Brazilian Journal of Anesthesiology 2023;73(5):620–625

Sociedade Brasileira de Anestesiologia

Brazilian Journal of ANESTHESIOLOGY

ORIGINAL INVESTIGATION

Nasogastric tube insertion using conventional versus bubble technique for its confirmation in anesthetized patients: a prospective randomized study

Ankur Sharma [a,*], **Varuna Vyas** [b], **Shilpa Goyal** [c], **Pradeep Bhatia** [c], **Priyanka Sethi** [c], **Akhil Dhanesh Goel** [d]

[a] *All India Institute of Medical Sciences (AIIMS), Department of Trauma & Emergency (Anaesthesiology), Jodhpur, India*
[b] *All India Institute of Medical Sciences (AIIMS), Department of Pediatrics, Jodhpur, India*
[c] *All India Institute of Medical Sciences (AIIMS), Department of Anaesthesiology & Critical Care, Jodhpur, India*
[d] *All India Institute of Medical Sciences (AIIMS), Department of Community & Family Medicine, Jodhpur, India*

Received 26 May 2020; accepted 15 January 2021
Available online 22 March 2021

KEYWORDS
Nasogastric intubation;
General anesthesia;
Fluoroscopy

Abstract
Background: Nasogastric tube insertion and confirmation of its position can be difficult in the anesthetized patient. The purpose of the present study was to compare the bubble technique with the conventional method for confirmation of nasogastric tube placement in these patients.
Methods: Two hundred sixty adult patients, aged between 20–70 years, posted for surgeries requiring general anesthesia, tracheal intubation, and a nasogastric tube were enrolled in this study. Patients were randomized into 2 groups: Group B (Bubble group) and Group C (Control group). In Group C, a conventional technique using a lubricated nasogastric tube was positioned through the nostril with head remained neutral. In Group B, 2% lidocaine jelly was added to the proximal end to form a single bubble. The correct placement of the nasogastric tube in the stomach was confirmed by fluoroscopy by an independent observer intraoperatively.
Results: The duration of nasogastric tube insertion was 57.2 ± 13.3 seconds in Group B and 59.8 ± 11.9 seconds in Group C ($p = 0.111$). The confirmation rate of the bubble technique was 76.8% (95% CI: 68.7–83.3), which was significantly better than the conventional method where the confirmation rate was 59.7% (95% CI 50.9–67.9), $p < 0.001$. When compared to fluoroscopy, bubble technique was found to have a sensitivity of 92.3% (95% CI: 85.6–96.1) with specificity of 81.0% (95% CI: 60.0–92.3), positive predictive value of 96.0% (95% CI: 90.2–98.4), and a moderate negative predictive value of 68.0% (95% CI: 48.4–82.8).

* Corresponding author.
E-mail: ankuranaesthesia@gmail.com (A. Sharma).

https://doi.org/10.1016/j.bjane.2021.01.011

Conclusions: The bubble technique of nasogastric tube insertion has a higher confirmation rate in comparison to the conventional technique.
Trial Registry Number: Clinical Trial Registry of India (CTRI/2018/09/015864).

Introduction

In anesthetized patients, the insertion and confirmation of a Nasogastric Tube (NGT) could be challenging, with a failure rate of almost 50% on the first attempt in neutral head position.[1,2] Multiple attempts, after a failure, are generally unsuccessful due to the coiling, kinking, or knotting of the NGT. Once kinked, the NGT is more likely to kink at the same site. Piriform sinuses and arytenoid cartilage are the most frequent impaction sites of the NGT.[3]

Although inserting an NGT is reasonably safe, incorrect placement may cause serious and fatal complications. The misplacement of NG tubes has been documented in quite different rates in the literature: 1.9–89.5% in adults and 20.9–43.5% in children.[4] One of the major incidents with NGT is the wrong connection. The design of these devices is such that it is possible to infuse enteral feed or drugs through an unwanted route, such as an intravenous route. Inadvertent placement of the NGT in the respiratory system can lead to bronchoaspiration, pneumothorax, subcutaneous emphysema, pulmonary hemorrhage, empyema, and bronchopleural fistula.[5] These incidents may occur while an NGT is being inserted or advanced through the gastrointestinal tract, such as sinusitis, nasal septal erosion, epistaxis, and esophageal perforation.[6] Other unusual events related to NGT include intracranial placement,[7] mediastinitis, pneumomediastinum, and perforation of the internal jugular vein.[8] Therefore, the correct placement of NGT requires to be checked.

