Original Article

Nasogastric tube insertion in anaesthetised, intubated adult patients: A comparison between three techniques

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ABSTRACT

Background and Aims: The existence of several methods for proper placement of nasogastric tube (NGT) and introduction of various novel methods day-by-day indicates that no method is perfect or universally accepted. However, the quest for the best is still on. Application of cold in various forms to stiffen the NGT has been tested inconsistently over the last three decades. In the recent past, frozen NGT has been compared only with conventional methods. Hence, the present study was designed to evaluate the efficacy of the frozen technique in comparison with conventional and reverse Sellick's manoeuvre. **Methods:** A total of 195 adult patients undergoing abdominal surgeries in anaesthetised and intubated state requiring NGT insertion were allocated to three groups to have their NGT placement using either the conventional method (Group A) or using frozen NGT (Group B) or applying reverse Sellick's manoeuvre (Group C). The number of successful placements of NGT within two attempts, procedure time, and incidences of adverse events were noted. **Results:** The highest success rate regarding the successful placement of NGT was observed using reverse Sellick's manoeuvre (95.2%), closely followed by the frozen NGT technique (84.6%) in comparison with conventional method (69.2%). The procedure time was the least with reverse Sellick's manoeuvre (31.5 ± 9.5 s) compared with conventional (42.2 ± 21.4 s) and frozen technique (42.1 ± 13.2 s). **Conclusion:** Nasogastric tube insertion using reverse Sellick's manoeuvre shows the highest success rate and having the least adverse events among the compared three methods in anaesthetised, intubated adult patients.

Key words: Anesthesia, gastric tube, intubation, nasogastric tube, orogastric tube, success rate

INTRODUCTION

Insertion of nasogastric tube (NGT) is an essential procedure for several abdominal as well as thoracic surgeries and is often performed by anaesthesiologists in the operating room (OR). Conventional insertion of NGT in anaesthetised, paralysed, and intubated patient is often a difficult and challenging job with a failure rate as high as 50% in the first pass.[1] According to the conventional method, NGT is inserted blindly through the nasal route with the head in a neutral position without instrumental assistance or any external laryngeal manipulation. The distal portion of the NGT has multiple apertures (the weakest part) making it susceptible to kink, coil, and knot.[2] The kinked or knotted NGT and the rugged wall due to apertures may invite mucosal tear leading to bleeding. Many modifications of conventional technique, such as head flexion,[1] lateral neck pressure,[3] neck flexion and lateral pressure[4,5] reverse Sellick's manoeuvre,[6] frozen NGT,[7] etc., – all have been tried to facilitate the NGT insertion and found better than conventional technique. Several authors have reported different techniques with varying success rates. No particular

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method of NGT placement is earmarked with the highest success rate. No specific method is universally preferred as well. Hence, it is obvious that the quest for the best is still on to find the most successful method of NGT insertion.

Immersing the NGT in ice-bath (0°C) for 10 min,[8] storing it in a refrigerator[9] or simply filling the NGT with distilled water at room temperature[10] have been reported to increase its rigidity, and thus, facilitating the insertion of NGT. Frozen NGT technique[7] and reverse Sellick's manoeuvre[6,11] have been reported to have success rates of 88% and 80%–86% within two attempts in two separate studies, respectively. To our knowledge, the success rate of NGT insertion between the frozen NGT technique and the reverse Sellick's method has not been directly compared in a single study. The present study was designed to compare the frozen NGT technique and the reverse Sellick's method with the conventional technique. It was hypothesised that either frozen NGT technique or reverse Sellick's manoeuvre would have a higher success rate than conventional method of NGT insertion.

METHODS

After obtaining permission from the Institute's Ethics Committee, a total of 195 patients of either sex, conforming to the American Society of Anesthesiologists' (ASA) physical status I or II, aged 18–60 years, scheduled for abdominal surgery under general anaesthesia requiring NGT insertion were included in the study. Patients with normal airway (modified Mallampati class I or II) were included in this study. The following exclusion criteria were considered presence of any nasal mass, history of corrosive poisoning, any uncontrolled bleeding diatheses or recent radiotherapy to head and neck, presence of cleft lip or palate, significant deviated nasal septum, or esophageal stricture and varices. Preanaesthetic evaluation was performed in each patient and informed consent was obtained.

