Original Article

An innovative technique for nasotracheal fiberoptic intubation using SNPA and its comparison with conventional technique: RCT

ABSTRACT

Background: Awake nasotracheal fiberoptic intubation by conventional technique is time consuming and requires expertise. Complications encountered in the conventional technique sometime leads to procedure failure.

Objective: The primary aim of this study was to compare the innovative technique using split nasopharyngeal airway (SNPA) with the conventional technique for nasotracheal fiberoptic intubation in terms of time taken for intubation.

Method: This was a prospective, randomized, and single blind study conducted with 80 patients who were scheduled for maxillofacial surgery. Patients were randomized into two groups, group CFBI (conventional fiberoptic intubation) and group SNPA (split nasopharyngeal airway). In both the groups patients were prepared for awake fiberoptic naso-tracheal intubation. In Group CFBI (N = 41) awake naso-tracheal intubation was achieved by conventional technique of bronchoscope first approach. In Group SNPA (N = 39) spirally split nasopharyngeal airway was used first as a conduit for the passage of fiberoptic bronchoscope. The primary objective was to assess the time taken for intubation. The secondary objectives were to assess the rate of complications in the form of bleeding, cough, desaturation during the procedure, laryngospasm, and nasal bleeding.

Result: The time taken for intubation was 6.15 ± 3.0 minutes in CFBI group and 3.10 ± 1.35 minutes in SNPA group and this this difference was statically significant with *P* value <0.001. Desaturation during the procedure was more in CFBI (99.46 ± 0.75) compared to SNPA (99 ± 0) group with significant difference *P* value <0.001.

Conclusion: Split nasopharyngeal airway was used as conduit for the passage for the flexible fibreoptic bronchoscope and it considerably reduced the time required for fiberoptic nasotracheal intubation compared to the conventional technique of endotracheal tube first approach. Split nasopharyngeal airway provided better intubating conditions with lesser complications and superior patient comfort.

Keywords: Awake fiberoptic, dexmedetomidine, difficult airway, endotracheal intubation, hemodynamic, nasopharyngeal airway

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INTRODUCTION

Anticipated difficult airway and intubation requires expertise and specialized equipment. American Society of Anesthesiologists and many European authors recommends awake fiberoptic intubation.[1] The benefit of awake fiberoptic intubation is the improved safety in the form of spontaneously breathing patient up to the point of securing the airway.[2-6] Awake patient is able to protect the airway. Difficult airway cases like limited jaw mobility, restricted mouth opening, surgical interventions, or procedures proposed in around

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oral cavity not only necessitate the awake flexible fiberoptic intubation but also naso-tracheal route for intubation. Endotracheal tube (ET) to be away from the surgical field is the primary requirement.

Intubation through nasal approach is usually easier and has a higher success rate compared to an oral approach.[7] Nasal approach provides aligned airway to larynx and trachea, it also secures the endotracheal tube more stably, but negotiating endotracheal tube can be tricky as there is initial resistance that is encountered during the passage of bronchoscope and ET. To overcome this resistance, gentle force is required that may lead to the bleeding of friable mucosa of the nasal passage. Bleeding in the nasopharynx and oropharynx can cause irritation of the airway and induce cough, coughing during the flexible fibreoptic bronchoscopy makes visualization of vocal cord difficult.

To aid in the procedure of awake flexible fiberoptic intubation through oral approach airways like Berman and Ovassapian are available. These airways act as conduit for the passage of bronchoscope and ET tube but no such airway is available for the nasal approach.

In this study, we hypnotized that awake naso-tracheal fiberoptic intubation through split nasopharyngeal airway (SNPA) will be quick and with less complications compared to conventional technique.

