operation theatres, has been seen to pass through posterior nares with minimal trauma to the nasal passage probably due to its soft consistency, flexibility and an atraumatic rounded tip. Being thin, it is likely to pass along the floor of the nose i.e. lower pathway following path of least resistance. It can also be pulled back anytime with ease owing to its long length.[3,5] Therefore, we used Nasogastric tube as a path finder, in two of the groups in our investigation, to facilitate the passage of the nasal endotracheal tube till it reaches the oropharynx, during nasotracheal intubation.

Nasotracheal route, of intubation is commonly needed in head and neck surgeries, and is frequently associated with complications like epistaxis, bacteremia during dental procedures, avulsion of the nasal mucosa and soft tissue which may cause partial or complete obstruction of the tube, atrophic nasal mucosa, loss of ciliary function, dry crusty and functionless airway, turbinate ulceration, sinusitis, CSF rhinorrhoea etc. [3,6]

In order to minimize the complications associated with the conventional technique of nasotracheal intubation, various methods have been introduced which include use of xylometazoline nasal drops for vasoconstriction, lubrication of the tube with jelly, thermo-softening the tubes before insertion, choosing various guides to facilitate smooth passage of the tube through the nose and using tubes that are more flexible and malleable to insert.[5,7,9]

Recently Parker Medical, Highlands Ranch, CO, USA introduced the Parker Flex-Tip (PFT) tube, suggesting that it causes less subglottic impingement during nasotracheal intubation as compared to conventional ET tube.[4]

The Parker Flex Tip tube features a “hooded” curved, flexible tapered tip that points towards the centre of the distal lumen on the concave surface of the tube so that the bevel faces posteriorly during insertion. There are Murphy eyes on both sides of the tube proximal to the curved, rounded tip. The PFT is available in all sizes with and without cuff. The curved flexible tip design of the tube has been shown to have advantages over the conventional ETT having a side bevelled distal tip, causing less impingement on laryngeal structures.[10,11]

In our study, we decided to use nasogastric tube as a guide to facilitate nasotracheal intubation in one group and in other group with help of recently introduced Parker flex tip tube we would be able to reduce nasal trauma associated with distal end of conventional tracheal tube as well as using nasogastric tube as path finder also, this combination of nasogastric tube as guide and round tip of Parker flex tip tube may be advantageous. Thus we would make nasotracheal intubation less traumatic to nasal mucosa and increase patient safety in clinical scenarios of head and neck surgeries.

Here, we reinforce that, fibreoptic endoscope guided nasotracheal intubation is the gold standard for airway management but it is expensive in terms of time and equipment required for routine maxillofacial and minor ENT surgeries. It is in this setting that careful intubation with the help of Magill forceps or with blind nasotracheal intubation forms a quick alternative for anaesthesiologist.[12,13]

Material and Methods

After approval from the institutional ethics committee, this prospective randomized controlled study was conducted on 90 adult patients (age 18 to 60 yrs.) of either sex, belonging to American Society of Anesthesiologists (ASA) physical status I and II, undergoing elective surgeries planned to be done under general anaesthesia. Patients with history of hypertension, recurrent epistaxis, abnormal coagulation status, basilar skull fracture, predicted difficult airway, severe mid-facial trauma and oropharyngeal or nasal growth were not included in this study.

Preparation of patient

The patients were assessed a day prior to surgery. Detailed clinical history was taken and general physical examination was carried out. All the routine investigations were checked. Detailed nasal examination was done. Findings of nasal patency test and anterior rhinoscopy were noted. Patients were explained about the procedure and VAS (0-10) in detail. Consent for participation in the study was taken from the patients. Patients were kept fasting for six hours prior to surgery. Nasal preparation was done with xylometazoline nasal drops a day prior to surgery as well as early morning before surgery.

Procedure

On the day of surgery, patients were taken in the operation theatre and standard monitors like ECG, non-invasive blood pressure (NIBP) and pulse oximeter attached. Intravenous access was established and intravenous fluid started. Baseline vital data was noted. Patients were then randomized into three groups by drawing slips from an opaque sealed envelope.

