Original Article

Modified Gastric Biopsy Forceps as a Flexible Stylet-Assisted Nasogastric Tube Insertion in Anesthetized and Intubated Patients: A Prospective Randomized Controlled Study

Narut Ruananukun MD[1], Amorn Vijitpavan MD[1], Chutima Simasatikul MD[1]

[1] Department of Anesthesiology, Faculty of Medicine, Ramathibodi Hospital, Mahidol University, Bangkok, Thailand

Background: Insertion of a nasogastric tube in an anesthetized intubated patient may be difficult. A nasogastric tube is prone to coil and kink during insertion. The authors hypothesized that gastric biopsy forceps could be used as a flexible stylet-assisted nasogastric tube insertion. It can improve the first-attempt success rate over the conventional blind technique during nasogastric tube insertion in the anesthetized intubated patient.

Materials and Methods: Eighty adult patients who required intraoperative nasogastric tube insertions were randomized to the gastric biopsy forceps assisted technique (stylet group) or the conventional blind technique (control group) for insertion of a nasogastric tube. The success rates, the duration of insertion, the incidences of coiling and kinking of a nasogastric tube, and the occurrences of complications were recorded.

Results: The first-attempt success rate was 92.5% in the stylet group compared with 65% in the control group (p=0.013). The overall success rate was higher in the stylet group (100% versus 85%, p=0.026). The mean time required to insert the nasogastric tube was shorter in the stylet group (24.85±9.62 versus 62.4±59.38 seconds, p=0.002). The incidences of coiling and kinking were lower in the stylet group (7.5% versus 32.5%, p=0.005). The incidence of minor bleeding was lower in the stylet group, but not statistically significant (2.5% versus 17.5%, p=0.057). No other complications were observed in either groups.

Conclusion: The gastric biopsy forceps-assisted nasogastric tube insertion resulted in a higher success rate, less time for insertion, and lower incidence of coiling and kinking of a nasogastric tube than the conventional blind technique in anesthetized intubated patients without serious complications.

Keywords: Nasogastric tube; Insertion; Stylet; Gastric biopsy forceps; Success rate

Received 31 May 2021 | Revised 15 July 2021 | Accepted 15 July 2021

J Med Assoc Thai 2021;104(8):1222-8

Website: http://www.jmatonline.com

Insertion of the nasogastric tube is easy to do when the patient awake as the patient can co-operate in the swallowing of the nasogastric tube. In an anesthetized intubated patient, the relaxation of pharyngeal muscles might be an obstacle. The most common sites of impaction are the piriform sinuses, arytenoid cartilages, and the esophagus which becomes compressed by the inflated cuff of an endotracheal tube[1].

Correspondence to:

Vijitpavan A.

Department of Anesthesiology, Faculty of Medicine, Ramathibodi Hospital, Mahidol University, Bangkok 10400, Thailand.

Phone: +66-2-2011552, **Fax**: +66-2-2011569

Email: fluotec@hotmail.com

How to cite this article:

Ruananukun N, Vijitpavan A, Simasatikul C. Modified Gastric Biopsy Forceps as a Flexible Stylet-Assisted Nasogastric Tube Insertion in Anesthetized and Intubated Patients: A Prospective Randomized Controlled Study. J Med Assoc Thai 2021;104:1222-8.

doi.org/10.35755/jmedassocthai.2021.08.13050

Another important concerning issue is the material of the nasogastric tube, which is usually made of polyurethane or silicone, making it soft and less traumatic[2]. Additionally, there are lateral orifices on the distal part of a nasogastric tube which are the weak points, make it easy to coil or kink when encountering an anatomical blockage[1].

The first attempt success rate of nasogastric tube insertion with the conventional blind technique in an anesthetized and intubated patient was only 50% to 60%[3,4]. Multiple attempts of nasogastric tube insertion might lead to complications such as trauma, bleeding, and unstable vital signs[5].

