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ORIGINAL ARTICLE

Retrospective Study

Effect of endoscopic submucosal dissection on gastrointestinal function and nutritional status in patients with early gastric cancer

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Abstract

BACKGROUND

Gastric cancer (GC) endangers the survival and prognosis of patients worldwide. Improving the prognosis of patients with early GC (EGC) is crucial to prolong their survival time.

AIM

To analyze the effects of endoscopic submucosal dissection (ESD) on gastrointestinal function and nutritional status in patients with EGC.

METHODS

Eighty patients with EGC between January 2021 and January 2024 were divided according to different surgical protocol into following two groups: 42 patients who underwent ESD in the ESD group and 38 patients treated with endoscopic mucosal resection (EMR) in the EMR group. Two groups were compared in the operative indices, lesion resection rate, postoperative recovery of gastrointestinal function, nutritional status, and incidence of surgical complications.

RESULTS

The overall resection rate of the lesion in the ESD group was higher. The operative bleeding volume and operation time were higher and gastrointestinal ventilation time was shorter in the ESD group than those in the EMR group ($P < 0.05$). The nutritional statuses of the two groups decreased after operation; however, the

levels of albumin, prealbumin, hemoglobin, and transferrin were higher in the ESD group than in the EMR group ($P < 0.05$). The post-operative pepsinogen (PG) I level in the ESD group was higher than that in the EMR group, and the PG II level was lower than that in the EMR group ($P < 0.05$). The incidence of postoperative complications was compared between the two groups ($P > 0.05$).

CONCLUSION
ESD can promote the immediate recovery of patient's postoperative gastrointestinal function, improve their nutritional level, and signifies its application in patients with EGC.

Key Words: Endoscopic submucosal dissection; Endoscopic mucosal resection; Early gastric cancer

Core Tip: Endoscopic submucosal dissection (ESD) application in patients with early gastric cancer (EGC) can significantly promote the recovery of gastrointestinal function, improve nutritional status, and reduce complications. This study confirmed the effectiveness of ESD in promoting the recovery of gastrointestinal function by observing the changes in gastrointestinal function and nutritional status in patients with EGC.

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INTRODUCTION

Dietary habit changes and excessive life pressure is causing an increase in the annual incidence of gastric cancer (GC). According to relevant surveys[1], the incidence of GC ranks second after lung cancer among all malignant tumors, with the highest incidence in East Asia, accounting for 50%. The development of diagnostic and treatment technologies has significantly increased the screening rate for early GC (EGC). EGC refers to the tumor that is only confined to the gastric mucosa or the lower layer, without lymph node metastasis, and a stable patient condition, which can be directly cured by surgery[2]. The extensive trauma and various complications associated with traditional radical gastrectomy significantly reduced the quality of life of patients after radical gastrectomy. In recent years, endoscopic surgery, which retain the structural and functional integrity of the patient's stomach, has gradually replaced traditional surgery as an important treatment method for EGC. Studies have confirmed that the long-term outcomes of endoscopic surgery for patients with EGC are comparable to those of traditional laparotomy[3,4]. With the advantages of less trauma, fewer complications, and shorter time, endoscopic surgery has been widely used for EGC. The rapid development of digestive endoscopy in China and the enhancement of health awareness has significantly increased the rates of early detection, diagnosis, and treatment of GC. Radical resection can completely remove tumor lesions with a low residual tumor rate for patients with EGC; however, it destroys the gastric structure of patients, affects gastric function, and cannot completely improve the quality of life of patients with EGC[5]. Recently, endoscopic surgery has become an important research direction in EGC treatment, with a low impact on gastric structure and function during the operation and a high tumor resection rate, which has been favored by most patients and physicians. The selection of endoscopic surgery has become the focus of clinical research on the classification of endoscopic surgery for GC into submucosal dissection and mucosal resection. Since the endoscopic submucosal dissection (ESD) was developed based on mucosal resection and starts late in clinical application, its surgical effect is still under study. Therefore, we analyzed the therapeutic effect of ESD and its impact on gastrointestinal function and nutritional status in patients with EGC.

MATERIALS AND METHODS

General data

Eighty patients with EGC between January 2021 and January 2024 were selected and divided into two groups according to different surgical protocol. The ESD group had 42 cases (22 males and 20 females), with age ranging from 35 to 70 (52.81 ± 5.68) years, and tumor diameter from 1.0 to 4.5 (2.48 ± 0.68) cm. Clinical TNM staging: 31 cases in stage Ia and 11 cases in stage Ib; Tumor sites: Gastric antrum 15 cases, gastric fundus 18 cases, gastric horn 9 cases. Undifferentiated and differentiated cases were 18 and 24, respectively. The endoscopic mucosal resection (EMR) group included 38 cases (20 males and 18 females), with age ranging from 32 to 70 (53.18 ± 6.01) years, and tumor diameter from 1.5 to 4.8 (2.51 ± 0.72) cm. Regarding clinical TNM staging, 30 cases were included in stage Ia and 8 cases in stage Ib; concerning tumor sites, 12 cases involved gastric antrum, 4 cases in gastric fundus, and 11 cases in gastric horn; 15 cases were undifferentiated and

23 cases were differentiated. No comparable difference was found in basic data between the two groups ($P > 0.05$).

