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PRE- AND POSTOPERATIVE ENDOSCOPIC ASSESSMENT OF ONE-ANASTOMOSIS GASTRIC BYPASS USING THE FUNDORING TECHNIQUE

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Introduction: Bariatric surgery, particularly one-anastomosis gastric bypass (OAGB), is one of the most effective treatments for morbid obesity. However, postoperative reflux esophagitis remains a significant concern. To enhance the antireflux effect, a modified technique FundoRing was developed.

Aim. To perform preoperative and postoperative endoscopic evaluation of the upper gastrointestinal tract in patients after OAGB and to analyze the preventive effect of the FundoRing modification on postoperative reflux esophagitis.

Materials and Methods: A single-center, prospective, interventional, open-label randomized controlled trial was conducted. The main group underwent FundoRing-OAGB (f-OAGB, n=500), and the control group underwent standard OAGB (s-OAGB, n=500). All patients had pre- and postoperative endoscopic assessment of the esophagogastric junction, gastric pouch, and gastroenterostomy.

Results: Endoscopic evaluation demonstrated hiatal hernia in 32% of patients in the f-OAGB group and 24% in the s-OAGB group. Preoperative identification of hiatal hernia without signs of gastroesophageal reflux disease was challenging and was detected in only 9.6–10.4% of cases. Preoperative reflux esophagitis was diagnosed in 21.6% (f-OAGB) and 11.6% (s-OAGB). Postoperatively, reflux esophagitis occurred in only 1% of the f-OAGB group versus 11.6% of the s-OAGB group, indicating a stronger antireflux barrier with the FundoRing technique. Mean gastric pouch volume under light insufflation was approximately 50 ml. The gastroenterostomy diameter measured 30–35 mm intraoperatively and 20–25 mm at 3-year follow-up.

Conclusion: Pre- and postoperative endoscopic evaluation showed advantages of the FundoRing modification of OAGB, particularly its preventive effect against postoperative gastroesophageal reflux disease and stable anatomical outcomes.

Keywords: *endoscopy, FundoRing, one-anastomosis gastric bypass, bariatric surgery, obesity, fundoplication*

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Резюме

РЕЗУЛЬТАТЫ ДО- И ПОСЛЕОПЕРАЦИОННОЙ ЭНДОСКОПИЧЕСКОЙ ОЦЕНКИ ЖЕЛУДОЧНОГО ШУНТИРОВАНИЯ ПО МЕТОДУ ФУНДОРИНГ

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Введение: Бариатрическая хирургия, в частности одноанастомозное желудочное шунтирование (ОАГШ), является одним из наиболее эффективных методов лечения морбидного ожирения. Однако развитие послеоперационного рефлюкс-эзофагита остаётся актуальной проблемой. Для усиления антирефлюксного эффекта был разработан модифицированный метод ФундоРинг.

Цель. Дооперационная и послеоперационная эндоскопическая оценка верхних отделов желудочно-кишечного тракта у пациентов после выполнения одно анастомозного желудочного шунтирования. Проанализировать эффект

превентивного воздействия разработанного метода ФундоРинг на развитие послеоперационного рефлюкс-эзофагита.

Материал и методы: Проведено одноцентровое, проспективное, интервенционное, открытое рандомизированное контролируемое исследование. В первой основной группе выполнено одноанастомозное гастрошунтирование по методу ФундоРинг (ф-ОАГШ n=500). Операцией в контрольной группе была стандартное одноанастомозное гастрошунтирование (с-ОАГШ n=500). Всем пациентам проведено до и послеоперационная эндоскопическая оценка пищеводно-желудочного перехода, малого желудочка и гастроэнтероанастомоза.

Результаты: В результате эндоскопического обследования выявлено, что процент грыж пищеводного отверстия диафрагмы (ГПОД) у пациентов с ожирением составляет 32% в группе ф-ОАГШ и 24% в группе с-ОАГШ. При этом дооперационная диагностика ГПОД без гастроэзофагеальной рефлюксной болезни (ГЭРБ) у пациентов с ожирением была затруднена и процент выявления ГПОД составил в двух группах от 9,6 % - 10,4 %. До операции рефлюкс – эзофагит диагносцирован в 21,6% в первой группе и в 11,6% во второй группе. После операции отмечена существенная разница в выявленном послеоперационом рефлюкс – эзофагите в группе ф-ОАГШ с фундопликацией, где он составил всего 1% против 11,6% в группе с-ОАГШ без фундопликации. Эндоскопическое измерение размеров малого желудочка, при легкой инсуфляции воздухом составлял в среднем 50 мл. Интраоперационно гастроэнтероанастомоз составлял 30–35 мм в диаметре, а через 3 года размер гастроэнтероанастомоза оценивался в диапазоне от 20 до 25 мм.

