



Endoscopic treatment of cardia lesions: the effects on gastroesophageal reflux disease

Xiufang Liu¹, Yaxuan Li¹, Xianjing Zhou¹, Zhen Huang², Xiaorong Dai¹, Juan Tang², Hongwei Cheng^{1,2}

¹Department of Gastroenterology, Taixing Municipal People's Hospital Affiliated to Bengbu Medical College, Taixing, China; ²Endoscopy Center, Taixing Municipal People's Hospital Affiliated to Bengbu Medical College, Taixing, China

Contributions: (I) Conception and design: X Liu, Y Li, H Cheng; (II) Administrative support: H Cheng; (III) Provision of study materials or patients: X Liu, Y Li, X Zhou, Z Huang; (IV) Collection and assembly of data: X Liu, Y Li, X Dai, J Tang; (V) Data analysis and interpretation: X Liu, Y Li, H Cheng; (VI) Manuscript writing: All authors; (VII) Final approval of manuscript: All authors.

Correspondence to: Hongwei Cheng. Department of Gastroenterology & Endoscopy Center, Taixing Municipal People's Hospital Affiliated to Bengbu Medical College, Taixing 225400, China. Email: gg222hk@163.com.

Background: Drug treatment is the main form of management for patient with gastroesophageal reflux disease (GERD). However, long-term medication can increase the psychological burden of patients. Furthermore, in some patients, standardized drug treatments do not effectively control their condition. Traditional anti-reflux surgery has a low degree of acceptance due to its trauma and many associated complications. In contrast, endoscopic minimally invasive surgery is preferable. This study explored the effects of endoscopic treatment of cardia diseases on GERD.

Methods: A retrospective analysis was conducted on 106 patients with cardia disease (including cardia polyp, precancerous lesion, and early cardia cancer) and reflux esophagitis (RE). Patients underwent endoscopic mucosal resection (EMR) or endoscopic submucosal dissection (ESD), and the rates of complete resection, postoperative complications, and postoperative reflux were assessed.

Results: Among the 106 lesions, 104 lesions were completely resected, and 2 early cancers were cured. No delayed hemorrhage was detected in any of the cases. The GERD-HRQL (gastroesophageal reflux disease-health related quality of life) and GERD-Q (gastroesophageal reflux disease-questionnaires) scores decreased significantly at 3 and 6 months post-operation ($P < 0.001$). Furthermore, the RE grade was significantly different before and after the operation ($P < 0.001$). The basic cure rate at 3 and 6 months after the operation was 83.96% and 84.91%, respectively, and the significant remission rate was 10.38% and 8.49%, respectively.

Conclusions: Endoscopic treatment of cardia conditions is advantageous due to low levels of trauma, higher complete resection rates, and fewer complications. Moreover, the fibrous scar generated after endoscopic treatment forms an anti-reflux barrier, which can alleviate or even cure RE to a certain extent. This may represent a promising method for the clinical treatment of GERD.

Keywords: Cardia lesion; endoscopic therapy; gastroesophageal reflux disease (GERD); reflux esophagitis (RE)

Submitted Apr 14, 2021. Accepted for publication May 28, 2021.

doi: 10.21037/apm-21-1154

View this article at: <http://dx.doi.org/10.21037/apm-21-1154>

Introduction

Cardia cancer is a special type of gastric malignancy. Due to the complex anatomical structure of the cardia, early clinical symptoms are easily missed. At diagnosis, most cardia cancers are classified as difficult-to-resect,

locally advanced, or at the systemic metastasis stage, and prognosis is generally poor (1). The incidence of cardia cancer had gradually increased in recent years (2,3), and the development of timely interventions to treat precancerous lesions of the cardia is warranted. Endoscopic treatment has the characteristics of being minimally invasive,

safe, convenient, and suitable for multiple treatments. Importantly, it has good application value in the treatment of precancerous lesions of the cardia (4). Endoscopic submucosal dissection (ESD) is the main treatment for early cancers of the digestive tract. It can not only clarify the pathological diagnosis, but can also effectively reduce the incidence of recurrence and metachronous cancers (5), while retaining the original physiological structure. Compared with traditional surgery, there are fewer complications after ESD, and the patient's quality of life is enhanced (6).