Group allocation was performed after induction of anaesthesia and intubation. It was performed each time by opening the sequentially numbered and sealed opaque envelopes containing computer-generated random numbers. After general anaesthesia was induced and the trachea was intubated, the patients were randomly allocated into either group A (control group), group B (frozen NGT technique), and group C (reverse Sellick's manoeuvre). In other words, the group A patients received NGT placement according to the conventional method (blind insertion), group B patients received NGT insertion following the frozen NGT technique, and group C patients had their NGT placed according to reverse Sellick's manoeuvre. Thus, it was a single-blinded trial. Only the patients were unaware of the group allocation.

Before entering the OR, an intravenous (iv) line was established with an 18-G iv cannula. Intravenous fluid was started with lactated Ringer's solution. Routine preparation of anaesthesia machines and drugs were done. Premedication such as inj. ranitidine (1 mg/kg), inj. metoclopramide (0.15 mg/kg), inj. midazolam (0.05 mg/kg), and inj. fentanyl (1.5 μg/kg) were administered as single push slowly through iv route. Induction of general anaesthesia with propofol 2–3 mg/kg iv and muscle relaxation with vecuronium was followed by intubation with appropriate-sized cuffed endotracheal tube. After tracheal intubation, oxymetazoline 0.05% was instilled into both nostrils.

In group A, the NGT was inserted blindly through the nasal route with the head in a neutral position and its curvature inward the nasal passage. No external laryngeal manipulation was done. No change of head position was allowed. No instrumental assistance was taken. This was considered as the conventional method for the present study. The appropriate length of the NGT placement to reach the stomach was determined by measuring the total distance from the ipsilateral nostril to ipsilateral tragus and then to the xiphoid process.[12] Sterile, lubricated, 14-Fr, 105 cm NGT (ROMOLENE®, Romsons International, Agra, Uttar Pradesh, India) was used [Figure 1]. If resistance was felt, the NGT was withdrawn and reinserted. After completion of NGT insertion, a finger was swapped within the oral cavity to detect coiling of the tube. If coiled, it was withdrawn to the nasal cavity

Figure 1: Specific type of 14-Fr nasogastric tube used

under gentle laryngoscopy. The next insertion was considered as the second attempt.

The success rate of NGT insertion was the primary outcome of the present study. The procedure was termed successful if the NGT could be placed in the correct position within two attempts. The correct position was confirmed by auscultation during which a characteristic whooshing sound was looked for while air was injected into the NGT with a 20-ml syringe—the so called whoosh test.[7,13] The number of attempts for each technique was noted. If more than two attempts were necessary, then it was declared as unsuccessful, and data was utilised for counting failures. In such cases after the two attempts, the anaesthesiologists on duty were free to exercise other methods for placement of NGT. Success rate of the selected technique expressed as the proportion of patients undergoing successful NGT insertion by conventional method, frozen NGT technique, and reverse Sellick's manoeuvre. The procedure time (secondary outcome) was calculated with a stopwatch commencing from the insertion of the tip of the NGT into nostril till the confirmation of its correct position by auscultation over the epigastrium.

In group B, a 14-Fr NGT package was opened at one edge. All except the distal-most opening on the lateral wall at the distal end of the NGT was sealed with sticking plaster and the NGT was filled with sterile water for injection using a 20-ml syringe connected to the proximal end of the tube. After driving the most of the air with water, the distal opening was closed and subsequently the proximal end was locked with the dedicated cap [Figure 2]. The curvature of the NGT was kept intact while freezing. The sticking plaster was removed after taking the tube out of the freezer and then was inserted similarly, as described in the conventional method. The ice within the NGT melts quickly once it comes in contact with body temperature. The tube was first aspirated with a syringe for the molten-ice water and then its correct placement was checked using whoosh test. In case of failure with the first attempt, the tube used for the second attempt was kept ready in a tray with ice packs.

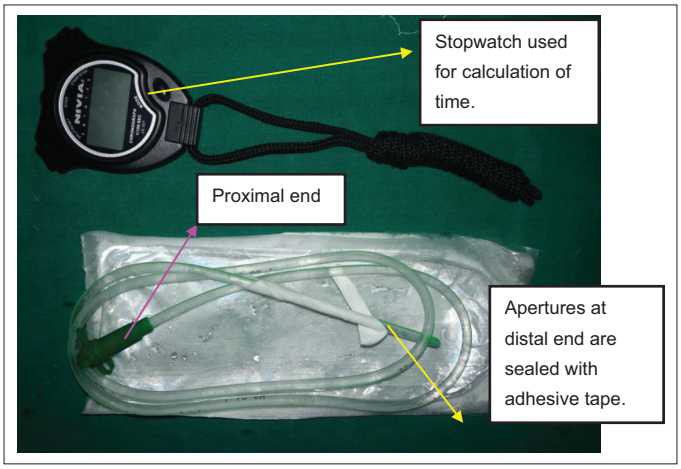

Figure 2: Frozen nasogastric tube with sticking plaster at the distal end

In group C, the head was in neutral position. In addition, anterior displacement or lifting of cricoid cartilage was done to facilitate the NGT passage.

