Prevention of PEG Tube Misplacement in the Transverse Colon: Method of Introducing a Gastrografin into the Stomach

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Conflict-of-interest statement: The authors declare that there is no conflict of interest regarding the publication of this paper.

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ABSTRACT

AIM: A colocutaneous fistula is a rare late complication of percutaneous endoscopic gastrostomy (PEG) feeding placement that occurs as a result of the interposition of the colon between the anterior abdominal and gastric walls. In the current study, we sought to retrospectively study the method of introducing the water-soluble contrast agent into the stomach by using a nasogastric tube before PEG feeding placement, with the intention to develop a method to prevent PEG-related colocutaneous fistula.

MATERIALS AND METHODS: Between October 2003 and April 2020, 341 patients underwent PEG placement at Seiwa Memorial Hospital. Patients were divided into two groups: 232 patients in Group A were given water-soluble contrast agent and 109 patients in Group B were not. All patients underwent PEG using introducer method placement after gastropexy under fluoroscopy.

RESULTS: In Group A, 139 (59.9%) patients received PEG with a water-soluble contrast agent placed into the transverse colon, 75 (32.3%) received PEG with gas in the colon, and 7 (3.0%) patients received surgical gastrostomy. In Group B, 38 (34.8%) patients received PEG with gas in the colon, 60 (55.1%) patients received PEG with finger palpation and transillumination, and 10 (9.2%) patients received surgical gastrostomy. Colocutaneous fistula was not observed in either group, but there was a significant difference in the frequency of surgical gastrostomy between Group A and B (p = 0.0148).

CONCLUSION: The use of water-soluble contrast agent in the stomach was safe, reliable, and cost effective for PEG tube placement, and is recommended to decrease surgical gastrostomy.

Key words: Colocutaneous fistula; Diatrizoate meglumine and diatrizoate sodium; Gastrografin; Percutaneous endoscopic gastrostomy; Transverse colon

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Ono H, Yokoyama H, Yoshida H, Fukushima H, Kawakami M, Okamura M, Aoki T, Asakage N, Nagashima K, Danjo Y, Hayashi H, Nishihara H, Shimizu Y, Shimamura T, Kusano M. Prevention of PEG Tube Misplacement in the Transverse Colon: Method of Introducing a Gastrografin into the Stomach. *Journal of Gastroenterology and Hepatology Research*. 2020; 9(5): 3320-3324 Available from: URL: http://www.ghnet.org/index.php/jghrr/article/view/2971

**INTRODUCTION**

Percutaneous endoscopic gastrostomy (PEG) is a safe and effective technique for enteral feeding[1]. Despite the widespread use of PEG tubes, this procedure is associated with a variety of complications, including peristomal infection, aspiration pneumonia, stomal leakage, and peritonitis[2]. Colocutaneous fistula is a delayed and rare complication of PEG tubes[3][4][5] that is believed to occur in a small minority (0.5%-1%) of adults undergoing PEG insertion[6][7], and more frequently in children, at a rate of 2%-3.5%[8][9][10]. It is well known that PEG tubes can occasionally migrate from the stomach into the transverse colon via a gastrocolic fistula. In most cases, the tube can be removed without the need for surgery, but emergent laparotomy or surgery is indicated in cases with perforation or peritonitis[10]. The conservative approach needs several days or weeks for complete healing of the colocutaneous fistula[11], and patients require the PEG to be replaced; therefore, it is important to avoid this complication. The aim of the current study was to prevent the occurrence of colocutaneous fistula. To this end, we changed the method of introduction of the water-soluble contrast agent into the stomach to involve insertion of the nasogastric tube prior to the PEG placement.

**METHODS**

**Patients**

We included 341 patients (141 males and 200 females, 46–103 years old; mean age, 83.3±9.1 years) who underwent PEG due to dysphagia from October 2003 to April 2020 at Seiwa Memorial Hospital. Of the 341 patients, 124 cases (36.4%) had cerebrovascular disease, 114 had dementia, and 21 had malignancy. None of the patients underwent surgery of the gastrointestinal tracts before PEG placement, and none of the patients had an ileus. This study was performed according to the principles of the Declaration of Helsinki, and approval was given by the Ethics Committee of Seiwa Memorial Hospital. Written informed consent was obtained from all patients or their families.

