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Clinical Features and Advantages of a Novel Percutaneous Endoscopic Gastrostomy Method

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Data Interpretation D
Manuscript Preparation E
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Background: To study the clinical characteristics of novel percutaneous endoscopic gastrostomy.





Material/Methods: We retrospectively analyzed the hospital records of 173 patients undergoing various methods of gastrostomy (a novel PEG, traditional PEG, and surgical gastrostomy). Clinical characteristics were analyzed. For the novel PEG, the operation was as same as the traditional method for initial steps until the annular guide wire was inserted. The following steps were different: water was injected through an injection port to expand the capsule, then the water sac was confirmed to be close to the gastric wall under endoscope, and, finally, the incision was sutured and covered.

Results: Patient ages ranged from 42 to 93 years (60.8±9.2 years, 91 males and 82 females). Among all patients, there were 27 cases of brain trauma, 42 cases of cerebral infarction, 74 cases of esophageal or cardiac carcinoma, 21 cases of laryngocarcinoma, and 9 cases of Alzheimer disease. Clinical features were significantly better for novel PEG compared to traditional PEG: duration of operation (19.75±3.14 min vs. 37.86±5.33 min and 54.12±9.48 min, P<0.001), intraoperative blood loss (27.14±3.63 ml vs. 43.53±6.24 ml and 75.78±12.41 ml, P<0.001), postoperative pain score (1.12±0.19 pts vs. 3.85±0.44 pts and 6.22±1.06 pts; P<0.001), infection rate (1.35% vs. 3.77% and 2.17%, P<0.001), length of hospital stay (3.16±0.42 d vs. 5.68±0.78 d and 8.29±1.31 d, P<0.001), and time to free activity (2.24±0.26h vs. 3.74±0.48 h and 14.85±2.38 d, P<0.001). The incidence of complications such as wound infection (1.35% vs. 3.77% and 4.76%), vomiting (1.35% vs. 5.66% and 6.52%), and nausea (2.70% vs. 1.88% and 6.52%) in the novel PEG group was lower than in the other groups (P<0.0001). Improved outcomes were obtained without increased medical costs in the novel PEG group.

Conclusions: For patients with difficult postoperative oral nutrition, the novel PEG treatment resulted in overall better clinical outcomes than traditional PEG.

MeSH Keywords: Administration, Cutaneous • Endoscopy, Digestive System • Gastrostomy • Nutritional Support

Full-text PDF: <https://www.medscimonit.com/abstract/index/idArt/918507>

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Background

Percutaneous endoscopic gastrostomy (PEG) is an effective method of gastrointestinal nutrition for patients with loss of swallowing function or difficulty in oral feeding [1]. PEG has been widely used in Europe, America, Japan, and China [2]. PEG has a wide range of indications, including sequelae of cerebrovascular diseases, Parkinson disease, and head and neck tumors [3]. It is most suitable for patients with oral ingestion disorders, normal gastrointestinal function, long-term nutritional support necessitating tube feeding, or long-term gastrointestinal decompression [4]. Compared with indwelling nasogastric tubes, PEG is more easily accepted by patients as it avoids stimulation of the nasopharynx caused by gastric tubes, reduces the risk of aspiration pneumonia caused by reflux, and improves the quality of life [5,6]. Traditional gastrostomy is suitable for patients who cannot undergo endoscopic surgery (e.g., esophageal obstruction or non-permeable esophagus) requiring anesthesia or open placement of gastric fistula, which is painful and risky for patients [7]. PEG (especially the improved novel PEG) is much simpler and requires only local anesthesia, and has fewer complications [8].

Material and Methods

Study groups

Our study focused on 173 hospitalized patients undergoing 3 different methods of gastrostomy between January 2016 and March 2019, including 74 cases of novel PEG (observation group), 53 cases of traditional PEG (control group 1), and 46 cases of percutaneous gastrostomy (surgical operation, SG, control group 2). Several aspects of clinical characteristics were analyzed. Data were compared among groups to evaluate features of operative and postoperative outcomes, such as demographic profiles, treatment efficacy, duration of operation, intraoperative blood loss, postoperative pain score, postoperative complications, duration of hospital stay, and incidence

of complications. This study is the first to show the clinically significant advantages of novel the PEG and provides reference values for further multi-center randomized control trials.