Gastroesophageal reflux disease (GERD) mainly refers to the reflux of the contents of the stomach and duodenum into the esophagus. Patients may have symptoms such as acid reflux and heartburn. In severe cases, complications such as esophageal stenosis, bleeding, and cancer may occur (7). According to a systematic review in 2005, the prevalence of GERD is 10–20% in western countries and less than 5% in Asian countries. In 2014, the prevalence rate rose to 18–27.8% in Europe and America, and 11.6% in Asia (8,9). In clinical, GERD has many kinds of extraesophageal symptoms, including clearing throat, chronic cough, hoarseness, excessive mucus in throat, sense of drip after nose, chronic cough, burning of foreign body in throat and asthma. GERD can be seen alone or coexist with typical symptoms. Different from GERD, it is found that there are many factors that cause the extraesophageal symptoms, the most important of which are “reflow” and “reflection” (10). The mechanism of reflux refers to the reflux of gastric contents to the throat, pharynx or inhaled into the respiratory tract, which directly stimulates or damages the mature abdomen, and thus causes a series of symptoms (11). Reflex mechanism refers to respiratory symptoms such as cough caused by the reflex of distal esophageal reflux through vagal nerve (12). According to the endoscopic findings, GERD can be divided into reflux esophagitis (RE) (inner mirror esophagitis), nonerosive reflux disease (no inner mirror esophagitis), or Barrett's esophagus (orange red velvet mucosal episode appeared near the gastroesophageal joint). The incidence of GERD in Western countries is 8–27% (13), and the incidence in China is 1.9–7.0% (14). Studies have shown standard doses of proton pump inhibitors (PPIs) once or twice daily were only partially effective or completely ineffective for 40% of GERD patients (15). It can only improve GERD symptoms, but not esophageal motor function (16). Therefore, the application of surgical treatment is crucial. This study explored the effects of endoscopic treatment of cardia conditions on GERD. We present the following article in

accordance with the STROBE reporting checklist (available at <http://dx.doi.org/10.21037/apm-21-1154>).

Methods

Patient selection

A total of 106 patients with cardia lesions combined with GERD who were treated with endoscopic mucosal resection (EMR) or ESD in our hospital from August 2013 to May 2020 were enrolled in this study. There were 58 males and 48 females, aged 39–79 years, with an average age of 61.4 ± 10.7 years. Patients who presented with following were eligible to participate in this study: cardia polyps or cardia precancerous lesions (including moderate, moderate to severe, or severe dysplasia) confirmed by pathological and endoscopic examinations, early cardia cancer (lesions limited to the mucosa or submucosa without invading the muscles layer, and no distant or lymph node metastasis), and GERD. Patients presenting with the following were excluded from the study: (I) lesions invading the muscle layer or distant metastasis; (II) other severe organ diseases (such as severe cardiopulmonary insufficiency, large-area myocardial infarction, etc.); (III) severe coagulation dysfunction; (IV) pregnant women; (V) esophageal varices; and (VI) severe psychological and mental disorders and thus, cannot cooperate with the surgery. This study was approved by the Ethics Committee of Taixing Municipal People's Hospital Affiliated to Bengbu Medical College (ethics approval number: KY425063) and conducted in accordance with the Declaration of Helsinki (as revised in 2013). All patients provided informed consent.

Instruments and equipment

The following instruments and equipment were used: gastroscopy (Olympus GIF-Q260J), insulation-tipped (IT) knife (Olympus KD-611L), hook knife (Olympus KD-620LR), hyperknife (ERBE Tuebingen, high frequency module), NM-400L-0423 injection needle, FD-1U-1 hot biopsy forceps, HX-610-135 titanium clips, snare device, APC300 argon plasma coagulation device, ERBEICC-200 high frequency electric cutting device workstation, and transparent caps.

Interventions

Prior to endoscopic surgical treatment, chest radiographs,

electrocardiograms, coagulation function tests, and other examinations were performed to exclude surgical contraindications. Patient was informed of the surgical risks and signed an informed consent. Patients prepared the gastrointestinal tract for endoscopy by fasting for 12 hours prior to the procedure.

Endoscopic operations were performed by experienced endoscopists. EMR was used for polyps less than or equal to 20 mm in diameter, as previously described. Briefly, the injection needle is inserted into the biopsy orifice, and sodium hyaluronate is injected into the submucosa to make the polyp swell. To removal the polyp, the injection needle is retracted, and the disposable polyp snare is extended and used to completely enclose the polyp. The power supply is switched on to remove the polyp. The wound is treated and monitored for oozing of blood. Finally, the resected lesions are sent for pathological examination. The patients fast for 24 hours after the operation.