METHODS

This was a prospective, single blind, and randomized control trial which was conducted in the department of anesthesiology from the period of July 2021 to November 2021. Approval from institutional ethical committee was taken and trial was registered with clinical trial registry (CTRI/2021/08/035320). Selection of patients was based on inclusion criteria of age between 20 years and 60 years, ASA (American Society of Anesthesiologist) grade I and II, indication of general anesthesia for oro-pharyngeal, maxilla-facial, or mandibular surgeries. Before enrolling the patients, the procedure was explained and written informed consent for naso-tracheal fiberoptic intubation, emergency surgical tracheostomy, delayed extubation, anesthesia, and surgery were taken from patients. Patients who refused to undergo the procedure, patients with any absolute contraindication for nasal intubation like head trauma, suspected base of skull fractures, nasal mass, deviated nasal septum were excluded from the study. After assessing the inclusion criteria 80 patients were randomized using computer generated random number. These selected patients were divided into two groups. Group allocation was done using sealed envelope technique and patients were allocated to either group CFBI (conventional fiberoptic intubation) or to group spirally SNPA (split nasopharyngeal airway). In CFBI (N = 41) conventional fiberoptic intubation where flexible fiberoptic bronchoscope is introduced first through the nasal passage. In SNPA (N = 39) split nasopharyngeal airway where a spirally cut, appropriate size nasopharyngeal airway was introduced in the nasal cavity first, and then flexible fiberoptic bronchoscope was introduced through it. Primary objective of the study was time taken for intubation. Secondary objectives of the study were to observe episodes of desaturation during the procedure, complications like cough, bleeding, and laryngospasm.

Patients were optimized before surgery; routine blood workup was sent and procedure of awake fiberoptic intubation was explained to them. Fasting guidelines were explained and advised to remain fasted for 6 hours on the night before surgery. On the scheduled day of surgery, patients were once again explained about the procedure; patients were shifted to the operation theatre, ASA standard monitors including pulse oximetry, capnography, electrocardiography, non-invasive blood pressure, and temperature monitoring were attached. Premedication was done with injection glycopyrrolate 5 microgram per kilogram (μg/kg) intra-muscularly 30 minutes prior to the procedure. Topical anesthesia was achieved with nebulization of 5 ml of 2% lignocaine + adrenaline over 20 minutes. All patients received xylometazoline 0.1% one drop in each nostril. Lignocaine spray of 10% (Lox TM, spray; Neon Laboratories Ltd. India) was given bilaterally in faucial pillars just before the procedure. Adequacy of topical anesthesia was assessed by heaviness of tongue in both the groups. Injection midazolam was given in the dose of 0.03–0.05 mg/kg, and sedation (targeted Ramsay sedation score was 3) was started with injection dexmedetomidine in the dose of 1 microgram per kilogram intravenously (IV) over 10 minutes for loading. Nasal patency was done and more patent nostril was chosen for the procedure. In CFBI group appropriate size endotracheal tube (ET, Portex®) 7.5 for male and 7.0 for female patients) was railroaded on 5.0-mm flexible fiberoptic bronchoscope (Model no. 11301BN1; Karl Storz GmbH & Co. KG, Germany) and tip of bronchoscope was introduced into the nasal cavity and vocal cords were identified. After identification of the vocal cords 2 milliliters (ml) of 2% lidocaine was sprayed on the supraglottic region through the working channel of the bronchoscope, additional 2 ml of 2% lidocaine was sprayed on the vocal cords and tip of ET tube was introduced in the vocal cords. In SNPA group appropriate size nasal airway was cut spirally [Figure 1], tip of the spirally slit nasopharyngeal airway was lubricated with 2% lignocaine jelly then this airway was introduced into the nasal cavity and moved up and down for jelly to spread in the nasal cavity. Appropriate size ET tube was railroaded on the fiberoptic bronchoscope and tip was moved down towards the vocal cords until the vocal cord were visualized. After identification of the vocal cords 2 milliliters (ml) of 2% lidocaine was sprayed on the supraglottic region through the working channel of the bronchoscope, additional 2 ml of 2% lidocaine was sprayed on the vocal cords and tip of ET tube was introduced in the vocal cords. Once the cuff of ET crossed the vocal cords, SNPA was peeled off. In both the groups, after successful passage of the ET tube through the vocal cords and after identification of the carina, the tube was secured and the cuff was inflated, correct placement of the ET tube in trachea was confirmed by bilateral equal air entry and capnography. In our study, fiberoptic intubation was done by the experts. Time taken for intubation was taken from insertion of scope in nares to the inflation of ET cuff and it was noted in minutes. The mean saturation of peripheral oxygen (Spo2) was noted during the procedure. The severity of cough was assessed using Helbo-Hensen cough scale,[8] it is 4-point scale (1 = none, 2 = slight, 3 = moderate, 4 = severe). Coughing was considered slight if no more than 2 coughs in sequence occurred, moderate if 3–5 coughs in sequence occurred and severe if more than 5 cough in sequence occurred. Incidence of bleeding and laryngospasm were noted.