Group A (n=30) – Conventional nasotracheal intubation

Group B (n=30) - Nasogastric tube guided nasotracheal intubation

Group C (n=30) - Nasogastric tube as guide for parker's tube for nasotracheal intubation

Patients in all the three groups were given general anaesthesia using standard protocol. Inj. glycopyrrolate 0.2mg and inj. fentanyl 2mcgkg-1 were given intravenously. Preoxygenation with 100% O2 was started using Bain's circuit for three minutes. Induction of anaesthesia was done using inj. propofol 2mgkg^{-1}. After checking adequacy of mask ventilation inj. vecuronium bromide 0.08mgkg^{-1} intravenously was given. The more patent nostril was chosen. For Group A patients (i.e. conventional nasotracheal intubation method), intubation was performed by advancing the nasotracheal tube along the nasal floor to the posterior nasopharyngeal wall. In Group B patients (i.e. in the nasogastric tube guided technique) with the head extended, a lubricated nasogastric tube (16Fr) was inserted into the tracheal tube (7.5 mm and 7.0 mm for male and female respectively) and positioned with its tip protruding about 20 cm from the distal end of the tracheal tube (Fig. 1). The nasogastric tube was lubricated with lignocaine jelly and inserted into the nasal cavity along the floor of the nose in an attempt to

advance it along the lower pathway (Fig. 2). Direct laryngoscopy was done and after the nasogastric tube become visible in oral cavity the tracheal tube was advanced along the nasogastric tube till the oropharynx. The nasogastric tube was then retrieved from the nose (Fig. 3). In Group C patients (i.e. nasogastric tube as guide for parker's tube) with the head extended, a lubricated nasogastric tube (16Fr) was inserted into the PFT-tube (7.5 mm and 7.0 mm for male and female respectively) and positioned with its tip protruding about 20 cm from the distal end(Fig. 4,5). The nasogastric tube was lubricated with lignocaine jelly and inserted into the nasal cavity along the floor of the nose in an attempt to advance it along the lower pathway. Direct laryngoscopy was done and after the nasogastric tube become visible in oral cavity, the Parker Flex Tip tube was advanced along the nasogastric tube till the oropharynx. The nasogastric tube was then retrieved from the nose.

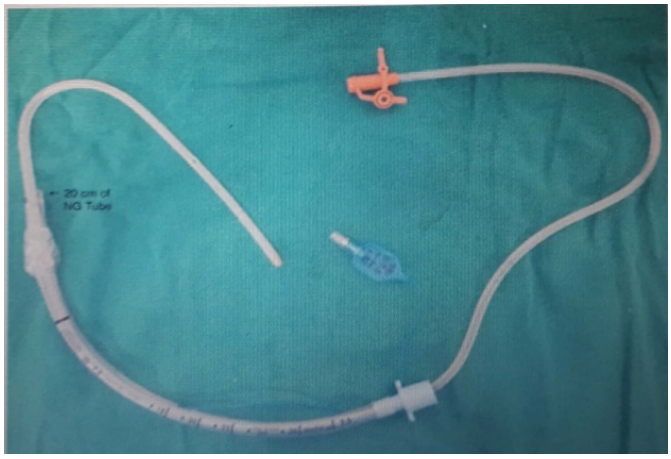

Fig 1: Endotracheal tube and nasogastric tube assembly showing 20 cm of nasogastric tube protuding from distal end of endotracheal tube

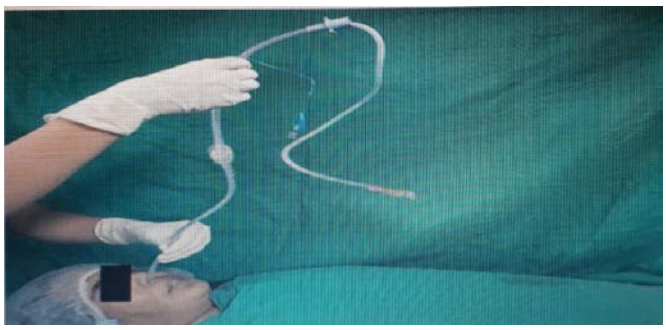

Fig 2: Introducing endotracheal tube and nasogastric tube assembly into patient's nostril