ESD surgery was used for patients with polyps greater than 20 mm in diameter, early cardiac cancers, or precancerous lesions. For this procedure, a transparent cap is attached to the end of the gastric lens. The lesion is marked with a needle-like knife around the periphery, about 5 mm from the outer edge of the lesion, with an interval of about 5–6 mm. The injection needle is inserted from the endoscopic biopsy hole, and sodium hyaluronate is injected outside the marked point to lift the lesion. Using a needle knife, a circular incision is made at the marked point at the distal end of the lesion. An IT knife is then used to peel off the submucosal layer of the lesion along the mark. During the peeling process, hemostatic forceps are used to burn the blood vessels. Swelling of the lesion is monitored during the peeling process. If necessary, additional submucosal injections are administered. Argon gas or hemostatic forceps are used to treat the wound for bleeding. The extracted specimens are placed flat and fixed with a pin, treated in formalin solution, and sent for pathological examination. The patients are fasted for 24 to 48 hours after the operation. Proton pump inhibitors are administered for 2 to 3 days post-operatively, and hemostasis and fluid rehydration are provided. Gastrointestinal decompression is performed for patients with longer operation time and heavy bleeding.

Evaluation indexes

Surgical resection of lesions and complications

Pathological examinations were performed on the cardia

lesions of each patient. The involvement of the edge and the base of the lesion were analyzed. Parameters including perforation, delayed bleeding, lung infection, and postoperative stenosis, were monitored.

Complete resection under endoscopy indicates that no residual diseased tissue is detected, and the lesion was removed in one operation. Curative resection indicates that there is no lesion at the base and lateral margins, the depth of the lesion infiltration did not reach the deep submucosal layer, and no tumor cells remain in the vessel.

The patient's quality of life and clinical symptom score before and after surgery

The GERD-health related quality of life (GERD-HRQL) and the gastroesophageal reflux disease-questionnaires (GERD-Q) scores were used to assess the quality of life and clinical symptoms of the patients. The GERD-HRQL scale (17) assesses 11 items related to the patient's quality of life, including heartburn, swallowing, drug efficacy, and general health status. This method of assessment is simple, efficient, has a high response rate, and has high reliability and validity (18). Asymptomatic patients are given 0 points; patients who are symptomatic but are not distressed are given 1 point; patients with symptoms which cause occasional distress are allocated 2 points; patients with symptoms which cause distress daily are given 3 points; patients with symptoms that are upsetting and affect daily activities are allocated 4 points; and patients with symptoms that incapacitate their daily activities are given 5 points. The GERD-HRQL score ranges from 0–50 points, with higher scores reflecting poorer quality of life.

The GERD-Q records the frequency of heartburn, reflux, epigastric pain, and nausea in patients in the past one week, the frequency of regurgitation or heartburn affecting sleep, and the frequency of taking additional drugs to relieve reflux or heartburn (19). Patients with a GERD-Q score 8 points are considered to have GERD. The maximum number of points is 18.

The degree of esophageal mucosal injury before and after surgery

Patients underwent gastroscopies at the 3- and 6-month post-surgical follow-up. The Los Angeles classification was used to assess the degree of esophageal mucosal damage (20). Grade A damage is defined as one or more region of the mucosa damaged in the esophageal mucosa, with a length less than 5 mm. Grade B is defined as one or several regions of mucosa damaged, with a length greater than 5 mm, but

Table 1 Surgical resection of lesions

Pathological type	N (%)
Polyp	29 (27.36)
Moderate dysplasia	28 (26.42)
Moderate to severe dysplasia	22 (20.75)
Severe dysplasia	24 (22.64)
Early adenocarcinoma	3 (2.83)

no fusion between the damaged areas. Grade C is defined as mucosa with more than 2 folds of fusion injury, but less than 75% of the circumference of the esophagus. Grade D is defined as mucosal damage with a combined mutual fusion range at least 75% of the circumference of the esophagus.

Evaluation of the curative effect of endoscopic treatment of cardia diseases

The efficacy of the treatment was assessed using the patient's clinical symptoms, GERD-HRQL and GERD-Q scores, and RE classification. A remission rate greater than 90% is defined as a basic cure, a remission rate greater than 50% is defined as a significant remission, a remission rate greater than 10% is defined as a partial remission, and a remission rate $\leq 10\%$ is defined as ineffective (21).

Statistical analyses

All statistical analyses were performed using SPSS 20.0 software (SPSS Inc., Chicago, IL, USA). Measurement data are expressed as mean \pm standard deviation ($\bar{x} \pm s$), and were compared using 2-tailed *t*-tests. Count data are expressed by rates and percentages, and were compared using the chi-squared (χ^2) test or rank-sum test. A *P* value < 0.05 was considered statistically significant.