There was a various way to facilitate nasogastric tube insertion such as neck flexion with lateral neck pressure[4], forward displacement of the larynx[6], frozen nasogastric tube[7], the use of devices such as slit endotracheal tube[4], laryngoscope or video laryngoscope (Glidescope®)[8], Rusch intubation stylet[9], and esophageal guidewire[10]. Each method can improve success rate around 66% to 99.2% which

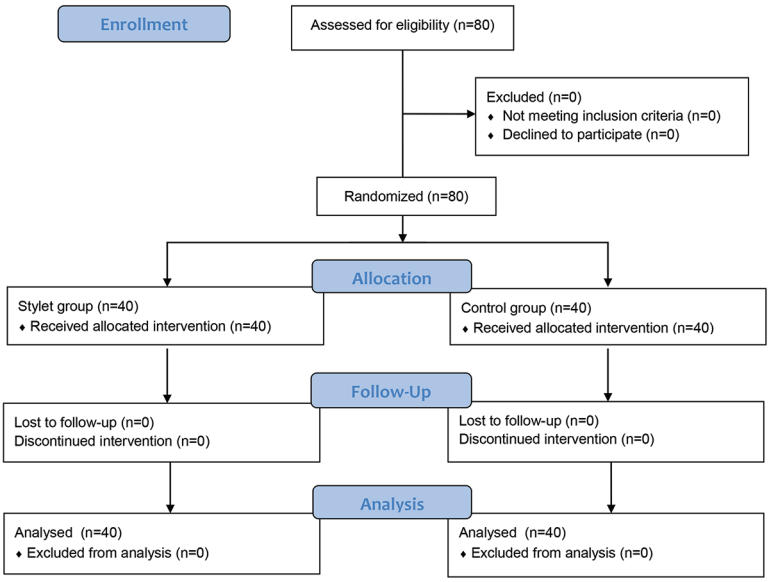

Figure 1. CONSORT flow diagram.

has different strengths and weaknesses[4,6-15].

The gastric biopsy forceps are common instruments in the endoscopic room and they can be sterile and reusable. Their flexible property, which is neither too rigid nor too soft, like spring that can move forward to the other ways with less trauma when they impact the barrier.

The authors introduce a new technique and hypothesize that the gastric biopsy forceps can be used as a flexible stylet assisted nasogastric tube insertion by an increase in nasogastric tube rigidity. It can significantly improve the first-attempt success rate over the conventional blind technique during its insertion in anesthetized intubated patients.

Materials and Methods

The present study was a prospective randomized controlled study conducted in the operating rooms in Ramathibodi Hospital between October 2014 and January 2015, after approval from the Ramathibodi Hospital's Ethics Committee, No. 08-57-17 (01/09/2014) and was registered at Thai Clinical Trials Registry (www.clinicaltrials.in.th), No. TCTR20141018001 (17/10/2014). The present study was performed in accordance with the declaration of Helsinki and adhered to the applicable CONSORT guidelines. The safety of the gastric biopsy forceps was approved because they were the medical devices which could be reused after the sterilize process.

Inclusion criteria were patients older than 18 years old, the American Society of Anesthesiologists (ASA) physical status I-IV, scheduled for surgery required an intraoperative nasogastric tube insertion, and a fasting time >6 hours for solid food or >2 hours for clear liquid food. Patients with nasal stenosis, nares obstruction, nasal septal deviation, a nasal mass, upper respiratory tract infection, history of corrosive chemical ingestion, previous esophageal surgery, unstable cervical spine, and coagulopathy were excluded.

Written informed consent was obtained from each patient on the day before the operation, then the patient's nostrils were evaluated by size and amount of fog produced on a metal tongue depressor during exhalation.

The patient was monitored for blood pressure, electrocardiography, heart rate, respiratory rate, and pulse oximetry before underwent general anesthesia with anesthetic agents, narcotic, and neuromuscular blocking agents depending on anesthesiologists. The endotracheal tube was placed and fixed. Cuff pressure was measured and adjusted to 25 cmH_2O. The nasogastric tube size was selected (Kendall Curity® stomach tube, Levin's type 125 cm size 14 Fr, 16 Fr, or 18 Fr, Kendall-Gammatron Co.,Ltd., Nakorn Prathom, Thailand) according to the patient's nostrils size and surgeon's request. The optimal length for the insertion of a nasogastric tube in each patient was determined by the distance from the tip of the nose to the xiphisternum via the tragus of the ear.

