RESEARCH ARTICLE

The Relationship Between the Location of the Nasogastric Tube and Ventilator-Associated Pneumonia in Patients Hospitalized in the Intensive Care Unit

Shahram Seifi[1], Shahrbanoo Latifii[1], Seyed Taghi Hamidian[1], Farbod Zahedi Tajrishi[1]

Background: It is recommended to start nutrition early in critically ill patients and the preferred method to do so is enteral nutrition which in most cases is achieved by inserting a feeding tube during the first 24 hours. These tubes are placed blindly so the tip of the tube can be placed in different locations. The authors had predicted that placing the tip of the feeding tube in various locations could produce different results in terms of the prevalence of ventilator-associated pneumonia.

Methods: We performed this cross-sectional study on 147 patients admitted to the intensive care unit of the Rohani hospital and intubated for at least 5 days receiving enteral feeding via nasogastric (NGT) or gastric tube. Patients were divided into two groups based on the location of the tip of the feeding tube-esophagus or stomach. They were compared in terms of early ventilator-associated pneumonia (VAP) within the first 3-5 days and nasogastric complications such as bleeding, sinusitis and obstruction of the feeding tube.

Results: Based on our findings, VAP occurred in 12.2%of the patients. This rate was 9.6% when we placed the nasogastric tube into the stomach and 27.2% when in the esophagus. This difference between the two groups was statistically and clinically significant, while the rate of bleeding, sinusitis and nasogastric tube obstruction was the same between them.

Conclusion: The rate of VAP is significantly different when we feed the patients by a nasogastric tube inserted into the stomach (9.6%) and when we do so by placing the tube into the esophagus (27.2%).

Keywords: ventilator-associated pneumonia; endotracheal tube; nasogastric tube

Early feeding in critically ill patients reduces the infection rate and improves wound healing [1]. The enteral method is preferred in most cases, because it is cheaper, helps maintain the integrity of the intestinal mucosal barrier and prevents the translocation of intestinal bacteria.

Since providing nutrition through stomach is closer to the normal state of the body, feeding tubes are placed within the first 24 hours. While inserting the tube, its tip is invisible to the professional doing the procedure, so the tip can be placed in several locations, including the airways and lungs, esophagus, stomach and intestines (Post Pyloric). Therefore, early feeding without documenting the location of the feeding tube may have different consequences.

Nasogastric tube can also have negetive effects: It may cause inadequate function of the upper and lower gastroesophageal sphincter, maxillofacial sinusitis and increased pharyngeal colonization [2]. It would also facilitate the occurrence of gastrointestinal reflux, micro-aspiration and ventilator-acquired pneumonia. In fact, enteral nutrition is recognized as a risk factor for ventilator-associated pneumonia (VAP). VAP is a type of nosocomial pneumonia that occurs more frequently in patients undergoing mechanical ventilation for more than 48 hours in the intensive care unit. It is the second most common nosocomial infection and also the first cause of death from nosocomial infections in the ICU with a crude mortality rate of 30 to 70 percent [3]. In addition to causing prolonged stay in the ICU, problems for the patient, his family and the hospital, VAP also increases mortality and treatment expenses [3]. Post pyloric feeding tube embedding, although not proven, may reduce aspiration, nosocomial pneumonia and mortality [4]. The authors designed and implemented this study because they had predicted that placing the tip of the feeding tube in different locations, could result in different prevalence rates of nosocomial pneumonia, especially VAP.

Methods

We performed this descriptive cross sectional study from spring 2014 to spring 2015 on 147 patients who were hospitalized in intensive care units of Rohani hospital of Babol, and were intubated for at least 5 days receiving enteral feeding via nasogastric tube (NGT). The inclusion criteria were as follows: (1) ICU admission immediately

From the [1]Clinical Research Development Unit of Rouhani Hospital, Babol University of Medical Science, Babol, Iran.
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*Corresponding author: Shahram Seifi, MD. Clinical Research Development Unit of Rouhani Hospital, Babol University of Medical Science, Babol, Iran. E-mail: ficu_ss@yahoo.com