Results

Surgical resection of lesions

A total of 106 cardiac lesions were removed in this study cohort, including 29 cases of cardia polyps (including hyperplastic polyps and inflammatory polyps), 28 cases of cardia glands with moderate dysplasia, 22 cases of moderate to severe dysplasia, 24 cases of severe dysplasia, and 3 cases of early cardia adenocarcinoma which were confirmed by postoperative pathology. Among them, 104 lesions were

completely resected, and 2 early cancers were curatively resected. None of the cases showed delayed postoperative bleeding. See *Table 1* for details.

GERD-HRQL and GERD-Q scores of patients before and after operation

The patient GERD-HRQL scores were significantly decreased at 3 months ($t=22.480$, $P<0.000$) and 6 months post-surgery ($t=22.059$, $P<0.000$) compared with the scores observed before surgery. However, there was no statistically significant difference between the scores at 3 months and 6 months after surgery ($t=-0.819$, $P=0.207$). Similarly, the patient GERD-Q scores were significantly decreased at 3 months ($t=49.003$, $P<0.000$) and 6 months ($t=45.594$, $P<0.000$) post-surgery compared with the scores before surgery. However, there was no statistically significant difference between the scores at 3 months and 6 months after surgery ($t=-1.156$, $P=0.125$). See *Table 2* for details.

RE classification of patients before and after surgery

In the preoperative RE grading, there were 0 normal case, 40 cases classified as grade A, 58 cases classified as grade B, and 8 cases classified grade C. At 3 months post-operation, there were 38 normal cases, 53 grade A cases, 13 grade B cases, and 2 grade C cases. At 6 months post-operation, there were 74 normal cases, 28 grade A cases, 3 grade B cases, and 1 grade C case. Compared with preoperatively, the proportion of grade B and C patients decreased gradually at 3 months and 6 months after the operation, and the proportion of normal patients gradually increased, and the differences were statistically significant ($P<0.000$; *Table 3*).

Evaluation of the curative effect of postoperative patients

Patients were hospitalized for 3–12 days postoperatively, and the average length of stay was 6.1 ± 2.1 days. The basic cure rates at 3 and 6 months after surgery reached 83.96% and 84.91%, respectively, and the significant remission rates were 10.38% and 8.49%, respectively (*Table 4*). Follow up gastroscopies were performed at 3 and 6 months after the operation. Gastroscopy showed that the esophageal motility was normal, the mucosa was smooth, the dentate line was clear, the entry of the cardia was smooth, and the surgical wound had healed well (*Figure 1*).

Table 2 A comparison of GERD-HRQL and GERD-Q scores of patients before and after the operation ($\bar{x}\pm s$, points)

Item	Preoperative	3 months post-operation	6 months post-operation	F value	P value
N	106	106	106	–	–
GERD-HRQL scores	19.03±6.72	3.84±1.80 ^a	4.05±1.93 ^a	16.346	0
GERD-Q scores	11.05±2.02	1.20±0.45 ^a	1.31±0.87 ^a	12.325	0

Compared with preoperative, ^aP<0.000. GERD-HRQL, gastroesophageal reflux disease health related quality of life; GERD-Q, gastroesophageal reflux disease questionnaires.

Table 3 A comparison of reflux esophagitis classification of patients before and after surgery

Item	Preoperative (n, %)	3 months post-operation (n, %)	6 months post-operation (n, %)	F value	P value
N	106	106	106	–	–
Normal mucosa	0 (0.00)	38 (35.85)	74 (69.81)	34.139	0
Grade A	40 (30.74)	53 (50.00)	28 (26.42)	23.142	0
Grade B	58 (54.72)	13 (12.26)	3 (2.83)	23.429	0
Grade C	8 (7.55)	2 (1.89)	1 (0.94)	15.306	0

Table 4 Evaluation of the curative effect in patients postoperatively

Time	3 months post-operation (n, %)	6 months post-operation (n, %)	χ^2 value	P value
N	106	106	–	–
Basic cure	89 (83.96)	90 (84.91)	0.036	0.393
Significant remission	11 (10.38)	9 (8.49)	0.221	0.135
Partial remission	5 (4.72)	7 (6.60)	0.353	0.103
Ineffective	1 (0.94)	0 (0.00)	1.005	0.094

Postoperative complications of patients

The postoperative complications are listed in *Table 5*. None of the patients experienced perforation or delayed bleeding. There were 2 cases (1.89%) of pulmonary infection postoperatively, and both were discharged after active anti-inflammatory treatment. One patient (0.94%) presented with severe dysplasia from the cardia to the upper gastric body, and postoperative stenosis was observed 1 month after surgery. Endoscopic tube dilation was performed and the patient recovered well.

