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Original Article

Endoscopic ultrasound-guided gastrojejunostomy with wire endoscopic simplified technique: Move towards benign indications (with video)

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Objectives: Endoscopic ultrasound-guided gastrojejunostomy (EUS-GJ) is an alternative to duodenal stenting and surgical GJ (SGGJ) in malignant gastric outlet obstruction (MGOO). European Society of Gastrointestinal Endoscopy guidelines restricted EUS-GJ for MGOO only, because of misdeployment. The aim was to evaluate its outcomes focusing on benign indications.

Methods: This was a retrospective study conducted from 2016 to 2023 in a tertiary center. Patients included had malignant or benign GOO indicated for EUS-GJ. Techniques were the direct approach until August 2021, and the wire endoscopic simplified technique (WEST) afterwards. The main objective was to compare outcomes in benign vs. MGOO. Secondary end-points were technical success, adverse events rates, and describing the evolution of techniques and indications.

Results: In all, 87 patients were included, 46 men, mean age 66 ± 16.2 years. Indications were malignant in 60.1% and benign in 39.1%. The EUS-GJ technique was direct in 33 patients (37.9%) and WEST in 54 (62.1%). No difference was found in terms of technical, clinical, or adverse events rates. The initial technical success rate was 88.5%. The final technical and clinical success rates were 96.6% and 94.25%, respectively. In the last year, benign exceeded malignant indications (70.4% vs. 29.6%, $P < 0.05$). Seven misdeployments occurred, six being addressed with the rescue technique. The misdeployment rate was significantly decreased using the WEST approach compared to the direct one: 3.7% vs. 18% ($P < 0.05$). The severe postoperative adverse events rate was 2.3%.

Conclusion: This study demonstrated similar outcomes of EUS-GJ between benign and MGOO, with a decreasing misdeployment rate (<4%) applying WEST. This represents an additional step towards recommending EUS-GJ in benign indications.

Key words: cancer, endoscopic ultrasound, gastric outlet obstruction, gastroenterostomy, gastroparesis

INTRODUCTION

ENDOSCOPIC ULTRASOUND-GUIDED GASTROJEJUNOSTOMY (EUS-GJ) procedures have dramatically increased over the las 5 years, since the first case was performed by our team in 2015.[1] The main current indication is malignant gastric outlet obstruction (MGOO), as validated in the last European Society of Gastrointestinal Endoscopy (ESGE) recommendations.[2] MGOO is an obstruction of the gastroduodenal output, precluding or delaying the passage of gastric content from stomach to jejunum. Symptoms include abdominal pain, vomiting, early satiety and weight loss, and re-establishing bowel continuity is crucial to maintain adequate nutritional status and quality of life during chemotherapy.[3,4]

Many studies and mete-analysis confirmed the high technical success of EUS-GJ in expert hands as well as a high efficacy rate, >90%.[5,6] In the meantime, the procedure is safe with 3–6% of severe adverse events (AEs) once the lumen apposing stent (LAMS) has been correctly placed.[7]

Moreover, the place of EUS-GJ in the therapeutic strategy has become clearer and clearer recently, compared to duodenal stenting (DS) and surgical gastrojejunostomies (SGJ).[8,9] Indeed, first, several randomized and propensity score-matched studies confirmed that EUS-GJ demonstrates a higher clinical success rate, of 85–95% vs. 68–73%, respectively, and significantly lowers the reintervention rate due to stent dysfunction than that of DS: 0.9–4% vs. 12–40%, respectively.[8,10–16] When compared to SGJ, EUS-GJ demonstrated similar clinical efficacy and safety, but faster recovery, refeeding, and chemotherapy resuming, and a

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shorter length hospital stay.[17–20] These results are progressively placing EUS-GJ as the treatment of choice in the situation of MGOO.

From a technical point of view, the gold-standard initial technique was the direct approach consisting of puncturing the jejunal lumen with a 19G needle, then filling it with saline, placing a wire, and finally deploying the HotAxios stent (Boston Scientific, Marlborough, MA, USA).[7] Nevertheless, this technique comes with nonnegligible rate of stent misdeployment, up to 20%, which required a high level of expertise to carry out a rescue therapy.[21,22] This is a major drawback, which made the procedure difficult to extend to centers with less experience in therapeutic EUS.

For this reason, ESGE has recommended EUS-GJ only for MGOO and not for benign indications.[2] However, these last 2 years the technique evolved towards wire endoscopic simplified technique (WEST), in which an over-the-wire naso-biliary drain is placed into the jejunum to fill it with water, creating a cystic-like target to perform EUS-GJ. This novel approach allowed for increasing the technical success rate and decreasing the risk of misdeployment from 20% to 5%, as demonstrated in the study from Monino *et al*. in a comparative study.[23,24] However, even though this approach has been highlighted in the last ESGE technical guidelines, this is the only study evaluation for this technique compared to the initial direct approach.[25]

Thus, we describe our experience of EUS-GJ in an expert center, focusing on the evolution from the direct technique towards WEST and its consequences in terms of success and safety, also reinforcing the impact on increasing benign indications.

