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ORIGINAL ARTICLE

A comparative study of two methods of nasal tracheal fiberoptic intubation

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ABSTRACT

Introduction: Conventional fiberoptic intubation in a well anesthetized and prepared airway is found difficult with success rates of around 68%. The difficulty presents in the form of longer duration taken for intubation, coughing and bleeding. This study aimed to compare two facilitated methods designed to reduce time taken, complication rate, ease of insertion and hemodynamic stability**.**

Methodology: After institute ethical committee clearance and a written informed consent, patients were randomly divided into two groups. Both groups were prepared, as per current standards. In Group-A (endotracheal tube group), the endotracheal tube was first inserted till 18 cm mark at the alae of nose. Fiberscope was passed through the tube, and navigated to pass through the true vocal cords and its adequate placement was confirmed. In the other group – Group-B (nasopharyngeal airway group), a spirally split Rusch® nasopharyngeal airway of adequate size was warmed, lubricated and inserted in the nasal cavity. Fiberscope was passed through the airway, vocal cords were visualized, and the nasopharyngeal airway was removed before railroading the pre-loaded tube through the vocal cords and correct placement was confirmed. Time taken to intubate, cough episodes, bleeding and hemodynamic parameters were recorded.

Results: The time taken for intubation in Group-A was 79.76 sec as compared to 44.15 sec in Group-B ($p < 0.001$). The increase in heart rate and mean arterial blood pressure were found to be significantly higher Group-A than those in Group-B.

Conclusion: We conclude that split nasopharyngeal airway is better in assisting awake fiberoptic nasal intubation than through the endotracheal tube in terms of less time taken and better hemodynamic parameters.

Key words: Endotracheal tube; Intubation; Fiberoptic intubation; Fiberoptic bronchoscope; Split nasopharyngeal airway

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INTRODUCTION

Conventional laryngoscopy and oral intubation is difficult or even impossible when there is limited jaw mobility, restricted mouth opening or surgical intervention/ procedure is proposed in or around oral cavity.[1-4]

Conventional fiberoptic intubation in a well anesthetized and prepared airway is found difficult with success rates of around 68%.[5] The difficulty presents in the form of longer duration taken to maneuver fiberoptic bronchoscope, advancing the tube, repeat attempts, inadvertent soft tissue trauma, edema, and bleeding compromising the visibility through the fiberoptic bronchoscope and discomfort to patient leading to coughing, pain, and anxiety.[6-10]

Over the years, facilitated methods for nasal fiberoptic intubation have been developed to address the above mentioned issues and reduce the total duration taken to intubate resulting in improved patient comfort and higher success rates.[1-14]

The primary objective of this study was to compare two methods to facilitate fiberoptic intubation; one with the novel approach of using spirally split nasopharyngeal airway (SNPA) to dilate the nasopharyngeal passages to avoid potential trauma, bleeding, and providing adequate space for smoother intubation thus reducing the time to intubate. The other being an endotracheal tube first approach, where the tube was inserted in the nasal cavity and advanced till mark of 18 cm was at the level of alae nasi. Secondary objectives were the frequency of complications and the effects on hemodynamics.

Sample size calculation:

A sample size of 70 patients was finalized after pilot study ($\alpha = 0.05$, $\beta = 0.2$) However, 80 patients were selected to account for any attrition and were randomized using table of randomization into two groups with matching ages ($p = 0.896$) and sexes ($p = 0.602$). The statistical analysis was done using SPSS for Windows version 16.0. For comparing two groups mean and Student's t-test was used. For categorical data, Chi-square and Fischer's Exact test were used. The critical value of 'p' indicating the probability of significant difference was taken as < 0.05 for comparisons.