Patients were randomized into 2 groups according to computer-generated randomization with sealed

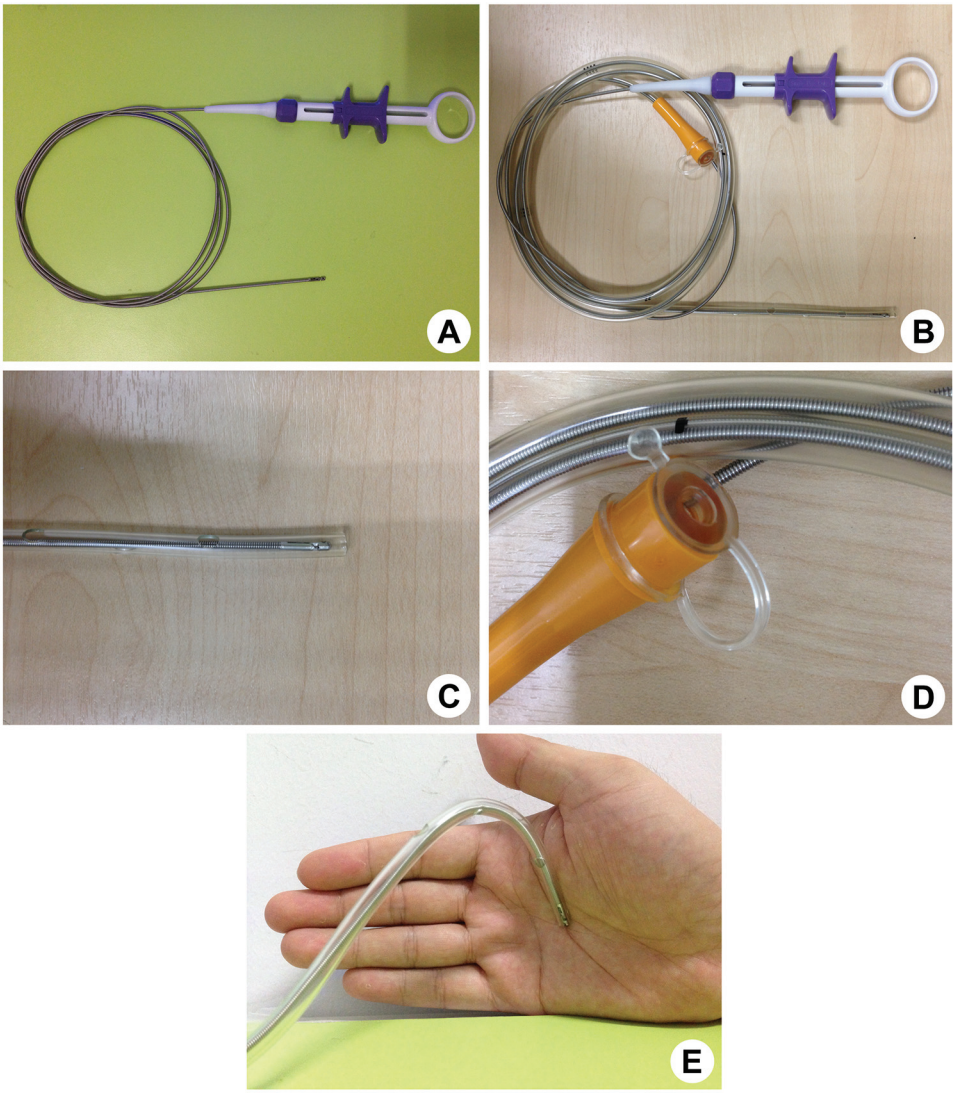

Figure 2. Gastric biopsy forceps and nasogastric tube.