Fig 3: Removal of nasogastric tube from endotracheal tube after laryngoscopy

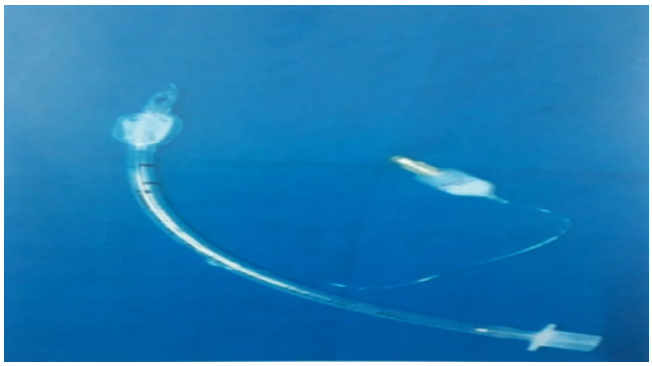

Fig 4: Parker Flex Tip tube

Fig 5: Image showing the curved tip of Parker Flex Tip tube

Then in all three groups, the nasotracheal tube was then further advanced into the trachea (using Magill forceps if required). After confirming the position of tube by capnography and auscultation, ventilation was resumed. The pathway taken by the tracheal tube was assessed using a fibreoptic endoscope alternately above and below the tracheal tube in the nostril. Maintenance of anaesthesia was done using isoflurane (up to 1%) in O2 and N2O (33:67), inj. vecuronium bromide 0.02mgkg^{-1} and fentanyl 1mcgkg^{-1} intravenously as required. Rest of the procedure proceeded as routine. At the end of surgery all anaesthetic agents were stopped and neuromuscular blockade was reversed using inj. Glycopyrrolate 0.4 mg and inj. Neostigmine 0.05mgkg^{-1} intravenously after spontaneous respiratory efforts were noted. Patients were extubated after arrival of protective airway reflexes, adequate muscle power and shifted to recovery room followed by ward thereafter.

To evaluate the role of nasogastric tube as a guide to facilitate nasotracheal intubation in patients posted for surgery under general anaesthesia and following parameters were noted:

1. Ease of insertion
2. Number of attempts of both nasotracheal intubation and nasogastric tube insertion
3. Incidence of nasal trauma
4. Time taken for nasotracheal intubation
5. Post operative nasal pain
6. Complications, if any

Ease of insertion was noted as easy - if no resistance is felt during intubation, or difficult - if resistance was felt. In case resistance was felt the tube was manipulated, if still resistance persisted then other nostril was chosen for nasotracheal intubation.

Number of attempts taken for nasogastric tube insertion and nasotracheal intubation were noted separately. More than 3 attempts were considered as failure and patient was excluded from the study. Nasal trauma was evaluated by direct laryngoscopy using a 4-point scale: no epistaxis; mild epistaxis (blood on the tracheal tube only); moderate epistaxis (blood pooling in the pharynx) or severe epistaxis (blood in the pharynx sufficient to impede intubation).

Time taken for nasotracheal intubation was taken as time from start of nasogastric tube insertion to successful placement of naso-tracheal tube either tracheal tube or PFT-tube for Group B and C patients respectively and for nasotracheal tube insertion and its placement into trachea for Group A patients.

Aim

Our primary aim in this study is to compare ease of insertion, number of attempts of both nasotracheal intubation and nasogastric tube insertion, incidence of nasal trauma and time taken for nasotracheal intubation. Secondary outcomes included post-operative nasal pain and complications, if any.

Sample size

According to previous study the incidence of proper placement of tracheal tube in conventional technique was 26.7% (8 out of 30) and in nasogastric tube guided technique was 66.7% (20 out of 30).[5] Considering that a clinically significant increase in proper tracheal tube placement was 40% in absolute terms, 30 patients were required for each group with an alpha error of 5% to achieve a significance level of 95% and power of 80%. Statistical Analysis The entire data was analyzed using statistical package for social science system version SPSS 18.0. For continuous variables, unpaired Student t-test was done while for categorical data, Chi-square

test or Fisher exact test (whichever applicable) was done. For all statistical tests, a “p” value less than 0.05 was considered as significant.

Results

All the data collected was compiled and subjected to relevant statistical tests, following observations and results were obtained:

Demographic profile and Baseline Vital Parameters: Three groups were comparable in terms of age, sex, ASA status and baseline vital parameters like temperature, pulse, NIBP and respiratory rate.

Table 1: Ease of Insertion

			Difficult	Easy	Total
Groups	Group A	N	17	13	30
		%	56.7%	43.3%	100.0%
	Group B	N	4	26	30
		%	13.3%	86.7%	100.0%
	Group C	N	4	26	30
		%	13.3%	86.7%	100.0%
Total		N	25	65	90
		%	27.8%	72.2%	100.0%

Chi square test, P value=0.001 (S)

Difficulty in insertion was found higher in group A (56.7%). both groups B (13.3%) and C (13.3%) showed same difficulty in insertion. On comparison, ease of insertion showed statistically significant results with three groups: Group A vs Group B = 0.001 (S); Group B vs Group C =NA; Group A vs Group C =0.001 (S).