Выводы: До и послеоперационная эндоскопическая оценка желудочного шунтирования по ФундоРинг выявила преимущество разработанного метода одно анастомозного гастрошунтирования с лучшим превентивным воздействием на развитие послеоперационного рефлюкс-эзофагита.

Ключевые слова: *эндоскопия, ФундоРинг, одноанастомозное желудочное шунтирование, бариатрическая хирургия, ожирение, фундопликация.*

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Түйіндеме

ФУНДОРИНГ ӘДІСІМЕН АСҚАЗАНДЫ ШУНТТАУДЫ ОТАҒА ДЕЙІН ЖӘНЕ ОТАДАН КЕЙІН ЭНДОСКОПИЯЛЫҚ ЖОЛМЕН БАҒАЛАУДЫҢ НӘТИЖЕЛЕРІ

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Кіріспе: Бариатриялық хирургия, соның ішінде бір-анастомозды асқазан шунттау (БААШ), морбидті семіздікті емдеудің ең тиімді әдістерінің бірі болып табылады. Дегенмен, операциядан кейінгі рефлюкс-эзофагит өзекті мәселе болып қала береді. Антирефлюкстік әсерді күшейту үшін модификацияланған ФундоРинг әдісі жасалды.

Мақсаты. Бір-анастомозды асқазан шунттаудан өткен пациенттерде жоғарғы асқазан-ішек жолдарының операцияға дейінгі және операциядан кейінгі эндоскопиялық бағалауын жүргізу және ФундоРинг әдісінің операциядан кейінгі рефлюкс-эзофагиттің алдын алудағы тиімділігін талдау.

Материалдар мен әдістер: Бір орталықта проспективті, интервенциялық, ашық рандомизацияланған бақылаулы зерттеу жүргізілді. Негізгі топта ФундоРинг әдісімен БААШ (ф-ОАГШ, n=500) жасалды. Бақылау тобында стандартты БААШ (с-ОАГШ, n=500) орындалды. Барлық пациенттерде операцияға дейін және кейін өңеш-асқазан түйіспесі, асқазан қалташасы және гастроэнтероанастомоз эндоскопиялық тұрғыда бағаланды.

Нәтижелер: Эндоскопиялық тексеру нәтижесінде семіздікке шалдыққан пациенттерде диафрагманың өңеш тесігінің жарығы ф-ОАГШ тобында 32%, ал с-ОАГШ тобында 24% жағдайда анықталды. Гастроэзофагеальдық рефлюкс ауруы белгілері болмаған кезде диафрагманың өңеш тесігінің жарығын операцияға дейін анықтау қиындық тудырып, екі топта да 9,6–10,4% жағдайларда ғана тіркелді. Операцияға дейін рефлюкс-эзофагит ф-ОАГШ тобында 21,6% және с-ОАГШ тобында 11,6% пациенттерде анықталды. Операциядан кейін рефлюкс-эзофагит ф-ОАГШ тобында тек 1% жағдайда, ал с-ОАГШ тобында 11,6% жағдайда байқалды, бұл ФундоРинг әдісінде сенімдірек антирефлюкстік тосқауыл қалыптасқанын көрсетеді. Эндоскопиялық өлшемдер бойынша асқазан қалташасының орташа сыйымдылығы жеңіл инсуфляцияда шамамен 50 мл болды. Интраоперациялық гастроэнтероанастомоз диаметрі 30–35 мм болса, 3 жылдан кейін эндоскопиялық бағалау бойынша 20–25 мм аралығына азайды.

Қорытынды: ФундоРинг әдісі қолданылған бір-анастомозды гастрошунттаудың операция алдындағы және кейінгі эндоскопиялық бағалауы осы әдістің операциядан кейінгі гастроэзофагеальдық рефлюкс ауруының алдын алуда және анатомиялық тұрақтылықты сақтауда артықшылығы бар екенін көрсетті.

***Түйін сөздер**:* эндоскопия, Фондоринг, бір - анастомозды асқазанды айналып өту, бариатриялық хирургия, семіздік, фундопликация

Дәйексөз үшін:

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Introduction

Currently, gastric bypass is considered the most effective treatment for morbid obesity and its consequences in cases where diet therapy, pharmacotherapy, and other non-surgical interventions are ineffective [1].

The national consensus of surgeons and endocrinologists of Kazakhstan defined the indications for metabolic surgery in patients with type 2 diabetes mellitus [2]. Other indications for bariatric and metabolic surgery are described in clinical protocols approved by the Ministry of Health of the Republic of Kazakhstan [3,4].

A thorough preoperative assessment of candidates for bariatric surgery includes comprehensive laboratory testing and instrumental examinations to identify comorbidities, define indications and contraindications to surgery, and determine the need for preoperative optimization by a multidisciplinary team [5].