(A) Gastric biopsy forceps, (B) Final preparation of nasogastric tube with the flexible stylet, (C) Tip of the flexible stylet is kept within the end of the nasogastric tube, (D) Recap of another end of the nasogastric tube to fix the flexible stylet, (E) Flexibility of a nasogastric tube with the flexible stylet

envelopes in serial order (Figure 1).

• Control group: Nasogastric tube insertion was performed by lifting a jaw and inserting a lubricated nasogastric tube via selected nostril until the optimal length was reached.

• Stylet group: A gastric biopsy forceps (ENDO-FLEX® 160 cm, ENDO-FLEX GmbH, Voerde, Germany) was used as a flexible stylet. The nasogastric tube with flexible stylet was prepared by inserting a decontaminated, and lubricated flexible stylet into a nasogastric tube in which the tip of the stylet must be kept within the end of the nasogastric tube and recap another end of the nasogastric tube to fix the stylet. Nasogastric tube insertion was performed by lifting a jaw and inserting a lubricated nasogastric tube with flexible stylet via selected nostril until the optimal length was reached. The stylet was withdrawn by removing the cap of the nasogastric tube and straight pulling the stylet. If the stylet could not be withdrawn, the nasogastric tube with flexible stylet should be pulled up a little and tried to withdraw the stylet again (Figure 2).

Operators must have at least 1 year of experience in nasogastric tube insertion in anesthetized patients and had been observed and trained in both techniques before the study began.

The successful placement of nasogastric tube was confirmed by auscultation of a gargling sound over the epigastrium when 10 mL of air was insufflated via nasogastric tube. Final confirmation was manual palpation of the nasogastric tube in the stomach by the surgeon.

If the first attempt failed, the second and the third attempt would be performed by the same procedure. If more than 3 attempts were made, it would consider to be failure of insertion. Then, nasogastric tube insertion was rescued by the assistance of a direct laryngoscope with Magill forceps or the other techniques.

The number of attempts, duration of insertion which was defined as the time interval between the first attempt of nasogastric tube insertion into the nostril and the positive gargling sound over the epigastrium or after failed insertion in the third attempts, operator's satisfaction score from a scale 0 to 10 (0=unsatisfied, 10=the most satisfied) were recorded.

Observers who were not participating in the present study evaluated the complications immediately after nasogastric tube insertion, at post-anesthetic care unit, and at the ward. Complications were defined as:

1. Minor injury is defined as an abrasion wound with self-limiting bleeding (blood loss of less than 2 mL).
2. Moderate injury is defined as an abrasion or laceration wound with 2 to 5 mL of bleeding which can be stopped by applying pressure on the wound.
3. Severe injury or life-threatening complications are defined as a laceration wound with bleeding more than 5 mL which required suture, pneumothorax, esophageal, or stomach perforation. If these complications occurred, the surgery consultation would be needed.

Sample size and statistical analysis

The sample size was calculated using data from the pilot study of 40 patients which showed the first attempt success rate in the stylet group was 95% and the control group was 70%. To detect this improvement with a power of 0.8 and type I error of 0.05, at least 36 subjects per group had to be included in the analysis to reject the null hypothesis. A dropout was added and the final sample size was 40 subjects for each group.

Statistical analysis was performed by using IBM SPSS Statistics for Windows, version 20.0 (IBM Corp., Armonk, NY, USA). Continuous numerical data (age, weight, height, and nasogastric tube insertion time) were analyzed by mean ± standard deviation. Discrete numerical data (satisfaction score) were analyzed by the median. The normality of distribution was tested by the Shapiro-Wilk normality test. If the distribution of data was normal, an independent t-test would be used to compare variables between the two groups. If the distribution of data was non-normal, the Mann-Whitney U test would be used.

Categorical data (ASA physical status, success rate, failure rate, and, complication rates) were analyzed by the Pearson chi-square test or Fisher's exact test. A p-value of less than 0.05 was considered statistically significant.