Discussion

Overview of the clinical management of GERD

Medication is the first-line treatment for patients with GERD, and PPI is the first tactic treatment. For the

treatment of patients with elderly Gerd patients, H2RA, active medicine, anti-anxiety depression, inhibit TLESR drug, gastric mucosa Protective drugs and other drugs to improve the cure rate. However, long-term medication can increase the psychological burden of patients. In addition, some patients may experience related symptoms that are difficult to control, while others may experience continuous and repeated attacks. Traditional anti-reflux surgery suffers from low patient acceptance due to large surgical trauma and associated complications. In contrast, endoscopic minimally invasive surgery has become a preferable option. In patients for whom oral proton pump inhibitors are ineffective or have poor therapeutic effects, the mucosa can be removed or stripped directly at the cardia reflux area to help build a scar barrier and block the reflux of gastric acid and gastric contents. This method neither transplants the gastroesophagus nor changes the

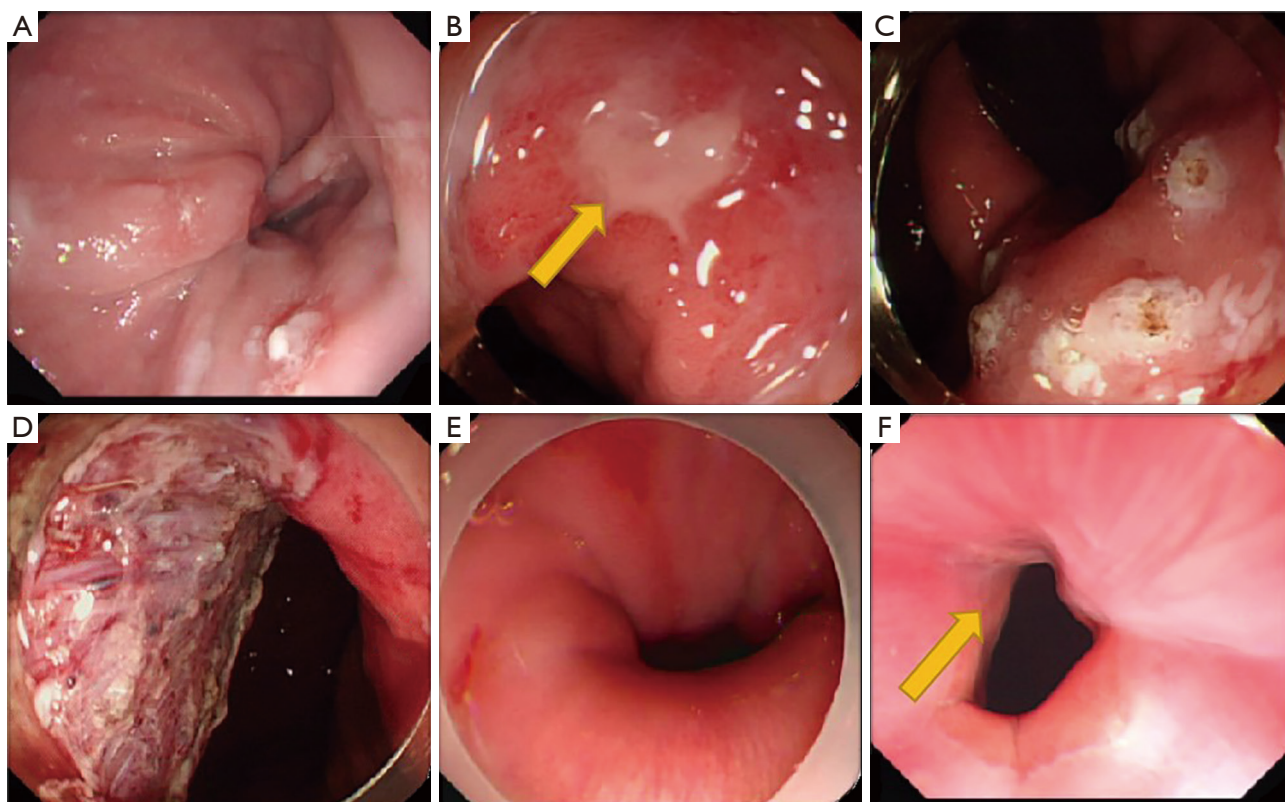


Figure 1 The patient's preoperative and postoperative endoscopic findings. (A) Preoperative reflux esophagitis (RE) grade B combined with moderate to severe cardia dysplasia. (B,C,D) The procedure of ESD surgery for moderate to severe dysplasia of the cardia. The yellow arrow indicates the lesion. (E) Re-examination with gastroscopy 3 months after the initial operation showed that esophageal reflux was significantly improved (Grade B to Grade A), and the wound had healed well. (F) Re-examination with gastroscopy 6 months after the initial operation showed that the esophageal mucosa was smooth and undamaged, and the surgical wound had healed well. The yellow arrow indicates the postoperative scar.

Table 5 Postoperative complications in the patients

Complication	N (%)
Perforation	0 (0.0)
Delayed bleeding	0 (0.0)
Lung infection	2 (1.89)
Postoperative stenosis	1 (0.94)

original physiological structure, and thus it may have good clinical prospects. The emerging anti-reflux mucosectomy (ARMS) principle is similar to the above, and it can be achieved by ESD or EMR surgery. In the implementation of ARMS, it is necessary to mark the mucosa to be removed. Generally, a crescent-shaped resection is performed on the mucosa of the lesser curvature of the

cardia, and about 2 cm of the mucosa is retained on the side of the greater curvature. Submucosal injection is then performed, followed by mucosal resection via ESD or EMR surgery. Circumferential mucosa should be preserved during surgery to prevent postoperative stenosis. Numerous studies have reported the feasibility, efficacy, and safety of ARMS in the treatment of GERD (22). Inoue *et al.* (23) performed ARMS on 10 patients with refractory GERD. Circumcision was performed in 2 cases, and crescent-shaped mucosal resection was performed in the remaining 8 cases. The results demonstrated that the typical symptoms of GERD were significantly relieved after the operation. In another study (24) the GERD-Q score, gastroesophageal valve classification, DeMeester score, and acid exposure times were all lower at 6 months after ARMS treatment compared to before surgery.

