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Comparison between Tuoren video laryngoscope-guided technique and blind method for nasogastric tube placement in anesthetized, intubated, adult patients

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ABSTRACT

Background: Nasogastric tube (NGT) insertion is apparent a simple procedure in conscious individual. However, it often turns to a challenging task in anesthetized, intubated patients with a failure rate of about 50% using blind method. Video laryngoscope (VL), an important armamentarium of difficult airway carts, can facilitate the placement of NGT owing to its advantage of real-time visualization of NGT and the necessary manipulation. **Aims and Objectives:** The study was designed to compare the Tuoren VL-guided technique with the blind method in terms of procedure time, success rate, and adverse events. **Materials and Methods:** A total of 148 adult patients requiring intraoperative NGT placements were recruited for this randomized, single-blind, experimental study. After anesthetizing, the patients were randomized to receive NGT placement using either Tuoren VL-guided (Group A, n = 74) or "Blind technique" (Group B, n = 74). Confirmation of correct placement of NGT was done using "auscultation" method. **Results:** VL-guided method was consistently faster, and considerable faster procedure time was achieved using VL-guided method over blind technique (36.8 ± 14.7 vs. 48.2 ± 21.7 s, respectively, P < 0.001), yielding a mean reduction of procedure time by approximately 12 s. A high success rate of correct placement of NGT was observed using VL-guided technique over blind insertion (100% vs. 55%, respectively). Overall, less adverse events (bleeding and coiling) were observed in VL-guided method. **Conclusion:** The study concludes that Tuoren VL can act as a better alternative to blind method for NGT placement in anesthetized, intubated patient in view of shorter procedure time, higher success rate, and favorable adverse event profile.

Key words: Anesthetized; Blind method; Intubation; Nasogastric tube; Videolaryngoscope

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INTRODUCTION

Insertion of nasogastric tube (NGT) is a simple procedure in an awake individual. Anesthesiologists often face difficulties in correct placement of NGT in anesthetized and intubated patients. Common sites of impaction of NGT are the pyriform sinus and the arytenoid cartilages.[1,2] Moreover, the esophagus becomes compressed by the inflated cuff of an endotracheal tube.[3] After a failure, repeated attempts often lead the NGT to the same unwanted path. Blind method (head in neutral position with no external laryngeal manipulation and without any instrumental and digital assistance) has been reported to have a successful placement of NGT within the first

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attempt in 50% of cases.[1,4] Various manipulations or equipment have been reported to steer the NGT into its intended path.[5]

Video laryngoscope (VL)-guided insertion of NGT has the potential of having higher success rate over blind insertion owing to the advantage of detecting specific hindrance at the earliest and real-time manipulation under vision. Literature mention high but variable success rate of VL to facilitate NGT insertion such as 85% with GlideScope-assisted technique,[6] 98% with McGrath VL[7], and 100% with King Vision VL[8] and combined use of GlideScope with modified Magill's forceps[9] had a success rate of 100%. This variation in reported success rate may indicate the ergonomic advantage of any particular design of VL. Hence, there is further scope for evaluating a newer VL to ascertain whether it can yield further advantage for NGT insertion or not.

Recently, Tuoren VL has been used to manage difficult intubation scenarios in many centers.[10,11] Besides its primary use for managing difficult airway, its performance to facilitate NGT insertion has not been evaluated. Hence, the present study was carried out to compare the performance of two methods of NGT insertion in anesthetized, intubated adult patients – Tuoren VL-guided technique and blind method. It was hypothesized that NGT insertion guided by Tuoren VL would be accomplished within shorter time than blind method.

Aims and objectives

The aim of the present study was to compare the procedure time (primary outcome) of NGT insertion within the first attempt between Tuoren VL-guided technique and blind method. Other outcome measures were to compare the proportion of the patients in whom successful NGT insertions were possible within the first attempt using either of the two methods and to compare the adverse events between the two groups while performing the procedures.