Upper gastrointestinal endoscopy plays a key role in the preoperative work-up [6,7]. It aims not only to detect pathology that may influence the feasibility of bariatric surgery, but also to support selection of the most appropriate procedure, including the need for concomitant interventions (for example, in the presence of preoperative reflux esophagitis) [8].

Therefore, preoperative endoscopy is frequently considered mandatory before bariatric surgery [9]. Morbid obesity is a risk factor for multiple upper gastrointestinal disorders, including gastritis, hiatal hernia (HH), concomitant gastroesophageal reflux disease (GERD), and Barrett's esophagus [10]. Several reports have described the spectrum of pathological findings in obese patients [11] and emphasized the value of preoperative endoscopy. Current German guidelines recommend upper gastrointestinal endoscopy for all bariatric candidates [12]. In contrast, the American Society for Metabolic and Bariatric Surgery (ASMBS) recommends an individualized approach to the indications for preoperative endoscopy in bariatric surgery [13].

Thus, although the clinical value of pre- and postoperative endoscopic findings is not in doubt, the necessity of routine endoscopy in every patient before and after bariatric surgery remains a matter of debate internationally.

In addition, endoscopic assessment is needed for newly developed bariatric interventions. Despite extensive national experience with one-anastomosis gastric bypass using the FundoRing technique, no publication has been devoted specifically to the role of endoscopic evaluation of the esophagus and stomach and its methodological features in this original procedure.

The aim of this study was to perform preoperative and postoperative endoscopic assessment of the upper gastrointestinal tract in patients undergoing one-anastomosis gastric bypass with the FundoRing technique, and to compare findings with those after standard OAGB.

Materials and Methods

Study design

This single-center, prospective, interventional, open-label randomized controlled trial was conducted at Astana Medical University (Astana, Kazakhstan). Endoscopic examinations were performed at GreenClinic (Astana, Kazakhstan). The study protocol was published previously and registered at ClinicalTrials.gov (NCT04834635) on April 8, 2021 [14].

The present article reports the study results related to preoperative and postoperative endoscopic assessment after OAGB performed with the FundoRing technique.

Participants

Eligibility criteria

Inclusion criteria:

• Class I–III obesity (body mass index [BMI] 30.0–50.0 kg/m²).

• Acceptable operative risk (ASA I–II).

• Age 18–60 years.

Exclusion criteria:

• Previous hiatal hernia repair and/or fundoplication.

• Giant hiatal hernia >5 cm (or ≥30% of the stomach located in the chest).

• Reflux esophagitis grade C or D (Los Angeles classification).

• Previous bariatric surgery.

Randomization and allocation concealment

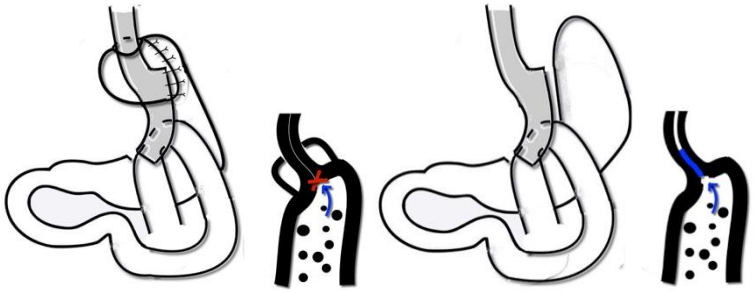
Eligible patients were enrolled consecutively and randomized into one of two study groups by the study statistician, who was involved only in randomization and statistical analysis. The randomization list was kept confidential. Allocation concealment was ensured using 1,000 consecutively numbered, identical, opaque, sealed envelopes. Envelopes contained one of the two signed intervention assignments (500 per stack) and were distributed by a medical manager to each patient at the preoperative visit in random order. The medical manager did not participate in patient recruitment or outcome assessment.

Surgical procedures

In the main group, patients underwent laparoscopic FundoRing-OAGB (f-OAGB) [15], which includes standard OAGB combined with a circumferential fundoplication using the mobilized fundus of the excluded stomach (Fig. 1A).

In the control group, patients underwent standard laparoscopic mini/one-anastomosis gastric bypass (s-OAGB) as described by *Carbajo et al.* (Fig. 1B) [16].

The gastroenterostomy was created identically in both groups using a linear stapler with a 45-mm purple cartridge.



А **Б.**

Figure 1. Schematic of the procedures and demonstration of the presence/absence of the antireflux mechanism. (A) FundoRing-OAGB. (B) Standard OAGB.

Endoscopic equipment and technique

Video gastroscopes (PENTAX, Japan) were used: (1) EG-2490K with an insertion tube diameter of 8.0 mm; and (2) EG-2990K with an insertion tube diameter of approximately 9.8 mm and a 2.8-mm working channel for biopsy, polypectomy, and balloon dilation of anastomotic strictures. Both endoscopes are equipped with HD/HD+ imaging and narrow-spectrum enhanced imaging (i-scan) with zoom for detailed mucosal assessment.