METHODOLOGY

Institutional ethical committee permission was taken. Written informed consent for fiberoptic nasal intubation, emergency surgical tracheostomy,

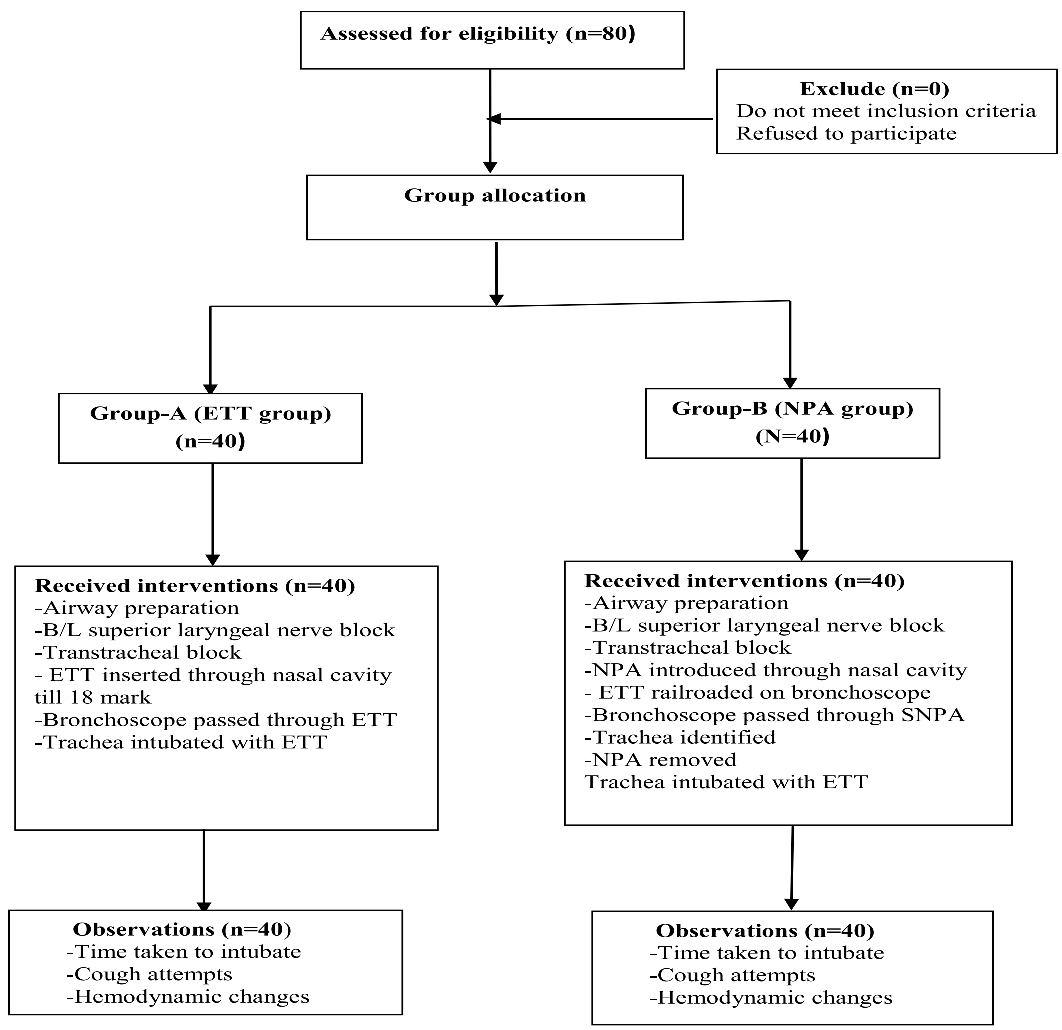

Figure 1: Flow diagram

anesthesia and surgery was taken from patients prior to the procedure. Study was conducted during 2015-2016. Patients, 20-60 years, undergoing general anesthesia for oro-pharyngeal or maxillofacial or mandibular surgeries and ASA grade I or II, were included in the study. Patients who refused to undergo procedure, presence of any absolute contraindication of nasal intubation like head trauma, suspected base of skull fractures, nasal mass and deviated nasal septum were excluded from the study. Patients were divided into two groups of nasal intubation; either Group A, in which nasal ETT was inserted through the patent nostril till 18 cm mark and Group B, in which split nasopharyngeal airway (SPNA) was inserted to be used as a conduit for fiberscope.

Patients were optimized for surgery, fasted for at least 8 hours and premedicated with glycopyrrolate 0.2 mg intramuscularly 30 min prior to the procedure. Inj midazolam 1 mg and fentanyl 50 μg intravenous 3 min were injected prior to the procedure in the operating room. Endotracheal tubes (Portex®) 7.5 for male and 7.0 for female patients were used. Patients were connected to standard monitors including pulse oximetry, capnography, electrocardiography, non-invasive blood pressure and temperature monitoring prior to giving premedication.