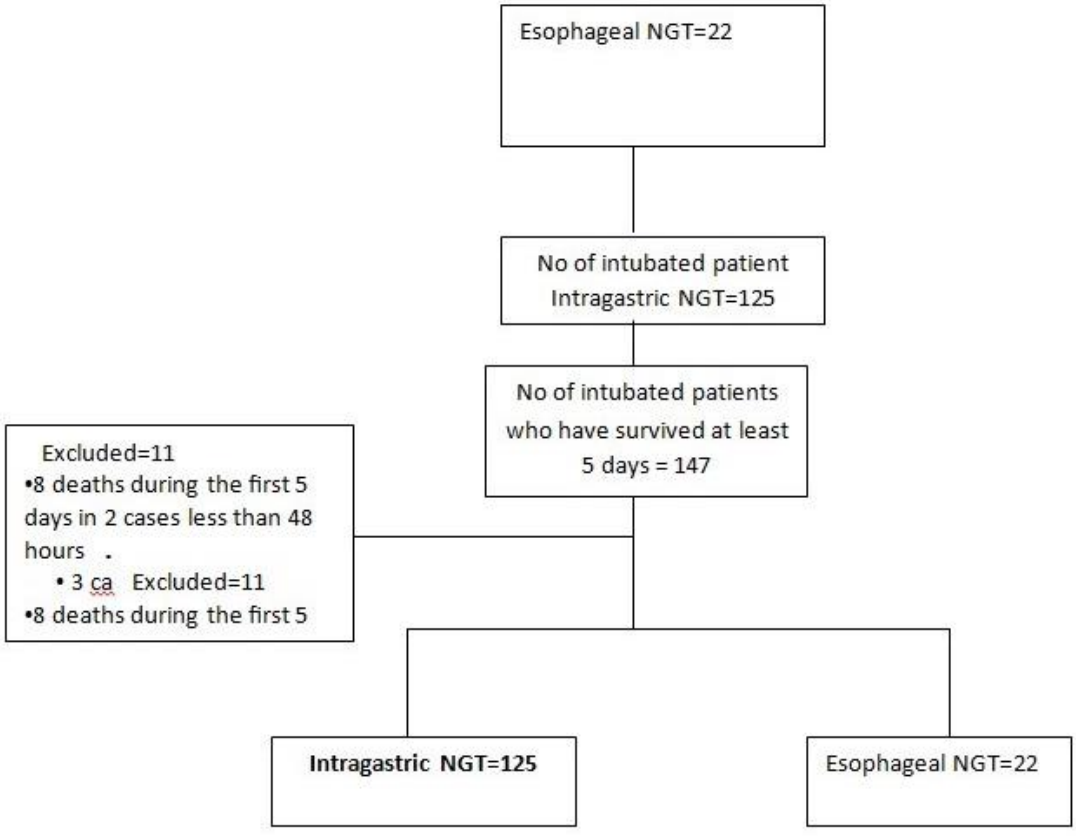
after intubation and nasogastric or orogastric tube insertion; (2) Intubation and nasogastric tube for at least 5 days; (3) Initiation of enteral nutrition during the first 48 hours of admission. The exclusion criteria included gastrointestinal diseases that would preclude enteral feeding, severe pulmonary disease, bronchoscopy and other diagnostic and therapeutic procedures on respiratory system, re-intubation, severe organ failure, chemotherapy, immunodeficiency, separation from the ventilator and patient's death. After placing the tube, we determined the position of its tip by measuring the distance between tragus and mentum, adding it to the distance between mentum and the thyroid. Also, on days 3 and 5, we performed plain radiography to confirm the position of the tip. The results were all recorded as either esophagus or stomach.

Daily nutrition was started with standard feeding solutions during the first 48 hours of hospitalization and with a volume of 1000-2000 ml.

Patients were evaluated for early VAP 3-5 days after admission. According to common ICU guidelines, cultures of airway secretions are obtained and evaluated for patients who have at least 6 symptoms of Clinical Pulmonary Infection Score (CPIS) (which includes temperature, blood leukocyte level, tracheal secretions, oxygenation, chest radiography presentations, tracheal culture). In our study, cultured airway secretions were obtained by mini ball in a standard setting and then were sent to the microbiology laboratory. Culture results and antibiogram were reported after 48 hours by the hospital microbiology laboratory and a diagnosis of VAP was recorded in the project questionnaires if there was a CPIS of 6 or more. Complications of gastric tube insertions include bleeding, sinusitis and obstruction were also reviewed. Bleeding was defined as an overt bleeding during placing the nasogastric tube and pressure on the nose was necessary to stop it. Purulent and malodorous discharges from one or both nasal cavities starting within two to three days after placing the nasogastric tube was defined as sinusitis, Obstruction on the other hand, was defined as the inability to pass feeding solutions through the NGT to an extent that washing the tube was necessary to open its path. In this study, 11 patients (of the total 158 cases) were excluded: 8 of them because of death and 3 others because of early separation from ventilator. (Figure 1)

In the end, according to the diagnostic criteria, patients' data were classified separately in tables and were analyzed using a chi-square test equal to 723/2, a degree of freedom of 1, and 0.05> P.

