



Original Article

Changes in Gastroesophageal Reflux in Patients With Nasogastric Tube Followed by Percutaneous Endoscopic Gastrostomy

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Background/Purpose: Despite frequent use of percutaneous endoscopic gastrostomy (PEG) for enteral feeding, the relationship between it and gastroesophageal reflux (GER) remains an incompletely answered question. We conducted this study to compare the GER between the same patients fed with a nasogastric (NG) tube and later with a PEG tube.

Methods: We enrolled 15 patients who had received NG tube feeding for > 6 months and were about to receive PEG tube insertion. We used Ponsky's pull method with 24 Fr feeding tubes. They received two GER scans, one just before PEG tube insertion and another 1 week after insertion. We drew regions of interest of radioactivity in the esophagus and stomach manually. The ratios of radioactivity of the region of interest in the esophagus over the stomach (GER ratio) were calculated to evaluate the severity of GER and compared.

Results: The GER ratios of these patients were all small and < 3% except one that was 4.7% in one patient before PEG tube insertion. There was a small but substantial decrease (65% risk reduction) in GER ratio after PEG tube insertion. After arcsine transformation, the difference in the transformed data between patients fed with an NG tube and after PEG tube insertion was significant ($t = 2.46$, $p = 0.028$), and was lower after PEG tube insertion.

Conclusion: Our study demonstrates by scintigraphy a small but significant reduction of GER after shifting from NG to PEG tube feeding.

Key Words: gastroesophageal reflux, nasogastric tube, percutaneous endoscopic gastrostomy, scintigraphy

Aspiration pneumonia is one of the serious complications of tube feeding and has been reported to occur in 10–22% of patients fed by gastrostomy in nursing homes.¹ There are several mechanisms that can contribute to occurrence of aspiration; among them, gastroesophageal reflux (GER) is considered

the most plausible. Although clinicians might take it for granted that the use of percutaneous endoscopic gastrostomy (PEG) decreases the risk for GER, this rationale has not been entirely justified. This controversy is supported by the conflicting results reported in the literature.^{2–6}

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In Taiwan, the demand for and application of PEG have substantially increased recently.^{7,8} However, to the best of our knowledge, the efficacy of PEG in decreasing GER and therefore for prevention of aspiration pneumonia have not been studied before. Also, studies that have directly compared PEG with nasogastric (NG) tube feeding have been rare.⁹ Therefore, we conducted this prospective study to compare the occurrence of GER before and after PEG tube insertion in patients who had received NG feeding, using an objective quantification method with radionuclide scanning.

Patients and Methods

Patients

We enrolled patients who had received NG feeding (16 Fr in size) for > 6 months and were about to undergo PEG tube insertion. After obtaining consent from the patients or their families, the patients received two GER scanning examinations; one examination just before PEG tube insertion and one at 1 week after insertion. Those who could not cooperate, or had active malignant diseases or infectious diseases were excluded. Prokinetic agents and proton pump inhibitors were not administered from 1 week before the first until the second GER examination. This study was approved by the reviewing board of Far Eastern Memorial Hospital and was monitored during its execution.

PEG tube insertion

We used Ponsky's pull method¹ with 24 Fr feeding tubes (PEG-24-Pull; Wilson-Cook Medical Inc., Winston-Salem, NC, USA). We administered 1 g cephalothin intravenously 30 minutes before the procedure for each patient. We opened the feeding tube for drainage for 24 hours and started to feed the patient from the day 2.

GER scan

After fasting for at least 6 hours, we injected a solution of 300 mL orange juice mixed with 2 mCi

(74 MBq) Tc-99m diethylenetriamine pentaacetic acid via either a NG or PEG tube into the stomach. The patients remained in the supine position for imaging. We used a dual-head gamma camera (Siemens E-CAM, USA) equipped with a low-energy high-resolution collimator to take anterior view images. We used a plastic band connected to the tourniquet of a sphygmomanometer to apply abdominal compression of 0, 40, 80, 120, and 160 mmHg. Static images were acquired and stored in 256 × 256 matrices. A nuclear physician drew manually the regions of interest of the esophagus and stomach. We counted the ratios of radioactivity of the regions of interest of the esophagus and stomach to obtain a GER ratio, to evaluate the severity of GER (Figure). We chose the highest value obtained by application of different abdominal pressures for analysis.

The percentages of GER ratio before or after PEG tube insertion were small, close to 0, and did not follow a normal distribution. Therefore, we converted them to arcsine values (arcsine value = $\sin^{-1}(\sqrt{\text{proportion}})$) and then compared these transformed values by means of a paired *t* test.