METHODS

Design and population

THIS WAS A retrospective observational analysis of consecutive cases performed in a tertiary expert center in therapeutic EUS. All patients who underwent EUS-GJ for a malignant or benign indication were included. Regarding the patients with malignant or benign GOO, all had upper gastrointestinal (GI) occlusion with Gastric Outlet Obstruction score (GOOS) ≤ 1[26] and were performed in relative emergency because of their clinical condition. For the patients with gastroparesis, all were refractory to all previous therapies, including gastric peroral endoscopic myotomy, with a Gastroparesis Cardinal Symptoms Index score (GCSI) >2.

Other kinds of EUS-guided digestive anastomoses were excluded. Two periods were identified: before October 2021 during which a direct technique was used, and after October 2021 after switching to WEST. All procedures were validated during multidisciplinary meetings either in oncology or in functional diseases.

Data collection included patients' characteristics, indications for EUS-GJ, and technical and clinical outcomes.

Procedures

All procedures were performed on patients under general anesthesia in the supine position, with oro-tracheal intubation, and using therapeutic linear echoendoscopes (operating channel 3.8 or 4 mm) with CO_2 insufflation. The stents used for completing the EUS-GJ were 20 mm HotAxios (Boston Scientific) LAMS. Two approaches were used according to the period:

- **Direct technique** consisted of detecting the jejunal loop at the Treitz angle; puncturing it with a 19G needle; injecting a mix of saline and contrast to confirm the position into the digestive lumen; advancing a guidewire into the jejunum; advancing the HotAxios applying autocut current; completing the GJ deploying the distal flange of LAMS into the jejunum under fluoroscopy, and proximal flange into the stomach.
- **WEST** consisted (Video S1) of placing at the level of the Treitz angle a naso-cavitary drain over a preinserted wire; filling the jejunum with saline mixed with contrast using a pump to obtain a good distention; repairing it with the EUS scope; puncturing the distended loop with the HotAxios and deploying both flanged under EUS and endoscopic control, successively (Fig. 1).

Postoperatively, patients were given antiemetic agents such as ondasetron 8 mg, droperidol 1.25 mg, and dexamethasone 4 mg, intravenously. Then patients were kept fasting the night following the procedure for 12 h, then started liquids at postoperative day 1 (POD1) and resumed a mixed diet from POD2 in the absence of AEs, continued for 1 week. They were finally discharged between POD2 and 5.

Objectives and definitions

The primary end-point was to compare the outcomes of EUS-GJ in benign and malignant indications, in terms of technical success, clinical success, and AE rates.

The secondary end-points were to compare both techniques in terms of clinical success, technical success, and AE rates, and to document the evolution of the proportion of malignant vs. benign indications, the technique used, and the outcomes over the years.

Technical success was separated into initial technical success (ITS) and final technical success (FTS). Initial technical success was defined as the ability to adequately

