Percutaneous Radiologic Gastrostomy in Patients with Stroke

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ABSTRACT

Objective: To investigate the effectiveness, safety, adverse events (AEs), and outcomes of percutaneous radiologic gastrostomy (PRG) in patients with dysphagia caused by cerebral infarction.

Study Design: An interventional study.

Place and Duration of Study: Department of Interventional Oncology, Dahua Hospital, and the Department of Internal medicine, Changqiao Community Health Service Center, Shanghai, China, from January 2016 and December 2019.

Methodology: This study included sixty patients with cerebral infarction-induced dysphagia aged between 49-79 years. All patients were equally and randomly divided into the observation group (PRG group) and the control group (NFT group). Early and long-term results of PRG and nasal feeding tube (NFT) treatment were assessed.

Results: No significant differences in serum albumin, prealbumin, haemoglobin, and circumference of triceps ($p>0.05$) were observed between the two groups before treatment. After treatment, both serum albumin, prealbumin, haemoglobin, and the circumference of the triceps increased in the PRG group compared with the NFT group ($p<0.05$), indicating better nutrition status. The adverse events (AEs) rate of the PRG group (3.33%, 1/30) was significantly lower than the NFT group (30%, 9/30, $p=0.005$). The comfort level of the PRG group (93.33%, 28/30) was significantly higher than the NFT group (53.33%, 16/30, $p<0.001$).

Conclusion: Percutaneous radiologic gastrostomy can improve the nutritional status of patients with dysphagia caused by cerebral infarction. It can reduce the incidence of AE and improve the comfort level.

Key Words: *Percutaneous Gastroscopy, Gastrostomy, Dysphagia, Nutrition status, Complications.*

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INTRODUCTION

Dysphagia is considered as one of the most serious complications following cerebral infarction, which may cause swallowing disorders, feeding difficulties, and eventually malnutrition. Other adverse events (AEs), may also aggravate the overall health status of patients.[1] Percutaneous gastrostomy insertion is the standard procedure for cerebral infarction patients who required long-term enteral nutrition or gastric decompression. Transnasal insertion of the nasogastric tube into the gastric cavity is a common approach used to provide nutrition for patients having dysphagia induced by cerebral infarction. However, many studies have shown a variety of AEs and therefore it may be not suitable for those patients in prolonged coma.[2,3]

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The approaches for the provision of enteral feedings, such as nasogastric feeding tubes (NFTs), percutaneous endoscopic gastrostomy (PEG) tube placement, and percutaneous radiological gastrostomy (PRG) are also there. PRG has been widely used in clinical practice to improve the nutritional status of dysphagia patients around the world. As it does not require any laparotomy or general anaesthesia, PRG has a few notable benefits, such as minimal invasiveness, less pain, and fast nutritional recovery.4 It has been shown that the use of PRG can maximally alleviate dysphagia-associated malnutrition, while reducing the reflux of gastric contents.5 Hence, PRG may be beneficial to patients with dysphagia caused by cerebral infarction.

In this study, the aim was to compare the effectiveness, indications, safety, adverse events, and outcomes of PRG treatment with traditional NFT treatment in patients with dysphagia caused by cerebral infarction.

METHODOLOGY

Sixty patients with dysphagia caused by cerebral infarction who were admitted in the Department of Interventional Oncology, Dahua Hospital, and the Department of Internal medicine,

Changqiao Community Health Service Center, Shanghai, China, from January 2016 and December 2019 were enrolled in this multi-arm pre-post interventional study. They were randomly and evenly divided into a PRG group and an NFT group, with 30 patients in each group. All PRG tube or NFT placements were decided and requested by clinicians in charge and approved by the Hospital Ethics Committee.

For patients in the NFT group, a nasogastric tube was inserted into the gastric cavity following standard procedure. The patient took a supine position, and the nasogastric tube was inserted transnasally into the gastric cavity. The inserted length was controlled at about 50 cm. Air was injected into the nasogastric tube and the gurgling sounds heard in the middle and upper abdomen using a stethoscope were used as proof of successful insertion. A bedside radiograph was performed to determine whether the nasogastric tube was located in the gastric cavity if necessary.[6] PRG was performed to overcome dysphagia (Figure 1).

Clinical nutrition status and AEs were compared between the two groups before and after treatment. Clinical nutrition status was evaluated using serum albumin, prealbumin, haemoglobin, and the circumference of the triceps. AEs were recorded using both digital medical records and oral interviews with patients, including pulmonary infection, tube dislodgement, reflux esophagitis, gastrointestinal tract haemorrhage, and purulent secretions. The level of comfort degree was assessed using the Kolcaba general comfort questionnaire (Kolcaba's GCQ), which covered five dimensions, including physiology, psychology, mentality, social culture, and environment. All patients were scored by Comfort Degree Grade, which is divided into severe discomfort, mild discomfort, and comfortable.