Furthermore, reflux symptoms were also significantly alleviated. Yoo *et al.* analyzed the short-term therapeutic effects of ARMS with transparent cap (ARMS-C)-assisted EMR (3). The study analyzed 33 patients with GERD who underwent ARMS-C surgery, and found that more than 60% of patients did not require proton pump inhibitors within 6 months after the surgery, and 30% of patients could reduce the amount of medication. The GERD-Q scores dropped from 11.0 points before surgery to 6.0 points post-surgery. The DeMeester score and the acid exposure time of the esophagus were also significantly improved after ARMS (3). Only 2 cases were treated with balloon dilatation due to postoperative stenosis, and no serious complications occurred in the other patients (3). These reports all suggested that ARMS is highly feasible and has good clinical prospects. However, due to the small clinical samples, further studies are warranted to verify the long-term clinical benefits of ARMS.

Analysis of the results of this study

In this report, 106 patients presented with gastric cardia disease combined with RE. After the removal or stripping of the gastric cardia mucosal lesions, the resultant fibrous scars caused the gastroesophageal valve to contract and rebuild (25). This resulted in a narrowing of the connection between the stomach and the esophagus (26), thereby producing a certain anti-reflux effect. In this study, the postoperative reflux conditions of the patients were significantly improved, demonstrating that through the therapeutic intervention of the cardiac mucosa, RE can be treated to a certain extent. The GERD-HRQL and GERD-Q scores are often used to evaluate the therapeutic effects of GERD (27). In this study, there were statistically significant differences in the GERD-HRQL and GERD-Q scores before treatment and at 3 and 6 months after the operation, suggesting that endoscopic treatment was effective and patients experienced good short-term benefits (including improved acid reflux, heartburn, related symptoms, and esophagitis healing), which in turn significantly improved the quality of life. In this investigation, no serious treatment-related complications occurred. Different surgical methods (EMR or ESD) were used according to the size and nature of the cardia lesions. EMR was used for benign polyps, and ESD was used for dysplasia and early cancers (28). The results showed that both methods could alleviate the symptoms of RE. In the actual operation, EMR is easier

to perform than ESD, as it does not involve resecting the dysplasia and early cancer, and thus, it is more acceptable to patients. However, in deciding between EMR and ESD, it is important to specifically analyze and evaluate the patient's individual condition and choose the most optimal treatment method (29). In this study, a patient with severe dysplasia from the cardia to the upper gastric body developed postoperative stenosis one month after ESD, but recovered after endoscopic tube dilation. Therefore, although ESD has good clinical prospects, one must consider all the appropriate indications prior to surgery to avoid complications.

