Clinical Investigation

A modification in the tube guide to facilitate retrograde intubation: A prospective, randomised trial

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ABSTRACT

Background: The technique of anterograde over a retrograde guide is considered to be more reliable and preferable in comparison to only retrograde one, for improving the success rate of retrograde intubation. As the prior technique requires a lengthy guidewire to negotiate the whole channel of a tube guide, we designed a side eye at one end of tube guide, which obviated the above requirement while maintaining the integrity of the whole channel assembly. The efficacy of this modified technique was compared with the conventional one for retrograde intubation procedure. **Methods:** In a prospective, randomised fashion, 98 cases posted for surgery of carcinoma buccal mucosa were included in this trial. These cases were randomised to the conventional (Group I) or the modified technique (Group II) for retrograde intubation. Intubation time (first attempt), total number of successful intubations, cause of failures and any associated side effects were recorded and compared between the groups. **Results:** The total number of successful intubations were significantly higher in group II (95.83%, 46/48 cases) as compared to group I (66.66%, 31/48 cases) (P<0.001). Mean intubation time was 118±22 second in group I versus 124±26 second in group II (P=0.39). The side effects did not differ significantly between the groups. **Conclusions:** Improvising the tube guide resulted in a significant rise in the number of successful intubations through a modified retrograde intubation technique, with no side effects. This should encourage the use of retrograde intubation technique as a first option for difficult airway management.

Key words: Carcinoma buccal mucosa, difficult airway, guidewire, retrograde intubation, tube guide

INTRODUCTION

Flexible fibre-optic intubation is currently the technique of choice for managing a difficult airway. However, restricted availability and higher cost of the instrument make its usage limited, especially in developing countries. Retrograde intubation (RI) is an alternative option to manage such an airway, though the success rate depends highly on personal expertise and the technique utilised. Anterograde over a retrograde guide is one of the optional techniques, which improve the efficacy of RI. A long retrograde guide is, however, required to negotiate the whole channel of an anterograde guide.[1] A variety of equipment (urethral stent, epidural catheter, etc) have been suggested for overcoming this problem. But due to a thin and pliable design, these alternatives are more prone to coiling and difficult to pass through the larynx.[2] The J-tipped vascular guidewire circumvents these limitations but is insufficient in length to guide an anterograde guide (tracheal tube guide) over it.[1,3,4] Extensive Medline search did not reveal any literature showing modifications in the tracheal tube guide as an anterograde guide in order to address this problem. Moreover, the existing literature is limited to case reports or experimental studies on cadavers. In this study, we modified a tracheal tube guide by making a side eye (SE) near its one end. Our aim was to compare such a modification with the conventional technique, in patients posted for carcinoma buccal mucosa surgeries.

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METHODS

This prospective study was undertaken to investigate the viability of a modified technique for RI and determine the sample size for such future trials. After approval from the ethics committee and written informed consent, all cases with anticipated difficult intubation posted for surgery of carcinoma buccal mucosa, of the american society of anesthesiologists (ASA) status I-III, between February 2008 and November 2010, were enrolled in the study. Assessment of the airway was done in accordance with those listed in Basic Preparation for Difficult Airway Management by the American Society for Anaesthesiology Task Force.[5] Exclusion criteria included patients with deranged coagulation profile, having grossly deviated nasal septum, midline neck mass, tracheal abnormalities, with mouth opening <1 cm, with history of lignocaine allergies.

RI set included a 16-gauge IV cannula, a J-tipped vascular guidewire (70 cm in length and 0.8 mm in diameter), hollow guiding catheter[6] and a modified tracheal tube guide (reusable, 15 CH, 700 mm) (artificial markings were made at a distance of every 2 cm by a permanent marker) with side eye (SE) made at a distance of 3 mm from one of its end (named SE end), of size 3×2 mm [Figure 1].