Table 2: Number of Attempts for Nasotracheal Intubation

			Attempt		Total
			One	Two	
Groups	Group A	N	13	17	30
		%	43.3%	56.7%	100.0%
	Group B	N	22	8	30
		%	73.3%	26.7%	100.0%
	Group C	N	25	5	30
		%	83.3%	16.7%	100.0%
Total		N	60	30	90
		%	66.7%	33.3%	100.0%

Chi square test, P value=0.003 (S)

Second attempt was recorded higher in group A (56.7%) as compared to groups B (26.7%) and C (16.7%) which showed statistically significant results with three groups: Group A vs Group B= 0.01 (S); Group B vs Group C = 0.34; Group A vs Group C = 0.001 (S). Statistical analysis using Pearson chi-square test showed statistically significant decrease in number of attempts required for successful placement of nasotracheal tube in group B and group C.

Table 3: Nasal trauma

			nasal trauma				Total
			Mild	Moderate	None	severe	
Groups	Group A	N	1O	14	0	6	30
		%	33.3%	46.7%	0.0%	20.0%	100.0%
	Group B	N	11	4	15	0	30
		%	36.7%	13.3%	50.0%	0.0%	100.0%
	Group C	N	4	0	26	0	30
		%	13.3%	0.0%	86.7%	0.0%	100.0%
Total		N	25	18	41	6	90
		%	27.8%	20.0%	45.6%	6.7%	100.0%

Chi square test, P value=0.001 (S)

Moderate nasal trauma was recorded higher in group A (46.7%) as compared to groups B (13.3%) while group C did not have any trauma which showed statistically significant results with three groups: Group A vs Group B=0.001 (S); Group B vs Group C=0.006 (S); Group A vs Group C=0.001 (S)

Table 4: Pathway taken by tracheal tube

			Pathway		Total
			Lower	Upper	
Groups	Group A	N	8	22	30
		%	26.7%	73.3%	100.0%
	Group B	N	27	3	30
		%	90.0%	10.0%	100.0%
	Group C	N	21	9	30
		%	70.0%	30.0%	100.0%
Total		N	56	34	90
		%	62.2%	37.8%	100.0%

Chi square test, P value=0.001 (S)

Upper pathway was recorded higher in group A (73.3%) as compared to groups B (10%) and group C (30%) which showed statistically significant results with three groups: Group A vs Group B=0.001 (S); Group B vs Group C=0.05; Group A vs Group C=0.001 (S).

Table 5: Time Taken for Intubation

	Mean	Std. Deviation	Minimum	Maximum	P value
Group A	.7223	.28897	.40	1.10	0.001 (S)
Group B	1.2273	.27635	.55	1.56	
Group C	1.3120	.25344	.55	2.12	
Total	1.0872	.37623	.40	2.12	

ANOVA

Average time taken for intubation was 72 seconds in Group A, 82 seconds in Group B, and 91 seconds in group C. Hence we observed that in group A (72 seconds +- 28 seconds)nasotracheal intubation took less time as compared to groups B (83 seconds +- 27 seconds) and group C (91 seconds +- 25 seconds) which showed statistically significant results with three groups.

Table 5(a): intra-group comparison of time taken

		Mean differences	P value
Group A	Group B	-0.505	.000 (S)
	Group C	-0.58	.000(S)
Group B	Group A	0.505	.000 (S)
	Group C	-0.08	.700
Group C	Group A	0.08	.700
	Group B	0.58	.000 (S)

Post HOC Bonferroni Test

Group A showed statistically significant results with group B and group C.

Table 6: Post-operative epistaxis classification among groups

			Epistaxis		Total
			Mild	None	
	Group A	N	5	25	30
		%	16.7%	83.3%	100%
	Group B	N	4	26	30
		%	13.3%	86.7%	100%
	Group C	N	3	27	30
		%	10.0%	90.0%	100%
		N	12	78	90
			13.3%	86.7%	100%

Chi-square test, p value =0.74

Group A vs group B=0.71; Group A vs Group C=0.44; group B vs Group C=0.68.