Figure 1- Flowchart of the patients



Results

Of the 147 study patients, 77 patients were male (%52/3), 70 were females (%47/7) and the mean age of patients was 58.78±18.4 years. Table 1 compares the mean age and gender differences of the study patients in both groups considering the provided P value. The presented differences are not statistically significant (P = 0.7) (Table 1)

We diagnosed 7 patients (%4.7) with sinusitis on the third day. One of these patients was in group Esophageal and the other 6 were in group Gastric (%4.5). Our team also observed bleeding in 10 studied patients on the third day (%6.8). 8 of them were in group Gastric (%6.4) and 2 in group Esophageal (%9). Obstruction was seen in 13 patients (%8.8) 11 of them were in group Gastric, (%8/8) and the

two others (one on the third day and another on the fifth) were in group Esophageal (%9). The provided data showed that the rate of sinusitis, bleeding, and obstruction in the two groups differ, but a chi-square test of 2.723 and a degree of freedom of 1 indicated that this difference was not statistically significant (P = 0.12).

Pneumonia was observed in 18 patients (%12/2): 12 in group gastric (%9/6) and the other 6 (four cases on third day and two on fifth) in group esophageal (%27/2) (Table 2).

Table 1- Comparison of background variables between the study groups

	Esophageal NGT=22	Intragastric NGT=125
Number (%)	22 (14.9)	125 (85.1)
Age (years)	0.97±19.78	59.59±17.14
Sex (%of men)	68.1	49.6

Table 2- Comparison of the dependent variables of two study groups

	Esophageal NGT=22	Intragastric NGT=125
Pneumonia (%)	27.2	9.6
Sinusitis (%)	4.5	4.8
Bleeding (%)	9	6.4
Obstruction (%)	9	8.8

Discussion

In our study, we observed improper placement of feeding tubes (Malpositioned Feeding Tube = MFT) in %14.97 of cases. Several studies have already been published on the effects of MFT, one of which reporting its occurrence rate to be 15% [5-6]. Based on our findings, VAP occurred in %12.2 of all patients, This rate was 6.9% and 27.2% for gastric and esophageal NGT groups respectively. The observed difference was statistically and clinically significant. In other words, according to this study, feeding patients with gastric feeding tube placed in the esophagus, increases VAP incidence by %17/6.

According to several studies, one in four cases of aspiration of gastric contents into the respiratory tract, results in pneumonia [7]. Also, our findings showed that aspiration increases by 52.8% in patients with gastric tube placed in the esophagus. A paper that has published similar results in dogs in 2013 though, failed to show an increased incidence of pneumonia in those fed through a tube into the esophagus [8]. Various studies, reported improper placement of the feeding tube including the insertion of the tube in air passages and pharynx, that can make it dangerous to start the feeding process [9]. Furthermore, similar studies as well as ours, have stated that feeding with tube placed in the esophagus can increase the risk for aspiration [7,9]. It is remarkable that in all these studies, nutritional complications can be prevented by correctly inserting nasogastric feeding tubes [7,9]. Therefore, they all agree that it's important to make sure the tip of the feeding tube before feeding tube is placed correctly before proceeding to start feeding. Of course, it is worth noting numerous studies have shown that although the risk of pneumonia in patients receiving entral feeding through NGT increases, the overall incidence risk of infection in these patients is less than those receiving intravenous feeding [1,7]. Also, note that because the contents of aspiration in these two categories of patients are different (due to differences in consumed gavage, chemical composition and osmolality, gavaged oral medications, gastric pH and volume, combination with gastric secretions, especially trypsin and bilirubin), different types of lung injuries that haven't been investigated in this study can possibly occur [7]. We recommend future studies to investigate them.

Improper placement of the feeding tube (Malpositioned Feeding Tube = MTF) is devided into two categories: respiratory and gastrointestinal [7]. MFT in the respiratory tract approximately occurs in %2/5 of cases [5,9] and can cause agent aspiration by proxy [7] and death. That is why in many centers, radiographic assessment by an ICU attendant or radiologist is necessary after placing the feeding tube and before starting gavage. In one study, interventions to reduce the incidence rate of improper placement of a feeding tube in the respiratory tract during a period of 15 months, were able to zero this rate [5]. Improper placement of gastric feeding tube is when the tube is placed in the esophagus or when its tip returns from the small bowel into the stomach [7]. Displacement of the feeding tube is common among patients with a feeding tube in the ICU. Tube being pulled out by unconscious patients, unwanted pulling of the tube by health care team or with patient movements, can all cause displacement of the feeding tube.

In one study, during a 3-day follow-up of 201 patients with correctly inserted feeding tubes, there was a displacement in 25 cases (%12/4): In only 2 cases, the tube had gone to the esophagus and in 23, it had moved from the small intestine into the stomach [10]. It's almost impossible that a properly embedded tube be moved into the respiratory tract and most of the displacements occur along the gastrointestinal tract [11].