Due to flexibility and a wide field of view, these endoscopes enabled adequate inspection of the gastroenterostomy, the gastric pouch, and the cardia in retroflexion both before and after surgery. The thinner endoscope (EG-2490K) was preferred in cases of anastomositis, where insertion of a standard-caliber endoscope may cause discomfort or increase the risk of mucosal injury.

Postoperative examinations were performed as video esophagogastroduodenoenteroscopy via the oral route with the patient in the lateral decubitus position. The esophagus, gastric pouch, gastroenterostomy, and 1–2 segments of the efferent and afferent jejunal limbs were inspected.

Statistical analysis

Statistical analyses were performed using Microsoft Excel for Mac (Microsoft Corp., Redmond, WA, USA) and StatPlus MacPro (AnalystSoft Inc., Walnut, CA, USA). Normality of distributions was assessed with the Kolmogorov–Smirnov test. Quantitative variables are presented as mean ± standard deviation, and categorical variables as counts and percentages. Between-group comparisons of quantitative variables were performed using the independent-samples Student's t-test, and within-group comparisons using the paired Student's t-test. Between-group differences in categorical variables were assessed with the chi-square test. Statistical significance was defined as $p < 0.05$.

Results

Patient allocation and baseline characteristics

Between January 2021 and December 2024, 1,000 patients were allocated to the f-OAGB group (n=500) or the s-OAGB group (n=500). No significant between-group differences were observed in baseline demographic characteristics or baseline BMI (Table 1).

As shown in Table 1, operative time was 104 ± 17 minutes in the f-OAGB group and 98 ± 20 minutes in the s-OAGB group (p=0.12).

Mean follow-up was 35.2 ± 8.3 months in the f-OAGB group and 37.6 ± 9.2 months in the s-OAGB group (p=0.15).

At three years, BMI reduction was greater in the f-OAGB group (17.93 ± 0.7 kg/m²) than in the s-OAGB group (13.5 ± 0.8 kg/m²; p=0.001).

Table 1.

Baseline characteristics, follow-up period, and operative time.

Variable	f-OAGB (n=500)	s-OAGB (n=500)	p value
Age (years)	39 ± 7.7	40 ± 9.2	0.4
Female, n (%)	421 (84.2%)	407 (81.4%)	0.6
BMI (kg/m²), preoperative	40.13 ± 12.7	41.1 ± 11.6	0.8
BMI (kg/m²), postoperative	24.2 ± 3.8	27.6 ± 3.1	0.001
Change in BMI (kg/m²)	17.93 ± 0.7	13.5 ± 0.8	0.001
Follow-up (months)	35.2 ± 8.3	37.6 ± 9.2	0.15
Operative time (minutes)	104 ± 17	98 ± 20	0.12

Endoscopic assessment of the esophagus and esophagogastric junction

Preoperative endoscopy began with a standard inspection of the esophageal mucosa and the esophagogastric junction (EGJ). Particular attention was paid to the distal third of the esophagus to determine the presence and severity of reflux esophagitis using the Los Angeles (LA) classification [17], and to identify hiatal hernia.

During preoperative assessment, the EGJ was described using the Hill classification of the gastroesophageal flap valve (Fig. 2) [18,19]. In Hill grade I, the prominent fold of tissue at the EGJ, together with the lesser curvature, closely grips the endoscope. In Hill grade II, the fold is present but shows

intermittent opening and rapid closing around the endoscope. In Hill grade III, the fold is barely present and does not close around the endoscope. In Hill grade IV, the fold is absent, there is a permanent open space around the endoscope, and hiatal hernia is always present.