Sample size calculation

Power calculation was based on pilot study in which time taken for intubation was the primary objective. Pilot study identified a minimum requirement for 40 patients to be randomized to each group in order to demonstrate a 20% difference in time taken for intubation with a power of 0.9 and a type-1 error of 0.05. To allow for study error and attrition, we included 25 patients in each group.

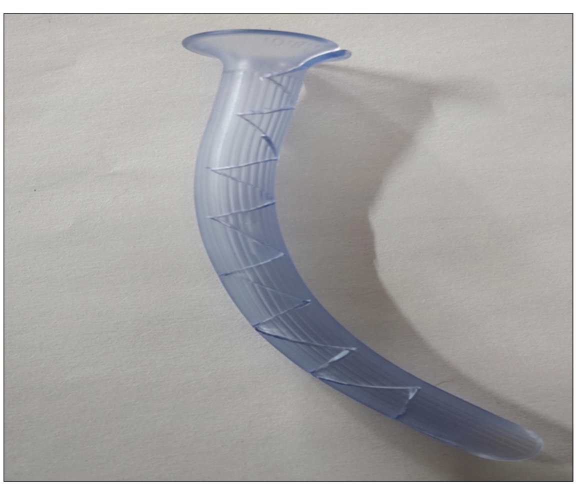

Figure 1: Split nasopharyngeal airway

Statistical analysis

Data was tabulated in excel spread sheet with a sample size of 80 patients. Data was presented as frequencies (%) for qualitative parameters or means ± standard deviation (SD) for quantitative variables. The collected data was transformed into variables, coded, and entered in Microsoft Excel. Data was analyzed and statistically evaluated using Statistical Package for Social Sciences (SPSS) 19 version. Quantitative data such as-demographic data, duration of intubation, hemodynamic parameters were expressed as mean ± SD or median with interquartile range and difference between two comparable groups were tested by student's t-test (unpaired) or Mann Whitney 'U' test. While the qualitative data like–age, gender, post procedure complications were expressed in percentage. Statistical differences between the proportions were tested by chi square test or fisher's exact test. A *P* value less than 0.05 was considered statistically significant.

Observation

Patient recruitment and intervention was done as per protocol [Figure 2]. Demographic data like gender (male and female), age (years) and weight (kilogram) were comparable at baseline with no significant difference [Table 1]. Mean time taken for intubation was noted in minutes which was more in CFBI group (6.15 ± 3.0) compared to SNPA group (3.10 ± 1.35) and this difference in time taken for securing the airway was statically significant with *P* value less than 0.001 [Table 2]. Episodes of desaturation during the procedure was observed and compared in both the groups. Mean saturation of peripheral oxygen was less in CFBI group compared to SNPA group as there was frequent desaturation in CFBI group. This difference was statically significant with *P* value less than 0.001 [Table 3]. Incidence of coughing while

Table 1: Comparison of demographic profile of the patients in group CFBI and SNPA

	CFBI (*n*=41)	SNPA (*n*=39)	*P*
Age (in years)	41.17±10.13	40.95±12.85	0.932
Sex (Male/Female)	13/28 (31.7%)/(68.3%)	16/23 (41%)/(59%)	0.386
Weight (kg)	57.44±6.501	58.36±5.823	0.601

Data for age and weight expressed as mean±standard deviation, gender data expressed as percentage. Demographic profiles of the patients were comparable with no significant difference. CFBI=Conventional fibreoptic intubation, SNPA=Split nasopharyngeal airway. *P*<0.05 is significant

Table 2: Comparison of mean time taken for intubation between group CFBI and SNPA

	CFBI (*n*=41)	SNPA (*n*=39)	*P*
Time for intubation (minutes)	6.15±3.0	3.10±1.35	<0.001

Data expressed as mean±standard deviation. CFBI=Conventional fiberoptic intubation, SNPA=Split nasopharyngeal airway. *P*<0.05 is significant