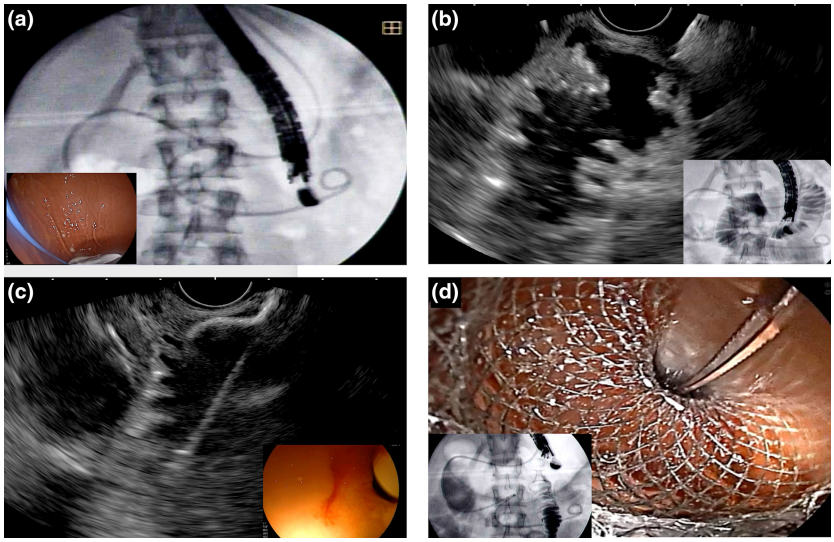

Figure 1 Pictures illustrating the main steps of the wire endoscopic simplified technique for endoscopic ultrasound-guided gastrojejunostomy (EUS-GJ): (a) Placement of a 7Fr naso-cavitary drain over a guidewire, pushed up to the Treitz angle, under fluoroscopic control. (b) Filling of the drain with saline mixed with contrast to obtain a distention of the jejunal lumen. (c) Direct puncture with the electro-cautery tip of the HotAxios (Boston Scientific, Marlborough, MA, USA) (VIO3; Erbe, Tübingen, Germany – Autocut current, effect 4.5) and proximal flange release under EUS control. (d) Proximal flange release under endoscopic control, showing the flow of contrast coming from the jejunum through the lumen apposing metal stent.

complete the EUS-GJ at the first attempt, without any rescue procedure due to misdeployment or other AE. Final technical success pooled ITS and successful rescue procedures, allowing for finally creating the GJ.

Clinical success was defined as: in MGOO and benign organic GOO, the ability to resume an oral diet without vomiting with a GOO score ≥2 within the weeks following the procedure and persisting at 3 months; in refractory gastroparesis, the decreasing of the GCSI score greater that 1 point from baseline at 3 months.[27]

Adverse events were assessed intraoperatively and postoperatively, using the AGREE classification[28] and classified between minor (grades I–II) and major (grades III–IV).

Statistical analysis

Numeric variables were expressed as mean (±SD) and discrete outcomes as absolute and relative (%) frequencies. We first created two groups according to the etiology of GOO, then two groups according to the GJ technique used four groups according to the year of treatment. Group comparability was assessed by comparing baseline demographic data and follow-up duration between groups. Normality and heteroskedasticity of continuous data were assessed with Shapiro–Wilk and Levene's test, respectively. Continuous outcomes were compared with an unpaired Student's *t*-test, Welch's *t*-test, or Mann–Whitney *U*-test according to data distribution, and with ANOVA, Welch's ANOVA, or Kruskal–Wallis tests according to data distribution. Discrete outcomes were compared with the χ^2-test or Fisher's exact test accordingly. The alpha risk was set to 5% and two-tailed tests were used. A two-sided *P*-value <0.05 was considered statistically significant. Statistical analysis was performed with EasyMedStat (version 3.30.2; www.easymedstat.com).

RESULTS

Patients and procedural characteristics

IN TOTAL, 87 patients were included, 41 women and 46 men, with a mean age of 66 ± 16.2 years. The indications for EUS-GJ were malignant in 60.9% of the cases, dominated by pancreatic adenocarcinoma (n = 39), and benign in 39.1%, dominated by chronic pancreatitis (n = 9) and gastroparesis (n = 16). The etiologies of gastroparesis were diabetes (n = 6) and idiopathic (n = 10). The details about the pathologies involved and responsible for GOO are presented in the diagram Figure 2. In MGOO, previous DS had been applied in four patients, whereas Gastric peroral

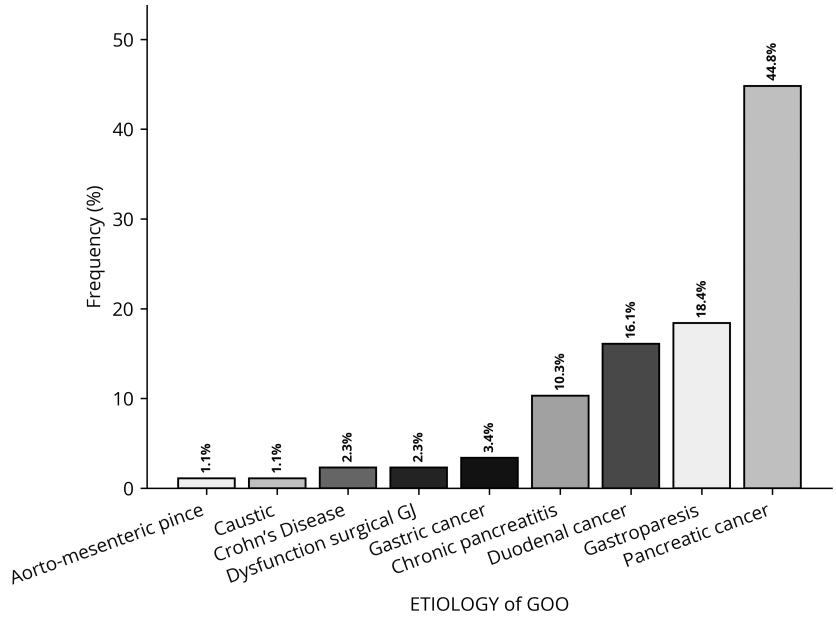

Figure 2 Diagram showing the distribution of the etiologies for indicating endoscopic ultrasound-guided gastrojejunostomy (EUS-GJ) in our population. GOO, gastric outlet obstruction.

endoscopic myotomy (GPOEM) had been performed in all patients with refractory gastroparesis.