Instrument and equipment

The Olympus GIF-HQ290 endoscopic system was used for PEG endoscopy. The PEG bag was produced by Create Medic Co., Japan (PEG 15, H1708045).

Operation procedures

For all the methods of gastrostomy, the preoperative routine examination consisted of routine blood work, coagulation function, and ECG. Subjects had no food or water for 6–8 h. Then, the 3 different operations were performed.

The steps for traditional PEG were as follows: under ECG monitoring, the patient was placed in supine position and for endoscope routine examination of the stomach duodenum. The peritoneal puncture point was determined by the light points reflected in the abdominal wall of the endoscope. After local anesthesia, the trocar puncture needle was used to vertically pierce the fully inflated gastric cavity, as shown in Figure 1. The needle core was removed, and the annular guide wire was inserted through the trocar. When the guide wire was held by a snare under the endoscope, they were pulled out together with the endoscope. The guide wire was connected with the fistula caudal dilatation catheter and pulled at the peritoneal puncture point, and the fistula was slowly pulled into the gastric cavity through the mouth. After that, the endoscope was inserted again to confirm that the anterior wall of the stomach was closely contacting the abdominal wall and the fistula was fixed. The incision was covered with sterile gauze for fixation [9].

For the novel PEG, the operation was as same as the traditional PEG for the initial steps, until the annular guide wire was inserted through the trocar, as shown in Figure 2. The following

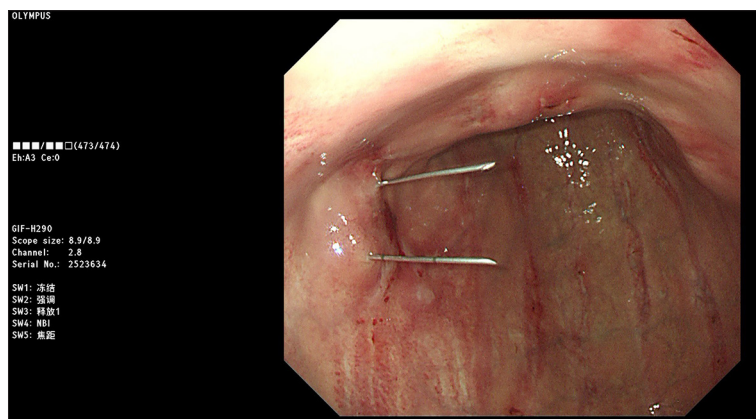


Figure 1. The trocar puncture needle was used to pierce the gastric cavity.

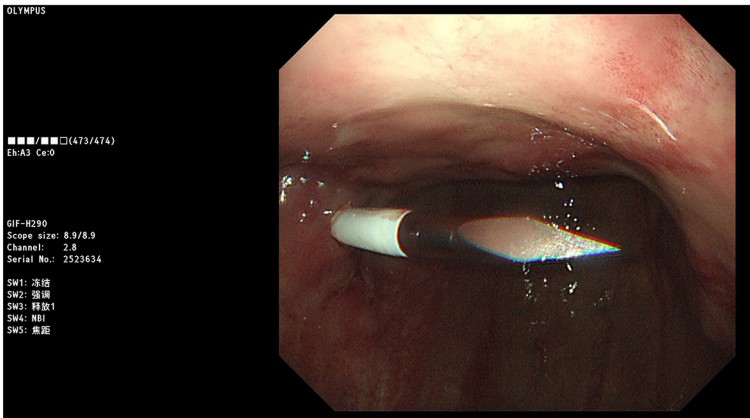


Figure 2. The annular guide wire was inserted through the trocar.

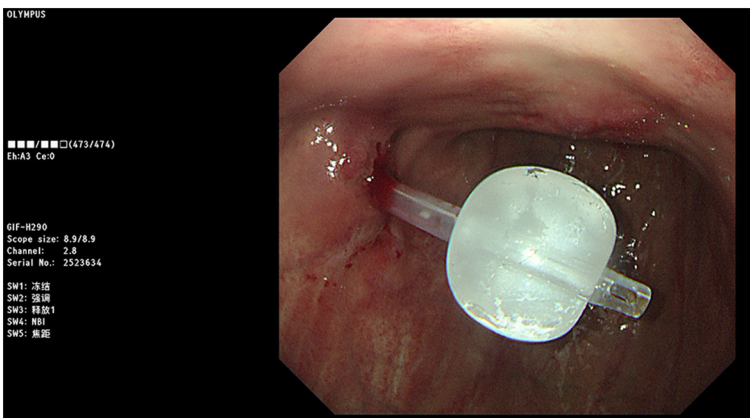


Figure 3. Water was injected through the port to make the water capsule expand.