Airway preparation included instilling xylometazoline 0.1% nasal drops in both nostrils 30 min prior to the procedure followed by nebulization with lignocaine 2% with adrenaline (1:200000) for 20 min supplemented with bilateral superior laryngeal nerve block and blocking the sensory input of recurrent laryngeal nerve by trans-tracheal block.

In the Group A, the well lubricated tube was inserted in the nasal cavity and advanced through it till mark 18 reached at the level of alae of nose. With the tube advanced to the 18 cm at nares, the tube tip stands just above the larynx and breath sounds are audible through the tracheal tube. The fiberoptic bronchoscope (Karl Storz® Intubation fiberscope 11301 BN1) was passed through the tube, vocal cords were visualized and the tube was passed through the glottic aperture. The final depth of the nasal tube was 24-28 cm at the nares, correct endotracheal placement was checked by confirming bilateral equal air entry and breathe sounds and visual visualization of carina and tracheal rings while withdrawing the fiberoptic bronchoscope.

In the Group B, a spirally split Rusch® silicon rubber nasopharyngeal airway of appropriate size was warmed, lubricated and inserted into the nasal cavity. It has been suggested that the split be performed spirally as cutting it straight through tends to make the SPNA collapse in the nasopharynx. The fiberoptic bronchoscope mounted with the nasal tube was passed through the split nasopharyngeal airway and vocal cords were visualized. The SPNA was then gently peeled off the bronchoscope and pulled out of the nasal cavity. The nasal tube was passed through the glottic aperture and correct placement was checked by confirming bilateral equal air entry and breath sounds.

During this period, patients were awake and co-operated well with the anesthesiologists. Time taken from insertion of scope in nares to endotracheal tube cuff inflation was noted in seconds was noted. The number of cough episodes according to Helbo-Hensen cough severity scale, hemodynamic changes at baseline, 01 min and 5 min, and any bleeding as seen through the bronchoscope and graded as mild, moderate or severe were also noted. If necessary, facilitating techniques like head flexion, and jaw thrusts were used.

A time period of more than 180 sec or more than two attempts were taken as a failed intubation. Intubation experience of the intubating anesthesiologist was also taken into consideration and graded as optimal, sub-optimal, difficult, or failure.

Data were analyzed using SPSS version 16.0

RESULTS

Demographic profile of patients was comparable and the differences were non-significant. The time taken from insertion of fiberoptic bronchoscope into the nasal cavity till the inflation of endotracheal cuff varied significantly 79.76 ± 11.879 sec for Group A to 44.15 ± 7.767 sec for Group B ($p < 0.001$) (Table 1).

Table 1: Age, sex and time taken for intubation in seconds

Variable	Group A Mean ± SD	Group B Mean ± SD	t-value	p value
Age	58.42 ± 14.028	58.00 ± 14.379	0.131	0.896
M/F	35/3	38/2		
Duration	7 9.76 ± 11.879	44.15 ± 5.767	16.976	<0.001

M/F- male and female

Cough severity was rated on a 4-point scale (1 = none, 2 = slight, 3 = moderate, 4 = severe) as devised by Helbo-Hansen et al.[17] Coughing was considered slight if no more than 2 coughs in sequence occurred, moderate if 3–5 coughs in sequence occurred and