Inclusion criteria: (1) The patient was diagnosed with EGC by gastrointestinal endoscopy and pathology[6] and the TNM stage was stage I; (2) No neoadjuvant chemotherapy was performed before surgery; (3) Patients underwent gastric surgery for the first time; and (4) The clinical data of the patients were complete.

Exclusion criteria: (1) Lymph node and organ metastases; (2) TNM stage II; (3) Anemia and malnutrition; (4) Autoimmune diseases, coagulation disorders, and organ dysfunction; (5) Preoperative history of anti-tumor treatment; and (6) Incomplete research data.

Methods

The patients in both groups underwent gastrointestinal endoscopic surgery under general anesthesia. After placing the patient in the lateral decubitus position, the lesion site was explored using the gastrointestinal endoscope and enlarged using the indigo carmine staining method or narrow-band imaging technology of the endoscope to identify the junction between the lesion and normal mucosa. Argon ion coagulation was used to mark the resection range, and one marking point was set at every interval of 2.0 mm - 3.0 mm. Submucosal injection was administered around the marked sites, and a mixture of epinephrine and indigo carmine was prepared at a ratio of 1:10000. At the end of the injection, the lesion was elevated, the basal eminence of the lesion was obvious, and it could be operated upon when it exceeded the normal surrounding mucosa by 5.0 mm - 8.0 mm.

In the ESD group, a HOOK or IT knife was used to annularly cut the lesion mucosa from the edge along the marked points and peel off the submucosa. Submucosal injection was intermittently administered during peeling to keep the lesion mucosa in a raised state, and ensure that the peeling layer was in the submucosa. Larger blood vessels were clamped and bleeding was controlled with hemostatic forceps, and the lesion was separated completely using an argon-ion scalpel. No active bleeding was detected, the bare blood vessels were treated with electrocoagulation for hemostasis, and the wound surface was sutured. Dissected lesion specimens were sent for inspection.

In the EMR group, after the lesion was elevated, a transparent cap with a high-frequency snare was placed at the front end of the endoscope. After the lesion site was attracted so that the marked tissue completely entered the transparent cap, the snare was tightened and the lesion tissue was cut by electric coagulation. If a one-time resection was difficult, multiple resections of the lesion were performed, and the wound surface was effectively treated after resection. Both groups underwent routine fasting, anti-infection therapy, and nutritional support after surgery.

Outcome indicators

Surgical effect: The diagnosis and treatment of GC were determined by referring to the guidelines for the diagnosis and treatment of endoscopic GC[7]. Lump resection: The lesion was removed as a lump during the endoscopic examination, and a single specimen was obtained. Curative resection: Lumpectomy without risk of lymph node metastasis; basal lesion residual: The lesion site and tumor lesion within 1 cm of the edge of the lesion were resected within six months after the operation.

Surgery-related indicators included operation time, bleeding volume, gastrointestinal ventilation time, and length of hospital stay.

Nutritional conditions: Collect 5 mL of venous blood of patients, and the levels of albumin (ALB), prealbumin (PA), hemoglobin (Hb), and transferrin (TRF) were measured using a Hitachi 7600 automatic biochemical analyzer.

Gastrointestinal hormones: Collect 3 mL of venous blood of patients and centrifuged for 10 minutes at 3000 rpm. After collecting the serum, the levels of pepsinogen (PG) I and PG II were detected using ELISA.

Complications: Surgical complications, such as mucosal perforation, anastomotic bleeding, and gastroparesis, were observed in both groups.

Statistical analysis

SPSS 26.0 statistical software was used for data analysis. The measurement data conformed to the normal distribution (mean ± SD) representation, and the inter-group and intra-group data were subjected to independent and paired sample *t* tests. Count data rate (%) was calculated using χ^2 tests; $P < 0.05$ indicated the statistical significance.

RESULTS

Surgical effect

The overall resection rate of lesions after surgery was higher in the ESD group than in the EMR group ($P < 0.05$; Table 1).

Surgical conditions

The bleeding volume and operation time were higher in the ESD group than in the EMR group; however, the gastrointestinal ventilation time was shorter in the ESD group than in the EMR group ($P < 0.05$). The difference in the length of hospital stay between the two groups was not significant ($P > 0.05$; Table 2).

Nutrition status

The difference in nutritional status between the two groups before surgery was not significant ($P > 0.05$). Nutritional status decreased in both groups after surgery but was higher in the ESD group than in the EMR group ($P < 0.05$; Table 3).