Different conventional approaches, including auscultations, gastric aspirate pH, and its visual inspection are implemented to verify that the nasogastric tube (intragastric position) is correctly positioned.[9] The other methods of verification of NGT placement identified are calorimetric carbon dioxide indicators, X-ray, ultrasound, endoscopy, fluoroscopy, and magnet tracking.[9] But while the NGT has to be placed intraoperatively, the abdomen is under the drapes, and most of the above procedures are not implementable.

In a brief report, Prasad et al introduced the bubble technique as an innovative method of NGT placement.[10] They described this technique as before inserting the NGT, a jelly is applied to its proximal end. When the NGT crosses gastroesophageal junction and reaches into the stomach, the gas in the stomach is supposed to form a bubble at the proximal end of the NGT. They further explained that no bubble forms if the NGT is coiled in an oral cavity and bubbles are formed repeatedly when placed intratracheally; in case of an intragastric placement, one or two bubbles appear. They successfully placed over 100 NGTs during general anesthesia using this technique. We have also done a pilot study on patients using this technique, and found it to be useful. This maneuver was not examined until now in the literature, so we planned this technique to validate.

The present study was carried out with an aim to compare the bubble technique of NGT insertion with the conventional method as a reference to confirm its position in the stomach. We hypothesized that the NGT position confirmation rate of the bubble technique would be higher than the conventional method.

Methods

This parallel group randomized controlled study was conducted in the operation theatre of a tertiary care hospital after approval from the Institutional Ethical committee [http://ctri.nic.in/Clinicaltrials/WriteReadData/ethic/1379127330EthicalNG.jpg]. The study was registered in the Clinical Trial Registry of India (CTRI n° CTRI 2018/09/015864) (http://ctri.nic.in/Clinicaltrials/rmaindet.php?trialid=28475&EncHid=25676.95146&modid=1&compid=19). Written informed consent was obtained from every patient. American Society of Anesthesiologists (ASA) physical status I and II patients with normal airway (Mallampati grade 1 or 2), aged between 20 to 70 years, posted for surgeries requiring general anesthesia with neuromuscular blocking agents, tracheal intubation, and a nasogastric tube were included in this study. Patients with predicted difficult airways (excessive obesity [Body Mass Index (BMI) > 40 $kg.m^{-2}$], thyroid diseases), full stomach, nasal deformation, epistaxis history, gastrointestinal hemorrhage, coagulopathy, or esophageal or thyroid diseases were excluded.

The study participants were enrolled by the first author (AS). The patients were randomly distributed with a 1:1 allocation ratio into two groups (Group B [Bubble technique] and Group C [Control], according to computer-generated randomization order following induction of general anesthesia and tracheal intubation. Random number sequence was generated by one of the authors (ADG) using the ''rand ()'' command in Microsoft Excel software. Allocation concealment was done using Sequentially Numbered Opaque Sealed Envelope (SNOSE) method. Another author (SG) assigned the study participants to trial groups.

In the control group, a conventional technique involving a lubricated NGT with 2% lidocaine was placed through the selected nostril, the head remained in the neutral position. In the bubble technique group, the distal end was lubricated with lidocaine jelly with 2% lidocaine, and the same jelly was also added to the proximal end to fill its lumen by 0.5 to 1.0 cm. When the NGT tip crosses over the gastroesophageal junction and reaches the stomach, a single

Figure 1 Arrow showing a single bubble formed at the proximal end of the nasogastric tube.

bubble was expected to form from the jelly due to gas in the stomach at the proximal end of the NGT (Fig. 1).

By gauging the distance from the tip of the patient's nose to the earlobe and from the earlobe to the xiphoid process, we determined the required length of NGT to enter the stomach. An experienced anesthesiologist (who had more than 3 years of experience in anesthesia and nasogastric tube insertion) carried out all the NGT insertion to reduce the bias of expertise. The nostril used for NGT insertion was preoperatively chosen according to two parameters; the amount of fog produced on a metal tongue depressor during exhalation and the relative nostril size. In all patient groups, a 14F, 119-cm STERILENE NGT (Sterimed Medical Devices Pvt. Ltd., Bahadurgarh, Haryana, India) with radio-opaque marking at the distal end was used.