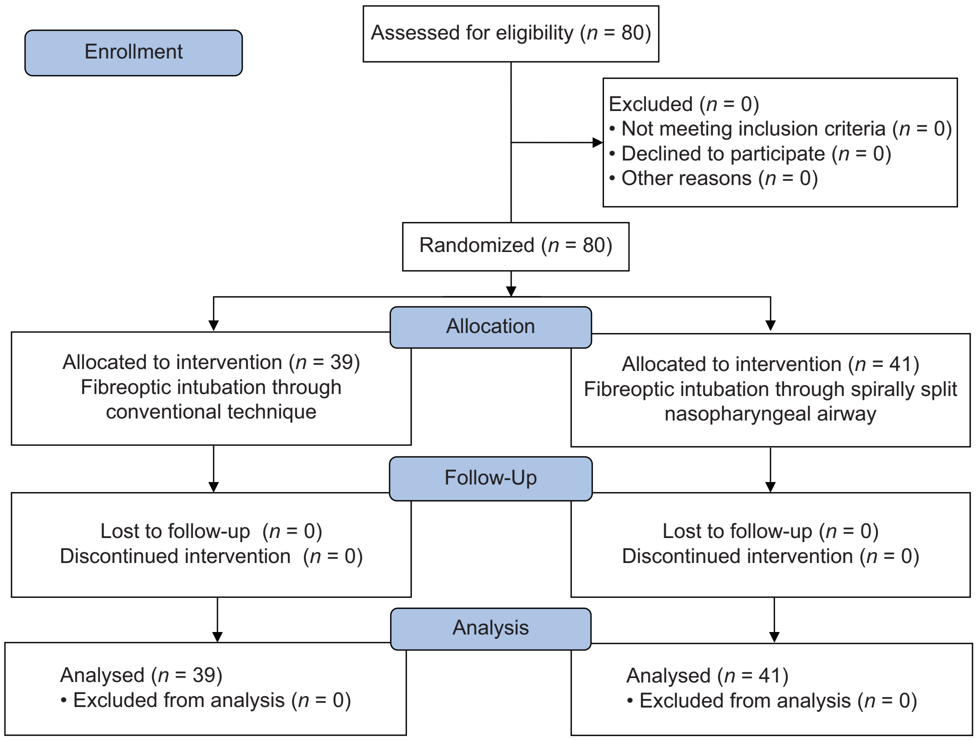

Figure 2: Consort flow of the study

Table 3: Comparison of mean SPO_2 during the procedure between group CFBI and SNPA

	CFBI (*n*=41)	SNPA (*n*=39)	*P*
SPO_2	99.46±0.75	99±0	<0.001

Data expressed as mean±standard deviation, SPO_2=Saturation of peripheral oxygen, CFBI=Conventional fiberoptic intubation, SNPA=Split nasopharyngeal airway. $P<0.05$ is significant

Table 4: Comparison of mean cough score between group CFBI and SNPA

	CFBI (*n*=41)	SNPA (*n*=39)	*P*
Cough Score	1.93±0.85	1.31±0.66	<0.001

Data expressed as mean±standard deviation. CFBI=Conventional fiberoptic intubation, SNPA=Split nasopharyngeal airway. $P<0.05$ is significant

Table 5: Comparison of cough score between group CFBI and SNPA

Helbo-Hensen cough scale score	CFBI (*n*=41)	SNPA (*n*=39)	*P*
1	14 (34.1%)	30 (76.9%)	
2	18 (43.9%)	7 (17.9%)	
3	7 (17.1%)	1 (2.6%)	
4	2 (4.9%)	1 (2.6%)	
Total	41 (100%)	39 (100%)	0.001

Data expressed as percentage. CFBI=Conventional fiberoptic intubation, SNPA=Split nasopharyngeal airway. $P<0.05$ is significant

doing the procedure was more in CFBI group (1.93 ± 0.85) group compared to SNPA group (1.31 ± 0.66) with *P* value less than 0.001 [Tables 4 and 5]. Complications like bleeding and laryngospasm was compared between group CFBI and SNPA. Incidence of bleeding was more in CFBI group (41%) than SNPA group (39%), this difference was statistically significant with a *P* value of 0.049. There was no statistical difference in incidence of laryngospasm between the two groups [Table 6].

DISCUSSION

This study is the first ever randomized control trial in which spirally slit SNPA have been used to facilitate the awake fiberoptic naso-tracheal intubation. Awake fiberoptic intubation is recommended technique for securing the airway in anticipated difficult intubation cases.[9] Awake fiberoptic intubation requires patient's co-operation, adequate preparation of the airway and equipments, but even after through preparation failure in awake fiberoptic intubation is faced very often. Complications that are encountered during the procedure can be lack of co-operation from the patients, bleeding, coughing and laryngospasm. Apart from the complications, technique of fiberoptic intubation in itself requires expertise. All these mentioned factors make the job of anesthesiologist very difficult. The method proposed in our study not only reduced the complications faced during awake fiberoptic intubation but also decreased the time taken for intubation.