Regarding the EUS-GJ techniques used, the direct technique was performed in 34 patients (37.9%), essentially before 2021, and the WEST was performed in 54 patients (62.1%), almost exclusively from this date.

Benign vs. malignant GOO

The mean overall follow-up was 16.02 ± 60.39 months, with a mean of 8.2 ± 9.04 months in MGOO and 27.76 ± 94.46 months in benign GOO. When comparing benign and MGOO, there was no difference in patients' gender, but they were significantly older in the MGOO group: 73.59 ± 9.49 vs. 53.22 ± 17.39 ($P < 0.001$), respectively. The proportion of direct vs. WEST were the same in both groups.

When comparing outcomes, the ITS rate was 91.2% vs. 86.6%, respectively ($P = 0.73$), and FTS rate was 94.1% vs. 98.1%, respectively ($P = 0.56$). The overall clinical success rate was 94.25% ($n = 82/87$) and similar in both groups. There were also no statistical nor clinically relevant differences in terms of misdeployment and AE rates. The results are summarized in Table 1.

Technical outcomes and misdeployment

The overall ITS rate was 88.5%. Among the 10 initial failures, seven were due to stent misdeployment with a distal flange released into the peritoneal cavity. Six benefited from rescue therapy thanks to the guidewire and had a second LAMS inserted to complete the GJ, whereas in one patient the procedure was stopped after gastric closure with over-the-scope clip (OTSC).

Among the three failed procedures, two were intraprocedural AEs due to severe peri gastric variceal bleeding occurring during puncture, due to portal hypertension. The third failure was a technical impossibility to cross the duodenal stricture with the wire. In the two first cases the procedure was stopped and an OTSC was placed to close the gastric wall (one patient finally underwent a S-GJ), whereas in the third one the procedure was successfully converted into direct EUS-GJ. Thus, the final success rate was 96.6%.

When comparing the direct technique with WEST, there were no differences in terms of age, gender, and overall proportion of malignant and benign etiologies. The technical success was not different (93.9% vs. 98.15%, $P = 0.55$); however, the misdeployment rate was significantly higher with the direct technique: 18.2% vs. 3.7% ($P < 0.05$). These results are summarized in Table 2.

Adverse events

As mentioned above, two patients experienced intraoperative AEs that led us to stop the procedure because of vascular interposition. There were no clinical consequences

Table 1 Group comparability according to type of etiology: benign vs. malignant

Etiology of GOO *N*	Malignant *N* = 53	Benign *N* = 34	*P*-value
Gender			
Male	28 (52.83%)	18 (52.94%)	>0.999
Female	25 (47.17%)	16 (47.06%)	
Age at inclusion (years)	73.59 (± 9.49)	53.22 (± 17.39)	<0.001
Follow-up	8.2 (± 9.04)	27.76 (± 94.46)	0.075
	Range: (1.0; 48.0)	Range: (2.0; 557.0)	
GJA technique			
Direct	20 (37.74%)	13 (38.24%)	>0.99
WEST	33 (62.26%)	21 (61.76%)	
Initial technical success			
Yes	46 (86.79%)	31 (91.18%)	0.734
No	7 (13.21%)	3 (8.82%)	
Intraoperative AEs (including misdeployments)			
Yes	6 (11.32%)	3 (8.82%)	>0.999
No	47 (88.68%)	31 (91.18%)	
Misdeployment			
Yes	5 (9.43%)	3 (8.82%)	>0.999
No	48 (90.57%)	31 (91.18%)	
Final technical success			
Yes	52 (98.11%)	32 (94.12%)	0.558
No	1 (1.89%)	2 (5.88%)	
Clinical efficacy			
Yes	50 (94.34%)	32 (94.12%)	>0.999
No	3 (5.66%)	2 (5.88%)	
Postoperative AEs			
Yes	7 (13.21%)	6 (17.65%)	0.759
No	46 (86.79%)	28 (82.35%)	

AE, adverse event; GJA, gastrojejunal anastomosis; GOO, gastric outlet obstruction; WEST, wire endoscopic simplified technique.

because the bleeding stopped after OTSC placement and were classified as grade I in the AGREE classification.

Thirteen patients experienced postoperative AEs, with a rate of 14.9%. Six AEs were classified as grade I of AGREE: five unexplained nonbiliary sepsis, since almost all the patients had previously undergone biliary drainage, treated with antibiotics, and one abdominal pain treated with analgesics. Five were classified as grade II: two patients with anemia and two with upper GI bleeding that stopped spontaneously and requiring blood transfusion, and one had stent dysfunction. One patient had infected collection because of a leak probably occurring during rescue therapy, which was managed successfully by endoscopic drainage under EUS, and classified grade III. One patient died following the procedure because he was in very poor condition, and he did not recover from the anesthesia, despite there was no intraoperative AE and a confirmed technical success by opacification (Grade V AE).