Statistical analysis showed that in group A, 16.7% patients had mild nasal epistaxis and 83.3% had no epistaxis whereas in group B and group C, 13.3%, 10.0%, patients had mild epistaxis and 86.7%, 90.0%, patients had no epistaxis in postoperative period

respectively. Using chi square test it was seen that there was no significant increase in the incidence or severity of postoperative epistaxis amongst the three groups (p=0.74)

Table 7a : VAS at 6 hrs

			VAS at 6 hrs						Total
			.00	4.00	5.00	6.00	7.00	8.00	
Groups	Group A	N	0	5	6	13	1	5	30
		%	0.0%	16.7%	20.0%	43.3%	3.3%	16.7%	100.0%
	Group B	N	0	0	0	13	4	13	30
		%	0.0%	0	0	43.3%	13.3%	43.3%	100.0%
	Group C	N	0	6	5	12	2	5	30
		%	0	20.0%	16.7%	40.0%	6.66%	16.7%	100.0%
Total		N	0	11	11	38	7	23	90
		%	0	12.2%	12.2%	42.3%	7.8%	25.5%	100.0%

P value=0.001 (S)

Table 7b : VAS at 24 hrs

			VAS at 24 hrs					Total
			.00	3.00	4.00	5.00	6.00	
Groups	Group A	N	0	17	11	2	0	30
		%	0.0%	56.7%	36.7%	6.6%	0	100.0%
	Group B	N	0	14	1	9	6	30
		%	0.0%	46.7%	3.3%	30.0%	20.0%	100.0%
	Group C	N	0	22	4	4	0	30
		%	0	73.3%	13%	13%	0	100.0%
Total		N	0	53	16	15	6	90
		%	0	58.8%	17.8%	16.7%	6.7%	100.0%

P value=0.001 (S)

Nasal pain was comparable post-operatively as the VAS score was around 6 in all three groups at 6 hours and it decreased to around 3 after 24 hours. However, in group C majority of patients (73.3%) had a VAS score between 2 and 3 i.e they had least nasal pain among the groups.

Discussion

Nasotracheal intubation, avoids sharing of airway between surgeon and anaesthesiologist in surgical procedures involving the oral cavity, and beneficial for head & neck region for better surgical access. Patients tolerate these nasotracheal intubations better and there are lesser chances of displacement of tube as compared to orotracheal intubation. Thus, it is of advantage to both surgeons as well as anaesthesiologists.

Advancement of nasotracheal tube can traumatize nasal passage as a large tube is passed through the narrow nasal passage. After reviewing many techniques suggested in literature to minimize nasal trauma, we decided to use nasogastric tube as a pathfinder for nasotracheal intubation because it appealed to us as a simple, atraumatic technique, readily available and an economic option. We therefore conducted a study to evaluate the role of nasogastric tube as a path finder for Naso-tracheal intubation in group B of our study.

The smooth transit of the tracheal tube through the nasal passage is essential to reduce the incidence of epistaxis or nasal trauma. When nasogastric tube is used as a guide in Parker Flex Tip tube(PFT-tube), it snugly fits with the hooded tip of the Parker Flex Tip tube and it further helps in the smooth passage of the tube via nasal cavity as an assembly. It also acts a path finder and takes the path of least resistance which causes further minimal damage to the highly vascularised portion of nasal cavity.[5] There are limited studies available where a guide is used with Parker Flex Tip tube during nasal intubation, so we decided to evaluate the role of nasogastric tube as a guide plus atraumatic hooded tip (distal end), of Parker flex Tip tube to facilitate nasotracheal intubation in group C.

Demographic Profile and Baseline Vital Parameters: The demographic data including age, sex and ASA status as well as baseline haemodynamic parameters were comparable in three groups as in the studies of Lim et al, Morimoto et al and Elwood et al.[5, 8,9]

Ease of Insertion: Group A had 43.3% patients with easy insertion of nasotracheal tube as compared to 86.7% in Group B and Group C had 86.7% patients with easy insertion of nasotracheal tube as compared to 43.3% in Group A. Difficulty in insertion was found to be higher in group A (56.7%)compared to other groups. Both groups B (13.3%) and C (13.3%) showed similar difficulty of insertion. On comparison, ease of insertion showed statistically significant results with three groups: Group A vs Group B=0.001 (S); Group B vs Group C=NA; Group A vs Group C=0.001 (S). In Group B and C there was statistically significant easy intubation in comparison to Group A ($p< 0.001$), probably due to smoother transit through nasal passage as path of least resistance(lower pathway) taken by nasogastric tube in group B plus parkers tip in group C.