MATERIALS AND METHODS

This was an interventional, single-blind, controlled study. In this experimental study, the procedure times of two techniques of NGT placement were primarily compared. The study protocol was approved by the Institutional Ethics Committee (No. IPGME&R/IEC/2023/834, dated 25/09/23). The study protocol was registered prospectively at the Clinical Trial Registry of India (CTRI) on April 16, 2024 (registration number CTRI/2024/04/065739). Thereafter, the recruitment was started in a prospective manner.

Sample size

From the literature,[8] it was noted that the procedure time of NGT insertion using King Vision VL and blind method were 52.5±17.1 and 65.9±39.9, respectively. The pooled standard deviation[12] was 30.7 from that population.

$$\text{Pooled SD}=\sqrt{[(SD_1^2+SD_2^2)/2]}=\sqrt{[\{(17.1)^2+(39.9)^2\}/2]}=30.7$$

It was assumed that detecting at least 15 s differences in the procedure time between the two techniques would be clinically significant. For the sample size calculation in the present study, the present researcher used the formula for comparison between two means as mentioned in Das et al.[13]

$$n=\frac{2(Z\alpha+Z_\beta)^2\cdot sd^2}{d^2}$$

n = Sample size
Zα = Conventional multiplier for alpha error=5%, here it is 1.96
Zβ = Conventional multiplier for power =80%, here it is 0.84
Sd = The pooled standard deviation is 30.7
d = Effect size (the difference in population mean within two groups), here it is assumed 15.

Setting the power of study at 80% and allowing α error of 5% and by replacing the values in the formula, the sample size comes was 66 (approx.). Hence, 132 patients were needed assuming 1:1 group allocation. Considering a 10% dropout, the sample size was adjusted to 148. Hence, 74 patients were taken in each group.

The study was conducted under the Department of Anaesthesiology at IPGME&R/SSKM Hospital. For this interventional study, 148 patients were selected based on inclusion and exclusion criteria. Informed and written consent were obtained from the selected patients in their own language. They were given the option to opt-out from the study at any time.

Exclusion criteria

- Anatomical/structural abnormalities such as gross-deviated nasal septum, abnormality involving lips and palate
- Patients with oral nasal pharyngeal, esophageal mass
- Patients with significant injuries involving head and neck
- Patients with thrombocytopenia or coagulation disorder
- Small mouth opening.

Pre-anesthetic evaluation was done on the day before surgery. Standard baseline investigations were considered as per Institutional protocol. A nasal patency test was done on the basis of better fogging on a metal tongue depressor during exhalation. This was done to identify which nostril was more patent. During this evaluation, any gross deformities such as a nasal spur or significant deviated nasal septum were also ruled out.

Sampling method was probability sampling involving random selection of patients. The group allocation was done using "sealed envelope" technique. For this, there were 74 sealed envelopes each containing one piece of paper marked either "A" or "B." There were 74 paper slips marked as "A" and the rest 74 paper slips were marked as "B." After tracheal intubation, an envelope was randomly picked up and opened to reveal the alphabet. The alphabet displayed ("A" or "B") corresponded to the group allocation of patients.

- Group A (n=74): Patients undergoing NGT insertion using Tuoren VL
- Group B (n=74): Patients undergoing NGT insertion with blind procedure.

An 18-G cannula was used to establish intravenous (i.v.) access for every patient. Monitoring of patients within the operating room was done continuously using ECG leads, BP cuff, $EtCO_2$ monitor, and SpO_2 probe. Before induction of anesthesia, the optimum nostril for NGT insertion was checked with pre-operative evaluation note. Premedication was done as appropriate for each patient using inj. fentanyl (2 mcg/kg), inj. glycopyrrolate (4 mcg/kg), and inj. ondansetron (0.1 mg/kg) through i.v. route. Inj. propofol (2 mg/kg) i.v. or inj. thiopentone (3–4 mg/kg) i.v. was the induction agent depending on the patients' clinical conditions. Depolarizing muscle relaxant, succinylcholine (2 mg/kg) was used for intubation by direct laryngoscope. Endotracheal tube of appropriate size was used depending on patient variables. Muscle relaxation was maintained with inj. atracurium (0.1 mg/kg) through i.v. route. Subsequent anesthesia was maintained with nitrous oxide, oxygen, and sevoflurane.