Patients enrolled in the study were randomly allocated to Group I (conventional technique) or Group II (modified technique), using computer-generated random numbers. The entire procedure and the associated risks were explained to all patients during pre-anaesthetic evaluation. Two experienced anaesthesiologists familiar with the RI set participated in the procedure; one for performing the procedure, and the other for assistance. The data collection was done by a third investigator, not involved in performing the procedure. The indication for planning RI was noted.

The initial procedural steps were similar in both groups. All patients were adequately fasted. On the day of surgery, all patients were pre-medicated with glycopyrrolate 0.2 mg intravenous (IV), ondansetron 4 mg IV , a nasal decongestant and nebulised with 3 ml of lignocaine 4%, half an hour prior to the scheduled procedure. On arrival to the operating room, standard monitors were applied and baseline parameters recorded. All patients were sedated with midazolam 30 μg/kg IV and fentanyl 2 μg/kg IV and pre-oxygenated by nasal prongs before starting the procedure. After

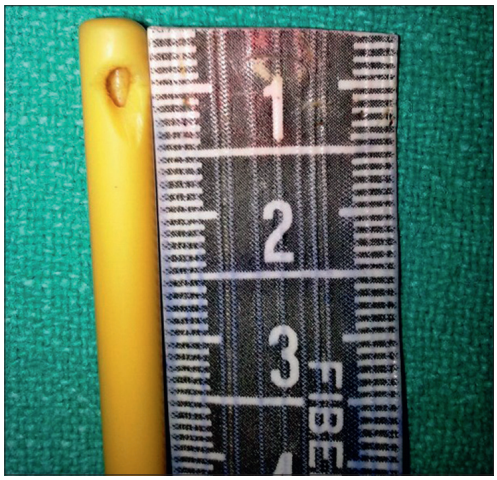

Figure 1: Side eye of a modified tube guide

adequate aseptic precautions, bilateral superior laryngeal nerve block was performed (lignocaine 2%) with neck in the neutral position. Supplemental oxygen was delivered throughout the procedure by a plastic cannula through one of the nostrils.

In the midline, over subcricoid region, local infiltration of lignocaine (2%) was done and a 16-gauge IV cannula was introduced into the trachea by piercing the crico-tracheal ligament at a 45° cephalic plane. After aspiration of free flow air, the cannula was advanced and 2% lignocaine (2 ml) was injected into the trachea. A J-tipped guidewire was then introduced through the cannula and made to pass rostrally to come out through any of the nostrils. In case, the guidewire coiled in the pharynx, it was retrieved through the oral cavity using a Magill's forceps. Thereafter, a suction catheter (10FG) was introduced through the nose to be taken out from the mouth in a similar fashion and tied to the guidewire. The assembly was then pulled out through the nose, and the suction catheter was detached from the guidewire. As the continuity of guidewire was now established from the trachea to the nasal opening, the cannula was removed and guidewire was secured in place using an artery forceps. From this point onwards, the steps of the procedure differed between the conventional and the modified technique.

Conventional technique

The hollow guiding catheter was introduced over the guidewire to facilitate the placement of the tracheal tube. The tracheal tube was inserted into the guiding catheter and pushed into the trachea following which the guidewire and catheter were removed and the correct position of tracheal tube was confirmed by capnography.[7,8]

Modified technique

The guidewire (nasal end) was threaded from one end of a tube guide (SE end) and brought out through the SE [Figure 2a and b]. The lubricated tube guide was then inserted into the nose by sliding it over the guidewire to the maximum depth and the markings at its nasal end were noted. If it matched the approximate length of the guidewire from nostril to the entry point in the neck, it was assumed that the tube guide is in the right place. Then, a tracheal tube of an appropriate size was threaded over the tube guide-guidewire assembly. Once the tube cannot be advanced any further and spontaneous breathing through the tube was confirmed, it was assumed that tube has engaged the laryngeal inlet. Now the tube guide was removed and it was then reinserted through the lumen of a tracheal tube, to avoid kinking and misplacement of the tracheal tube during its advancement into the trachea.[9] Correct placement of tube guide into the trachea was confirmed by using capnography.[8] The guidewire was now removed from the nasal end and tracheal tube was advanced into the trachea. The tube guide was taken out and the correct position of the tracheal tube was reconfirmed using capnography.