The start time of the procedure was defined when the NGT insertion was initiated into the selected nostril. The end time procedure was defined as the time when the NG tube was correctly placed. This time included NGT insertion time plus fluoroscopy time for confirmation. The duration of the procedure was estimated by the stopwatch. A blinded observer outside the operating theatre during nasogastric insertion and not aware of the group allocation confirmed the NGT position with fluoroscopy (OEC Brivo Plus C-arm, GE Healthcare, India) in both groups (Fig. 2). The contrast and brightness of the image were set at 80-peak kilovoltage (kVp) and 2-milliamperage (mA) in the C-arm, respectively. The duration of insertion was calculated in cases that were confirmed by fluoroscopy in the stomach. If the NGT was not seen by fluoroscopy in the stomach using the chosen technique at the first attempt, then the technique was considered a failure. We collected data for the confirmation rate of the selected technique at the first attempt, duration of insertion using the selected technique, and complications during insertion, i.e., kinking, knotting, and bleeding. The primary outcome of the present study was to

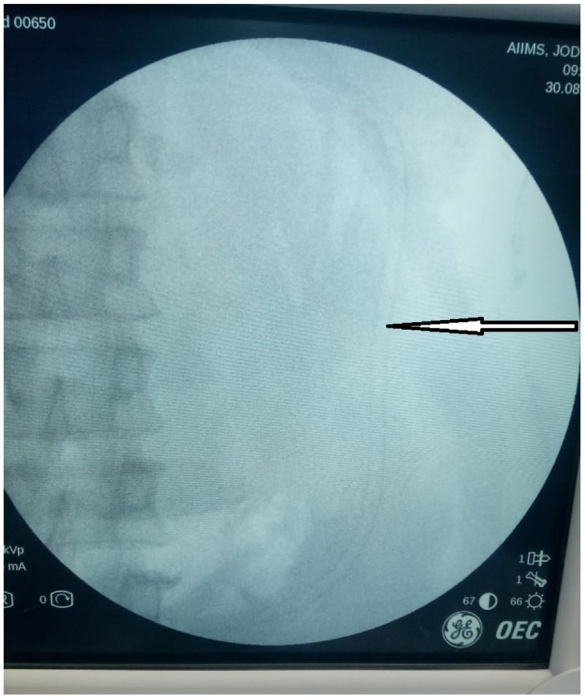

Figure 2 Fluoroscopy image showing correct nasogastric tube position in the stomach.

confirm the position of the nasogastric tube in the stomach in both groups. The secondary outcomes were to compare the duration of insertion using the selected technique and complications during insertion, i.e., kinking, knotting, and bleeding.

In the intervention group (Group B), if the bubbles appeared at the proximal end of NGT, but NGT was not seen by fluoroscopy, it was defined as false positive. If the bubbles were not formed at the proximal end, but NGT was seen by fluoroscopy, it was defined as a false negative.

Statistical analysis

For the calculation of sample size, we first carried out a pilot study on 20 patients which showed 20% improvement of confirmation rate from 60% in conventional technique to 80% after Bubble procedure. At two-sided effect size of 20%, a 95% Confidence Interval, 80% power, and 10% contingency, we estimated a sample size of 101 in each group, i.e., a total of 202 patients. Data collected during the study was compiled using Microsoft Excel spreadsheet. Continuous data were presented as mean $\pm$ SD and analyzed using unpaired *t*-test; categorical data were presented as frequency and percentage and analyzed by Pearson's X^2 test or Fisher's Exact test. A $p < 0.05$ value was considered statistically significant.

Results

In the present study, 260 patients were assessed for eligibility. Eleven patients were excluded from the study (5 patients did not meet inclusion criteria, 3 patients decline to participate, and 3 for other reasons). Thus, a total of 249 patients