In both the groups, a decongestant nasal drop was instilled into both nostrils. The tip of the NGT was lubricated with 2% lidocaine jelly. The length of the NGT to be inserted was determined by measuring the distance from the ipsilateral nostril to the ipsilateral tragus and further to the xiphoid process.[14]

An anesthesiologist with a minimum of 5 years of experience was considered as the qualified personnel for performing the procedure of NGT placement. One such qualified anesthesiologist performed, all the procedures to minimize interpersonal variability of efficiency. In both the groups, a sterile, well-lubricated NGT (14-French Gauge, 105 cm length, Romson) was inserted through a more patent nostril until it reached a length of 10 cm. The difficulty of manipulating the tip of NGT usually occurs when the tube is inserted around 15–20 cm.[15]

In Group A, placement of NGT was done through the more patent nostril after pyriform sinus or the esophagus was brought into view by insertion of Tuoren VL intraorally. Tuoren VL, size 3 and 4 non-channeled blades were used (Figure 1).

In Group B, placement of NGT was done through the more patent nostril without visual aid or any other assisting device. In this "blind" method, the patient was in supine position with head neutral. No external manipulation of laryngeal apparatus was done. No instrumental assistance was utilized.[16]

In Group A, the time required for NGT insertion was measured from the time of insertion of the VL into the mouth up to the confirmation of correct placement of the NGT.

In Group B, the time required for NGT insertion was measured from the time of starting transnasal insertion of the gastric tube up to the confirmation of correct placement of the NGT.

In both the groups, after NGT insertion, the placement of NGT was verified by pushing 10 mL of air rapidly into the tube, and auscultation for a "whoosh" sound over epigastrium.[14] If the NGT was found to be correctly placed in the *first attempt*, the case was taken as "successful."

Figure 1: Nasogastric tube (NGT) placement using Tuoren video laryngoscope. The endotracheal tube is at right upper portion (at 12–3 O'clock position) and the NGT is at the lower central portion (at 6 O'clock position) of the screen

The procedure time (Primary Outcome) for successful placement of NGT was recorded from the moment of insertion of NGT into the nostril till the confirmation of its correct position by auscultation method ("whoosh test"). The other outcome measures were the success rate of the procedures and adverse events. *Success* rate was measured by the proportion of patients having correct placement of NGT in the *first attempt* using either of these methods. Adverse events such as mucosal hemorrhage in the oropharynx, epistaxis, kinking, and coiling of the NGT were noted in both the groups. Twisting maneuver was applied when it was needed in those who received NGT placement using Tuoren VL as it was possible to see the real-time course of NGT. The proportions of patients requiring the twisting maneuver were noted in that group. In the blind method, it was not applicable owing to the absence of vision.

It was not possible to conceal the specific technique of NGT placement to the conducting anesthesiologist (performing the procedure) and the data keeper. Only the anesthetized patients remained unaware of the particular method employed for the NGT placement. Thus, the study was a single-blind design.

Statistical analysis

The study spanned between August 2023 and December 2024, over a duration of 12 months. Data from all 148 patients were available for analysis (Figure 2). The data