Finally, the severe AE rate was 2.3%. No difference was observed in the AE rates depending on etiologies or techniques used (18% vs. 13%, respectively).

As for EUS-GJ performed for gastroparesis, in the five patients with more than 1 year of follow-up, the LAMS was left in place without any related delayed AE and an endoscopic control showed no stent ingrowth of anastomotic ulceration.

Evolution of EUS-GJ over the years

The evolution of EUS-GJ was analyzed in four different periods: before 2021, 2021, 2022, and 2023. We observed a change in the main technique in favor of WEST from the end of 2021, and in the meantime a decreasing of the misdeployment rate. The first attempt at technical success increased after the initial experience, suggesting a learning curve effect in our early experience.

Very importantly, the proportion of a benign indication was significantly higher in 2023 compared with the previous years: 70.6% vs. 29%, 36.4% and 33.3%, respectively, especially because of the introduction of gastroparesis as benign indications. The results of this analysis are summarized in Table 3.

Table 2 Groups comparison according to gastrojejunal anastomosis (GJA) technique: direct vs. wire endoscopic simplified technique (WEST)

	Direct *N* = 33	WEST *N* = 54	*P*-value
Gender			
Male	19 (57.58%)	27 (50.0%)	0.642
Female	14 (42.42%)	27 (50.0%)	
Age at inclusion (years)	63.2 (± 14.56) Range: (30.63; 85.95)	65.49 (± 20.9) Range: (−18.9; 87.18)	0.173
Year of inclusion	2019 (± 2.14) Range: (2014–2023)	2020 (± 13.65) Range: (2021–2023)	<0.001
Origin of GOO			
Benign	13 (39.39%)	21 (38.89%)	>0.999
Malignant	20 (60.61%)	33 (61.11%)	
Etiology of GOO			
Caustic	1 (3.03%)	0 (0.0%)	NS
Superior mesenteric artery syndrome	1 (3.03%)	0 (0.0%)	NS
Chronic pancreatitis	6 (18.18%)	3 (5.56%)	NS
Crohn's disease	2 (6.06%)	0 (0.0%)	NS
Duodenal cancer	7 (21.21%)	7 (12.96%)	NS
Dysfunction SGJ	0 (0.0%)	2 (3.7%)	NS
Gastric cancer	0 (0.0%)	3 (5.56%)	NS
Gastroparesis	2 (6.06%)	14 (25.93%)	0.009
Pancreatic adenocarcinoma	14 (42.42%)	25 (46.3%)	NS
Initial technical success			
Yes	27 (81.82%)	50 (92.59%)	0.169
No	6 (18.18%)	4 (7.41%)	
Misdeployment			
Yes	**6 (18.18%)**	**2 (3.7%)**	**0.049**
No	27 (81.82%)	52 (96.3%)	
Final technical success			
Yes	31 (93.94%)	53 (98.15%)	0.554
No	2 (6.06%)	1 (1.85%)	
Clinical success			
Yes	30 (90.91%)	52 (96.3%)	0.363
No	3 (9.09%)	2 (3.7%)	
Postoperative AEs			
Yes	6 (18.18%)	7 (12.96%)	0.546
No	27 (81.82%)	47 (87.04%)	

AE, adverse event; GOO, gastric outlet obstruction; NS, not significant; SGJ, surgical gastrojejunostomy.

DISCUSSION

THESE STUDIES DESCRIBE, in a large sample of patients, the evolution of the technical aspects and indications of EUS-GJ in the team that developed the technique on porcine models and then performed the first worldwide case.[1,29] We also described the evolution from the initial direct technique towards a wire-assisted technique, which appeared in our practice during 2021. The outcomes in terms of clinical efficacy are perfectly consistent with the literature, with a high clinical success greater than 90% and a fast recovery and discharge from the hospital.

However, we intended to add two originalities in this study. First, we decided to compare the outcomes between benign and malignant indications for EUS-GJ. Importantly, no difference was found between the technical, clinical, and AE rates depending on the etiology, confirming the high clinical success even in benign diseases including gastroparesis, which was the main indication.