The following data were also collected: demographic parameters of the patient such as age, height, weight, body mass index (BMI), and the vital parameters such as heart rate (HR) and mean arterial pressure (MAP) before and after insertion of NGT using each technique. Any adverse events such as-kinking, knotting, bleeding, etc., if occurred during NGT insertion, were also noted.

The data were analysed using Statistical Package for Social Sciences version 22.0 for Windows (IBM Corp. Released 2013. IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp.). The continuous variables such as age, height, weight, BMI, and procedure time for insertion of NGT in seconds of the three groups were calculated using one-way analysis of variance (ANOVA). Intergroup analysis of heart rates and MAP at any point of time was performed using one-way ANOVA. Intragroup comparisons of mean HR and MAP before and after insertion of NGT were performed using paired *t*-test. The remaining categorical variables analysed using the Pearson Chi-square test. A P value < 0.05 was taken to be statistically significant.

From previous studies, it was evident that successful NGT insertion within two attempts using conventional method is 70%,[11] frozen NGT technique is 88%,[7] and reverse Sellick's manoeuvre is 96%[11] with two attempts. It was assumed that there would be 20% improvement in the success of NGT insertion within two attempts over the conventional method using either of the modified techniques. Setting the power of the study at 80% and at 95% confidence limit, the calculated sample size becomes 59 for each group. Expecting a 10% dropout, 65 patients were enrolled for each group. So for three groups, a total of 195 patients were enrolled for this study. The study period

spanned over 1 year approximately (from May 2015 to April 2016). Data of 193 patients were available for analysis [Figure 3].

RESULTS

The study groups were comparable in terms of demographic profile such as age, sex, height, weight, BMI, and ASA physical status [Table 1].

In group A, 29 out of 65 patients (44.6%) had successful placement of NGT with the first attempt. For the remaining 36 subjects, a second attempt was necessary and successful NGT insertion was possible in further 16 subjects. Hence, the overall success rate was 69.2% (NGT could be inserted properly in 45 out of 65 subjects) using the conventional method. In group B, 45 out of 65 patients (69.2%) had successful placement of NGT with first attempt. For the remaining 20 patients, a second attempt was required and successful placement of NGT was possible in extra 10 subjects. So, the overall success rate was 84.6% in frozen NGT technique as NGT could be inserted properly in 55 out of 65 patients. In group C, 59 out of 63 patients (93.6%) had successful placement of NGT in the first attempt. One out of the remaining four patients had successful NGT insertion within the second attempt. Hence, the overall success rate by reverse Sellick's manoeuvre was 95.2% as NGT could be inserted properly in 60 out of 63 patients [Table 2].

On intergroup analysis of the overall success rate, the difference between the three groups were significant (P = <0.001). When comparing between any two groups, the difference between conventional and frozen techniques were comparable (P = 0.06),

