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Success rate of nasogastric tube insertion in anesthetized, intubated, adult patients: A comparison between endotracheal tube cuff inflated and deflated states

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ABSTRACT

Background: Although proper placement of nasogastric tube (NGT) is a simple procedure, it can turn into a tedious task in an anesthetized intubated patient due to the absence of propulsive movement of swallowing. Different techniques of NGT placement are in vogue in clinical practice with varying success rates. The effect of endotracheal tube (ETT) cuff deflation on the success rate of NGT placement has been evaluated only in one study, and the first-attempt success rate was reported to be not high (55%). **Aims and Objectives:** This interventional study primarily aimed at comparing the success rates of proper placement of NGT in the first attempt between the ETT cuff inflated and deflated states. **Materials and Methods:** The present study was carried out on 244 adults scheduled for abdominal surgeries requiring NGT insertion. Patients received NGT placement with either an ETT cuff inflated (Group A, n = 122) or ETT cuff deflated (Group B, n = 122). The success rate of correct placement of NGT in the first attempt was the primary outcome. Procedure time and adverse events were also evaluated. **Results:** Considerably higher success rate of correct placement of NGT in the first attempt was noted with ETT cuff deflated over-inflated state (85.2% vs. 55.7%, P < 0.001). A shorter procedure time was observed with ETT cuff deflated over an inflated state (16.8 ± 7.0 vs. 38.1 ± 27.33 P < 0.001). Adverse events were comparable. **Conclusion:** The higher success rate of correct NGT placement was observed with endotracheal cuff deflated state over cuff-inflated state. Faster placement of NGT was noted with endotracheal cuff deflated state.

Key words: Anesthetized; Cuff deflation; Cuff inflation; Endotracheal tube; Intubation; Nasogastric tube

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INTRODUCTION

Placement of nasogastric tube (NGT) is an essential procedure in abdominal, thoracic, and laparoscopic surgeries. Although it is a simple procedure, NGT insertion in an anesthetized and intubated patient may turn into a difficult or tedious task. Blind insertion with the head in a neutral position can have a high failure rate of around 50% on the first attempt.[1] Failure leads to repeated insertion attempts causing trauma to oropharyngeal structures, which makes the situation clumsy. Many techniques have been suggested in the past to overcome the difficulty of conventional techniques such as head flexion,[1-3] lateral rotation of the neck,[2,3] reverse Sellick's maneuver (RSM),[4,5] the use of a split endotracheal tube (ETT),[6] use of instruments such as GlideScope[7] Magill forceps,[8] and frozen NGT.[9] However, the existence of so many techniques in the literature in

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an effort to solve a problem indicates that the quest for the best is still on.

The inflated cuff of ETT puts pressure on the membranous portion of the posterior tracheal wall that causes anterior esophageal compression.[10] This can put a hindrance to the passage of NGT into the esophagus. Recently, only one study[11] has evaluated the effect of ETT cuff deflation in facilitating NGT insertion. In that study,[11] the cuff deflation technique has achieved a higher success rate in comparison with cuff inflated state (first attempt, 55% vs. 25%, respectively). The success rate increased further to 80% versus 55% in the second attempt (ETT cuff deflated versus inflated state, respectively). In the literature search, it was found that no further study exists evaluating the effect of ETT cuff deflation on the success rate and ease of NGT insertion. In that study,[11] although the researchers deflated the ETT cuff, they have not taken any measures to prevent gas leaks or aspiration of pharyngeal secretion. Placement of throat pack before attempting deflation of ETT cuff could minimize such unwanted effects though it may not assure 100% protection from aspiration and gas leak. Thus, there is a scope for further evaluation of the effect of ETT cuff deflation on the success rate of NGT placement while adopting some protection using a throat pack *in situ*. Moreover, it would also evaluate whether keeping the throat pack in its position during NGT insertion is a "friend or foe" for the normal passage of NGT.[12]

Hence, the present study was conducted to compare the first-attempt success rate (primary outcome) of blind NGT insertion in a neutral position between patients with ETT cuff inflated state and those with ETT deflated state, using "throat pack *in situ*" as an additional safety measure.