Second, we aimed to describe and compare the two techniques, direct and WEST, regarding stent misdeployment. Indeed, peritoneal deployment of the LAMS leads to very difficult situations, requires high level endoscopic skills to manage them, and avoid peritonitis and surgery. Thus, we

Table 3 Evolution of the etiologies, endoscopic ultrasound-guided gastrojejunostomy (EUS-GJ) technique applied, and outcomes over the years of experience

Variable	2018–2020 *N* = 21	2021 *N* = 11	2022 *N* = 38	2023 *N* = 17	*P*-value
Origin of GOO					
Benign	7 (33.33%)	4 (36.36%)	11 (28.95%)	**12 (70.59%)**	0.029
Malignant	14 (66.67%)	7 (63.64%)	27 (71.05%)	**5 (29.41%)**	
Etiologies of GOO					
Caustic	1 (4.76%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0.032
Superior mesenteric artery syndrome	0 (0.0%)	1 (9.09%)	0 (0.0%)	0 (0.0%)	
Chronic pancreatitis	5 (23.81%)	1 (9.09%)	2 (5.26%)	1 (5.88%)	
Crohn's disease	1 (4.76%)	0 (0.0%)	1 (2.63%)	0 (0.0%)	
Duodenal cancer	6 (28.57%)	1 (9.09%)	6 (15.79%)	1 (5.88%)	
Dysfunction SGJ	0 (0.0%)	0 (0.0%)	2 (5.26%)	0 (0.0%)	
Gastric cancer	0 (0.0%)	0 (0.0%)	2 (5.26%)	1 (5.88%)	
Gastroparesis	0 (0.0%)	2 (18.18%)	6 (15.79%)	**8 (47.06%)**	
Pancreatic carcinoma	8 (38.1%)	6 (54.55%)	19 (50.0%)	6 (35.29%)	
Technique for EUS-GJ					
Direct	21 (100.0%)	9 (81.82%)	**2 (5.26%)**	**1 (5.88%)**	<0.001
WEST	0 (0.0%)	2 (18.18%)	**36 (94.74%)**	**16 (94.12%)**	
Initial technical success	16 (76.19%)	10 (90.91%)	36 (94.74%)	15 (88.24%)	0.195
Misdeployment	5 (23.81%)	1 (9.09%)	**1 (2.63%)**	**1 (5.88%)**	0.044
Final technical success	19 (90.48%)	11 (100.0%)	37 (97.37%)	17 (100.0%)	0.458
Clinical success	18 (85.71%)	11 (100.0%)	36 (94.74%)	17 (100.0%)	0.297
Postop AEs					
Yes	5 (23.81%)	0 (0.0%)	3 (7.89%)	5 (29.41%)	0.054
No	16 (76.19%)	11 (100.0%)	35 (92.11%)	12 (70.59%)	
	N = 21	*N* = 11	*N* = 38	*N* = 17	

AE, adverse event; GOO, gastric outlet obstruction; SGJ, surgical gastrojejunostomy; WEST, wire endoscopic simplified technique.

wanted to underline the impact of WEST in terms of procedure security to increase the benign indications for EUS-GJ.

With regard to technical success and AEs, only two previous smaller sample sized studies compared the direct and WEST techniques. In the first one published by Chen *et al*.,[30] no difference was found, but the techniques were more heterogeneous, since the direct technique included WEST and was compared with the balloon-assisted technique. The other one, from Monino *et al*. on 71 patients, recently demonstrated a higher technical success rate (95.1% vs. 73.3%) and lower AE rate (14.6% vs. 46.7%) in the WEST group, with comparable clinical success rates.[24] In our study, the technical success was also higher, but not statistically (92.6% vs. 81.8%), probably because of our expertise in the direct technique as well, and an insufficient number of events, but the misdeployment rate was significantly decreased from 18.2% to 3.7% ($P < 0.05$). This reinforced the feeling that this approach comes with clinically relevant lower technical AEs, which is an important step towards standardization and an extension to benign indications in the next ESGE guideline. Moreover, in the case of the technical impossibility to cross the stricture with a drain, the direct technique remains possible in expert hands, and in the case of misdeployment, the rescue technique with stent-in-stent was successful in 86% of the cases (six out of seven in our series).

The safety profile of the procedure was also confirmed. Indeed, except misdeployments, we encountered only one intraoperative AE that was a bleeding related to portal hypertension requiring the procedure to be stopped. Postoperative AEs occurred in 14.9%, but most of them were considered minor according to the AGREE classification, and only 2.3% were major. The only patient who died was a particular case of malignant GOO in whom the EUS-GJ was performed in a terminal disease and a poor patient condition. This is another argument in favor of placing EUS-GJ first over DS and SGJ for managing MGOO, and second, extending this technique to benign indications.

Finally, we decided to analyze the evolution of the indications over the years; we noticed that 2022 was

probably a year in which the safety profile of the WEST technique was confirmed in our practice. However, in 2023 the high standardization and technical success without misdeployment of WEST allowed us to significantly increase benign indications that significantly exceeded MGOO (70.6% vs. 29.4%; $P < 0.05$). The main benign disease indicated for EUS-GJ was initially chronic pancreatitis in 23% of them, before 2021, and more recently, gastroparesis representing 25% of the cases in 2023.