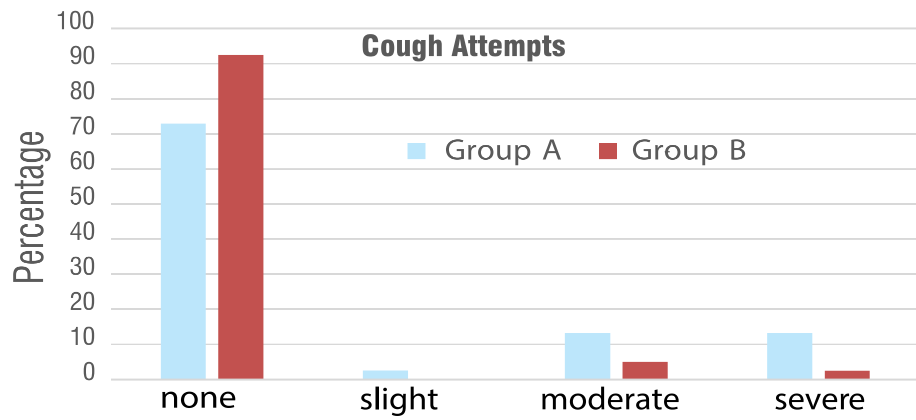

Figure 2: Comparison of the frequency and severity of cough attempts

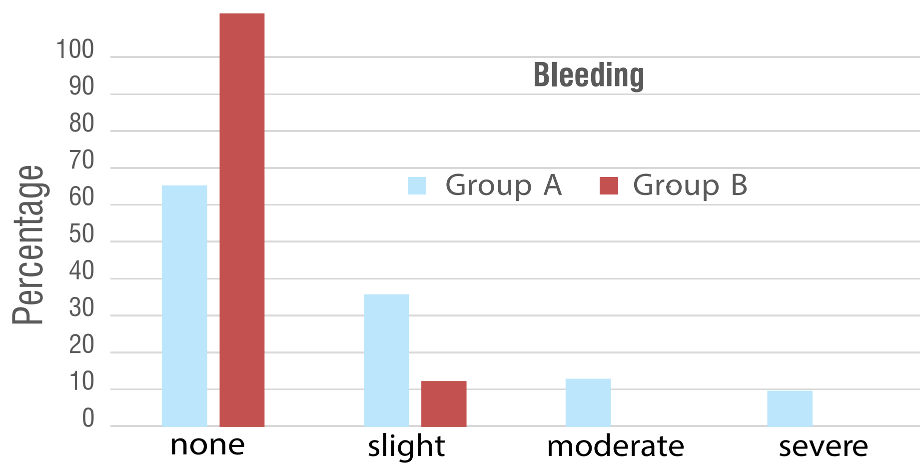

Figure 3: Comparison of the frequency and severity of bleeding

Table 2: Comparative heart rate

Time interval	Group A Mean ± SD	Group B Mean ± SD	t-value	p-value
Baseline	77.50 ± 9.226	81.62 ± 9.122	-1.985	**.051**
0 min	92.87 ± 12.395	82.48 ± 10.660	3.977	< 0.001
1 min	83.61 ± 10.093	78.42 ± 8.667	2.436	0.017
5 min	73.50 ± 6.476	77.20 ± 6.966	-2.426	0.018

Table 3: Mean blood pressure mm of Hg

Time interval	Group A Mean ± SD	Group B Mean ± SD	t-value	p-value
Baseline	95.29 ± 8.12	93.18 ± 8.31	1.136	0.260
0 min	108.43 ± 8.50	94.80 ± 9.28	6.751	< 0.001
1 min	94.64 ± 12.71	87.65 ± 8.12	2.912	0.005
5 min	90.10 ± 7.30	88.94 ± 6.23	0.758	0.451

severe if more than 5 coughs in sequence occurred (Figure 2).

Cough attempts caused airway trauma resulting in mucosal bleeding ranging from mild to severe in 47.3% patients in Group A as compared to mild bleeding in 10% patients in Group B, the difference being statistically significant($p = 0.002$).

Bleeding was classified as; mild - just a streak outside the ETT; moderate – some blood in the laryngopharyngeal region along with streak on the ETT, and severe - bleeding that obscured the visual field (Figure 3).

Baseline heart rate and blood pressure were comparable in both groups. A statistically significant ($p < 0.001$) increase of 19.83% in heart rate was observed in Group A during the procedure as compared to 1.05% in Group B (Table 2 & 3).

Mean blood pressure also followed the same trend with a statistically significant ($p < 0.001$) increase of 12.09% in the Group A as compared to 1.9% in Group B.

DISCUSSION

Conventional fiberoptic intubation in a well anesthetized and even in prepared airway can be difficult. Nasal fiberoptic intubation can be as difficult as oral fiberoptic intubation. Differences in the definition between various studies might have produced these differences in the reported incidences; however, other factors such as a different size of fiberscope, or else the type and size of the endotracheal tube, might have affected the incidence.

The difficulty presents in the form of longer times taken to maneuver fiberoptic bronchoscope,

railroading the tube, repeated attempts, inadvertent soft tissue trauma, edema, and bleeding compromising the visibility through the fiberoptic bronchoscope and discomfort to patient leading to coughing, pain, and anxiety. The major reason for difficulty in advancing an endotracheal tube over a fiberscope is considered to be the deviation of the course of the tube from that of the fiberscope (because of the gap between the two) towards the epiglottis, arytenoid cartilage, pyriform fossae, or esophagus.