Aims and objectives

The study aimed primarily to compare the proportions of patients having successful NGT insertion with ETT cuff inflated versus deflated state using "throat pack *in situ*" as an additional safety measure in anesthetized, intubated adult patients. Other outcome measures were to compare the procedure times and adverse events during the procedure between the two groups.

MATERIALS AND METHODS

This was a hospital-based interventional study where the success rates of two techniques of NGT placement were compared. The study was conducted under the department of anesthesiology in the general surgery operating room at IPGME and R/SSKM Hospital. The study design and methods were placed before the Institutional Ethics Committee (IEC). After approval from IEC (IPGME and R/IEC/2023/235, dated April 18, 2023), and permission from West Bengal University of Health Sciences, the study was registered with the Clinical Trial Registry of India (CTRI) prospectively. The study had the trial registration number CTRI/2023/06/053679 dated June 08, 2023. Thereafter, the recruitment was started in a prospective manner. The study spanned over 12 months approximately. Patients were recruited only after receiving informed written consent in their own language to participate in the study. They were given the option to opt out of the study at any time.

Exclusion criteria

Patients having anatomical/structural abnormalities such as gross deviated nasal septum, abnormality involving lips and palate, patients with oral nasal pharyngeal or esophageal mass, and those with significant injuries involving head and neck were excluded from the study. Patients with thrombocytopenia or coagulation disorder were not considered for this study.

Sample size

From the literature[1], the success rate of blind insertion of NGT in a supine neutral position (with endotracheal cuff inflated state) was reported to be as 50%. It was assumed that detecting at least 25% difference in the success rate between the techniques was clinically significant. The proportions of the patients with successful NGT insertion with the ETT cuff at a deflated state was 25% more than the proportion of patients having NGT placement with a cuff inflated state. Hence, the effect size (d) is assumed to be 0.25. The sample size was calculated using the following formula and method as described in the literature.[13] Setting the power of the study at 80% and allowing an alpha error of 5%, the sample size was 109.7 approximated to 110. Therefore, 220 patients were needed assuming a 1:1 group allocation. Considering a 10% dropout, the sample size was adjusted to 244. Hence, 122 patients were taken in each group.

Sample design

For this interventional study, 244 patients were selected based on inclusion and exclusion criteria. The group allocation was done using "sealed envelope" technique. For this, there were 244 sealed envelopes each containing one piece of paper marked either "A" or "B." There were 122 paper slips marked as "A" and the rest 122 paper slips were marked as "B." After tracheal intubation, an envelope was randomly picked up and was opened to reveal the alphabet. The alphabet displayed ("A" or "B") corresponded to the group allocation of patients.

Group A (n=122): Patients undergoing NGT insertion during ETT cuff inflated state.

Group B (n=122): Patients undergoing NGT insertion during ETT cuff deflated state.

Study variables

1. Number of patients having successful NGT placement in the first attempt with either of the two techniques
2. Time taken for successful NGT placement (the procedure time)
3. Adverse events, if any.

Pre-anesthetic check-up is done on the day before surgery. Standard baseline investigations were completed as per institutional protocol. A nasal patency test was done preoperatively to find the more patent nostril and to rule out any gross nasal deformities such as a spur or significant deviated nasal septum.

An 18-G cannula was used to establish intravenous access for every patient. Monitoring of patients within the operating room was done continuously using electrocardiogram leads, blood pressure cuff, $EtCO_2$ monitor, and SpO_2 probe. Before induction of anesthesia, the optimum nostril for NGT insertion was chosen based on the better fogging procedure on a metal tongue depressor during exhalation. Fentanyl (2 mcg/kg), glycopyrrolate (4 mcg/kg), and ondansetron (0.1 mg/kg) were used as premedication.

Propofol (2 mg/kg) or thiopentone (3–4 mg/kg) was the induction agent depending on the patients' clinical conditions. Succinylcholine (2 mg/kg) was used for intubation by laryngoscope. ETT of appropriate size was used depending on patient variables. Muscle relaxation was maintained with atracurium (0.1 mg/kg).