Statistical analysis was performed using GraphPad Prism v9.0.2 software. All measurements were expressed, and a t-test was performed for intergroup comparison. Two-way ANOVA was performed for intergroup comparison in Figure 2. Counts were expressed as percentages (%) and the chi-square test or Fisher's exact test was used for intergroup comparison. A p-value less than 0.05 indicated a significant difference.

RESULTS

Sixty patients with dysphagia were included in this study. The thirty patients in the NFT group had a mean age of 61.23±3.58 years, and 53.33% (16) of the patients were males. The thirty patients in the PRG group had a mean age of 61.54±3.47 years and 60% (n=18) of the subjects were male. There was no significant difference between these two groups regarding age and GCS scores (p=0.335).

Before treatment, clinical nutrition status was evaluated in both groups, including serum albumin, prealbumin, haemoglobin, and triceps circumference, which were tested by point-of-care testing. After treatment, all of these nutrition indicators, such as serum albumin (p<0.001), Prealbumin (p<0.001), haemoglobin (p=0.001), and triceps circumference (p=0.015), are increased significantly in the two groups (Figure 2).

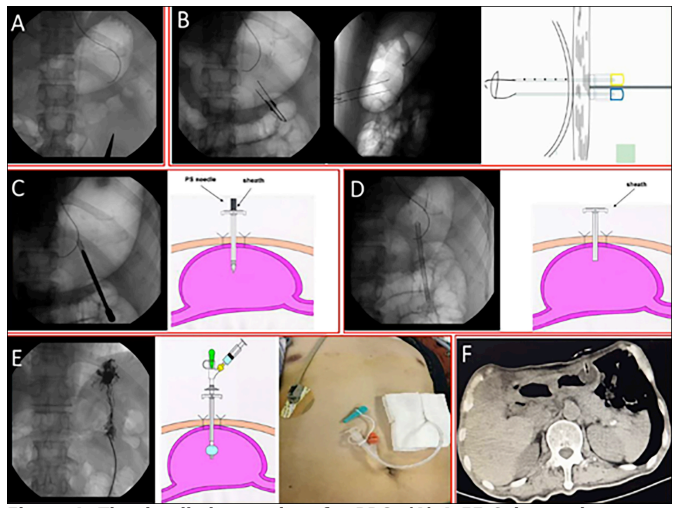

Figure 1: The detailed procedure for PRG. (A) A 5F Cobra catheter was inserted into the stomach from the nose to the stomach and the gastric cavity was inflated under the guidance of the perspective. (B) Gastric wall fixator fixes stomach wall and abdominal wall at two points. (C and D): In perspective, pierce the assembled PS needle with a vertically T-shaped sheath into the gastric cavity, and remove the PS needle, leaving the T-shaped sheath. (E) The sheath was removed and the gastrostomy tube was fixed to the skin. (F) The abdominal CT showed that the fistula was completely in the gastric cavity one day after the operation.

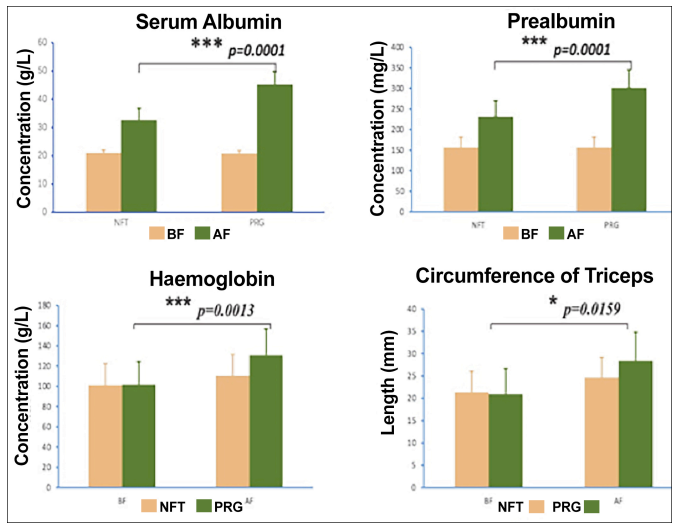

Figure 2: Quantitative evaluation of nutritional indicators before and after treatment in NFT and PRG group. (A) The concentration of peripheral serum albumin in the PRG group is higher than in the NFT group (p<0.0001). (B) The concentration of peripheral prealbumin in the PRG group is higher than in the NFT group (p<0.0001). (C) The concentration of peripheral hemoglobin in PRG group are higher than NFT group (p=0.0013). (D) The length of circumference of the triceps in the PRG group is higher than in the NFT group (p=0.0159). BF: Before Treatment; AF: After Treatment; *p <0.05,p <0.01, ***p <0.001,****p<0.0001 indicated a significant difference (Two-way ANOVA).**