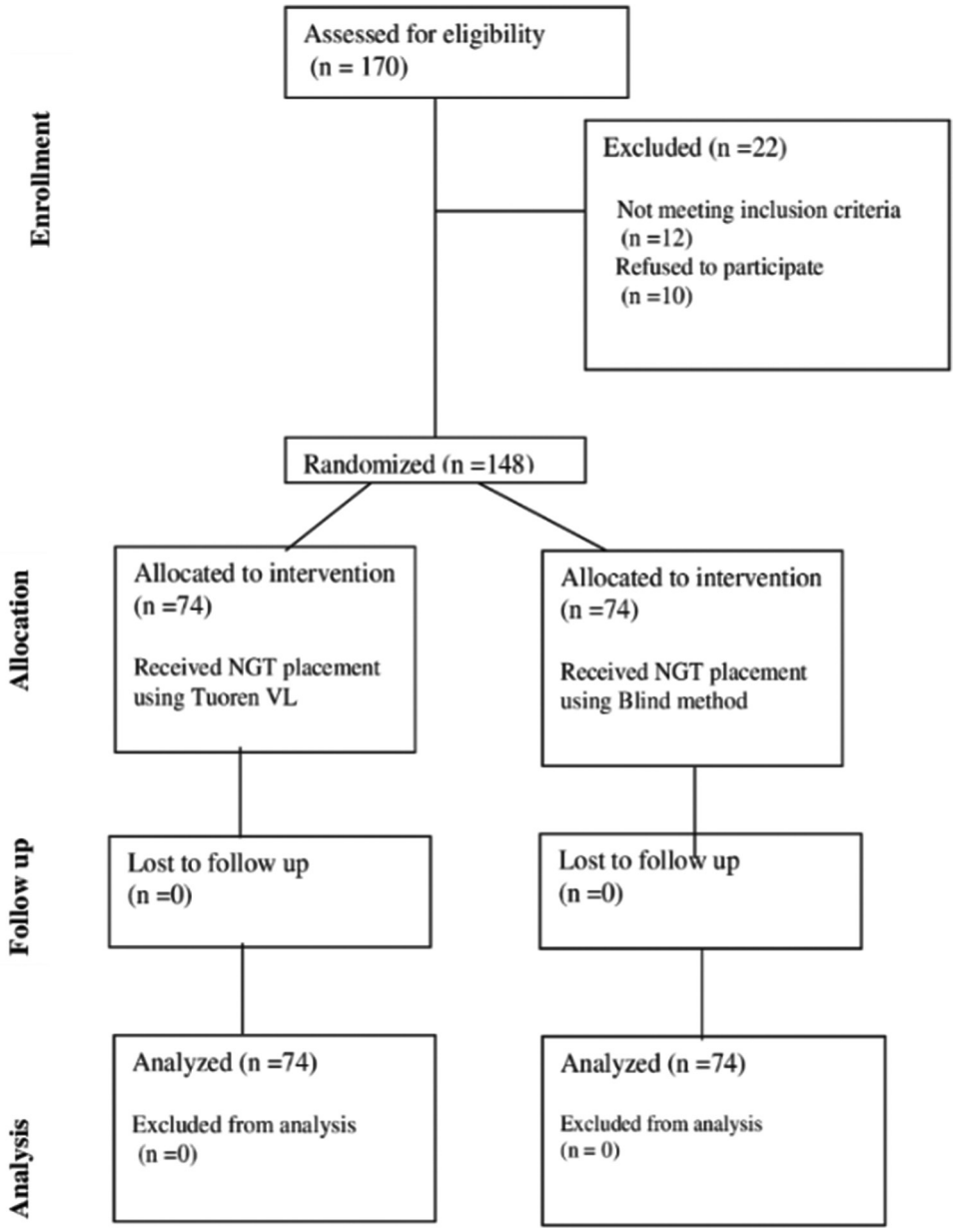

Figure 2: The CONSORT diagram showing the flow of participants

were decoded and tabulated in a Microsoft Excel Sheet. It was then processed and analyzed with suitable statistical software with the help of a biostatistician. Continuous data were expressed as mean±Standard Deviation (SD) and were analyzed with Student's t-test. The categorical data were expressed as number of patients (Proportion) and analyzed using Pearson's Chi-square test with Fischer's exact test, as appropriate. The data were analyzed with the help of a statistician. The P≤0.05 is considered statistically significant.

RESULTS

Patients of both the two groups were comparable regarding their demographic parameters (Table 1).