Table 1 Surgical effect, *n* (%)

Group	Lump resection	Curative resection	Basal lesion residual
ESD group (n = 42)	40 (95.24)	2 (4.76)	0
EMR group (n = 38)	28 (73.68)	8 (21.05)	2 (5.26)
χ^2	7.269	3.466	0.622
P value	0.007	0.063	0.430

ESD: Endoscopic submucosal dissection; EMR: Endoscopic mucosal resection.

Table 2 Surgical conditions, mean ± SD

Group	Operation time (minute)	Intraoperative bleeding volume (mL)	Gastrointestinal ventilation time (hour)	Length of stay (day)
ESD group (n = 42)	62.83 ± 8.48	28.48 ± 5.28	25.85 ± 5.48	12.83 ± 4.28
EMR group (n = 38)	51.36 ± 7.15	22.52 ± 4.19	36.76 ± 7.15	13.28 ± 4.51
t value	6.504	5.553	7.701	0.458
P value	< 0.001	< 0.001	< 0.001	0.648

ESD: Endoscopic submucosal dissection; EMR: Endoscopic mucosal resection.

Table 3 Nutrition status, mean ± SD

Group	ALB (g/L)		PA (mg/L)		Hb (g/L)		TRF (g/L)	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
ESD group (n = 42)	47.86 ± 4.28	42.28 ± 3.67[a]	328.84 ± 35.26	302.15 ± 24.78[a]	118.20 ± 8.87	108.24 ± 7.48[a]	2.38 ± 0.82	1.90 ± 0.47[a]
EMR group (n = 38)	48.04 ± 4.36	35.86 ± 4.15[a]	331.05 ± 37.82	278.53 ± 25.69[a]	120.49 ± 9.36	98.89 ± 7.27[a]	2.40 ± 0.85	1.67 ± 0.41[a]
t value	0.186	7.343	0.270	4.184	1.123	5.658	0.107	2.321
P value	0.853	< 0.001	0.788	< 0.001	0.265	< 0.001	0.915	0.023

[a]P < 0.05 compared with that in the same group before operation.
ESD: Endoscopic submucosal dissection; EMR: Endoscopic mucosal resection; ALB: Albumin; PA: Prealbumin; TRF: Transferrin.

Gastrointestinal hormones

The difference in the index expression between the two groups before surgery was not significant (P > 0.05). PG I levels increased and PG II levels decreased in both groups after surgery. However, the PG I level in the ESD group was higher than that in the EMR group, and the PG II levels were lower in the ESD group than those in the EMR group (P < 0.05; Table 4).

Complications

The incidence rate of ESD group was 4.76%. The incidence rate of EMR group was 10.53%. These differences were not significant (χ^2 = 0.305, P = 0.581).

DISCUSSION

This study showed that the overall resection rate of the lesion in the ESD group was higher. The surgical bleeding volume and operative time were higher and gastrointestinal ventilation time was shorter in the ESD group than those in the EMR group (P < 0.05). The results indicated that ESD required a long operation time and resulted in copious bleeding; however, it had a high resection rate of lesions, a low residual rate of basal lesions, and a short recovery time for postoperative gastrointestinal function. Meng *et al*[8] confirmed that the complete resection rate of the lesion in patients with heterogeneous EGC treated with ESD was higher than that in patients undergoing EMR. Yang *et al*[9] reported that

Table 4 Gastrointestinal hormones, mean ± SD (μg/L)

Group	PG I		PG II	
	Pre	Post	Pre	Post
ESD group (n = 42)	65.82 ± 6.89	82.48 ± 6.48[a]	25.04 ± 2.48	15.28 ± 3.15[a]
EMR group (n = 38)	66.27 ± 7.15	73.89 ± 6.35[a]	24.76 ± 2.51	18.96 ± 3.37[a]
t value	0.287	5.978	0.501	5.048
P value	0.775	< 0.001	0.618	< 0.001

[a]P < 0.05 compared with that in the same group before operation.

ESD: Endoscopic submucosal dissection; EMR: Endoscopic mucosal resection; PG: Pepsinogen.

the recurrence rate of undifferentiated EGC after ESD was lower than that after traditional surgery. Several studies have confirmed the therapeutic effect of ESD. EMR can inhibit lesion metastasis by removing the local mucosal tissue. The operation is relatively simple, and the operation time is shorter with less bleeding. However, the requirement of repeated submucosal injections in ESD increases the operation time and bleeding volume to a certain extent[10]. However, the mucosa is stripped without removing the mucosal tissue, which preserves the relatively complete gastric mucosal tissue of the patient. This method has a relatively low impact on the overall structure and function of the patient's stomach and is conducive to the immediate recovery of gastrointestinal function of the patient after surgery[11]. Simultaneously, the lesion could not be included once for mucosal resection owing to the influence of the transparent cap or snare. The lesion could not be removed at once for lesions with volume ≥ 2 cm, and it requires multiple removal, resulting in lesion residue. However, when using mucosal stripping, the lesion tissue can be stripped simultaneously and gradually separated into the submucosa, reducing tumor residue and achieving curative resection of tumor lesions[12].