Furthermore, these indicators were significantly higher in the PRG group than in the NFT group after the treatment (p<0.05, Figure 2). There was no difference of nutritional indicators between the two groups before treatment (Table I).

Four main complications occurred in the NFT group but only one complication occurred in the PRG group. The incidence of pulmonary infection (10.00%, 3/30) and purulent secretion (3.33%, 1/30) in the NFT group was significantly higher than in the PRG group (0%, 0/30) (p=0.001, Table II).

Table I: Comparison of nutritional indicators before and after treatment in NFT and PRG groups.

Group	Serum Albumin (g/L)		Prealbumin (mg/L)		Hemoglobin (g/L)		Circumference of Triceps (mm)	
	Before	After	Before	After	Before	After	Before	After
NFT Group (n=30)	21.06±4.71	32.64±6.02	156.61±24.74	231.52±38.49	101.23±21.35	110.32±22.57	21.37±4.68	24.65±5.78
PRG Group (n=30)	20.85±4.58	45.19±7.38***	156.98±24.56	301.72±43.24***	101.76±21.41	130.96±25.67***	20.89±4.51	28.41±6.39*
t	0.175	7.218	0.058	6.642	0.096	3.307	0.405	2.39
p-value [a]	0.862	0.0001	0.954	0.0001	0.924	0.0013	0.687	0.0159

[a] **p <0.05, **p <0.01, ***p <0.001, ****p <0.0001 indicated a significant difference(two-way ANOVA).*

Table II: Comparison of the AE rate (%) (count/n) in the NFT group and the PRG group.

Group	Pulmonary infection	Tube dislodgement	Reflux esophagitis	Gastrointestinal hemorrhage	Purulent secretion	Incidence of complications
NFT group (n = 30)	10% (3/30)	6.67% (2/30)	10% (3/30)	0 (0/30)	3.33% (1/30)	30.00% (9/30)
PRG Group (n=30)	0 (0/30) (0.00%)**	0 (0/30)**	0 (0/30) (0.00%)**	0 (0/30)	3.33% (1/30)	3.33% (1/30)**
χ^2	-	-	-	-	-	7.68
p-*value* [a]	0.0012	0.0071	0.0012	NS	NS	0.0056

[a] **p <0.05, **p <0.01, ***p <0.001 indicated a significant difference (chi-square test).*

The incidence of tube dislodgement was 6.67% (2/30) in the NFT group, also significantly higher than the PRG group (0%, (0/30), p=0.007, Table II). The incidence of reflux esophagitis was 10.00% (3/30) in the NFT group, significantly higher than 0% (0/30) in the PRG group (p=0.001, Table II). The frequency of complication in the NFT group (30.0% (9/30)) was significantly higher than the PRG group (3.33%, 1/30, p=0.005, Table II).

To evaluate the clinical outcome of PRG and NFT procedure, all patients were scored by Comfort Degree Grade (severe discomfort, mild discomfort, and comfortable). Twenty-eight patients in the PRG group (93.33%, 28/30) were scored comfortable, which is significantly high than the NFT group (53.33%, 16/30, p=0.001). Only 2 patients in the PRG group (6.67%, 2/30) were described mild discomfort compared to 9 patients in the NFT group (30%, 9/30, p=0.041). However, the NFT group had 5 patients who described severe discomfort (13.33%, 5/30) and the PRG group had 0 patient (0%, 0/30), there was no significant difference between the two groups.

DISCUSSION

This multi-arm interventional study conducted in a group of patients with cerebral infarction-induced dysphagia found that PRG is a more efficient technique than NFT to improve the nutritional status of patients with cerebral infarction. The provision of adequate nutrition remains an important treatment goal in dysphagia conditions, including cerebrovascular or other chronic diseases. There was a rapid development in healthcare in recent years and the treatment of dysphagia has also improved dramatically. In particular, the development and application of PRG provide strong support data for the treatment of dysphagia caused by cerebral infarction.[7] Enteral feeding by PRG is the best route of nutrition in dysphagia patients, as it provides greater immunological and nutritional benefits compared to other parenteral feedings. Furthermore, this approach can also facilitate the delivery of drugs in patients of dysphagia.[7,9] Percutaneous gastrostomy techniques by radiological or endoscopic guidance have replaced other surgical approaches, because of the risk of anaesthesia or increased morbidity.