Table 1. Patient characteristic data

	Stylet group (n=40); n (%)	Control group (n=40); n (%)
Age (years)		
18 to 65	16 (40.0)	22 (55.0)
>65	24 (60.0)	18 (45.0)
Sex		
Male	30 (75.0)	29 (72.5)
Female	10 (25.0)	11 (27.5)
ASA physical status		
II	5 (12.5)	4 (10)
III	22 (55.0)	22 (55)
IV	13 (32.5)	14 (35)
Weight(kg); mean±SD	62.5±10.29	62.48±10.89
Height (cm); mean±SD	161.59±7.97	160.58±7.75
Nasogastric tube size (Fr)		
14	11 (27.5)	15 (37.5)
16	21 (52.5)	19 (47.5)
18	8 (20.0)	6 (15.0)

ASA=American Society of Anesthesiologists; SD=standard deviation

Results

Eighty patients were enrolled in the present study. There were no statistically significant differences in the patient characteristic data (sex, ASA physical status, age, weight, height, and nasogastric tube size) between the two groups (Table 1).

The first attempt success rate of nasogastric insertion was 92.5% (37 in 40 patients) in the stylet group which was significantly higher than 65% (26 in 40 patients) in the control group (p=0.013). There were three failed nasogastric tube placements on the first attempt in the stylet group, but successful reinsertions were achieved on the second attempt. Failure insertions of a nasogastric tube (more than 3

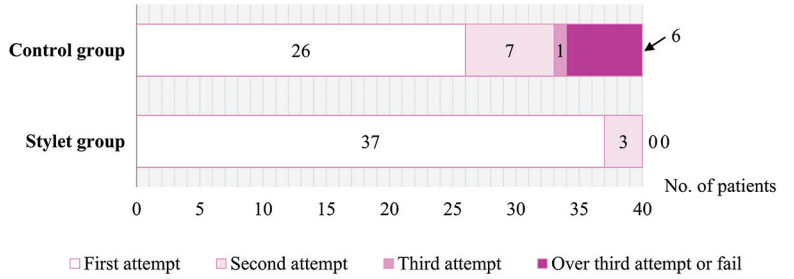

Figure 3. Nasogastric tube insertion success rate.

Table 2. Nasogastric tube insertion data

	Stylet group (n=40); n (%)	Control group (n=40); n (%)	p-value
Success within			
1 attempt	37 (92.5)	26 (65.0)	0.013*
2 attempts	3 (7.5)	7 (17.5)	
3 attempts	-	1 (2.5)	
Fail insertion >3 attempts	-	6 (15.0)	
Success rate (%total – %fail)	40/40 (100)	34/40 (85.0)	0.026*
Time of insertion (second); mean±SD (min-max)	24.85±9.62 (14 to 66)	62.4±59.38 (15 to 195)	0.002*
Satisfaction score (0 to 10)	10 (5 to 10)	8 (1 to 10)	<0.001*

SD=standard deviation

* p<0.05, statistical significance

Table 3. Complications of nasogastric tube insertion

	Stylet group (n=40); n (%)	Control group (n=40); n (%)	p-value
Coiling	3 (7.5)	14 (35.0)	0.003*
Injury			
Minor	1 (2.5)	7 (17.5)	0.057
Moderate	-	-	-
Severe	-	-	-

* p<0.05, statistical significance

attempts) were found in 6 patients in the control group (15%) as Figure 3.

The mean time required to insert the nasogastric tube was 24.85±9.62 seconds in the stylet group which was significantly shorter than 62.4±59.38 seconds in the control group at p=0.002 (Table 2).

The most common complication of nasogastric tube insertion was coiling and kinking of the tube found in 3 cases in the stylet group (7.5%), and 14 cases in the control group (35%) with p=0.003. Only minor complications were found in 1 patient of the stylet group and 7 patients of the control group, but no statistical significance (Table 3).

Discussion

Various techniques to facilitate nasogastric tube insertion in anesthetized patients have been described. According to a review of literature, an esophageal guidewire and the Rusch intubation stylet are 2 methods that improve the first attempt success rate to >90%[9,10].