Over the years, facilitated methods of fiberoptic intubation have been developed to address the above mentioned issues and to reduce the total time taken to intubate resulting in improved patient comfort and higher success rates. Examples of such methods include, using tube first approach, or using SPNA.

The tube first approach may lead to higher incidences of soft-tissue trauma, bleeding, impingement of tube leading to patient discomfort in form of cough attempts and even blockage of the tube due to inferior turbinate tissue.[18] In our study we inserted the tube in nasal cavity till 18 cm mark at the nares. This method has been described by Ali Mohammadzadeh et al. in Iranian population.[19]

The SPNA was originally described for atraumatic nasogastric tube insertion. If the SPNA is adequately prepared (warm, soft, and lubricated with local anesthetic gel), it allows for nasal fiberoptic endoscopy to be performed with little distress to the awake patient.

Most importantly, since the SNPA can be peeled off the bronchoscope, nasotracheal intubation can be facilitated. When compared to direct nasal endoscopy, the SNPA may require less anesthetic depth and it affords for the repeated fiberoptic procedures atraumatically if required.

In our study, we found that the duration taken for intubation using SPNA method was lesser than tube first method. This was attributed to significant lesser incidence of bleeding, cough attempts and hence a smoother passage of the fiberscope and intubation. The time taken for intubation in our study was 79.76 ± 11.87 sec to the reported 90.3 seconds by Ali Mohammadzadeh et al.[19]

Patient comfort was measured in terms of absence of cough attempts, which was higher at 92.5% in Group B as compared to 72.7% in Group A ($p = 0.076$). Furthermore, only 5% patients in Group B had mild cough attempts (single cough attempt) as compared to 13.2% in tube first group. 13.2% patients in the later group also had severe cough attempts (2 or more) as compared to 2.5% in Group B. The cough attempts invariably led to soft tissue trauma and loss of orientation and blocked field of vision, thus prolonged the time taken for intubation. In our experience, PVC endotracheal tubes caused much discomfort to the patient during insertion even after adequate lubrication. Similar problems were avoided with warmed and lubricated SNPA, which are softer and slide easily into the nasal cavity. This resulted in more patient comfort and lesser trauma to the airway.

While introducing the fiberscope through the nasal tube or SPNA, no bleeding was seen in 90% of the patients in Group B, as compared to 52.6% in Group A. 28.9% patients in Group A had mild bleeding as compared to 10% in Group B. This was attributed to the difference in suppleness of the material of the endotracheal tube and the nasal airway.[20] In Group A 10.5% patients had moderate bleeding and 7.9% had severe bleeding as compared to 0% in both categories in the Group B.

An important finding of our study was the report of failure of procedure in 5.3% of patients in Group A. These patients had multiple episodes of cough attempts and severe bleeding from the mucosa and required more than 180 sec to intubate and were hence excluded from the study.

The baseline heart rates of patients in both groups were similar. At the time of insertion of the endotracheal tube in Group A, heart rate was noted to be significantly higher than that of Group B, presumed to be due to sudden dilatation with the relatively hard endotracheal tube as compared with the soft pliable nasal airway. Subsequent readings at 1 and 5 min were lower as general anesthesia was induced.

Mean blood pressures showed significantly more rise from baseline in Group A as compared to Group B. This difference continued to be significant until effects of drugs used for induction of general anesthesia blunted the sympathetic responses to the nasal intubation. Mean blood pressures increased by 13.68% in Group A as compared to 1.73% in SPNA group..

CONCLUSION

Based upon the results of our study, we conclude that split nasopharyngeal airway assisted method is a better alternative to the tube first method for awake facilitated fiberoptic nasal intubation in terms of time taken to intubate, patient comfort, success rates, and hemodynamic stability. We recommend the use of split nasopharyngeal airway over tube first approach for difficult airway management in situations where a faster intubation is required.

Conflict of interest: None declared by the authors

Authors' contribution:

RKM- concept of study and manuscript editing

RRM- conduction of study

KM- statistical analysis

DKS- concept of study

SP- manuscript editing

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