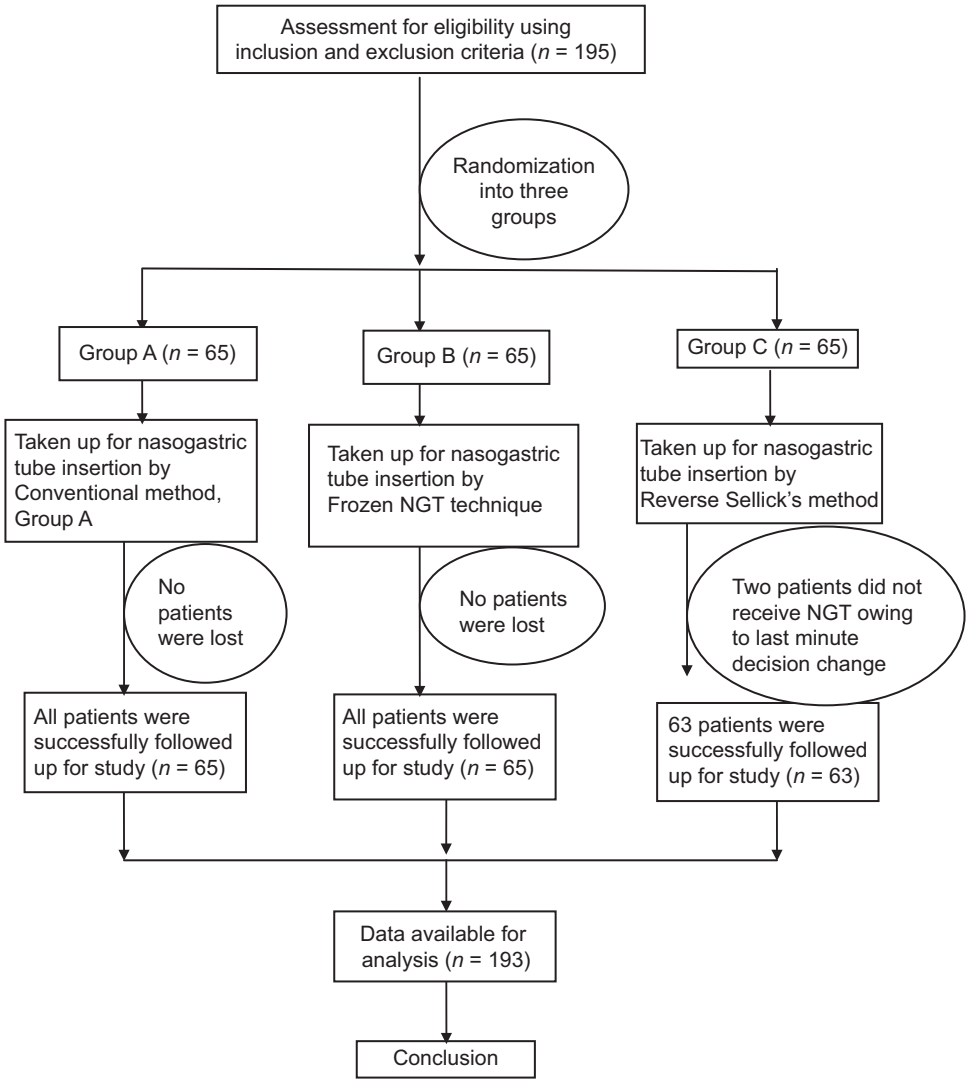

Figure 3: Consort flow diagram showing patient selection, randomization, and lost to follow-up

the difference between frozen NGT and reverse Sellick's manoeuvre were comparable ($P = 0.08$) but considerable difference was observed between conventional and reverse Sellick's manoeuvre groups; $P = 0.0003$; [Table 2].

The procedure time was considerably faster when NGT was placed using reverse Sellick's manoeuvre compared with other methods [Table 2].

The heart rate and mean arterial pressure in all the three groups before and after the procedure were found comparable [Table 3].

Adverse events such as bleeding, coiling and kinking – all occurred in more number of patients receiving NGT in conventional method and frozen NGT method compared with those receiving NGT by reverse Sellick's technique. Bleeding and coiling was the highest in patients following frozen NGT technique [Table 4]. The highest number of patients was free from complications in the reverse Sellick's group, followed by the group receiving NGT by conventional method and the least in group receiving NGT placement using frozen NGT technique.

Table 1: Demographic parameters

Parameters	Group A (*n*=65)	Group B (*n*=65)	Group C (*n*=63)	*P*
Age (years)	41.18±10.05	40.09±10.54	43.57±12.62	0.198
Height (cm)	160.22±6.54	159.66±6.12	160.65±6.2	0.673
Weight (kg)	60.85±6.0	60.85±5.8	59.89±7.7	0.638
BMI (kg/m^2)	23.74±2.38	23.86±1.81	23.11±1.68	0.075
Sex (male/female)*	30/35	29/26	30/33	0.944
ASA PS (1/2)*	32/33	34/31	33/30	0.92

Data expressed as mean±SD except marked. *Which are expressed in numbers. Group A – Patients receiving NGTs by conventional method; Group B – Patients receiving frozen NGTs; Group C – Patients receiving NGTs following reverse Sellick's method; NGTs – Nasogastric tubes; SD – Standard deviation; ASA – American Society of Anesthesiologists; BMI – Body mass index; PS – Physical status