Kirtania et al used an esophageal guidewire with manual forward laryngeal displacement and the first attempt success rate was 99.2%[10]. After the article was published, there were reports of lung complications, such as tracheal insertion, pneumothorax, and carinal bleeding[11]. They might cause by the spring-tipped end of the esophageal guidewire remained outside the nasogastric tube and the body of the esophageal guidewire was too rigid. These problems were cautioned in the present study. Tip of gastric biopsy forceps was kept at the end of the nasogastric tube and their biopsy mouth could not open within the nasogastric tube. The entire body of gastric biopsy forceps has spring-like flexibility, so they are not too rigid and less trauma.

Tsai et al used the "Rusch" intubation stylet tied with a nasogastric tube by Highwayman's hitch. The first attempt success rate was 94.3%. The "Rusch" intubation stylet was originally designed for tracheal intubation which stylet length might be insufficient in some cases and had to be tied outside the nasogastric tube. Although researchers had claimed that the Highwayman hitch was easy to perform and allowed for a quick release, there was a case that the Highwayman's hitch unexpectedly untied during the procedure[9].

The obstacle to the insertion of the nasogastric tube is due to its soft properties lead to coil and kink. The solution could be an increase in its rigidity. Chun et al made a silicone nasogastric tube rigid by filling distilled water and freezing. But distilled water inside

the nasogastric tube melted quickly on contact with body temperature led to leak and fill the oral cavity causing liquid aspiration[7]. There were reports of modified special device such as ureteral guidewire which the first attempt success rate was 66% (overall success rate 92%)[4]. Other reports were Fogarty catheter[12], guitar string[13], angiography catheter[14], and endoscopic equipment[4], but most of them were reports or letters to the editor to suggest techniques without experimental study.

The other method, for instance, laryngoscope and Glidescope®[8] or digital guidance to navigate nasogastric tube[15] had a limitation in a patient with restricted mouth opening. Flexible stylet could be a benefit in these patients. In the present study, six patients in the control group required rescue technique by direct laryngoscope and Magill forceps after failure of the third attempt insertion which 2 of 6 patients were failed insertion by laryngoscope but successed insertion by the flexible stylet.

The time for the successful placement of nasogastric tube insertion in the control group was significantly longer than that of the stylet group. The reason might be the first attempt success rate in the control group was lower than the stylet group resulted in a longer time interval. If only the time for the first attempt successful placement was considered, it might be no different.

The limitation of the present study method was coiling which found 3 of 40 patients in the stylet group. The stylet was unable to remove from the nasogastric tube. The experiment was performed and found that if the unit of the nasogastric tube with the stylet was bent too much in the stomach or coiled in the mouth or the pharynx, the stylet would be struck in the nasogastric tube. The solution was made by little withdrawn the whole unit of the nasogastric tube and try to remove the stylet again or reinserted. The optimal length of the nasogastric tube with the stylet must be measured from the tip of the nose to the xiphisternum via the tragus of the ear, not to the stomach, and further insert the nasogastric tube to the stomach after the stylet is removed.

Complications were found only minor injuries with self-stopping bleeding. This complication could be lessened by prepared patients' nostrils with a vasoconstrictor such as ephedrine.

No patient in either group had moderated or severe or any life-threatening complications from the nasogastric tube insertion procedure in the present study. So the authors suggest that the safety profile of the modified gastric biopsy forceps as a flexible stylet technique is acceptable. Nevertheless, further study with more sample size should be performed to detect any incidences.

Conclusion

The gastric biopsy forceps assisted nasogastric tube insertion resulted in a higher success rate, less time for insertion, and lower incidence of coiling and kinking than the conventional blind technique without serious complications in anesthetized intubated patients. The present technique should be an alternative accessory instrument to help the nasogastric tube insertion in anesthetized intubated patients or difficult insertion patients.

What is already known on this topic?