Intubation time was the duration from the puncture of crico-tracheal ligament to inflation of cuff of the tracheal tube (after placement into the trachea). Intubation was considered to be effective if the tracheal tube could be positioned into the trachea in the first attempt. Unsuccessful intubations (tracheal tube could not be positioned into the trachea) in the first attempt were managed by repositioning the tracheal tube/tube guide which ever was misplaced, by repeating the entire procedure or using a tracheal tube of lesser size, whichever required (second attempt). The procedure was considered to have failed if it took more than 5 min or after second unsuccessful attempt of intubation. Such cases were managed by invasive airway access. If at any point, the patients became unstable [hypoxia (SpO_2<95%), hypotension (systolic blood pressure <90 mm Hg), bradycardia (heart rate <50/min)] during the procedure, they were managed by bag-and-mask ventilation±invasive airway access, atropine, IV fluids or vasopressors, whichever required, and were excluded from the study. Any possible complications occurring during the procedure were noted. After completion of the procedure, all patients were given general anaesthesia. Follow-up was done for any procedure-related complications during the postoperative period.

Statistical analysis was performed using SPSS 16.0 statistic software. The parametric data [patient demographic characteristics, baseline systolic blood pressure and heart rate, intubation time (first attempt)] was noted and compared by one-way analysis of variation (ANOVA) test. Post hoc intergroup comparisons were made using Bonferroni correction. The nominal data (sex distribution, indication for planning RI, total number of successful intubations, number of effective intubation, unsuccessful intubations in the first attempt, number of failed procedures and any associated complications) was also noted and compared by Fisher's exact test & Chi-square test, whichever appropriate.

RESULTS

A total of 98 cases were recruited in the study. Two were excluded (one in each group) because of bradycardia during the procedure. These cases were managed by 0.4 mg atropine injection and subsequently RI was done. No patient developed hypoxia or hypotension. Forty-eight cases in each group completed the study successfully.

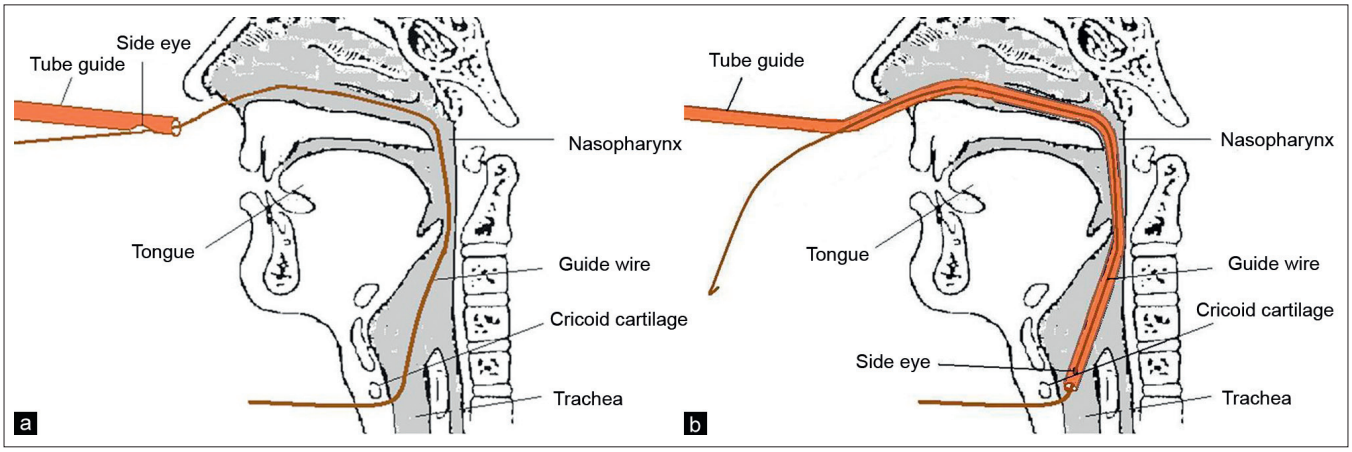

Figure 2 (a, b): Method of insertion of a tube guide over the J-tipped vascular guidewire