Number of attempts for Nasotracheal Intubation

In Group A, B, C, 43.3%, 73.3%, 83.3% patients had successful nasotracheal intubation in first attempt and 56.7%, 26.7%, 16.7% required second attempt for nasotracheal intubation respectively. Second attempt was recorded higher in group A(56.7%) as compared to group B (26.7%) and C (16.7%) which showed statistically significant results with three groups: Group A vs Group B=0.01 (S); Group B vs Group C=0.34; Group A vs Group C=0.001 (S). There was statistically significant decrease in number of attempts required for successful placement of nasotracheal tube in Group B ($p = 0.01$) and Group C ($p = 0.001$). Low resistance in nasal cavity due to use of nasogastric tube in Group B & which was further improved by parker's tip in Group C, probably resulted in a decrease in the number of attempts required to insert nasotracheal tube. Our results are thus consistent with those of Sugiura et al, Lim et al who also used nasogastric tube and Elwood et al who used red rubber catheter as a guide.[5,6,8]

Nasal Trauma

Group A had 33.3% patients with mild nasal trauma, 46.7% had moderate nasal trauma and 20% patients had severe nasal trauma. In Group B, 50% patients had no nasal trauma, 36.7% had mild nasal trauma, 13.3% had moderate nasal trauma and none had severe trauma. In Group C 13.3% patients had mild nasal trauma, and remaining 86.7% patients had no nasal trauma. Moderate nasal trauma was recorded higher in group A (46.7%) as compared to groups B (13.3%) while group C did not have any trauma which showed statistically significant results with three groups: Group A vs Group B=0.001 (S); Group B vs Group C=0.006 (S); Group A vs Group C=0.001 (S). There was significant reduction in nasal trauma in Group B and Group C as compared to Group A ($p < 0.001$). Reduced incidence of nasal trauma may be attributed to the fact that less number of attempts for intubation were required in nasogastric tube guided nasotracheal intubation in group B and group C. Moreover, nasotracheal tube passed through lower pathway which resulted in less trauma to the nasal passage in Group B and C. However the PFT-tube itself has a hooded, curved and flexible tip which reaches the curvature of nasopharynx where its posterior facing bevel touches and slides along the irregular surfaces and mucous membranes leading to less catching on the upper airway anatomical structures and posterior wall. The flexible tip of PFT- tube on encountering resistance would bend and redirect itself

and cause less trauma while the standard ETT wedges against and bruises the mucosa coming in contact. Thus the results were comparable between the two groups (p = 0.006). In the study of Earle et al, they found no significant reduction in the incidence and severity of epistaxis when Parker Flex Tip tube was compared with RAE ETT (p = 0.78).[14] In the study of Ahlawat et al in Group I where nasogastric tube was used as a guide for nasotracheal intubation, 50% patients had no nasal trauma, 36.7% had mild nasal trauma, 13.3% had moderate nasal trauma and none had severe trauma. In Group II where conventional nasotracheal intubation was done, 33.3% patients had mild nasal trauma, 46.7% had moderate nasal trauma and 20% patients had severe nasal trauma (p < 0.001).[15] Hence our findings are comparable to the study of Earle et al and contrary to that of Ahlawat et al.

Nasal Pathway

The pathway taken by tracheal tube was assessed using fiber optic endoscope in three groups. In our study, all the tracheal tubes were observed in one of the two pathways, consistent with previous studies. Nasogastric tube is likely to pass through lower pathway as it follows the path of least resistance (i.e. lower pathway, below the inferior turbinate). This was re-established in our study where we found that for Group A, Upper pathway was recorded higher in group A (73.3%) as compared to groups B (10%) and group C (30%) which showed statistically significant results with three groups: Group A vs Group B=0.001 (S); Group B vs Group C=0.05; Group A vs Group C=0.001 (S). (using Chi square test, P value=0.001 (S)). In Group B there was statistically significant increase in chances of passing of nasotracheal tube via lower pathway as compared to Group A (p < 0.001) and In Group C there was statistically significant increase in chances of passing of nasotracheal tube via lower pathway as compared to Group A (p < 0.001). This was so because the nasogastric tube most likely passed through the lower pathway and nasotracheal tube followed the same path of nasogastric tube in a guided fashion. Lim et al found that the incidence of passage via lower pathway was statistically more in nasogastric tube guided technique (p = 0.004) and our results are similar to those of Lim et al.[5]