Successful NGT insertion was possible in all patients using Tuoren VL while correct placement of NGT was possible only in 41 patients (~55%) using "Blind" method without any instrumentation. Thus, the use of Tuoren VL can lead to quite higher success rate than the blind method (Table 2). However, it is noted that there was requirement of twisting maneuver in 26 patients (35%) in those who received NGT placement using Tuoren VL (Table 2).

The procedure time between the two techniques is presented as a raincloud plot (Figure 3). The plot shows a combined depiction of data distribution (represented as the "cloud"), with jittered raw data (depicted as the "rain"). The plot also has "boxplots" and there is nothing to be "hidden away" and appears better than a boxplot. It also provides measures of "central tendency." It provides a *visual impact* about how the data are distributed, about its bimodal nature, and other important aspects.[17]

Heart rate, systolic and diastolic blood pressure, and peripheral oxygen saturation were noted before and after NGT insertion. All such parameters were found to be comparable between the groups (Table 3).

Comparatively lesser number of patients had bleeding in those receiving NGT insertion using Tuoren VL (4 vs. 17 patients). Similarly, lesser number of patients faced coiling in those receiving NGT placement using Tuoren VL (15 vs. 34 patients). However, proportions of patients who experienced kinking of NGT were found comparable between the two groups (Table 4).

Table 1: Demographic characteristics

Parameters	Group A (n=74)	Group B (n=74)	P-value
Age (years)	48.0±14.5	48.9±13.8	0.682
Gender (M/F)	34/40	32/42	0.741
Weight (kg)	57.2±10.2	56.6±7.7	0.683
BMI (kg/sq. meter)	22.1±2.5	22.4±2.2	0.448
ASA-PS (I/II/III)	30/39/5	37/37/0	0.055
Mallampati Grade (1/2/3)	33/36/5	32/40/2	0.470

Group A-Patients receiving NGT placement using Tuoren video laryngoscope, Group B-Patients receiving NGT placement using Blind method without instrumentation

Table 2: Procedure parameters

Parameters	Group A (n=74)	Group B (n=74)	P-value
Procedure time (seconds)			
Mean±SD	36.8±14.7	48.2±21.7	0.000
Median	34.5	40	
Range (Minimum-Maximum)	72 (18–90)	130 (30–160)	
Procedure success (%)			
Success	74 (100)	41 (55.4)	0.000
Failure	0 (0)	33 (44.6)	
Number of attempts (%)			
First	74 (100)	41 (55.4)	0.000
Second	0 (0)	28 (37.83)	
Third	0 (0)	5 (6.7)	
Twisting required	26 (35.1)	NA	NA

Group A – Patients receiving NGT placement using Tuoren video laryngoscope, Group B – Patients receiving NGT placement using blind method without instrumentation, SD: Standard deviation, NA: Not applicable

Table 3: Hemodynamic before and after NGT placement

Parameters	Group A (n=74)	Group B (n=74)	P-value
Heart rate (HR, in beats per minute)			
Pre-HR	77.1±12.3	73.4±14.6	0.103
Post-HR	79.2±10.1	77.7±11.7	0.427
Systolic blood pressure (SBP, in mmHg)			
Pre-SBP	128.8±19.3	126.6±14.5	0.439
Post-SBP	125.8±16.2	127.3±12.6	0.532
Diastolic blood pressure (DBP, in mmHg)			
Pre-DBP	79.8±12.8	77.2±9.4	0.148
Post-DBP	76.3±11.8	76.1±8.9	0.875
Peripheral arterial oxygen saturation			
Pre-SpO_2	99.8±0.5	99.9±0.4	0.497
Post-SpO_2	99.9±0.3	99.9±0.1	0.153

Group A – Patients receiving NGT placement using Tuoren video laryngoscope, Group B – Patients receiving NGT placement using blind method without instrumentation. The prefix "Pre"- and "Post"- indicates that of before and after NGT placement, respectively. HR: Heart rate, SBP: Systolic blood pressure, DBP: Diastolic blood pressure, SpO2: Peripheral oxygen saturation