DISCUSSION

In the present study, considerably higher success rate was observed in the reverse Sellick's method and frozen NGT method when compared to the conventional method. Higher success rate in the frozen NGT method can be attributed to strengthening its distal end by freezing. In this study, NGT of 14-Fr size from the same manufacturer was used to nullify the effect of tube size in its rigidity. The increase of rigidity of NGT by storing in the refrigerator was reported more than three decades ago.[8,14] To our knowledge, there have been only three reports,[7-9] which have examined the beneficial effect of imparting rigidity by cooling or freezing for facilitation of NGT insertion without any comparison to conventional or modified techniques. In 2009, Chun *et al*.[7] studied the frozen NGT technique and found it to be highly successful over the conventional method (88% vs 58%, respectively) in intubated paralyzed patients. Observations of Chun *et al*.[7] and that of the present study indicate that the

Table 2: Success rate and procedure times

Parameters	Group A (*n*=65)	Group B (*n*=65)	Group C (*n*=63)	*P*
Attempts				
1st	29	45	59	<0.001*
2nd	16	10	1	
Success rate				
Overall success, *n* (%)	45 (69.2)	55 (84.6)	60 (95.2)	<0.001*
Unsuccessful	20	10	03	
Procedure times	**Group A (*n*=45)**	**Group B (*n*=55)**	**Group C (*n*=60)**	***P***
Procedure times (s)	42.2±21.4	42.1±13.2	31.5±9.5	<0.001*
Intergroup analysis of procedure times: *P* values are-0.97 (A vs. B), <0.0001 (B vs. C), 0.001 (A vs. C)				

Categorical data, expressed as number of patients. *P<0.05 denotes statistical significance; Group A – Patients receiving NGTs by conventional method; Group B – Patients receiving frozen NGTs; Group C – Patients receiving NGTs following reverse Sellick's method; NGTs – Nasogastric tubes

Table 3: Heart rates and mean arterial pressure before and after the procedure

Parameters	Hemodynamics					
	Group A (*n*=65)		Group B (*n*=65)		Group C (*n*=63)	
	HR (bpm)	MAP (mm Hg)	HR	MAP	HR	MAP
Before	74.78±8.86	77.97±9.08	74.18±6.61	78.20±9.22	73.73±5.99	77.67±8.85
After	74.86±8.87	77.98±9.10	74.29±6.58	78.6±9.15	73.86±5.96	77.70±8.99
P (intragroup)	0.058	0.892	0.128	0.051	0.088	0.798

Data expressed as mean±SD. Group A – Patients receiving NGTs by conventional method; Group B – Patients receiving frozen NGTs; Group C – Patients receiving NGTs following reverse Sellick's method; NGTs – Nasogastric tubes; MAP – Mean arterial pressure (mm Hg); HR – Heart rate; HR expressed as beats per minute (bpm)

Table 4: Adverse events profile

Adverse events	Group A (*n*=65), *n* (%)	Group B (*n*=65), *n* (%)	Group C (*n*=63), *n* (%)
Bleeding	3 (4.6)	20 (30.8)	0
P values of bleeding: 0.000* (A vs. B vs. C); 0.000* (A vs. B); 0.000* (B vs. C); 0.084 (A vs. C)			
Coiling	12 (18.5)	16 (24.6)	5 (7.9)
P values of coiling: 0.041* (A vs. B vs. C); 0.393 (A vs. B); 0.011* (B vs. C); 0.079 (A vs. C)			
Kinking	8 (12.3)	6 (9.2)	0
P values of kinking: 0.021* (A vs. B vs. C); 0.571 (A vs. B); 0.014* (B vs. C); 0.004* (A vs. C)			
Uneventful	47 (72.3)	36 (55.4)	58 (92.1)
P values of uneventful: 0.000* (A vs. B vs. C) 0.045* (A vs. B); 0.000* (B vs. C); 0.001* (A vs. C)			

Categorical data, expressed as number of patients (percentage). **P*<0.05 denotes statistical significance; Group A – Patients receiving NGTs by conventional method; Group B – Patients receiving frozen NGTs; Group C – patients receiving NGTs following reverse Sellick's method; NGTs – Nasogastric tubes

overall success rate of NGT insertion by frozen NGT method appears to be more than 80%. The cooling preserved the memory of its coiled shape, and thus helped in achieving a higher success.