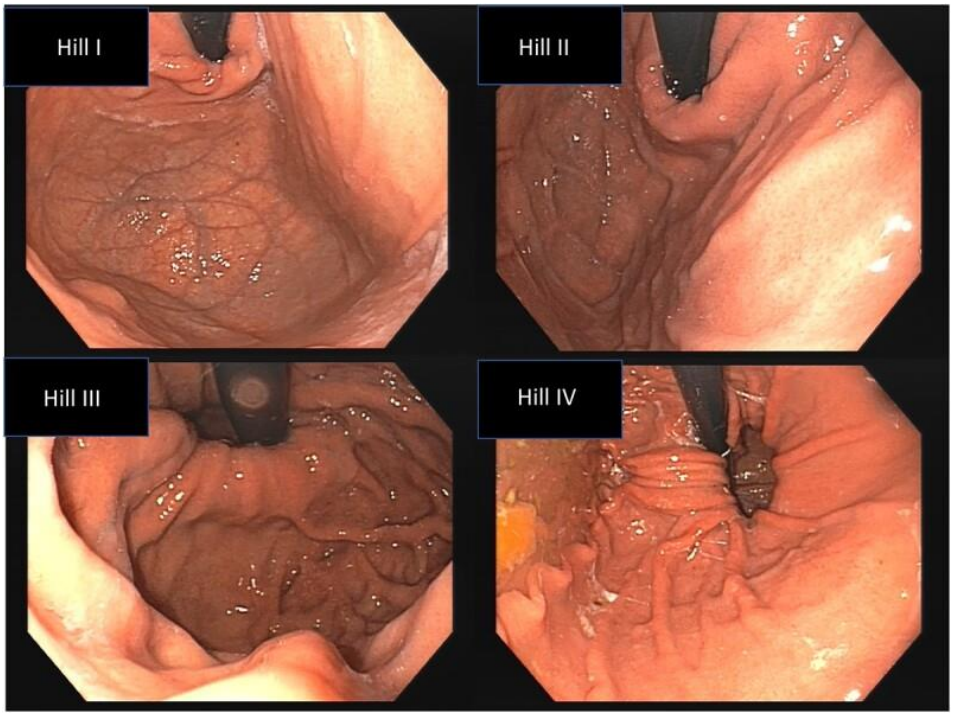


Figure 2. Preoperative endoscopic appearance of the esophagogastric junction by the Hill classification: Hill grade I (A), Hill grade II (B), Hill grade III (C), and Hill grade IV (D).

The Hill classification is associated with GERD as strongly as the axial length of a hiatal hernia [20].

After OAGB, the Hill classification cannot be fully applied because the gastric fundus is separated from the EGJ and the gastric tube is narrow. Nevertheless, postoperative endoscopy allowed indirect assessment of the mechanical barrier by evaluating how tightly the gastric wall encircled the endoscope in the standard OAGB anatomy versus after FundoRing (Fig. 3A–B). Retroflexion of the endoscope within the gastric pouch, especially early after surgery, was difficult and carried a risk of mucosal injury. These difficulties were more pronounced after FundoRing due to the long and tight wrap created by the mobilized fundus of the excluded (bypassed) stomach.

A B

Figure 3. Postoperative endoscopic appearance of the esophagogastric junction: (A) after standard OAGB; (B) after the FundoRing technique.

Accuracy of preoperative hiatal hernia diagnosis and intraoperative validation

Table 2 summarizes the discrepancy between the frequency of hiatal hernia and GERD detected endoscopically before surgery and those identified intraoperatively.

In most cases, the presence of endoscopic signs of GERD increased the likelihood of diagnosing hiatal hernia preoperatively; this proportion was 21.6% in the f-OAGB group and 14.4% in the s-OAGB group (Table 2).

However, hiatal hernia was not detected preoperatively in 10.4% of f-OAGB patients and 9.6% of s-OAGB patients. This discrepancy is mainly explained by the absence of clear endoscopic criteria for asymptomatic hiatal hernia without GERD. Preoperative diagnosis was especially difficult in the absence of cranial displacement of the abdominal esophagus and stomach above the diaphragmatic crura, and when the hernia was small. In contrast, laparoscopic surgery provides direct visualization

of the esophageal hiatus, allowing reliable identification even of small hiatal hernias.

Overall, the prevalence of hiatal hernia in obese patients was high: 32% in the f-OAGB group and 24% in the s-OAGB group.

Table 2.

Proportions of patients with hiatal hernia and GERD detected endoscopically preoperatively and intraoperatively.

	f-OAGB (n=500)				s-OAGB (n=500)			
	HH* (≤2 cm)	HH (>2–≤4 cm)	HH (>4–≤5 cm)	Total	HH*** (≤2 cm)	HH (>2–≤4 cm)	HH (>4–≤5 cm)	Total
1. HH with GERD** detected preoperatively	74 (14.8%)	26 (5.2%)	8 (1.6%)	108 (21.6%)	69 (13.8%)	3 (0.6%)	0	72 (14.4%)
2. HH without GERD detected intraoperatively	26 (5.2%)	19 (3.8%)	7 (1.4%)	52 (10.4%)	28 (5.6%)	17 (3.4%)	3 (0.6%)	48 (9.6%)
Total	100 (20%)	45 (9%)	15 (3%)	160 (32%)	97 (19.4%)	20 (4%)	3 (0.6%)	120 (24%)

**HH - hiatal hernia.*

***GERD - gastroesophageal reflux disease.*

****In the s-OAGB group, patients with HH underwent hiatoplasty only, without fundoplication.*

Dynamics of endoscopically confirmed reflux esophagitis

Changes in endoscopically confirmed reflux esophagitis are presented in Table 3.