Tip of the flexible fibreoptic bronchoscope is hard, in conventional fiberoptic intubation when the tip of

Table 6: Comparison of incidence of bleeding and laryngospasm between group CFBI and SNPA

	CFBI (n=41)	SNPA (n=39)	P
Hemorrhage	41 (100%)	39 (100%)	0.049
Laryngospasm	41 (100%)	39 (100%)	3.859

Data expressed as percentage. CFBI=Conventional fiberoptic intubation, SNPA=Split nasopharyngeal airway. $P<0.05$ is significant

fiberscope is introduced in the nasal cavity, it encounters resistance which require slight force to overcome, it damages the friable mucosa of the nasal cavity which leads to bleeding. When bleeding occurs in the nasal cavity it obliterate the view through flexible fibreoptic bronchoscope, and to clear the secretion suction is required. Repeated suction of naso-pharynx and oropharynx causes trauma to the nasal and oral mucosa causing bleeding. Requirement of suction because of bleeding and bleeding because of suction becomes vicious cycle landing into procedure failure.

Cases of difficult intubation were included in the study. Nasal vasoconstrictor was given to decrease the incidences of bleeding.[10,11] Unlike other studies done previously.[12,13] in our study glycopyrrolate was used as anti-sialagogue. Injection glycopyrrolate (5 μg/kg) was given intra-muscularly 30 minutes prior to the procedure. Atropine can be used for the same purpose but it causes tachycardia[9] and interferes in the measurement of actual hemodynamic parameters during the procedure and post procedure.

Anesthesia of the airway was achieved using nebulization with 5 ml of 2% lignocaine + adrenaline and just before the procedure 10% Lignocaine (LoxTM, spray; Neon Laboratories Ltd., India) spray was sprayed on bilateral faucial pillars.

SNPA acts as conduit for the passage of fiberscope. It overcomes the resistance that is encountered during the direct passage of fiberscope in the nasal cavity. Tip of the appropriate size SNPA ends just above the vocal cords which make the visualization of vocal cords quick and easy thus reducing the time taken for intubation. Our study is in correlation with the study done by Chakravarthy *et al*.;[14] in his study, he concluded that natural curve of nasopharyngeal airway takes the tip of bronchoscope towards the vocal cords so that tip easily orients towards vocal cord and enters the vocal cord. Time taken for intubation is also influenced by the episodes of desaturation and longer time taken for procedure reduces like hood of success, SNPA reduces the time taken for intubation thus reducing the episodes of desaturation and increasing the success rate of the intubation.

In a case report by Eipe,[15] two nasopharyngeal airways were used for intubation of cervical spine ankylosing spondylitis. One nasopharyngeal airway was non split for oxygenation and other was longitudinally split fiberoptic intubation. In the technique mentioned in case report, bronchoscope and SNPA was advanced one after the other. Our study is different from the case report mentioned because our study is a randomized control trial in which spirally split nasopharyngeal was used and spiral splitting provided more stability to the nasopharyngeal airway. In this case report, airway anaesthetization was achieved using superior laryngeal nerve block and tracheal injection of local anesthesia. Airway nerve blocks, though achieve the desired level of anesthesia but these are more invasive compared to spray as you technique (SAYGO) and drugs given for airway nerve blocks adds to the secretion of the airway. In our study, we have used SAYGO to avoid these complications.

Bleeding in the nasal cavity and oral cavity irritates the patient's airway which results in frequent coughing complicating the procedure. SNPA decreases the episode and severity of bleeding providing improved vision compared to conventional technique.

Sedation was achieved using injection dexmedetomidine, it provides conscious sedation without affecting the respiration. This property of dexmedetomidine makes it suitable for sedation in cases of difficult intubation.[16,17]

CONCLUSION AND RECOMMENDATIONS

Spirally split nasopharyngeal airway acts as conduit and provides the uninterrupted passage for fiberoptic bronchoscope. Spiral splitting provides more stability to the airway and prevents the collapse of the airway inside the nasal cavity. Awake fiberoptic intubation through this technique decreases the time taken for intubation, episodes of desaturation and complications like cough, bleeding, and laryngospasm. In this study, we included the cases of difficult intubation and intubation was done by experts for this procedure. Similar study can be carried in simpler airway cases with inexpert trainee or residents to demonstrate the learning curve with or without SNPA.

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Conflicts of interest
There are no conflicts of interest.

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