Summary and outlook

This study was limited by the small number of cases, and more clinical samples are needed to confirm the conclusions of this investigation. Due to the limitations of the hospital medical facilities, there was no 24-hour pH-impedance monitoring for patients to more intuitively reflect acid exposure before and after surgery. Furthermore, no accurate records were made for the analysis of the lesions and the scope of surgery. The follow-up time for patients was relatively short, and future studies with extended follow-up time should be conducted to observe long-term effects. Additionally, the effects of different factors such as the degree of reflux and the range and location of the mucosal resection, on treatment efficacy warrant further exploration. This study was a retrospective study, and future multi-center, randomized, controlled, and prospective studies should be conducted to confirm the clinical efficacy of EMR and ESD in the treatment of GERD.

Conclusions

Endoscopic treatment of cardia conditions is advantageous due to low levels of trauma, higher complete resection rates, and fewer complications. Moreover, the fibrous scar generated after endoscopic treatment forms an anti-reflux barrier, which can alleviate or even cure RE to a certain extent. This may represent a promising method for the clinical treatment of GERD.

Acknowledgments

Funding: This work was supported by Hospital-level Project Foundation of Taixing People's Hospital of Jiangsu Province (try1925) and School-level Project Foundation of Bengbu

Medical College (Byycx1978).

Footnote

Reporting Checklist: The authors have completed the STROBE reporting checklist. Available at <http://dx.doi.org/10.21037/apm-21-1154>

Data Sharing Statement: Available at <http://dx.doi.org/10.21037/apm-21-1154>

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at <http://dx.doi.org/10.21037/apm-21-1154>). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was approved by the Ethics Committee of Taixing Municipal People's Hospital (ethics approval number: KY425063) and was conducted in accordance with the Declaration of Helsinki (as revised in 2013). All patients provided informed consent.

Open Access Statement: This is an Open Access article distributed in accordance with the Creative Commons Attribution-NonCommercial-NoDerivs 4.0 International License (CC BY-NC-ND 4.0), which permits the non-commercial replication and distribution of the article with the strict proviso that no changes or edits are made and the original work is properly cited (including links to both the formal publication through the relevant DOI and the license). See: <https://creativecommons.org/licenses/by-nc-nd/4.0/>.

References

- Liu H. Assessment of anti-reflux treatment on pulmonary ventilation function and inflammatory cytokines in patients with stable chronic obstructive pulmonary disease combined with gastroesophageal reflux. *Exp Ther Med* 2018;15:5528-36.
- Broers C, Tack J, Pauwels A. Review article: gastro-oesophageal reflux disease in asthma and chronic obstructive pulmonary disease. *Aliment Pharmacol Ther* 2018;47:176-91.
- Yoo IK, Ko WJ, Kim HS, et al. Anti-reflux mucosectomy using a cap-assisted endoscopic mucosal resection method for refractory gastroesophageal disease: a prospective feasibility study. *Surg Endosc* 2020;34:1124-31.
- Castro R, Pimentel-Nunes P, Dinis-Ribeiro M. Evaluation and management of gastric epithelial polyps. *Best Pract Res Clin Gastroenterol* 2017;31:381-7.
- Zheng X, Zuo N, Lin H, et al. Margin diagnosis for endoscopic submucosal dissection of early gastric cancer using multiphoton microscopy. *Surg Endosc* 2020;34:408-16.
- Costa RS, Ferreira A, Leal T, et al. Endoscopic Submucosal Dissection for the Treatment of Superficial Epithelial Gastric Neoplasia in a Portuguese Centre. *GE Port J Gastroenterol* 2019;26:90-8.
- von Diemen V, Trindade EN, Trindade MRM. Hiatal hernia and gastroesophageal reflux: Study of collagen in the phrenoesophageal ligament. *Surg Endosc* 2016;30:5091-8.
- Dent J, El-Serag HB, Wallander MA, et al. Epidemiology of gastro-oesophageal reflux disease: a systematic review. *Gut* 2005;54:710-7.
- El-Serag HB, Sweet S, Winchester CC, et al. Update on the epidemiology of gastro-oesophageal reflux disease: a systematic review. *Gut* 2014;63:871-80.
- Asaoka D, Nagahara A, Matsumoto K, et al. Current perspectives on reflux laryngitis. *Clin J Gastroenterol* 2014;7:471-5.
- Stanghellini V. Relationship between upper gastrointestinal symptoms and lifestyle, psychosocial factors and comorbidity in the general population: results from the Domestic/International Gastroenterology Surveillance Study (DIGEST). *Scand J Gastroenterol Suppl* 1999;231:29-37.
- Poe RH, Kallay MC. Chronic cough and gastroesophageal reflux disease: experience with specific therapy for diagnosis and treatment. *Chest* 2003;123:679-84.
- Menezes MA, Herbella Fernando AM. Pathophysiology of Gastroesophageal Reflux Disease. *World J Surg* 2017;41:1666-71.
- GBD 2017 Oesophageal Cancer Collaborators. The global, regional, and national burden of oesophageal cancer and its attributable risk factors in 195 countries and territories, 1990-2017: a systematic analysis for the Global Burden of Disease Study 2017. *Lancet Gastroenterol Hepatol* 2020;5:582-97.
- Tustumi F, Bernardo WM, Mariano da Rocha JR, et al. Anti-reflux surgery for controlling respiratory symptoms of gastro-oesophageal reflux disease: A systematic review