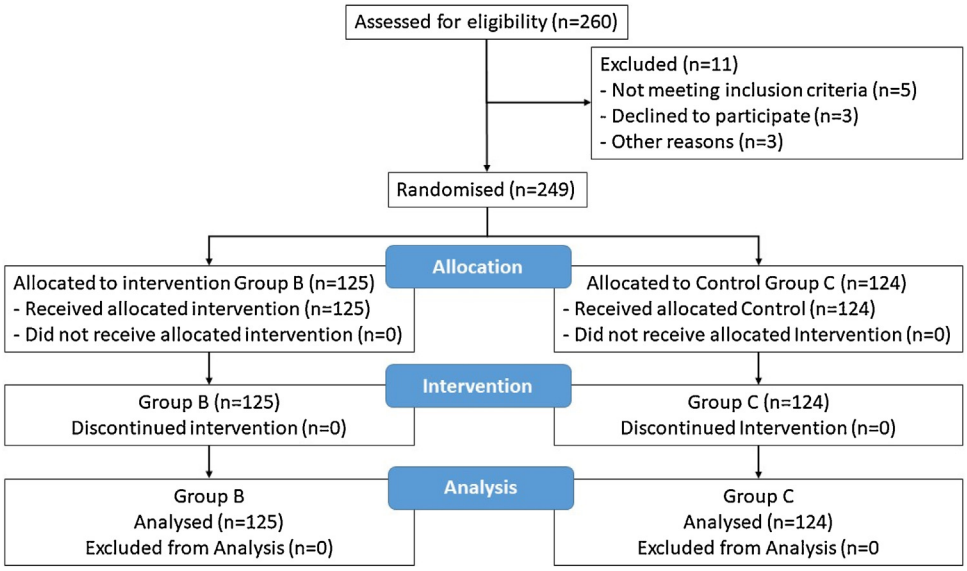

Figure 3 CONSORT diagram.

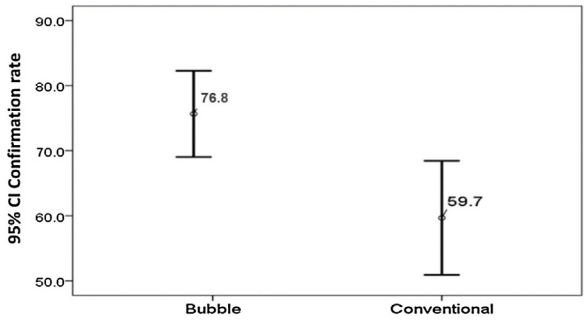

Figure 4 Figure showing the confirmation rate of Bubble and Conventional technique.

were randomized into 2 groups: 125 patients in Group B and 124 patients in Group C (Fig. 3).

Both groups were comparable for demographic characters, and there was no significant difference. There was also no significant difference noted for Mallampati grade, ASA physical status grading between both groups. There was no difficulty during insertion of the nasogastric tube through the selected nostril in both the groups.

The confirmation rate of bubble technique was 76.8 (95% CI: 68.7–83.3), which was significantly better than the conventional method where confirmation rate was 59.7% (95% CI: 50.9–67.9), $p < 0.001$ (Fig. 4). When compared to the fluoroscopy, the bubble technique was found to have a sensitivity of 92.3% (95% CI: 85.6-96.1) with specificity of 81.0% (95% CI: 60.0-92.3), positive predictive value of 96.0% (95% CI: 90.2–98.4) and a moderate negative predictive value of 68.0% (95% CI: 48.4–82.8).

The duration of nasogastric tube insertion was 57.2 ± 13.3 seconds in Group B and 59.8 ± 11.9 seconds in Group C, Effect size (Cohen's d) = 0.21, which was not statistically significant ($p = 0.111$). There was also no difference for complications, i.e., kinking, knotting, and bleeding for nasogastric tube between the two groups (Table 1).

Discussion

In the present study, we aimed to compare Bubble technique with Conventional technique for confirmation of correct NGT placement and also verified its position with direct radiography intraoperatively. According to the results of our study, the Bubble technique is quite sensitive with higher confirmation rate to detect the right location of the nasogastric tube. There was no significant difference for duration of insertion and complications for nasogastric tube between the two groups.

Although this technique was described in 2011 by Prasad et al.,[10] it was not investigated in the literature. We found bubble technique of NGT placement simple and useful without any major adverse effects. This technique can be used during intraoperative period, when abdomen is under the drapes, and most of the other methods are not implementable. When placed improperly, NGT can cause few or no symptoms, particularly in those at high risks, such as those who are unconscious or intubated or who lack a gag or swallowing reflex.[11] The gold standard method for confirming the correct position of the nasogastric tube is fluoroscopy or chest radiography. For patients experiencing difficult anatomies with advanced head and neck cancer, Chen et al found that fluoroscopic guided placing of NGT is a very effective procedure.[12] We used the bubble technique for nasogastric tube placement and confirmed its position by fluoroscopy in patients with normal neck anatomy.