Results

From November 2002 to June 2004, we enrolled 15 patients for this study. There were nine male and six female patients, with a mean age of 74.5 years, who had received GER scanning examinations before and after PEG tube insertion. The indications for PEG tube insertion were 10 with cerebrovascular accident, two with dementia, and one each with head injury, Parkinsonism, and nasopharyngeal carcinoma after radiotherapy. All these patients had smooth courses after PEG tube insertion and tolerated GER scanning examinations well. Three of these patients had mild erosive esophagitis diagnosed during PEG tube insertion. The GER ratios before and after PEG tube insertion are listed in the Table. The GER ratios before and after PEG tube insertion were all small and < 3%, except for one that was 4.7% in one patient before PEG tube insertion. The

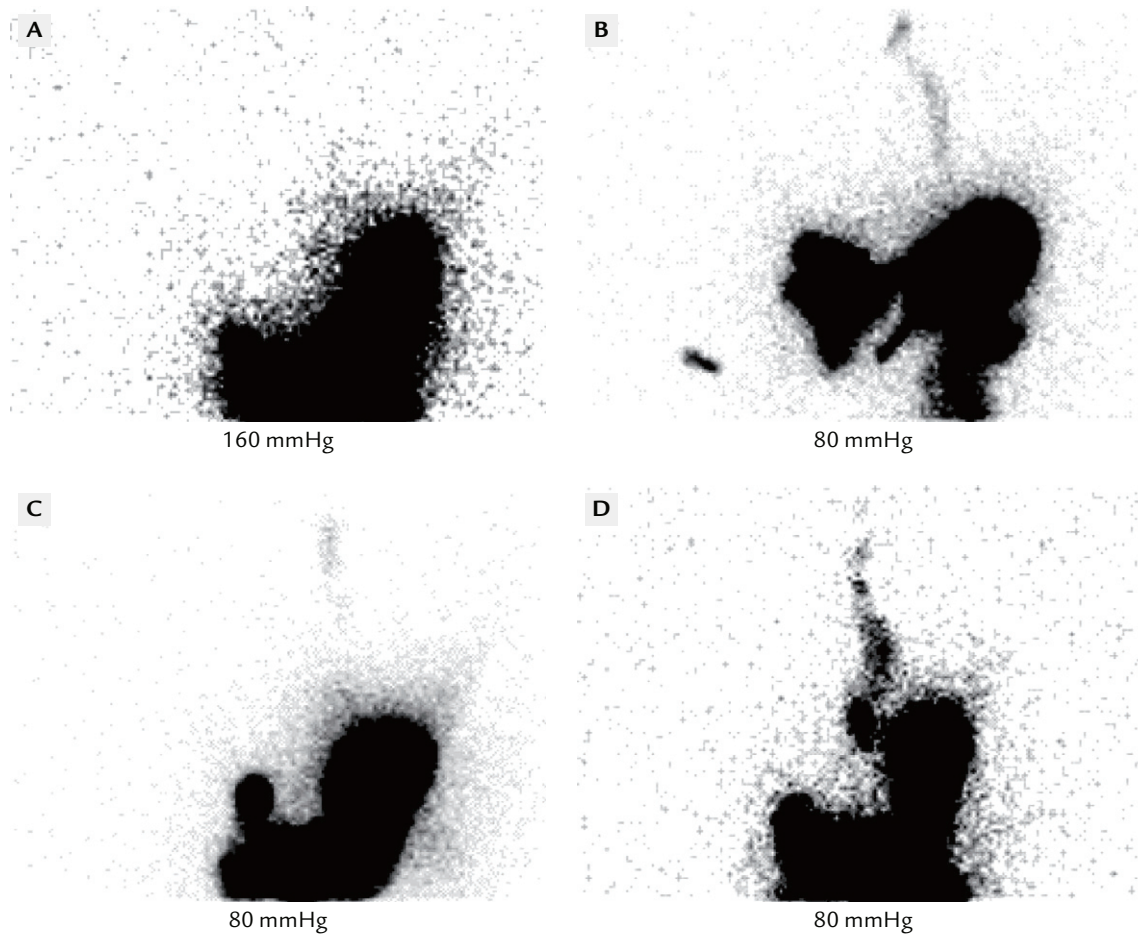


Figure. Scintigraphic images of gastroesophageal reflux with different severities: (A) 0.29%, (B) 0.43%, (C) 0.72%, and (D) 1.75%.