Time Taken for Intubation

In our study, average time taken for intubation was 72 seconds in Group A, 83 seconds in Group B, and 91 seconds in group C. Hence we observed that in group A (72 seconds +- 28 seconds)nasotracheal intubation took less time as compared to groups B (83 seconds +- 27 seconds) and group C (91 seconds +- 25 seconds) which showed statistically significant results with three groups. Sugiura et al concluded that faster intubation was difficult to achieve in blind technique as compared to nasogastric tube guided technique in which the average time required for complete intubation was 8.25 mins which was faster than the previous studies.[16] In the study of Lim et al nasogastric tube guided technique took longer time for nasotracheal intubation as compared to conventional technique (177 secs versus 175 secs).[5] Morimoto et al found that nasotracheal intubation using curved tipped suction catheter took longer time for intubation as compared to conventional group (p = 0.002).[17] In the study of Abrons et al, the average time take by bougie guided technique was longer (81 secs) than conventional technique (70 secs); (p = 0.039).[18] Vadhanan et al observed in their study that average time taken for intubation in bougie guided technique was 30.45 secs and non bougie

guided technique was 18.25 secs; ($p < 0.01$).[19] In their study, Ahlawat et al observed that the average time required for nasogastric tube guided nasal intubation was 72.87 seconds and 74.2 seconds in conventional technique ($p = 0.855$).[15] The results of our study are comparable to the findings of Sugiura et al, Lim et al, Morimoto et al, Abrons et al, Vadhanan et al but contrary to Ahlawat et al.

Nasal Pain

Nasal pain was found to decrease at 6 hours postoperative to 24 hours in all groups. However in group C majority of patients had VAS score between 2 and 3 i.e having least nasal pain among the groups. Other parameters like postoperative epistaxis ($p=0.74$), persistent nasal pain, nasal stuffiness, nausea & vomiting were comparable and insignificant in the three groups. This could be the result of good premedication, adequate intra-operative analgesia. In the study conducted by Lim et al, there was no statistically significant change in nasal pain for nasogastric tube guided technique and conventional technique ($p=0.131$).[5] Enk et al found diminished post-operative nasal pain in Wendl tube guided technique ($p=0.036$).[20] Sugiura et al found no adverse outcome in their study.[16] Ahlawat et al found that none of the patients developed significant post operative complications.[15] Hence our results are in concordance with their studies.

Therefore, in our study we found that, when compared with the conventional technique, nasotracheal intubation done using a nasogastric tube as a guide was easier, faster and required less attempts. Also Parker flex tip (PFT-tube) tube fits snugly over nasogastric tube, so they move as a single unit during manipulation to cross nasopharynx. The flexible tip of PFT on encountering resistance would bend and redirect itself and causes less trauma while the standard ETT wedges against and bruises the mucosa coming in contact. So the PFT-tube followed the nasogastric tube and passed through the lower pathway, this intubation (Group C) was less traumatic both in terms of any bleeding as well as post-operative nasal pain without affecting the haemodynamics of the patient irrespective of their demographic profile. Fiber-optic technique is an gold standard technique for nasotracheal intubation. It requires additional specialized equipment and also needs a higher level of training. Our study enforces that easy availability and short learning curve makes nasogastric tube guided technique, a feasible option for less traumatic nasotracheal intubation. Hence, it offers the anesthesia professionals additional option for patient care, especially in emergency setups.

Limitations of our study

Our study was limited to the patients with normal nasal cavity who had no history of nasal trauma, epistaxis or coagulation disorder and an experienced anaesthesiologist performed all the intubations in paralyzed patients. Moreover the anaesthesiologist could not be blinded to the type of technique used for intubation. Hence, further studies where patients with comorbidities are included and anesthesiologist could be blinded to the type of technique used are recommended in future.

Conclusion

Nasogastric tube guided nasotracheal intubation technique improves ease of intubation, requires lesser attempts, ensures placement of nasotracheal tube in lower pathway resulting in reduced nasal trauma as well as nasal pain without affecting the haemodynamics of the patient irrespective of their demographic profile. The combination of nasogastric tube and parker flex tip

tube further enhances easy, smooth transit through nasopharynx and smooth naso-tracheal intubation. Also it was seen to have reduced nasal trauma as parker flex tip tube results in less impingment on nasal mucosa, hence atraumatic intubation. It is thus recommended, as a good alternative method for nasotracheal intubation.

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