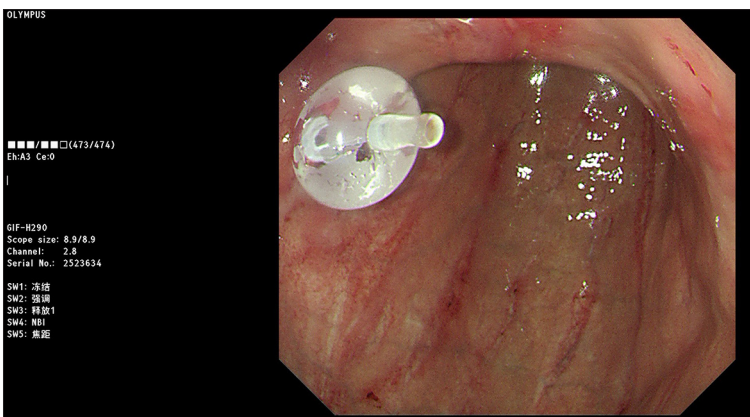


Figure 4. The water sac was confirmed to be close to the gastric wall.

steps in the PEG were different from in the traditional PEG: 5 ml of water was injected through the water injection port to make the water capsule expand, as shown in Figure 3. The water injection tube was pulled outside the body to make the water sac contact with the gastric wall, and the water sac was confirmed to be close to the gastric wall under the endoscope, as shown in Figure 4. The incision was sutured and covered with sterile gauze for fixation [10], as shown in Figure 5.

However, the steps performed in SG were quite different from those in the previous 2 endoscopic operations: After routine

disinfection of the surgical area, a longitudinal incision was made in the left upper abdomen, and the abdominal wall was cut into the abdomen layer by layer. The anterior wall of the stomach near the pylorus was selected as the site of the stoma, and a purse suture was made first. After cutting the stomach wall and absorbing the gastric contents, a transparent rubber tube was inserted and the purse suture was ligated. A further purse string suture was made around the catheter, and the gastric wall was turned inside out. The catheter was attached to the gastric wall along the longitudinal axis and sutured with a row of sarcoplasmic layers using fine thread. The catheter

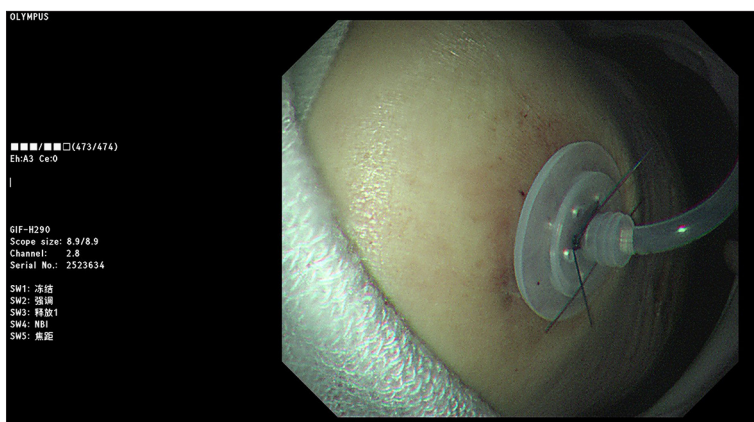


Figure 5. The incision was sutured and covered.

was embedded 5 cm to prevent the contents from flowing into the abdominal cavity after extubation. A small incision was made at the left side of the previous incision to extract the catheter and fix it on the abdominal wall. The catheter outlet of the gastric wall was also sutured and fixed with the peritoneum. The incision was sutured layer by layer and covered with sterile gauze for fixation [11].

All surgical procedures conformed to appropriate clinical guidelines [12].

Clinical characteristics

Operation-associated features were analyzed and compared, such as duration of operation, intraoperative blood loss, post-operation pain score, duration of hospital stay, incidence of complications, and direct medical costs. The pain score was determined 24 h after the operation as follows: painless, 0–2; mild pain, 3–5; moderate pain, 6–8; and severe pain, 9–10. Complications were recorded during a 2-month postoperative follow-up.