Table. Gastroesophageal ratios of 15 patients fed with nasogastric tubes and then with percutaneous endoscopic gastrostomy tubes

Patient	Nasogastric tubes	Percutaneous endoscopic gastrostomy tubes
1	1.20	0.88
2	0.43	0.41
3	0.91	0.24
4	4.72	0.24
5	0.45	0.12
6	0.29	0.43
7	2.03	0.40
8	0.30	0.51
9	0.62	0.11
10	0.38	0.38
11	0.52	0.55
12	1.75	0.15
13	0.32	0.23
14	0.35	0.17
15	0.26	0.30

GER ratio showed a substantial decrease after PEG tube insertion. The summation of GER ratio before and after PEG tube insertion showed that the application of PEG, albeit in a small number of patients, yielded a 65% reduced risk of GER $[(14.53 - 5.12)/14.53 = 65\%]$ as compared with NG feeding. After arcsine transformation, the difference in the transformed data between patients fed with NG tube and after PEG tube insertion was significant ($t = 2.46, p = 0.028$), and was lower after PEG tube insertion.

Discussion

Aspiration pneumonia is a common and serious complication of tube feeding.^{1,10} It occurs as a result of swallowing disturbance, which is inevitable in patients who are undergoing tube feeding,

and GER. Cole et al demonstrated continued aspiration in a patient despite changing from an NG tube to PEG tube by scintigraphy study in 1987.¹¹ Canal et al also have showed increased GER and decreased lower esophageal sphincter pressure in cats receiving Stamm gastrostomy.¹² Thereafter, some studies have shown that GER increases after PEG tube insertion.^{2,3,13} However, other studies have revealed conflicting results and no increase of GER after PEG tube insertion.⁴⁻⁶ These inconsistent results are probably related to different study populations and modalities to detect GER, including pH meter, manometry, scintigraphy, barium study, and clinical outcome.

Our study demonstrated a significant reduction in GER after the shift from NG to PEG tube feeding. This result is similar to that of 11 patients reported by Wakamatsu et al in 2008.¹⁴ There are some differences between NG and PEG tube feeding, such as the presence of the NG tube across the gastroesophageal junction, and the anatomical and physiological changes induced by gastrostomy, especially for gastric emptying. Canal et al have proposed that the increase in GER after Stamm gastrostomy in cats was due to changes in the gastroesophageal angle caused by the operation.¹² However, the influence of PEG tube insertion on the gastroesophageal junction might be much less than that caused by surgical gastrostomy. Johnson has demonstrated increased lower esophageal sphincter pressure in patients after PEG tube insertion,⁴ which differs from the animal study of surgical gastrostomy performed by Canal et al.¹² Some authors have proposed that gastric emptying might be interfered with by PEG tube insertion leading to GER. However, the studies of Ono et al⁹ and Wakamatsu et al¹⁴ have both shown that the gastric emptying improves after PEG tube insertion.

Only a few studies have directly compared the effect of PEG and NG tubes on GER.¹⁴ Only scintigraphy can be used for such comparison. Our study compared the GER before and after PEG tube insertion in adults who had received NG feeding, using a scintigraphic method as proposed by Balan et al.¹⁵ Several prospective studies

have compared aspiration in different patients fed via NG or gastrostomy tubes.¹⁶⁻¹⁹ Two studies did not reveal any difference in a short period of observation.^{17,18} The other study with follow-up of >6 months showed a lower rate of aspiration in the PEG group.¹⁹ Although our study demonstrated a significant reduction in GER after the shift from NG to PEG tube feeding, the difference in reflux activity was relatively small. This implies that more patients or longer follow-up is required to see a significant difference in GER and its complications in these two groups of patients in a clinical setting.

Aspiration is a major concern of tube feeding, and there are several approaches for its prevention. Pump-assisted enteral feeding, semi-recumbent position, and half-solid nutrients for PEG feeding have been reported to reduce the occurrence of aspiration.²⁰⁻²² Razeghi et al have proposed avoidance of PEG tube insertion in the gastric antrum because it could significantly increase GER.²³ Arnbjornsson and Larson have reported that laparoscopic gastrostomy does not increase GER in children.²⁴ Transpyloric feeding, although with some controversy, is recommended for tube-feeding patients with frequent aspiration pneumonia.^{25,26} However, it still cannot prevent oropharyngeal aspiration, and Lien et al have demonstrated that jejunal feeding can still provoke GER.²⁷ Therefore, prevention of aspiration should not be the sole reason for the patients to receive PEG and jejunostomy.

There were some limitations in our study. The case number was small and therefore it was difficult to demonstrate any statistically significant difference. Therefore, we needed to transform our GER data for analysis. Although we also recorded the presence of reflux esophagitis during PEG tube insertion, we could not find any correlation with GER detected by scintigraphy and endoscopy, which was probably due to the small sample size. In addition, this was a short-term cross-sectional study. The long-term effect of PEG tube insertion and the presence of reflux esophagitis on aspiration needs further investigation.

In conclusion, our study demonstrated scintigraphically a small but significant reduction in

GER after the shift from NG to PEG tube feeding. Our results imply that PEG might yield a small advantage over NG feeding and reduce aspiration pneumonia in long-term enteral feeding.

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