Most cases of EGC display no specific symptoms; however, they experience upper abdominal discomfort, dyspepsia and other symptoms and no weight loss, vomiting, anemia, malnutrition, or other manifestations. Although we found that the nutritional status of the two groups decreased after surgery, the levels of ALB, PA, Hb, and TRF were higher in the ESD group than in the EMR group (P < 0.05). The results showed that gastrointestinal endoscopic surgery led to a decreased nutritional level in patients, but the use of ESD had little effect on the nutritional level of patients. Mucosal stripping could strip the mucosal tissue of the lesion without damaging the surrounding tissues around the lesion. The normal physiological structure of the stomach can be preserved to some extent, which promotes the recovery of gastrointestinal motility and improves gastrointestinal digestion and absorption function of patients. Simultaneously, it can reduce the impact of the operation on the intestinal mucosa, maintain intestinal barrier function, and maintain gastrointestinal physiological function, thereby reducing the impact of the operation on the nutritional status of patients and maintaining a high nutritional level after surgery[13].

PG I and PG II are important indicators of gastric mucosal function. PG I is secreted by the mucous neck cells and main cells through the gastric fundus glands, whereas PG II is secreted by glands throughout the gastric mucosal layer. When the gastric mucosa becomes cancerous, the secretion of PG by cells is affected, leading to changes in serum PG levels. When the gastric mucosa shrinks and gastric acid secretion is reduced, the secretory function of the main cells of the gastric fundus is affected and PG I levels are reduced. However, after tumor cells destroy the gastric wall function, they can promote PG II entry into the peripheral blood and increase the level of PG II[14]. This study showed that the PG I level after surgery in the ESD group was higher, and that the PG II level in the ESD group was lower (P < 0.05). This indicates that ESD can promote the recovery of gastric mucosal function. As ESD can completely strip the tumor tissue and avoid tumor residue, the damage of the tumor cells to the gastric mucosa layer can be avoided, and the secretion function of PG can be improved. EMR can also remove tumor lesions, but the complete resection rate is low, and the damage to the gastric mucosa layer of patients is more obvious, so the effect of pepsin is not as good as that of ESD. The difference in the incidence of postoperative complications between the two groups was not significant. The complications between the two surgeries probably did not differ owing to the limitations of the small sample size and short observation time, which require further clinical exploration.

ESD has a strong therapeutic effect on EGC; however, there are significant indications. The main complications of ESD include perforations and hemorrhages. According to a survey by Odagiri *et al*[15], the bleeding rate after ESD was 4.9%, and the incidence of perforation during the operation was 1%-5.2%. Therefore, it is necessary to avoid excessive surgery and repeated electrocoagulation during surgery. Moreover, gastrointestinal decompression should be performed after surgery to avoid the occurrence of postoperative perforation. Simultaneously, appropriate medications should be administered postoperatively to avoid postoperative hemorrhage.

In summary, ESD is superior to EMR for treating EGC and has the advantages of good outcomes and rapid recovery. However, this was a single-center study and all participants were from the same hospital, which may have led to biased results. In future, we will conduct multicenter studies with different populations to validate these results.

CONCLUSION

Treatment of EGC with ESD can promote the immediate recovery of gastrointestinal function after surgery and improve the nutritional status of patients. It has a low impact on the gastric mucosa and is therefore worthy of clinical application. However, this study had certain limitations. This was a retrospective study with a small sample size and did not observe long-term prognosis of the patients, which biased the results. Therefore, prospective randomized controlled trials with larger sample sizes and long-term follow-up studies are needed to provide a reference for the surgical treatment of EGC. The effects of different surgical protocols on the psychological state of patients can be considered to explore the influence of different surgical schemes on patients' anxiety levels.

FOOTNOTES

Author contributions: Xu QD and Wu ZY designed the study; Zhang HW, Gao XM, Li YG, and Wu ZY contributed to the analysis of the manuscript; Xu QD and Liu H involved in the data and writing of this article; all authors have read and approved the final manuscript. Xu QD and Liu H contributed equally to this work as co-first authors. They jointly participated in the designing and planning of the research, proposed innovative research ideas and methods, laid the foundation for the smooth progress of the research. They played a crucial role in data collection and organization, rigorously screened and organized patient data to ensure accuracy and completeness. They jointly undertook the important tasks of data analysis and interpretation. Meaningful research conclusions were drawn through in-depth exploration and comprehensive judgment, and core viewpoints and important arguments were contributed during the paper writing process.

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