Before surgery, reflux esophagitis was diagnosed in 21.6% of patients in the f-OAGB group and 11.6% in the s-OAGB group. At ≥36 months, a marked between-group difference was observed: reflux esophagitis was found in 1.0% of f-OAGB patients versus 11.6% of s-OAGB patients, indicating a more effective antireflux barrier in the f-OAGB group.

Notably, the five cases of reflux esophagitis detected at ≥36 months in the f-OAGB group were LA grade A only, whereas in the s-OAGB group reflux esophagitis included LA grades A, B, and C. .

Table 3.

Preoperative and postoperative endoscopic diagnosis of reflux esophagitis (Los Angeles classification).

Outcome	f-OAGB preop	f-OAGB ≥36 months	s-OAGB preop	s-OAGB ≥36 months	p value (≥36m f vs s)
Reflux esophagitis, n (%)	108 (21.6%)	5 (1.0%)	72 (14.4%)	58 (11.6%)	0.0001
LA grade A	99	5	64	49	
LA grade B	9	0	8	7	
LA grade C	0	0	0	2	

LA, Los Angeles classification.

Endoscopic assessment of the gastric pouch

Endoscopic inspection of the staple-line scar (Fig. 4) indicated a straight, non-twisted configuration. The scar was located along the greater-curvature aspect of the pouch and extended from the fundal region to the gastroenterostomy.

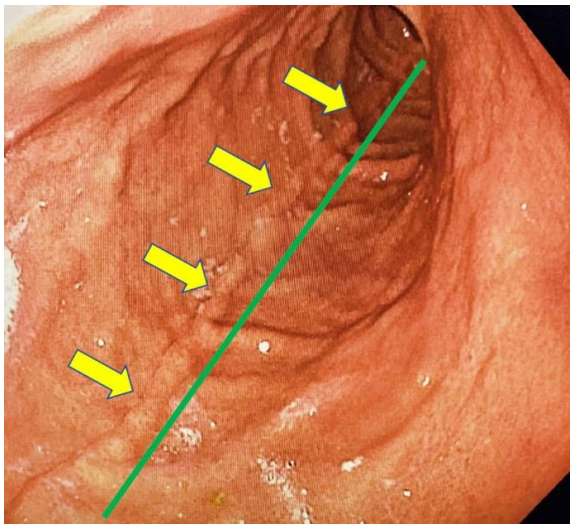


Figure 4. Inner surface of the gastric pouch. Correctly formed, non-twisted postoperative scar line at the stapler line on the pouch along the greater-curvature side from the fundal region to the gastroenterostomy. Yellow arrows indicate the scar line; the green straight line represents the estimated long axis of the pouch.

With time, the scar line became less distinct and may be unrecognizable in long-term follow-up.

Endoscopic measurements showed a pouch length of 10 cm in both groups. Pouch diameter under the minimal insufflation achievable during endoscopy averaged approximately 2.5 cm. Assuming a cylindrical shape ($V = \pi \times R^2 \times h$), the pouch volume was estimated at approximately 50 mL under light insufflation.

Endoscopy also enabled detection of bile reflux into the pouch and diagnosis of gastritis of the gastric pouch mucosa (Fig. 5).