In both the groups, after the tracheal intubation and before NGT insertion, one pharyngeal pack, or the so-called "throat pack" was placed with the help of a Magill's forceps or gloved finger. In both the groups, nasal patency was tested by a simple occlusion test[14] and by asking the patients about their feelings about which one nostril was clearer.[15] A nasal decongestant nasal drop was instilled into both nostrils. The pharyngeal pack was applied gently to allow a palpable and audible leak, thus avoiding a tightly applied pack. The tip of the NGT was lubricated with 2% lidocaine jelly. Then, a sterile well-lubricated NGT (14 Fr or 16 Fr Gauge, 105 cm length, Romson) was inserted through the more patent nostril until it reached a length of 10 cm.[11] Then, lateral pressure was applied to the ipsilateral neck around the cricoid area on the side of the selected nostril. This was done to obliterate the pyriform sinus which is a common site of NGT impaction. 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.[16]

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 Group A, NGT was inserted through the more patent nostril without deflating ETT cuff. In Group B, NGT was inserted through the more patent nostril after deflating the ETT cuff. Once the NGT was successfully placed, the ETT cuff was re-inflated. 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.[16] The case was taken as "successful" if the NGT could be correctly placed in the first attempt.

It was not be possible to conceal the specific technique of NGT placement to the anesthesiologist who was performing the procedure. Only the anesthetized patient remained unaware of the particular method employed for the NGT placement. Thus, the study was a single-blind design.

Data collection and interpretation

One dedicated anesthesiologist acted as an observer and data-keeper who was not involved otherwise with the procedure. The proportion of patients having successful insertion of NGT in the first attempt using either of these methods was compared (primary outcome). The secondary outcome measure was the procedure time and adverse events, if any. The procedure time for the successful placement of NGT was recorded from the moment of insertion of NGT into the nostril until the confirmation of its correct position by auscultation method – the so-called "whoosh test."[17]

Statistical analysis

The data were tabulated in Microsoft Excel and analyzed with Statistical Packages for the Social Sciences V.24 software. Continuous data were displayed as mean±standard deviation. The categorical variables were presented with frequency and percentage. Whether the data conform to normal distribution was checked using the Kolmogorov–Smirnov test. Comparison of the continuous variables (e.g., age, time taken, mean arterial pressure [MAP], and heart rate [HR]) was done using an independent t-test. A comparison of the categorical variables (e.g., sex, ASA, MP grade, and number of

attempts) was done using theChi-square test. P≤0.05 is considered statistically significant.

RESULTS

Data from all 244 patients were available for analysis. Patients of both the two groups were comparable regarding their demographic parameters (Table 1).

NGT insertion with an ETT cuff deflated was feasible in a considerably greater number of patients compared with those where the ETT cuff was kept inflated. The procedure time for NGT placement was considerably longer with ETT cuff inflated state compared to ETT cuff deflated state (38.1 vs. 16.8 s, respectively) (Table 2).

MAP and HR were noted at different time points during the procedure: Baseline, before NGT insertion, and after NGT insertion. MAP and HR were found to be comparable at all observed time points between the inflated cuff and deflated cuff groups (Table 3).

Although higher adverse events were observed with ETT cuff inflated state, the difference between the two groups was not significant when analyzed (Table 4).

DISCUSSION

NGT insertion is a common procedure in patients with a wide range of diseases or conditions, ranging from healthy subjects undergoing elective surgeries to critically ill intubated patients. NGT helps to deflate the stomach to have a better view of the camera during laparoscopic surgery and reduces the chances of gastric perforation as well. The NGT is coiled inside the oral cavity in anesthetized and intubated patients due to the absence of propulsive movement of swallowing and the presence of an inflated cuff in the proximal part of the trachea.[18,19] Moreover, the flexible nature of NGT may also lead to coiling and failure of proper placement. Non-opposing lateral openings near the tip can cause kinking of NGT.[20,21] An average failure rate of nearly 50–66% was reported on the first attempt using the conventional method with the patient's head in an intubating position.[3] Most of the difficulties in NGT insertions are due to anatomic reasons such as impaction at pyriform sinus, arytenoids cartilage[22,23], and even in its intended path – the esophagus, which becomes compressed by the inflated cuff of an ETT.[2]