DISCUSSION

NGT insertion is a simple procedure. However, it may turn to a difficult task in anesthetized and intubated patients owing to the absence of swallowing action that generates propulsive movement.[16] Non-opposing lateral openings near the tip can cause kinking of NGT.[7] An average failure rate of nearly 50% was reported on the first attempt using blind method with the patient's head in neutral position.[18] Most of the difficulties in NGT insertions are due to anatomic reasons such as impaction at pyriform sinus and arytenoid cartilage.[19,20] During re-insertion, often

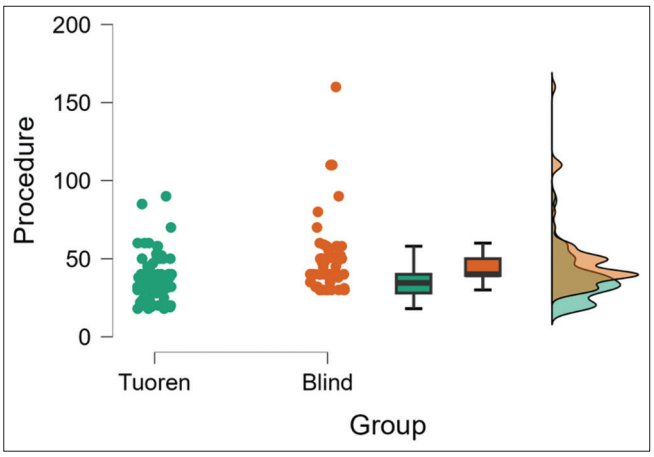

Figure 3: Raincloud plots showing procedure times between the two techniques. It slows that there is greater dispersion of data in blind technique (represented by brown color) compared with video laryngoscope-guided method (malachite green color)

Table 4: Adverse events

Parameters	Group A (n=74) (%)	Group B (n=74) (%)	P-value
Bleeding	04 (5.4)	17 (22.9)	0.004
Coiling	15 (20.3)	34 (45.9)	0.002
Kinking	15 (20.3)	17 (22.9)	0.842

Group A – Patients receiving NGT placement using Tuoren video laryngoscope, Group B – Patients receiving NGT placement using blind method without instrumentation

kinking and coiling occur at the same place owing to the so-called "*memory effect*."[21] Repetitive attempts prolong the procedure, generate frustration, and invite different adverse events. Direct visualization of the event might be helpful in adopting certain maneuver to circumvent the situation in an attempt to steer the NGT toward its intended path. In the past, a few VLs such as GlideScope,[6,9] King Vision[8], and McGrath[7] all have been used with some merits and demerits.

The present study was a single-blind study designed to compare the procedure time of correct placement of NGT between the use of Tuoren VL-guided method and blind method. The use of VL guidance resulted in shorter duration of procedure time for NGT placement. It was found that there was about 12 s shorter duration (difference of two means) of procedure time. The large dispersion of data regarding procedure time in blind technique compared with VL-guided methods (range, 130 vs. 72 s, respectively) indicates that there was a high variation of procedure times in blind technique while the VL-guided technique consistently took shorter procedure time. Probably direct visualization of the course of NGT with necessary twisting movement of the tube to steer the NGT toward its intended path has resulted in this consistently shorter procedure time. In contrast, in blind method, repeated effort with "back and forth" movement without visualization resulted in undue delay with case-to-case variation in the procedure times.

In the present study, all the patients had successful NGT insertion using Tuoren VL while the correct placement of NGT was possible only in 41 patients (~55%) using "Blind" method without any instrumentation. Thus, the use of Tuoren VL resulted in a considerable higher success rate (about 45% higher) than the blind method.