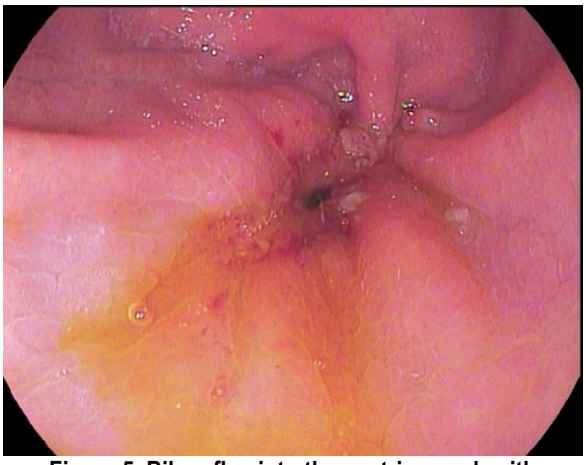


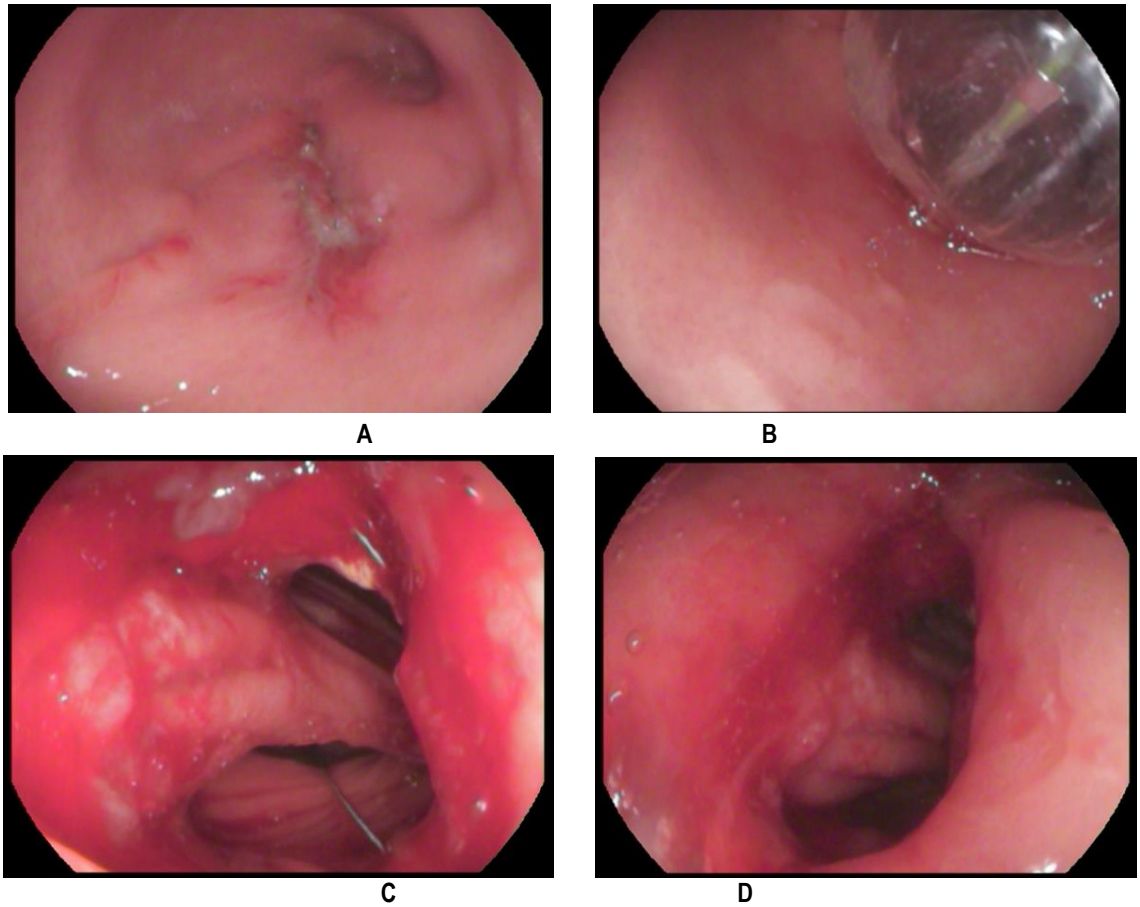
Figure 5. Bile reflux into the gastric pouch with endoscopic signs of gastritis of the pouch mucosa.

Gastroenterostomy

Intraoperatively, the linear size of the gastroenterostomy was up to 40 mm, with an estimated diameter of 30–35 mm. At 3-year postoperative endoscopy, the gastroenterostomy diameter was typically 20–25 mm.

In both groups, anastomositis with impaired gastric emptying was observed. Anastomositis occurred in 3 patients (0.6%) in the f-OAGB group and in 2 patients in the s-OAGB group, requiring not only anti-inflammatory medical therapy but also balloon dilation of the gastroenterostomy (Fig. 6A–D).

A single dilation session was sufficient to restore patency of the gastroenterostomy.



A **B**

C **D**

Figure 6. Balloon dilation of the gastroenterostomy after FundoRing-OAGB: (A) anastomositis at the gastroenterostomy; (B) balloon dilation; (C) after dilation with the guidewire in the lumen; (D) after guidewire removal.

Discussion

Our earlier publications suggested that fundoplication using the excluded stomach (FundoRing-OAGB) is significantly more effective in reducing the probability of de novo reflux esophagitis and in eliminating pre-existing reflux esophagitis during the first postoperative year, with no need for revision surgery [30]. The present endoscopic follow-up at ≥36 months supports these findings, demonstrating a substantially lower rate of reflux esophagitis in the f-OAGB group compared with standard OAGB.

In this cohort, we did not observe staple-line leak, thromboembolic events, or other emergency surgical complications. We anticipated a higher incidence of postoperative dysphagia in the f-OAGB group due to the additional fundoplication component; however, clinically relevant dysphagia was not encountered. We interpret this finding as follows. First, in the f-OAGB group, after double calibration the loose wrap was not fixed to the esophagus. Second, the wrap did not constrict the proximal part of the small gastric pouch, because the fundus of the excluded stomach was widely mobilized, with mandatory division of

the gastrosplenic ligament. Notably, with the FundoRing technique we did not observe twisting ("twist"), which is a known issue with a conventional circumferential fundoplication wrap in isolated surgical treatment of gastroesophageal reflux disease (GERD) [31]. The primary cause of twist, leading to dysphagia and chest pain, is inadequate mobilization of the gastric fundus resulting in axial or rotational tension on the wrap [32]. Under tension, the wrap tends to pull the fundus back toward its original posterolateral position: the right side of the fundoplication migrates upward and posteriorly, whereas the left side shifts downward and anteriorly.