Cost analysis

Direct medical costs (e.g., admission fees, operation fees, consumable fees, and medication fees) were tabulated from hospital charge lists spanning the time from patient admission to discharge.

Statistical analysis

Statistical analysis was performed using SPSS 19.0 software (SPSS, Inc., Chicago, IL, USA). Data are presented as mean±SD. The *t* test was used for comparison between groups. The χ^2 test was performed for enumeration data. $P<0.05$ was considered a significant statistical difference.

Result

Demographic profiles

Patient ages ranged from 42 to 93 years with a mean of 60.8 ± 9.2 years, (91 males and 82 females). The 173 total study cases comprised 27 brain trauma, 42 cerebral infarction, 74 esophageal or cardia carcinoma, 21 laryngocarcinoma, and 9 Alzheimer disease. Observation group patients ($n=74$; 42 males and 32 females, mean age 69.0 ± 10.2 years) were treated by novel PEG. Control group 1 patients ($n=53$; 28 males and 25 females, mean age 65.4 ± 8.8 years) were treated by traditional PEG. Control group 2 patients ($n=46$; 21 males and 25 females, mean age 56.2 ± 6.7 years) received SG. Details of patient features are shown in Table 1.

Comparative operation and postoperative indices

The mean operation duration for observation group patients was 19.75 ± 3.14 min, which was significantly shorter than for control group 1 and control group 2 patients (37.86 ± 5.33 min and 54.12 ± 9.48 min) ($P<0.05$). Results of additional indices all indicated significantly improved outcomes ($P<0.05$) for patients receiving novel PEG compared to traditional PEG and SG: intraoperative blood loss (27.14 ± 3.63 ml vs. 43.53 ± 6.24 ml and 75.78 ± 12.41 ml; $P<0.001$), postoperative pain score (1.12 ± 0.19 points vs. 3.85 ± 0.44 points and 6.22 ± 1.06 points; $P<0.001$), duration of hospital stay (3.16 ± 0.42 d vs. 5.68 ± 0.78 d and 8.29 ± 1.31 d; $P<0.001$), time to free activity (2.24 ± 0.26 h vs. 3.74 ± 0.48 h and 14.85 ± 2.38 d; $P<0.001$) (Table 2).

Postoperative complications

Compared with traditional PEG and SG, the incidence of postoperative complications was significantly lower for patients receiving novel PEG. After 2 months of follow-up, the total complication rate in the observation group was 6.75%, compared to 13.21% for control group 1 and 19.56% for control group 2 ($P<0.0001$). The observation group had a 1.35% rate

Table 1. Demographic profiles.

Features	Observation group	Control group 1	Control group 2	Total
Number (n, %)	74, 42.8%	53, 30.6%	46, 26.6%	173
Age (y)	69.0±10.2	65.4±8.8	56.2±6.7	
Sex				
Male (n, %)	42, 24.3%	28, 16.2%	21, 12.1%	91
Female (n, %)	32, 18.5%	25, 14.5%	25, 14.5%	82
Diseases (n)				
Brain trauma	8	9	10	27
Cerebral infarction	17	15	10	42
Esophageal or cardia carcinoma	37	21	16	74
Laryngocarcinoma	7	5	9	21
Alzheimer disease	5	3	1	9
Treatment	Novel PEG	Traditional PEG	SG	

Table 2. Comparative surgical and postoperative indices.

Group	Case n	Operation time (min)	Intraoperative blood loss (ml)	Post-operation pain score	Hospital stay (d)	Time to free activity (h)
Observation	74	19.75±3.14	27.14±3.63	1.12±0.19	3.16±0.42	2.24±0.26
Control 1	53	37.86±5.33	43.53±6.24	3.85±0.44	5.68±0.78	3.74±0.48
Control 2	46	54.12±9.48	75.78±12.41	6.22±1.06	8.29±1.31	14.85±2.38
P value		0.00054 <0.001	0.00017 <0.001	0.00010 <0.001	0.00035 <0.001	0.00079 <0.001

Table 3. Comparative postoperative complications during 2 months of follow-up.