Both groups were comparable in terms of demographics, baseline characteristics and indications for performing RI [Table 1]. The total number of successful intubations was significantly higher in group II (95.83%, 46/48 cases) as compared to that in group I (66.66%, 31/48 cases), with an intergroup difference of 29.17% (15 cases) ($P<0.001$). The number of effective intubations was 42/48 cases (87.5%) in group II versus 25/48 cases (52.08%) in group I ($P<0.001$). Among the 29 unsuccessful intubations (23 in group I and 6 in group II) in the first attempt, 15 were due to failed negotiation of a tracheal tube into the trachea (11 in group I and 4 in group II) ($P=0.049$) and 14 were due to accidental extubation while removing the tube guide (12 in group I and 2 in group II) ($P=0.003$). A tracheal tube of smaller size was used in cases with failed tracheal tube negotiation and four of these (two in both groups) could be intubated in the second attempt. Accidental extubation was managed by taking a second attempt and six of these cases (four in group I and two in group II) could be intubated. Tracheal intubation failed in 17 cases in group I and two cases in group II ($P<0.001$) [Table 2].

Mean intubation time (first attempt) was 118±22 second in group I and 124±26 second in group II, and this does not vary significantly between the groups ($P=0.39$) [Table 2]. No procedure lasted for more than 5 min. There was no statistically and clinically significant difference in the incidence of side effects between both groups [Table 3].

Table 1: Comparison of demographic profile, baseline characteristics and indication for planning retrograde intubation

Parameters	Group I	Group II	*P*
Age (years)	47.20 ± 4.61	46.91 ± 3.53	0.88
Baseline HR (beats/min)*	87.21 ± 7.26	85.81 ± 9.42	0.51
Baseline SBP (mm Hg)**	121.14 ± 7.22	120.52 ± 9.41	0.87
Sex distribution (males)	25/48 (52.08)	27/48 (56.25)	0.68
Protruding upper incisor	24/48 (50.0)	21/48 (43.75)	0.53
Obstructive sleep apnoea	30/48 (62.5)	26/48 (54.16)	0.40
Limited neck movement	14/48 (29.16)	19/48 (39.58)	0.28
Tumour of tongue, mandible or floor of mouth	34/48 (70.83)	30/48 (62.5)	0.38
Rheumatoid arthritis	4/48 (8.33)	5/48 (10.41)	0.72
Short neck	14/48 (29.16)	17/48 (35.41)	0.51
Mallampati class 3 or 4	38/48 (79.16)	34/48 (70.83)	0.34

*HR: Heart rate; **SBP: Systolic blood pressure; Figures in parenthesis are in percentage; *n*=48; Data expressed as mean±SD or number (proportion); *P*<0.05 considered as significant

Table 2: Comparison of efficacy and intubation time between the groups

Parameters	Group I	Group II	*P*
Total number of successful intubations	31 (64.58)	46 (95.83)	<0.001
Number of effective intubations	25 (52.08)	42 (87.50)	<0.001
Unsuccessful Intubation in first attempt			
Failed negotiation of tracheal tube	11 (22.91)	4 (8.33)	0.049
Accidental extubation	12 (25)	2 (4.16)	0.003
No. failed tracheal intubations	17 (35.42)	2 (4.16)	<0.001
Intubation time for first attempt (sec)	118±22	124±26	0.39

Figures in parenthesis are in percentage; *n*=48; Data expressed as mean±SD or number (percentage); *P*<0.05 considered as significant