There are obvious limitations in our study: this was a retrospective report, with sometimes patients coming from other centers and lost in long-term follow-up (particularly in MGOO). Thus, the clinical evaluation of the clinical outcomes after EUS-GJA is less standardized, with no quality-of-life assessment, nor systematic data about chemotherapy. Moreover, a higher number of patients in the WEST group would have been interesting to statistically confirm some trends, in terms of technical success particularly.

Nevertheless, this study is the largest to date to confirm the high technical and clinical success of EUS-GJ using WEST. Moreover, this approach allows for dramatically decreasing the risk for misdeployment and proposing the procedure in benign organic and even functional GOO.

CONFLICT OF INTEREST

AUTHORS J.M.G. AND M.B. are consultants for Boston Scientific and Pentax. G.V. is a consultant for Boston Scientific and lectured for Pentax. The other authors declare no conflict of interest for this article.

FUNDING INFORMATION

NONE.

ETHICS STATEMENT

APPROVAL OF THE research protocol by an Institutional Reviewer Board: N/A.
Informed Consent: N/A.
Registry and the Registration No. of the study/trial: N/A.
Animal Studies: N/A.

REFERENCES

1 Barthet M, Binmoeller KF, Vanbiervliet G, Gonzalez JM, Baron TH, Berdah S. Natural orifice transluminal endoscopic surgery gastroenterostomy with a biflanged lumen-apposing stent: First clinical experience (with videos). *Gastrointest Endosc* 2015; **81**: 215–8.
2 Van Der Merwe SW, Van Wanrooij RLJ, Bronswijk M *et al*. Therapeutic endoscopic ultrasound: European Society of Gastrointestinal Endoscopy (ESGE) guideline. *Endoscopy* 2022; **54**: 185–205.
3 Papanikolaou IS, Siersema PD. Gastric outlet obstruction: Current status and future directions. *Gut Liver* 2022; **16**: 667–75.
4 Koop AH, Palmer WC, Stancampiano FF. Gastric outlet obstruction: A red flag, potentially manageable. *Cleve Clin J Med* 2019; **86**: 345–53.
5 Li JS, Lin K, Tang J, Liu F, Fang J. EUS-guided gastroenterostomy for gastric outlet obstruction: A comprehensive meta-analysis. *Minim Invasive Ther Allied Technol* 2023; **32**: 285–99.
6 Carbajo AY, Kahaleh M, Tyberg A. Clinical review of EUS-guided gastroenterostomy (EUS-GE). *J Clin Gastroenterol* 2020; **54**: 1–7.
7 Ribas PHBV, De Moura DTH, Proença IM *et al*. Endoscopic ultrasound-guided gastroenterostomy for the palliation of gastric outlet obstruction (GOO): A systematic review and meta-analysis of the different techniques. *Cureus* 2022; **14**: e31526.
8 Boghossian MB, Funari MP, De Moura DTH *et al*. EUS-guided gastroenterostomy versus duodenal stent placement and surgical gastrojejunostomy for the palliation of malignant gastric outlet obstruction: A systematic review and meta-analysis. *Langenbeck's Arch Surg* 2021; **406**: 1803–17.
9 Cheung SLH, Teoh AYB. Optimal management of gastric outlet obstruction in unresectable malignancies. *Gut Liver* 2022; **16**: 190.
10 Chen YI, Itoi T, Baron TH *et al*. EUS-guided gastroenterostomy is comparable to enteral stenting with fewer re-interventions in malignant gastric outlet obstruction. *Surg Endosc* 2017; **31**: 2946–52.
11 Khashab MA, Bukhari M, Baron TH *et al*. International multicenter comparative trial of endoscopic ultrasonography-guided gastroenterostomy versus surgical gastrojejunostomy for the treatment of malignant gastric outlet obstruction. *Endosc Int Open* 2017; **5**: E275–81.
12 Martins RK, Brunaldi VO, Fernandes AL, Otoch JP, Artifon ELA. Palliative therapy for malignant gastric outlet obstruction: How does the endoscopic ultrasound-guided gastroenterostomy compare with surgery and endoscopic stenting? A systematic review and meta-analysis. *Ther Adv Gastrointest Endosc* 2023; **16**: 263177452211496.
13 van Wanrooij RLJ, Vanella G, Bronswijk M *et al*. Endoscopic ultrasound-guided gastroenterostomy versus duodenal stenting for malignant gastric outlet obstruction: An international, multicenter, propensity score-matched comparison. *Endoscopy* 2022; **54**: 1023–31.
14 Seitz N, Meier B, Caca K, Wannhoff A. Propensity score-matched retrospective cohort study of endoscopic ultrasound-guided gastroenterostomy and enteral stenting for malignant gastric outlet. *Surg Endosc* 2024; **38**: 2078–85.
15 Bellocchi C, Conti Bellocchi MC, Gasparini E *et al*. Endoscopic ultrasound-guided gastroenterostomy versus enteral