**Protocol for PEG placement**

Patients were divided into two groups. In Group A patients (232 cases; from March 2007 to April 2020), 40 ml of diazirote meglumine and diatrizoate sodium, and Gastrografin (Schering AG, Berlin, Germany) was administered through a nasogastric tube into the stomach at the semi-Fowler position 4 hours before PEG placement. With the patients in supine position, fluoroscopy of the abdomen was performed, and the state of the transverse colon was confirmed before using the endoscope. Next, we observed the transverse colon and stomach after inserting an endoscope into the abdomen was performed, and the state of the transverse colon could not be recognized. There were significant differences between Group A and B as the cases who could not recognize the transverse colon (p < 0.0001) (Table 2).

In Group A, 139 cases (59.9%) were constructed with clues of Gastrografin, 75 cases (32.3%) were confirmed with clues of gas, five cases were constructed by finger palpation and transillumination, seven cases were confirmed at a later by the surgical gastrostomy, and six cases were constructed at a later using the colonoscope (Figure 4). In Group B, 38 cases (34.8%) were confirmed with clues of gas, 60 cases (55.1%) were constructed by finger palpation and transillumination, 10 cases were confirmed at a later by surgical gastrostomy, and one case was constructed at a later using the colonoscope. There were significant differences between Group A and B as the cases who performed by the finger palpation and transillumination (p < 0.0001), and those who underwent surgical gastrostomy (p = 0.0148) (Table 3).

**DISCUSSION**

The exact mechanism for formation of fistulous communication between the stomach and colon is unknown, but various theories have been postulated, especially in children where the complication is encountered more frequently. The five most popular theories are as follows: (1) Following introduction of the endoscope, air is insufflated in the stomach to facilitate transillumination. Although the stomach is mobile, the gastrocolic ligaments limit its rotation. In the paediatric population, these ligaments may be more rudimentary, allowing for rotation of the stomach[11]. (2) Adhesions from a previous laparotomy may tent the colon, and prohibit close apposition of the stomach to the anterior abdominal wall. The colon is closely juxtaposed to the
anterior abdominal wall, leading to subsequent erosion and fistulous communication\(^4,7,13\). (3) When the transverse colon is short, the colon is raised and easily moved to the anterior wall of the stomach\(^7,14\). (4) The transverse colon may be accidentally punctured when the PEG insertion site is too low at the mid-kidney level near the umbilicus due to gastroptosis\(^15\). (5) Patients with neurologic disorders tend to have abnormal posture and spinal deformity, which may contribute to abnormal positioning of the stomach, resulting in injury of other viscera during gastrostomy tube insertion\(^9,16\).

In the current study, we modified the previously described Gastrografin method for the prevention. Gastrografin was administered 4 hours before PEG placement, because it has been reported that water-soluble contrast generally reaches the right colon 4-6 hours after ingestion in cases without significant small bowel obstruction\(^17,18\). Distilled water was initially mixed, but it was difficult to distinguish under fluoroscopy, and so the undiluted solution was administered. The amount of Gastrografin was started at 80 mL, but 10 mL each was weight loss because we wanted to reduce the amount even a little. Since it was difficult to image the transverse colon at 30 mL, the final dose was 40 mL. As a result of adopting this method, the transverse colon with Gastrografin or gas images was observed in 226 cases (97.4%), and the transverse colon could not be observed in only six cases. A total of five cases underwent finger palpation and transillumination, and one was constructed using a colonoscope at a later date.

The number of patients that were changed to surgical gastrostomy was significantly decreased with the described method. In Group A, the transverse colon was raised due to colon puncture or mesenteric puncture (Figure 5), or the stomach was raised and was not present under the rib. In Group B, no gas image was observed in the transverse colon; thus, these cases were finally surgically constructed. When Gastrografin was administered, the gas image in the transverse colon became clear, even if only gas was admitted, and the transverse colon could be observed easily.

Furthermore, the frequency of finger palpation and transillumination test were also significantly reduced. Techniques using both transillumination and finger pressure as a guide to place the puncture site are useful for preventing this complication\(^17,18,19\). This method is basic, but the position of transverse colon can not be determined completely.

Abdominal plain X-ray examination after 500 mL of air insufflation into the stomach is a useful method to determine the abdominal puncture point for PEG\(^20,21\); however, the position of the transverse colon cannot be determined completely. Although abdominal ultrasound examination under gastrostomy is useful to prevent colocutaneous fistula\(^22\), this method may not become apparent on the transverse colon. Computed tomography-guided PEG placement is an optional method for the estimation of intra-abdominal, anatomical orientations that may minimize the risk of complications\(^23,24\); however, CT scan cannot be use under gastrostomy. Another CT-guided PEG placement is useful under gastrostomy when an endoscope cannot pass through the stenosis or occlusion of pharynx due to head and neck cancer\(^25\), but the manipulation of gastrostomy is complicated, has a long procedure time, and required exposure to radiation. Therefore, although