The present study was conducted to compare the success rate (primary outcome) of blind NGT insertion in a neutral position within the first attempt between the patients with ETT cuff inflated state and those with ETT cuff deflated state. Cuff deflation of ETT is a simple technique that does not require any skill or instrument to facilitate NGT placement. In the current study, NGT insertion was possible in a considerably more proportion

Table 1: Comparison of demographic parameters

Parameters	Group A (n=122)	Group B (n=122)	P-value
Age (years)	47.2±14.6	47.4±14.7	0.930
Gender (F/M)	62/60	57/65	0.522
ASA (I/II/III)	42/61/19	69/47/6	0.101
MP grade (I/II/III/IV)	44/66/11/1	41/66/15/0	0.632

Group A-patients receiving NGT with ETT cuff inflated state, Group B-patients receiving NGT with ETT cuff deflated state
NGT: Nasogastric tube, ETT: Endotracheal tube

Table 2: Procedure parameters

Parameters	Group A (n=122) (%)	Group B (n=122) (%)	P-value
Number of attempts			
1 (success)	68 (55.7)	104 (85.2)	<0.001
>1 (failure)	54 (44.3)	18 (14.7)	
Procedure time (seconds)	38.1±27.33	16.8±7.0	<0.001

Group A-patients receiving NGT with ETT cuff inflated state, Group B-patients receiving NGT with ETT cuff deflated state. NGT: Nasogastric tube, ETT: Endotracheal tube

Table 3: Comparison of mean arterial pressure and heart rate

Parameters	Group A (n=122)	Group B (n=122)	P-value
Mean arterial pressure			
Baseline	91.1±12.5	95.2±13.1	0.053
Before NGT insertion	94.6±14.4	96.2±15.5	0.401
After NGT insertion	97.6±13.63	99.9±12.8	0.163
Heart rate			
Baseline	87.8±10.3	85.6±13.8	0.176
Before NGT insertion	94.2±12.1	91.9±13.0	0.159
After NGT insertion	98.1±11.6	95.0±14.4	0.064

Group A-patients receiving NGT with ETT cuff inflated state, Group B-patients receiving NGT with ETT cuff deflated state, NGT: Nasogastric tube, ETT: Endotracheal tube

Table 4: Adverse events

Parameters	Group A (n=122) (%)	Group B (n=122) (%)	P-value
Kinking	7 (5.7)	3 (2.4)	
Coiling	10 (8.1)	6 (4.9)	0.886
Bleeding	6 (4.9)	4 (3.2)	

Group A-patients receiving NGT with ET cuff inflated state, Group B-patients receiving NGT with ET cuff deflated state. (*): Statistically significant. Data were presented as the number of patients (proportion) and analyzed using Chi-square test. The Chi-square statistic is 0.2408. The *P*=0.886565. The result is not significant at P<0.05. NGT: Nasogastric tube, ETT: Endotracheal tube

of patients with the ETT cuff at deflated state compared with a cuff at inflated state (approximately 85% versus 55%, respectively). NGT placement with ETT cuff deflated state achieved about 30% more success rate. The present study findings are in line with the observation of Bangarwa et al.,[11] who also found a considerably higher first-attempt success rate for correct placement of NGT in intubated patients with ETT cuff deflated state over inflated state (55% vs. 25%). Comparatively higher first-attempt success rates achieved in the present study compared with the previous study can be due to the presence of a throat pack which might steered the NGT toward its intended path.