The ''Whoosh test'' is traditionally used for confirmation of NGT position in routine practice.[13] Using this procedure, the air is insufflated through the NGT while the epigastrium is auscultated; however, the efficacy of this technique is highly questionable. Multiple reports of its ineffectiveness have contributed to unintended consequences. The bronchial ''rumbling'' sound can be mistaken for epigastrium sound; thus, it is not a reliable method. In a study carried out by Metheny et al., the analysis of NG placement was found to be correct in only 34.4% of cases by the aus-

Table 1 Comparison between Bubble (B) and Control (C) Group.

Variables	Group B (n = 125)	Group C (n = 124)	*p*-value	
Age in years (Mean ± SD)	42.1 ± 13.4	40.9 ± 12.5	–	
Height (Mean ± SD)	160.6 ± 12.2	162.9 ± 10.6	–	
Weight (Mean ± SD)	70.8 ± 17.1	71.4 ± 17.0	–	
Sex, n (%)	Female	54 (43.2%)	58 (46.8%)	–
	Male	71 (56.8%)	66 (53.2%)	
ASA physical status, n (%)	1	71 (56.8%)	74 (59.7%)	–
	2	54 (43.2%)	50 (40.3%)	
Mallampatti grade, n (%)	1	72 (57.6%)	72 (58.1%)	–
	2	53 (42.4%)	52 (41.9%)	
Duration of nasogastric tube insertion (s)	57.2 ± 13.3	59.8 ±11.9	0.111	
Kinking, n (%)	No	121 (96.8%)	113 (91.1%)	0.060
	Yes	4 (3.2%)	11 (8.9%)	
Knotting, n (%)	No	118 (96.8%)	115 (90.3%)	0.067
	Yes	7 (3.2%)	9 (9.7%)	
Bleeding, n (%)	No	123 (98.4%)	117 (94.4%)	0.102
	Yes	2 (1.6%)	7 (5.6%)	

$p < 0.05$ is considered significant; ASA, American Society of Anesthesiologists; n, number of patients.

cultation method.[14] Similarly, Seguin et al.[15] found higher sensitivity (96%) but lower specificity (17%) of the insufflation and auscultation method for confirmation of NGT position. Therefore, we did not use this method to verify nasogastric tube placement in the present study. In comparison to air insufflation method, the confirmation rate of bubble technique used in this study was higher (76.8%).

Another option to confirm the correct position of the nasogastric tube is ultrasound. Yıldırım et al studied the neck and subxiphoid ultrasound in 49 patients in comparison with chest radiography for verification of nasogastric tube location.[4] They found the sensitivity of neck ultrasound 91.5% and positive predictive value 100%. The subxiphoid ultrasound sensitivity was 78.72%. They suggested that ultrasound of neck and subxiphoid could be used to verify the location of the nasogastric tube. Similar to this, we found the sensitivity of Bubble technique 92.3% and positive predictive value of 96.0%. However, abdominal and neck ultrasonography requires expertise in confirming the NGT position and is not always available in the operating theatre.

Muslu et al. assessed pH meter for NGT location validation. They took a pH between 1 and 5 for the tip position of the NGT in the stomach. They found the specificity for the pH meter was 100% (95% CI 16.6–100%), while the sensitivity 76.5% (95% CI 58.8–89.2%).[16] Seguin et al. found the sensitivity of pH measurement of gastric fluid 49% and specificity 74% for NGT position.[15] We found higher sensitivity and specificity than pH measurement by Bubble technique, but pH measurement is not practical inside operation theatre as sometimes there is no aspiration of gastric fluid in the NGT.

Chen et al. investigated the use of manometer pressure readings to guide the movement of NGT in 40 adult mechanically ventilated patients and compared them with the traditional blind insertion technique.[17] They confirmed the NGT location by using a fiberscope. They noticed that the NGT insertion was effective at the first attempt more often in the manometry-guided group than in the blind insertion group (100% vs. 70%; $p = 0.02$).[17] In our study, we also found a similar result that confirmation rate of bubble technique was significantly higher than the conventional group (76.8% vs. 59.7%, $p < 0.001$).

Bercik et al.[18] have tested whether a magnet tracking system can reliably assess the position of the NGT in 22 patients. An external sensor array, connected to the computer, monitored the location of a small permanent magnet at the end of an NGT. They found NGT position precision 100% by magnet tracking compared to fluoroscopy. While this technique is more accurate than the bubble technique but more expensive, requires extensive training for users and is not practical for anesthetized patients inside the operation theatre.

The limitation of the present study was that we only studied patients under anesthesia and did not include awake patients requiring NGT placement in the ward.