Group	(n)	Wound infection	Abdominal infection/septicemia	Vomiting	Nausea	Incidence
Observation	74	1 (1.35%)	1 (1.35%)	1 (1.35%)	2 (2.70%)	5 (6.75%)
Control 1	53	2 (3.77%)	1 (1.88%)	3 (5.66%)	1 (1.88%)	7(13.21%)
Control 2	46	1 (2.17%)	2 (4.35%)	3 (6.52%)	3 (6.52%)	9(19.56%)
P value						<0.0001

of postoperative abdominal infection or septicemia, which was 1.88% in control group 1 and 4.35% in control group 2. All other types of complications recorded were lower in observation group patients compared to control group 1 and control group 2 patients, such as wound infection (1.35% vs. 3.77% and 4.76%; $P<0.001$), vomiting (1.35% vs. 5.66% and 6.52%; $P<0.001$), and nausea (2.70% vs. 1.88% and 6.52%; $P<0.001$) (Table 3).

Cost comparison

Direct costs were separated into categories, including hospitalization, laboratory, radiology, nursing, medication, anesthesia, consumables, and operation fees. More specific itemized costs requiring access to hospital financial system records (restricted) were precluded from this study. Total costs were National Health Insurance (NHI) covered fees and uncovered fees (paid by patients). No significant overall cost difference was observed between the observation group and control group 1 ($P>0.05$). However, the observation group and control

Table 4. Comparison of medical costs (Chinese yuan, RMB) for observation and control patient groups.

Category	Observation group	Control group 1	Control group 2
Operation	Novel PEG	Traditional PEG	SG
Case (n)	74	53	46
Hospitalization	122	131	157
Laboratory	1324	1452	1859
Radiology	717	703	794
Nursing	108	116	148
Medication	3428	4019	5340
Anesthesia	140	144	2146
Consumables	2073	2345	3048
Operation	1995	1995	3746
Covered by NHI	4557	5152	8446
Paid by patient	5350	5753	8792
Total	9907	10905	17238

group 1 had significantly lower costs than the control group 2 ($P < 0.05$) (Table 4).

Discussion

Some patients suffered the loss of swallowing function or dysphagia; they still had normal digestive tract functions, but could not take food by mouth and need long-term enteral nutrition (EN) [13]. For these patients, in the past, gastric fistula was usually performed by surgical operation, which required general anesthesia and open stomach procedure, which not only increases pain, but also increases the risk of anesthesia and surgery [14]. At present, surgical gastrostomy is performed according to different indications, such as patients who cannot undergo an endoscopic operation (e.g., esophageal obstruction and non-permeable esophagus). In contrast, percutaneous endoscopic gastrostomy (PEG) provides a more effective and safer method of gastrointestinal nutrition for decompression and replacement of nasal feeding for EN [15]. Compared with surgical operation, PEG operation does not require laparotomy or general anesthesia, which can significantly reduce pains, medical costs, and postoperative complications caused by surgery or anesthesia [16,17]. For most of the patients with poor physical or nutrition situation, even critical illnesses can be treated with this operation. It is a better alternative to traditional surgery [18]. Since Ponsky et al. first carried out the PEG technique in 1981, it has been widely used all over the world [19]. Now, the technically improved novel PEG operation has more advantages than traditional PEG and SG [20].

In the treatment of patients with dysphagia or swallowing dysfunction, our study proved significant advantages of novel PEG

compared to traditional PEG. Novel PEG showed significantly better clinical outcomes in terms of duration of surgery, intra-operative blood loss, postoperative pain score, length of hospital stay, and time to free activity. Favorable outcomes were observed for postoperative complications as well, such as wound infection, vomiting, nausea, abdominal infection, and septicemia. Our comparison of the medical costs of these 3 operations showed that these clinical improvements of novel PEG were obtained without increased medical costs. Comparing patient costs across multiple categories showed that the novel PEG method had obviously lower costs.

Conclusions

Based on its superior clinical outcomes and lower costs, our study results demonstrated the clear value and advantages of novel PEG as a general and preferred approach for treatment of patients with swallowing dysfunction or any difficulty with oral feeding.

Limitations

Because of the retrospective approach, our study has some limitations. This was not a randomized study. Data were collected from a single research center. It was difficult to quantify and standardize the ability of all surgeons. The follow-up period for these 3 groups was only 2 months. A multi-center, randomized, controlled trial should be done in the future to further clarify the relative merits.

Conflict of interest

None.

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