Table 1 Comparisons of the pre-PEG patients between Group A and B.

| Parameter            | Group A (232 cases) | Group B (109 cases) | p value |
|----------------------|---------------------|---------------------|---------|
| Age (years)          | 84.1±9.0 (46-100)   | 81.6±9.3 (46-105)   | 0.011   |
| Gender (male)        | 92 (39.7)           | 49 (45.0)           | 0.354   |
| **Principle diseases** |                     |                     |         |
| CVD                  | 76 (32.8)           | 48 (44.0)           | 0.044   |
| Dementia             | 88 (37.9)           | 26 (23.9)           | 0.010   |
| **Nutritional methods** |                     |                     |         |
| PN                   | 121 (52.2)          | 69 (63.3)           | 0.053   |
| EN                   | 111 (47.8)          | 40 (36.7)           | 0.053   |
| **Nutritional conditions** |                   |                     |         |
| Serum albumin (g/dL) | 3.1±0.4 (1.8-4.2)   | 3.3±0.5 (2.3-4.6)   | 0.006   |
| Total cholesterol (mg/dL) | 156±143.9 (49-363) | 150±93.3 (70-247)  | 0.113   |
| Cholinesterase (U/L) | 179±69.9 (36-471)   | 180±467.5 (67-366)  | 0.095   |
| Total lymphocyte (/μL) | 1341±608.9 (276-666) | 1376±496.2 (387-3003) | 0.287   |

CVD: cerebrovascular disease, PN: parenteral nutrition, EN: enteral nutrition. Data on age and nutritional conditions are demonstrated as mean±SD and a range. Numbers in parenthesis on gender, principle diseases, and nutritional methods are shown as percentage.
Table 2 Comparisons of the condition of the transverse colon between Group A and B (post EGD).

| Parameter                                      | Group A (232 cases) | Group B (109 cases) | p value |
|------------------------------------------------|---------------------|---------------------|---------|
| Cases with introduction of Gastrografin only into the transverse colon | 94 (40.5)           | -                   | -       |
| Cases with introduction of both Gastrografin and gas into the transverse colon | 55 (23.7)           | -                   | -       |
| Cases with introduction of gas only into the transverse colon | 77 (33.2)           | 49 (45.0)           | 0.036   |
| Cases with no introduction into the transverse colon | 6 (2.6)             | 60 (55.0)           | <0.0001 |

EGD: esophagogastroduodenoscope, Numbers in parenthesis on all of them are shown as percentage.

Table 3 Comparisons of percutaneous endoscopic gastrostomy placement between Group A and B (post EGD).

| Parameter                                      | Group A (232 cases) | Group B (109 cases) | p value |
|------------------------------------------------|---------------------|---------------------|---------|
| Cases who received Gastrografin                | 139 (59.9)          | -                   | -       |
| Cases who received gas                         | 75 (32.3)           | 38 (34.8)           | 0.643   |
| Cases who received finger palpation and transillumination | 5 (2.2)             | 60 (55.1)           | <0.0001 |
| Cases who received surgical gastrostomy        | 7 (3.0)             | 10 (9.2)            | 0.015   |
| Cases who received EGD and CS                 | 6 (2.6)             | 1 (0.9)             | 0.311   |

EGD: esophagogastroduodenoscope, CS: colonoscope, Numbers in parenthesis on all of them are shown as percentage.

CONCLUSION

To decrease surgical gastrostomy, the use of Gastrografin into the stomach was safe, reliable, and cost effective for PEG tube placement and is recommended. However, as a disadvantage, this method is not possible in the endoscopic chamber without fluoroscopy.

ACKNOWLEDGMENTS

Guarantors of the article: Hiromi Ono.

Specific author contributions: Acquisition of data: Ono. Analysis and interpretation of data: Ono, Yokoyama, Yoshida, Fukushima, Okamura, Aoki, and Nagashima. Drafting of the manuscript: Ono. Critical revision of the manuscript for important intellectual content: Asakage, Danjo, Hayashi, Nishihara, Shimizu, and Shimamura. Statistical analysis: Ono. Obtaining funding: Kawakami. Administrative, technical, or material support: Asakage, Shimizu, Shimamura, and Kusano. Study supervision: Asakage and Kusano. All authors had access to the study data and reviewed and approved the final manuscript.

Financial support: This study was supported in part by funds from the Seiwa Memorial Hospital, which paid for the Gastrografin and the nasogastric tube.
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