It is also reported that placing a feeding tube into the esophagus, particularly in combination with other risk factors for aspiration such as ascites, abdominal distension and loss of consciousness may increase the risk for aspiration [7,12-13].

Center for Disease Control has recommended that feeding tube displacement be considered before each meal gavage [14] and the easiest method proposed for doing so is to observe the length of the feeding tube. Also, increased lavage fluid volume, decreased pH of the lavage fluid, a change in the appearance of lavage fluid before each gavage meal, and ETCO2 measurement can show the displacement of feeding tube from small bowel into the stomach.

Conclusions

Safe placement of the feeding tube and daily improvement during feeding decreases the risk of aspiration and VAP.

Instructions for feeding tube safe placement in patients:

1. Review indications, absolute and relative contraindications of NGT placement to reduce complications, especially hemorrhage.
2. Position the patient accordingly and, if necessary, administer a mild sedative and properly lubricate the NGT.
3. Insertion of the feeding tube should be supervised

by the ICU fellow or attendant. Using capnography or direct laryngoscopy is recommended to make sure the NGT is not inserted into the trachea.

4. Proper length of the feeding tube should be inserted to the stomach- 30 to 35 cm from the tip of the nose, or 20-25 cm from the mouth. Monitoring the process by capnography is also mandatory. If it doesn't confirm the presence of CO2, push the feeding tube 5 cm further, and again monitor by capnograph.

5. After placing a feeding tube in the desired location using the recommended methods, listen to the sound of the air injected by a gavage syringe into the stomach via the NGT and then fix it with adhesives. This process should be conducted to evaluate the location of feeding tube, according to, the feeding tubes are radiopaque, abdominal or chest radiography was performed by the ICU fellow or attendant or radiologist, be allowed to start gavage.

6. It is recommended that the location of feeding tube be controlled by the nurse in charge of the patient before each meal. Gavage if you suspect improper placement.and if necessary, correct the location of the tube.

7. Daily washing of the NGT with water can prevent its obstruction.

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References

1. Bigatello LM, Alam H, Allain RM. Critical care handbook of the Massachusetts General Hospital: Lippincott Williams & Wilkins; 2010.
2. Alp E, Voss A. Ventilator associated pneumonia and infection control. Ann Clin Microbiol Antimicrob. 2006; 5(1):7.
3. Vincent J-L, Abraham E, Kochanek P, Moore FA, Fink MP. Textbook of critical care: Elsevier Health Sciences; 2011.
4. Zhang Z, Xu X, Ding J, Ni H. Comparison of Postpyloric Tube Feeding and Gastric Tube Feeding in Intensive Care Unit Patients A Meta-Analysis. Nutr Clin Pract. 2013; 28(3):371-80.
5. Sorokin R, Gottlieb JE. Enhancing patient safety during feeding-tube insertion: a review of more than 2000 insertions. JPEN J Parenter Enteral Nutr. 2006; 30(5):440-5.
6. Pillai JB, Vegas A, Brister S. Thoracic complications of nasogastric tube: review of safe practice. Interact Cardiovasc Thorac Surg. 2005; 4(5):429-33.
7. Metheny NA. Preventing respiratory complications of tube feedings: evidence-based practice. Am J Crit Care. 2006;15(4):360-9.
8. Yu MK, Freeman LM, Heinze CR, Parker VJ, Linder DE. Comparison of complication rates in dogs with nasoesophageal versus nasogastric feeding tubes. J Vet Emerg Crit Care (San Antonio). 2013; 23(3):300-4.
9. Metheny NA, Meert KL, Clouse RE. Complications related to feeding tube placement. Curr Opin Gastroenterol. 2007;23(2):178-82.
10. Metheny NA, Schnelker R, McGinnis J, Zimmerman G, Duke C, Merritt B, et al. Indicators of tubesite during feedings. J Neurosci Nurs. 2005; 37(6):320-5.
11. Metheny NA, Spies M, Eisenberg P. Frequency of nasoenteral tube displacement and associated risk factors. Res Nurs Health. 1986; 9(3):241-7.
12. Seguin P, Le Bouquin V, Aguillon D, Maurice A, Laviolle B, Malledant Y, editors. Testing nasogastric tube placement: evaluation of three different methods in intensive care unit. Ann Fr Anesth Reanim; 2005; 24(6):594-9.
13. Nakajima M, Kimura K, Inatomi Y, Terasaki Y, Nagano K, Yonehara T, et al. Intermittent oro-esophageal tube feeding in acute stroke patients–a pilot study. Acta Neurol Scand. 2006; 113(1):36-9.
14. Tablan OC, Anderson LJ, Besser R, Bridges C, Hajjeh R. Guidelines for Preventing Health-CareAssociated Pneumonia. InAtlanta, GA: US National Centers for Infectious Disease, MMWR 53/RR-3 2003.