A manikin-based study[22] reports that VL (Pentax Airway scope)-guided NGT insertion can be accomplished in shorter time compared with manual and direct laryngoscope placement, both by experienced medical and non-medical staff. In a case report, the use of C-MAC VL D-Blade was described to facilitate NGT insertion in terms of easy and quick placement, with less risk of trauma and malposition.[23] In another case report,[24] VAMO VL (an experimental model, with a small size and allowing simultaneous use of Magill forceps) was found useful for NGT placement in patient with small mouth opening. C-MAC VL was found to achieve a higher success rate with the least number of adverse events over reverse Sellick's maneuver and blind technique.[25] Use of VL was found to facilitate NGT placement with shorter procedure time, higher success rate, and lower adverse events over direct laryngoscopy. Thus, VL-guided method can be utilized as an alternative method when NGT insertion turns to a difficult task using conventional direct laryngoscope-guided technique.[26] Alhafidh et al.,[27] opined that GlideScope is advantageous in terms of shorter procedure time, with less radiation exposure, and can prevent serious adverse events by directly visualizing the path of NGT insertion. In many published literature,[6,9,28,29] GlideScope was found to be advantageous over blind method in terms of shorter procedure time, higher success rate, and curtailed adverse events. Moharari et al.,[6] found increased success rate of correct placement of NGT using GlideScope over blind method (85% vs. 57.5%, respectively) with reduction of procedure time (10.9±9 vs. 38.6±29 s, respectively). Use of other types of VL such as McGrath VL had also resulted in shorter procedure time compared with blind technique (42.4±4.2 vs. 62.5±15.3 s, respectively) and increased success rate (98%, vs. 66%, respectively) for NGT placement.[7] Okabe et al.,[8] have observed King Vision VL to be advantageous over blind technique in terms of shorter procedure time (52.5±17.1 vs. 65.9±39.9 s, respectively, mean difference of about 12 s) and higher success rate (100% vs. 90%, respectively).

In the present study, there was requirement of twisting movement in 26 patients (35%) in those who received NGT placement using Tuoren VL. During VL-guided NGT insertion, it was possible to visualize the progress of NGT with minute details of its movement and any deviation from

its intended path in real-time manner. Hence, whenever the NGT tends to get kinked or coiled, slight withdrawal of the NGT and a twisting maneuver was done to rotate its tip toward esophageal opening. Thus, the success rate was increased and adverse events were reduced. During NGT insertion using blind method, when the tip gets kinked and coiled, multiple attempts of reinsertion without real-time visualization increase the risk of bleeding and other adverse events.[21] This twisting movement of NGT has already been utilized in a four-step "SORT" maneuver (sniffing position, NGT orientation, contralateral rotation, and twisting movement), where the tip of NGT is directed deep into esophagus by twisting movement of the NGT to steer into the desired path (esophagus) with less resistance.[30] Gentle twisting movement of NGT can also help in forward advancement of the NG tube.[30]

In the present study, auscultation method was used to ascertain the correct placement of NGT owing to its applicability at bedside without the need for any gadget. However, it is not confirmatory absolutely. Radiological verification is accepted as the gold standard in the confirmation of NGT. However, it has certain demerits such as high cost, exposure to radiation, and the difficulty of interpretation by health personnel owing to insufficient radio-opacity in the material of some NGTs.[31] Other methods such as pH measurement, electromagnetic navigator, and ultrasound can be used to supplement confirmation of correct placement of NGT.[32] Although, in non-obese patients, both auscultation and ultrasound techniques are equally useful in the confirmation of correct placement NGT, ultrasound is easier than auscultation in overweight and obese patients.[33] It can be a future scope.

Limitations of the study

It was a single-blind study design. The variation of sample was limited owing to single-center study. Confirmation of NGT placement was done using auscultation method owing to its simplicity and ease of application. Radiography and other methods such as pH measurement of the aspirated material could not be performed owing to feasibility ground.

CONCLUSION

Tuoren VL-guided method can achieve considerably quicker placement of NGT. The VL-guided method can achieve high success rate for proper placement of NGT insertion with a favorable adverse event profile compared with blind technique.

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