stenting for malignant gastric outlet obstruction: A retrospective propensity score-matched study. *Cancer* 2024; **16**: 724.
16 Teoh AYB, Lakhtakia S, Tarantino I *et al*. Endoscopic ultrasonography-guided gastroenterostomy versus uncovered duodenal metal stenting for unresectable malignant gastric outlet obstruction (DRA-GOO): A multicentre randomised controlled trial. *Lancet Gastroenterol Hepatol* 2023; **9**: 124–32.
17 Canakis A, Bomman S, Lee DU *et al*. Benefits of EUS-guided gastroenterostomy over surgical gastrojejunostomy in the palliation of malignant gastric outlet obstruction: A large multicenter experience. *Gastrointest Endosc* 2023; **98**: 348–59.e30.
18 Kumar A, Chandan S, Mohan BP *et al*. EUS-guided gastroenterostomy versus surgical gastroenterostomy for the management of gastric outlet obstruction: A systematic review and meta-analysis. *Endosc Int Open* 2022; **10**: E448–58.
19 Vanella G, Dell'Anna G, Capurso G *et al*. EUS-guided gastroenterostomy for management of malignant gastric outlet obstruction: A prospective cohort study with matched comparison with enteral stenting. *Gastrointest Endosc* 2023; **98**: 337–47.e5.
20 Miller C, Benchaya JA, Martel M *et al*. EUS-guided gastroenterostomy vs. surgical gastrojejunostomy and enteral stenting for malignant gastric outlet obstruction: A meta-analysis. *Endosc Int Open* 2023; **11**: E660–72.
21 Jaruvongvanich V, Mahmoud T, Abu Dayyeh BK *et al*. Endoscopic ultrasound-guided gastroenterostomy for the management of gastric outlet obstruction: A large comparative study with long-term follow-up. *Endosc Int Open* 2023; **11**: E60–6.
22 Itoi T, Baron TH, Khashab MA *et al*. Technical review of endoscopic ultrasonography-guided gastroenterostomy in 2017. *Dig Endosc* 2017; **29**: 495–502.
23 Bronswijk M, van Malenstein H, Laleman W *et al*. EUS-guided gastroenterostomy: Less is more! The wireless EUS-guided gastroenterostomy simplified technique. *VideoGIE* 2020; **5**: 442.
24 Monino L, Perez-Cuadrado-Robles E, Gonzalez JM *et al*. Endoscopic ultrasound-guided gastroenterostomy with lumen-apposing metal stents: A retrospective multicentric comparison of wireless and over-the-wire techniques. *Endoscopy* 2023; **55**: 991–9.
25 Van Wanrooij RLJ, Bronswijk M, Kunda R *et al*. Therapeutic endoscopic ultrasound: European Society of Gastrointestinal Endoscopy (ESGE) technical review. *Endoscopy* 2022; **54**: 310–32.
26 Moura EGH, Ferreira FC, Cheng S, Moura DT, Sakai P, Zilberstain B. Duodenal stenting for malignant gastric outlet obstruction: Prospective study. *World J Gastroenterol* 2012; **18**: 938–43.
27 Revicki DA, Rentz AM, Dubois D *et al*. Gastroparesis cardinal symptom index (GCSI): Development and validation of a patient reported assessment of severity of gastroparesis symptoms. *Qual Life Res* 2004; **13**: 833–44.
28 Nass KJ, Zwager LW, van der Vlugt M *et al*. Novel classification for adverse events in GI endoscopy: The AGREE classification. *Gastrointest Endosc* 2022; **95**: 1078–85.e8.
29 Vanbiervliet G, Bonin EA, Garcès R *et al*. Gastrojejunal anastomosis using a tissue-apposing stent: A safety and feasibility study in live pigs. *Endoscopy* 2014; **46**: 871–7.
30 Chen YI, Kunda R, Storm AC *et al*. EUS-guided gastroenterostomy: A multicenter study comparing the direct and balloon-assisted techniques. *Gastrointest Endosc* 2018; **87**: 1215–21.

SUPPORTING INFORMATION

ADDITIONAL SUPPORTING INFORMATION may be found in the online version of this article at the publisher's web site.

Video S1 Video showing the different steps of endoscopic ultrasound-guided gastrojejunal anastomosis (GJA) according to the wire endoscopic simplified technique, with some tips and tricks in comments.