Table 3: Comparison of complications between the groups

Parameters	Group I (*n*=31)	Group II (*n*=46)	*P*
Epistaxis	0	0	-
Pretracheal abscess	0	0	-
Local surgical emphysema	0	0	-
Pneumomediastenum	0	0	-
Haematoma	0	0	-
Retained wire	0	0	-
Minor bleed at site of puncture	2 (6.45)	3 (6.52)	0.99
Breath holding	0	0	-
Folding of tracheal tube inside airway	0	0	-
Upper airway obstruction	0	0	-
Sore throat and hoarseness	20 (64.51)	28 (60.86)	0.74

Figures in parenthesis are in percentage; Data expressed as number (percentage); *P*<0.05 considered as significant

DISCUSSION

Retrograde intubation is a well known alternative for securing an airway in difficult airway algorithm. Over the past 50 years, various equipments have surfaced as a retrograde guide to improve the success rate of this technique. Among these, the J-tipped vascular guidewire has every advantage over the other conventional materials, but is insufficient in length to guide the whole anterograde guide (gum elastic bougies, tube guide, suction catheter, etc) over it.[1,3,4] To overcome this problem, we made an SE in the tube guide in our study. After threading the guidewire from one end (near SE) of the tube guide and taking it out from the SE, we need not negotiate the wire through the whole channel of a tube guide. Hence, the problem of short length is obviated with this technique.

In our study, the total number of successful intubations was 66.66% with the conventional technique, which is reasonably low to classify this procedure as satisfactory for cases of difficult airway. These results are quite comparable to a previous study done on human cadavers, showing a success rate of 69% with the same

technique.[9] The causes of intubation failures with this technique were unintentional extubation during guidewire removal and due to failed negotiation of the tracheal tube through an acute pharyngo-laryngeal angle.[1,9]

The modification of this technique, however, increased the total number of successful intubations to 95.83%; the number of successful intubations was 87.5% in the first attempt (effective intubation). Previous literature, however, reports an overall success rate of 89%, with the same technique using Cook's intubation set.[9] They suspected that all failures were related to incorrect positioning of the tracheal tube during placement or removal of guiding catheter over the guidewire. In our study, an improvement was made in this technique by using a modified tube guide (made an SE in the tube guide), in place of guiding catheter as an anterograde guide. Since only a small part of the guidewire now lies inside the lumen of a tube guide, lesser force is required during placement or removal of a tube guide over the guidewire; moreover, the chances of accidental extubation may be less with this technique. The modified tube guide reduced the incidence of accidental extubations to 4.1% (2 cases) in comparison to 11% in the previous study.[9] Overall, the RI procedure failed in two cases (4.16%) with the modified technique. One possible explanation is that this study was done on living patients, so difficult airway anatomy or stress due to the situation might have affected the results.

The time required for RI procedure depends highly on anatomical characteristics of the patient.[9] As the indications for performing RI did not vary significantly between the groups, we do not consider it to have created a bias in the study. The average intubation time for the first attempt was comparable between groups and also with the duration mentioned in the previous literature.[10-12] Thus, a modification in this technique did not made the procedure longer.

Literature on the complications associated with the RI technique is sparse. We chose the site of puncture as the crico-tracheal ligament to eliminate the chance of intra-tracheal bleed, haematoma formation and injury to the vocal cords or thyroid gland.[13,14] Post-operatively, the incidence of sore throat was about 60-65% in our study, which is comparable to a previous literature documenting an incidence of 65% following retrograde intubation.[15] No other major complication was observed in any of the cases.

LIMITATIONS

The complications may have been under-recognised, as we were unable to assess any airway injury by direct laryngoscopy or fibre-optic bronchoscopy after the procedure. The modified technique may not be appropriate for paediatric age group where narrow tracheal tubes are used and tube guide may be difficult to negotiate through them.

CONCLUSION

Introduction of a simple modification in the anterograde over a retrograde technique significantly increased the number of successful intubations. This should encourage the use of retrograde intubation technique as a first option for difficult airway management.

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