There is a great variety of indications for PRG, including dysphagia caused by cerebrovascular accidents, Parkinson's disease, and brain injury. The present results show that the clinical nutritional indicators such as serum albumin, prealbumin, haemoglobin, and triceps circumference were both improved in the PRG group and significantly higher than the NFT group. This indicated that PRGs were more conducive to improving the nutritional status of patients than conventional nasogastric tube feeding. The possible reasons were listed as followings. First of all, the fistula tube used in PRG is thicker than the nasogastric tube and supplies food in a way closer to normal eating.[8] Second, feeding of the nasogastric tube is associated with a greater risk of tube blockage and may lead to the repeated replacement of the tube, which disrupts the nutrition supply. However, this problem can be solved with PRG.[9] Blockage of the insert feeding tube is a serious problem, which is observed in patients of dysphagia with long-term enteral feeding. Blacka *et al.* reported that the patients treated by PEG, from 16% to 31% of tubes had at least 1 serious blockage during 18 months of follow-up, and nearly 7% of the tube in these patients required removal.[10] In this study, there are none of the tube blockages occurred in patients of PRG, and none of them was substantial. Deep infection of the stoma was more frequent in NFT (3.33%) than in PRG (10.00%). Four main complications occurred in the NFT group and but only one complication (purulent secretion) occurred in the PRG group (3.33%). Because of NFT is inserted through the mouth and oropharynx, which have high risk of contamination by the oral flora, leading to wound infection and purulent secretion.

In addition, PRG is a minimally invasive procedure for the postoperative recovery of patients. Compared with conventional open gastrostomy and nasogastric tube feeding, PRG can reduce the risk of gastrointestinal decompression, respiratory tract infection, and gastroesophageal reflux which is more beneficial method for postoperative recovery of patients.[11]

The overall number of episodes of complications with the results in two groups, the rates in the NFT group was higher than the PRG group ($p < 0.05$). These results proved that PRG is safer, which is probably due to these reasons. PRG causes fewer stimulus and less trauma to the nasopharynx, thereby reducing the incidence of inflammation and infection. On the other hand, the insertion of the nasogastric tube may increase the risk of nasopharyngeal inflammation and lung infection due to the limitation of the nasogastric tube.[12] And PRG requires no repeated manipulations, but nasopharyngeal tube feeding does. Therefore, there is a higher risk of nausea and mistaken aspiration after the repeated procedure of nasopharyngeal tube insertion.[13] In addition, the fistula tube does not require frequent replacement in PRG. However, in nasogastric tube feeding, the tube needs to be replaced from time to time, thereby increasing the morbidity of reflux esophagitis and aspiration pneumonia.[14]

Clinical practice has shown that it is easier to perform PRG since only local anaesthesia is required. Therefore, PRG is safer and more applicable to elderly patients and those with poor overall health conditions when nutritional status needs to be improved.[15] It was also found that more patients considered the procedure comfortable in the PRG group than in the NFT group indicating that PRG can increase the compliance and adherence of patients. This is probably because PRG is minimally invasive and has little impact on patients. It is noteworthy that PRG has its limitations. For example, after the gastric cavity is aerated, the gastric wall may not come into close contact with the abdominal wall, which may further influence the treatment efficacy. In addition, some difficulties may occur during puncture if the patient is overweight or if the patients had a history of subtotal gastrectomy.[16]

CONCLUSION

This study suggests that PRG is relatively safe and effective method for gastrostomy placement in patients of cerebral infarction. It can improve the nutritional status of patients with dysphagia caused by cerebral infarction. It can reduce the incidence of AEs and improve comfort level.

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ETHICAL APPROVAL:
This study was approved by the Dahua Hospital Ethics Committee before the research initial.

PATIENTS' CONSENT:
All patients were assessed to determine eligibility and informed consent were obtained before the research.

COMPETING INTEREST:
No potential conflict of competing interests was reported by these authors.

AUTHORS' CONTRIBUTION:
TY: Conceptualisation, data curation, investigation, visualisation, and writing original draft.
YH: Investigation.
ZZ: Formal analysis, writing review and editing.
QY: Methodology, software.
PK: Investigation, writing-review and editing.
SW: Software.
XZ: Validation.
JC: Funding acquisition, visualisation, writing the original draft.
All the authors have approved the final version of the manuscript to be published.

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