The time taken for NGT insertion was the least in reverse Sellick's group (group C), followed by frozen technique with a difference of the mean time of about 11 s. The time taken in the conventional method was comparable with the frozen technique. Although the procedure time for correct placement of NGT might not be that lengthy using the frozen technique, the waiting time for melting the ice, subsequent aspiration of the melted ice-water, followed by auscultation- all together has increased the predefined procedure time. Had we separately observed the procedure time in two phased manner – the time for insertion of the tube and the time for confirming proper placement of tube, and had there been some method of confirmation of proper placement of the tube irrespective of its patency such as X-ray – the frozen technique would have emerged as the method requiring shorter time than the conventional NGT placement!

In the present study, the reverse Sellick's method which is the most successful method of all the three took the least time to place the NGT. Reverse Sellick's manoeuvre causes anterior displacement of the cricoid cartilage, thus, widening the esophageal opening further. This opening-up phenomenon[13] reduces the resistance for the passage of NGT, resulting in higher success rate by reverse Sellick's manoeuvre. This probably contributed to the less time consumption than conventional method.

Gupta *et al*.[15] observed higher rate of successful NGT insertion following inflation with air in anaesthetised and intubated patients with the head in neutral position. The opening up of the collapsed upper oesophageal sphincter by this method is transient but is sufficient enough for the successful advancement of the NGT to reach the stomach. Reverse Sellick's manoeuvre is the technique of widening[6] the oesophageal opening mechanically while the air inflation technique of Gupta *et al*.[15] achieves the same with pneumatic splinting effect.

In the present study, the incidence of adverse events such as bleeding, coiling, and kinking of the NGT was the highest in the frozen NGT group, followed by conventional and reverse Sellick's group. The heightened rigidity of the frozen NGT probably yields greater success rate than the conventional technique at the cost of the increased adverse events. Literature[4,7] also supports that the imparted rigidity of NGT in any modified technique attributes to its higher success rate at the cost of increased adverse events.[14] Appukutty and Shroff[4] reported that, when the NGT was made more rigid using oesophageal guidewire, the procedure required less number of attempts at the cost of higher incidence of adverse events such as trauma and bleeding. In the current study, the incidence of adverse events was the least in the reverse Sellick's group.

Following induction of anaesthesia and tracheal intubation, the sphincter is closed and the act of deglutition is also not possible. This might be responsible for the failure of nasogastric intubation and deflection of the NGT to the pyriform fossa.[15] Moreover, the inflated tracheal cuff may create some posterior bulge towards oesophageal wall and transmits pressure; thereby, put some hindrance for smooth passage of NGT. Freezing the NGT and thereby hardening it, may circumvent to some extent the above hindrance, and thus, facilitates the introduction of NGT in anaesthetised, intubated adult patients.

There are quite a few methods for the confirmation of the position of NGT insertion, such as auscultation

at the epigastrium of a whooshing sound by deflating a feeding syringe, aspiration of the tube content and testing of the pH of the aspirate with pH paper, capnography, and using portable X-ray.[16-19] The last one remains to be the gold standard. Although not definitive, auscultation is the most readily available method at the bedside requiring minimal logistic support. In the present study, we used this technique to confirm the position of the NGT in anaesthetised and intubated adult patients. As the patient already had endotracheal tube *in-situ*, the NGT was less likely to enter the trachea-bronchial tree. Second, the surgeon also confirmed the position of NGT later on in the intraoperative period by palpating the stomach.

The present study has some other limitations. Additional confirmation using pH paper could not be performed due to local unavailability of the entity at the time of this study. Moreover, we could not use polyurethane NGT owing to its unavailability at the time of the present research work. This probably has led to higher adverse events. Further study involving a larger population using frozen polyurethane NGT is warranted to find out any conclusive evidence in this regard. Use of X-ray instead of auscultation technique for confirming proper placement of NGT, would rather allow the researcher to diagnose or declare the correct placement without waiting for the ice to be melted. A study designed by addressing the above shortcomings might be better in assessing the success rate and procedure time for correct placement of NGT. This would remain a future scope.

CONCLUSION

The reverse Sellick's method appears to be the best considering the highest success rate, least procedure time, and acceptable adverse event profile compared with the frozen technique and conventional method for proper placement of nasogastric tube placement in anaesthetised and intubated patients. On the other hand, the frozen technique has the second best success rate at the cost of the highest adverse events among the three groups. However, the procedure time was comparable with the conventional method.

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Conflicts of interest

There are no conflicts of interest.

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