Insufficient mobilization of the fundus may lead to rotational tension and axial twisting of the lower esophagus after fundoplication, which can cause chest pain, dysphagia, and hypersalivation. Careful division of the gastrosplenic ligament and adequate mobilization of the excluded stomach are therefore essential to prevent wrap migration or torsion.

Several authors have evaluated and discussed whether routine preoperative endoscopy of the esophagus, stomach, and duodenum is necessary [21]. Frequent preoperative findings that alter the initially planned operative strategy underscore the need for mandatory preoperative upper gastrointestinal endoscopy in candidates for bariatric surgery [22–24]. Endoscopic findings that may affect surgical planning include abnormalities such as large hiatal hernias or severe reflux esophagitis, which are considered relative contraindications to bariatric surgery - particularly in the setting of limited surgical experience [25].

The most clinically relevant preoperative endoscopic findings in our cohort were hiatal HH, detected in up to 21.6% of patients with GERD symptoms and in up to 10.4% of asymptomatic patients (without GERD). In these patients, the surgical plan included a circumferential fundoplication using the FundoRing technique only in the first group. In the second group, we limited the procedure to hiatoplasty (cruroplasty) without fundoplication, even when preoperative GERD was identified. This strategy was intended to test the assumption that postoperative reduction of gastric volume decreases acid exposure in the small gastric pouch and that correction of HH alone would be sufficient. Our findings—namely, intraoperative detection of HH in 32% of patients in the first group and 24% in the second group, together with a high rate of postoperative reflux esophagitis in the second group (up to 11.6%) - support the use of the FundoRing technique in gastric bypass surgery.

Atrophic gastritis and gastric intestinal metaplasia may be relevant to surgical planning because gastric bypass precludes endoscopic assessment of the excluded stomach, thereby complicating surveillance of premalignant gastric lesions [26]. Accordingly, sleeve gastrectomy may be preferable to gastric bypass in such patients [27,28]. Upper gastrointestinal endoscopy also enables detection of Helicobacter pylori (H. pylori), which may require preoperative eradication therapy and can delay the index operation [29]. A recent analysis reported that endoscopic assessment of failed fundoplications varies between endoscopists [33]. This highlights the importance of close collaboration between endoscopists and surgeons when evaluating postoperative anatomy and complications.

The long wrap created by the FundoRing technique, together with double calibration, may act as an 'autologous gastric band' [34] and changes the postoperative endoscopic appearance. This should be taken into account when interpreting postoperative findings and when deciding whether retroflexion is safe.

Conclusions

Pre- and postoperative endoscopic assessment showed that the prevalence of HH in obese patients was 32% in the f-OAGB group and 24% in the s-OAGB group. Preoperative diagnosis of hiatal hernia without GERD is challenging and was missed in approximately 9.6–10.4% of obese patients.

Before surgery, reflux esophagitis was diagnosed in 21.6% of patients in the f-OAGB group and in 11.6% of patients in the s-OAGB group. At ≥36 months, postoperative reflux esophagitis was detected in 1.0% of f-OAGB patients versus 11.6% of s-OAGB patients, indicating a more effective antireflux barrier after FundoRing-OAGB.

Endoscopic measurement of the gastric pouch allows estimation of pouch volume, which under light insufflation averaged approximately 50 mL. Endoscopy also enables timely detection of bile reflux into the pouch and diagnosis of gastritis.

When the intraoperative gastroenterostomy diameter is 30–35 mm, long-term postoperative endoscopy at 3 years typically shows a diameter of 20–25 mm, with no significant between-group difference.

Pre- and postoperative endoscopic assessment of FundoRing gastric bypass demonstrated advantages of the developed one-anastomosis gastric bypass technique, with a stronger preventive effect against the development of postoperative reflux esophagitis.

Declarations

Conflict of interest

The authors declare no conflict of interest.

Ethics approval

All procedures involving human participants were performed in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

The study protocol was approved by the Local Bioethics Committee of Astana Medical University (Approval No. 24, November 26, 2023).

Use of Artificial Intelligence Tools

During the preparation of this manuscript, artificial intelligence tools were used solely for language editing and technical refinement. Specifically, Grammarly was employed for grammar and punctuation checking; DeepL was utilized for refining translations of selected passages; and QuillBot was used for limited paraphrasing to enhance readability.

These tools were not used for generating scientific hypotheses, designing the methodology, performing data analysis, interpreting results, or drawing scientific conclusions. All research design, data analysis, and interpretations were conducted independently by the authors.

The authors take full responsibility for the integrity, originality, and accuracy of the work.

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