Conclusion

The bubble technique of nasogastric tube placement in anesthetized patients is a simple method which has a higher confirmation rate for correct NGT placement in comparison to the conventional technique.

Conflicts of interest

The authors declare no conflicts of interest.

References

1. Mandal M, Karmakar A, Basu SR. Nasogastric tube insertion in anaesthetised, intubated adult patients: A comparison between three techniques. Indian J Anaesth. 2018;62:609–15.
2. Mahajan R, Gupta R, Sharma A. Role of neck flexion in facilitating nasogastric tube insertion. Anesthesiology. 2005;103:446–7.
3. Kayo R, Kajita I, Cho S, Murakami T, Saito H. A study on insertion of a nasogastric tube in intubated patients. Masui. 2005;54:1034–6.
4. Yıldırım Ç, Coşkun S, Gökhan Ş, Pamukçu Günaydın G, Özhasenekler A, Özkula U. Verifying the Placement of Nasogas-

tric Tubes at an Emergency Center: Comparison of Ultrasound with Chest Radiograph. Emerg Med Int. 2018;18:2370426.
5. Gimenes FRE, Pereira MCA, Prado PRD, Carvalho REFL, Koepp J, Freitas LM, et al. Nasogastric/Nasoenteric tube-related incidents in hospitalised patients: a study protocol of a multicentre prospective cohort study. BMJ Open. 2019;9:e027967.
6. Numata Y, Ishii K, Seki H, Yasui N, Sakata M, Shimada A, et al. Perforation of abdominal esophagus following nasogastric feeding tube intubation: A case report. Int J Surg Case Rep. 2018;45:67–71.
7. Psarras K, Lalountas MA, Symeonidis NG, Baltatzis M, Pavlidis ET, Ballas K, et al. Inadvertent insertion of a nasogastric tube into the brain: case report and review of the literature. Clin Imaging. 2012;36:587–90.
8. Smith KA, Fleming JP, Bennett RD, Taitano AA. A case of fatal internal jugular vein perforation during nasogastric tube insertion. J Surg Case Rep. 2017;7:rjx128.
9. Fan EMP, Tan SB, Ang SY. Nasogastric tube placement confirmation: where we are and where we should be heading. Proc Singapore Healthc. 2017;26:189–95.
10. Prasad G, Garg R. Thebubble technique: an innovative technique for confirming correct nasogastric tube placement. J Clin Anesth. 2011;23:84–5.
11. Taylor SJ. Confirming nasogastric feeding tube position versus the need to feed. Intensive Crit Care Nurs. 2013;29:59–69.
12. Chen PT, Lee BC, Huang YC, Chang YC, Tzeng HL, Liu KL. Fluoroscopic-guided nasogastric tube placement in patients with advanced head and neck cancers. J Formos Med Assoc. 2019, http://dx.doi.org/10.1016/j.jfma.2019.11.003. S0929-6646(19)30780-6 [Epub ahead of print].
13. Peter S, Gill F. Development of a clinical practice guideline for testing nasogastric tube placement. J Spec Pediatr Nurs. 2009;14:3–11.
14. Metheny N, McSweeney M, Wehrle MA, Wiersema L. Effectiveness of the auscultatory method in predicting feeding tube location. Nurs Res. 1990;39:262–7.
15. Seguin P, Le Bouquin V, Aguillon D, Maurice A, Laviolle B, Mallédant Y. Testing nasogastric tube placement: evaluation of three different methods in intensive care unit. Ann Fr Anesth Reanim. 2005;24:594–9.
16. Muslu B, Demircioglu R, Gözdemir M, Usta B. Comparison of neck ultrasonography with a pH meter to confirm correct position of nasogastric tube. Clin Invest Med. 2016;39:27520.
17. Chen HS, Chung KC, Yang SH, Li TS, Wu HF. A manometry-guided technique to facilitate insertion of a nasogastric tube in intubated, mechanically ventilated patients; 2011. p. 1–2, http://dx.doi.org/10.1109/NEBC.2011.5778617, 2011 IEEE 37th Annual Northeast Bioengineering Conference (NEBEC) Troy, NY.
18. Bercik P, Schlageter V, Mauro M, Rawlinson J, Kucera P, Armstrong D. Noninvasive verification of nasogastric tube placement using a magnet-tracking system: a pilot study in healthy subjects. J Parenter Enteral Nutr. 2005;29:305–10.