- and meta-analysis. *Asian J Surg* 2021;44:2-10.
16. Katz PO, Gerson LB, Vela MF. Guidelines for the diagnosis and management of gastroesophageal reflux disease. *Am J Gastroenterol* 2013;108:308-28; quiz 329.
 17. Velanovich V, Vallance SR, Gusz JR, et al. Quality of life scale for gastroesophageal reflux disease. *J Am Coll Surg* 1996;183:217-24.
 18. Chan Y, Ching JY, Cheung CM, et al. Development and validation of a disease-specific quality of life questionnaire for gastro-oesophageal reflux disease the gerd-qol questionnaire. *Aliment Pharmacol Ther* 2010;31:452-60.
 19. Miyake H, Chen Y, Hock A, et al. Are prophylactic anti-reflux medications effective after esophageal atresia repair? Systematic review and meta-analysis. *Pediatr Surg Int* 2018;34:491-7.
 20. Dewan KR, Patowary BS, Bhattarai S, et al. Barrett's Esophagus in Patients with Gastroesophageal Reflux Disease. *J Nepal Health Res Counc* 2018;16:144-8.
 21. Miwa H, Igarashi A, Teng L, et al. Systematic review with network meta-analysis: indirect comparison of the efficacy of vonoprazan and proton-pump inhibitors for maintenance treatment of gastroesophageal reflux disease. *J Gastroenterol* 2019;54:718-29.
 22. Hedberg HM, Kristine K, Michael B, et al. First Experience with Banded Anti-reflux Mucosectomy (ARMS) for GERD: Feasibility, Safety, and Technique (with Video). *J Gastrointest Surg* 2019;23:1274-8.
 23. Inoue H, Ito H, Ikeda H, et al. Anti-reflux mucosectomy for gastroesophageal reflux disease in the absence of hiatus hernia: A pilot study. *Ann Gastroenterol* 2014;27:346-51.
 24. Jiang LQ, Ye BX, Wang MF, et al. Acid exposure in patients with gastroesophageal reflux disease is associated with esophageal dysmotility. *J Dig Dis* 2019;20:73-7.
 25. DeMeester SR. Laparoscopic Hernia Repair and Fundoplication for Gastroesophageal Reflux Disease. *Gastrointest Endosc Clin N Am* 2020;30:309-24.
 26. Sowa P, Samarasena JB. Nonablative Radiofrequency Treatment for Gastroesophageal Reflux Disease (STRETTA). *Gastrointest Endosc Clin N Am* 2020;30:253-65.
 27. Armijo PR, Hennings D, Leon M, et al. Surgical Management of Gastroesophageal Reflux Disease in Patients with Severe Esophageal Dysmotility. *J Gastrointest Surg* 2019;23:36-42.
 28. Ahmed Y, Othman M. EMR/ESD: Techniques, Complications, and Evidence. *Curr Gastroenterol Rep* 2020;22:39.
 29. Shahidi N, Bourke MJ. ESD, not EMR, should be the first-line therapy for early gastric neoplasia. *Gut* 2020;69:1-2.
- (English Language Editor: J. Teoh)

Cite this article as: Liu X, Li Y, Zhou X, Huang Z, Dai X, Tang J, Cheng H. Endoscopic treatment of cardia lesions: the effects on gastroesophageal reflux disease. *Ann Palliat Med* 2021;10(6):6669-6677. doi: 10.21037/apm-21-1154