In the present study, quicker placement of NGT was possible with the ETT cuff at a deflated state than inflated state (approximated, 17 s vs. 38 s, respectively). Thus, the ETT cuff deflated state yielded about 20 s quicker placement of NGT. Bangarwa et al.[11] also observed a quicker placement of NGT with the ETT cuff deflated state. They observed a benefit of about 22 s quicker placement of NGT with ETT cuff deflated state.[11]

The posterior tracheal wall, deficient of any cartilaginous structure, is supported only by a thin band of smooth muscle – the trachealis muscle that is present on the posterior aspect of the tracheal wall next to the anterior esophagus.[10] The inflated cuff of the ETT puts pressure posteriorly through the membranous portion of the trachea and compresses the esophagus. Thus, it narrows the space for the passage of the NGT.[2,11,24]

The tracheal rings are C-shaped, that is, incomplete at its posterior part. A membranous wall connects the C-shaped cartilages of the trachea at its posterior end. The esophagus is a collapsible tube and situated just behind the trachea. Contraction of trachealis muscle in the posterior wall of the trachea decreases tracheal diameter by pulling the cartilages together.[25] This action is helpful, especially when eating food, which requires the expansion of the esophagus.[6] Hence, passing a tube through esophagus would be easier if the bulging of posterior membrane of trachea can be minimized. Possible explanations regarding the beneficial effects of ETT cuff deflation in facilitating NGT placement are ergonomic advantages. ETT cuff deflation creates more space inside trachea and reduces posterior bulge, thereby reduces the friction between the posterior tracheal wall and NGT approaching through esophagus. Moreover, this cuff deflation yields some ergonomic advantages such as easy alignment of NGT with the esophagus and better flexibility in manipulating the NGT.

RSM is a technique that also facilitates the placement of NGT by relieving pressure on esophagus – a collapsible muscular tube. Lifting of the thyroid cartilage can relieve the pressure on the esophagus and can facilitate the NGT insertion. RSM or lifting thyroid cartilage technique was found to yield a higher success rate of NGT insertion. Mandal et al.,[5] observed the highest success rate with RSM compared with other techniques such as neck flexion, wire guide, and neutral head (86% vs. 75% vs. 65% vs. 56%, respectively). Illias et al.,[2] have observed that the lifting thyroid cartilage technique had achieved the improved success rate compared with "neck flexion with lateral pressure" and "conventional" techniques (88% vs. 82% vs. 52%, respectively). Siddhartha et al.,[19] found a higher success rate with RSM than "neck flexion" or "head in neutral position" (77.5% vs. 40% vs. 37.5%).

In the present study, HR and MAP were found comparable at all points of observation between the two groups. This translates into the fact that the process of tracheal cuff deflation and re-inflation for a brief period had produced a non-significant hemodynamic response.

In the present study, the occlusion test was used to determine the patency of the nostril for NGT insertion. This occlusion test has a high sensitivity (around 92%) and fair specificity (approximately 61%) and appears to be a suitable test to check the patency of the nostril for NGT insertion.[14]

In the present study, there was a decreased incidence of complications such as mucosal bleeding. Although apparently a higher proportion of patients in the ETT cuff inflated group had suffered coiling of NGT compared with ETT cuff deflated group, it was not significant when analyzed. In a previous study, Roy et al.[26] reported a higher rate of coiling during blind insertion compared with "throat pack *insitu*" technique (30% vs. 9%, respectively). In another study, Roy et al.,[27] reported a higher rate of coiling using RSM technique compared with combined "reverse Sellick's maneuver with throat pack *in situ*" (16.2% vs. 7.2%, respectively). These two studies indicate that the presence of a throat pack might have reduced coiling.[26,27] The low incidence (8%) of coiling in the present study can be attributed to the presence of a throat pack.

Limitations of the study

In spite of every sincere effort, the present study has some lacunae. This was a single-center study. The auscultation method was used for confirmation of NGT instead of a more robust method such as ultrasonography, pH paper, or the gold standard- the X-ray, due to limited resources. The study was carried out in a tertiary care hospital, so hospital bias cannot be ruled out. Further research could

explore additional factors across the larger and more diverse patient groups.

CONCLUSION

Endotracheal cuff significantly affects the success rate of NGT insertion. The ETT cuff deflation-assisted technique improved the chances of successful NGT placement. It is also associated with reduced adverse events such as bleeding by avoiding multiple attempts.

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