Insertion of a nasogastric tube in an anesthetized intubated patient may be difficult. A nasogastric tube is prone to coil and kink during insertion because of the soft material and the weak points of the lateral orifices. Multiple attempts of nasogastric tube insertion might lead to complications. There was a various way to facilitate nasogastric tube insertion. Each method can improve success rate but has different strengths and weaknesses.

What this study adds?

The gastric biopsy forceps assisted nasogastric tube insertion will be an alternative accessory instrument to help the nasogastric tube insertion in anesthetized intubated patients or difficult insertion patients. This study showed higher success rate, less time for insertion, and lower incidence of coiling and kinking than the conventional blind technique, without no serious complications in anesthetized intubated patients.

Acknowledgements

The authors acknowledge the effort of the entire site investigating team for making this work possible, and Dr. Varinee Lekprasert for language editing.

Ethics approval and consent to participate

The present study was approved by the Ramathibodi Ethics Committee (ID 08-57-17).

Authors' contributions

All authors were responsible for the conception and design of the study. Ruananukun N, Vijitpavan A, and Simasatikul C were responsible for the collection of data. Ruananukun N analyzed and interpreted data. Ruananukun N and Simasatikul C drafted the

manuscript and approved the final version. All authors read and approved the final manuscript.

Funding disclosure

The present study was funded by Ramathibodi Hospital, Mahidol University, Thailand. The study received no specific grant from any funding agency in the commercial sector.

Conflicts of interest

The authors declare that they have no competing interests.

References

1. Ozer S, Benumof JL. Oro- and nasogastric tube passage in intubated patients: fiberoptic description of where they go at the laryngeal level and how to make them enter the esophagus. Anesthesiology 1999;91:137-43.
2. Boyes RJ, Kruse JA. Nasogastric and nasoenteric intubation. Crit Care Clin 1992;8:865-78.
3. Bong CL, Macachor JD, Hwang NC. Insertion of the nasogastric tube made easy. Anesthesiology 2004;101:266.
4. Appukutty J, Shroff PP. Nasogastric tube insertion using different techniques in anesthetized patients: a prospective, randomized study. Anesth Analg 2009;109:832-5.
5. Fassoulaki A, Athanassiou E. Cardiovascular responses to the insertion of nasogastric tubes during general anaesthesia. Can Anaesth Soc J 1985;32:651-3.
6. Perel A, Ya'ari Y, Pizov R. Forward displacement of the larynx for nasogastric tube insertion in intubated patients. Crit Care Med 1985;13:204-5.
7. Chun DH, Kim NY, Shin YS, Kim SH. A randomized, clinical trial of frozen versus standard nasogastric tube placement. World J Surg 2009;33:1789-92.
8. Moharari RS, Fallah AH, Khajavi MR, Khashayar P, Lakeh MM, Najafi A. The GlideScope facilitates nasogastric tube insertion: a randomized clinical trial. Anesth Analg 2010;110:115-8.
9. Tsai YF, Luo CF, Illias A, Lin CC, Yu HP. Nasogastric tube insertion in anesthetized and intubated patients: a new and reliable method. BMC Gastroenterol 2012;12:99.
10. Kirtania J, Ghose T, Garai D, Ray S. Esophageal guidewire-assisted nasogastric tube insertion in anesthetized and intubated patients: a prospective randomized controlled study. Anesth Analg 2012;114:343-8.
11. Moon HS, Kang JM, Chon JY. Beware of lung complications when using guidewire-assisted nasogastric tube insertion. Anesth Analg 2013;116:263-4.
12. Rosenberg H. A new technique for inserting nasogastric tubes during anesthesia. Anesthesiology 1975;42:632.
13. Matsuki A, Zsigmond EK. Simple and reliable method of inserting a nasogastric tube during anasthesia. Br J Anaesth 1972;44:610.
14. Ghatak T, Samanta S, Baronia AK. A new technique to insert nasogastric tube in an unconscious intubated patient. N Am J Med Sci 2013;5:68-70.
15. Mahajan R, Gupta R. Another method to assist nasogastric tube insertion. Can J Anaesth 2005;52:652-3.