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CASE REPORT

Laparoscopic Gastrectomy with Roux-En-Y Anastomosis for Pediatric Duodenal Ulcer: A Case Report with 3-Year Follow-Up

Zhijie Qin, Miao Luo, Yize Zhuang, Huang Huang, Yingming Tang

Department of Pediatric General Surgery, Shanghai Children's Medical Center GuiZhou Hospital, Shanghai Jiao Tong University School of Medicine, Guiyang, Guizhou, People's Republic of China

Correspondence: Yingming Tang, Department of Pediatric General Surgery, Shanghai Children's Medical Center GuiZhou Hospital, Shanghai Jiao Tong University School of Medicine, 166 Jinzhu East Road, Guanshanhu District, Guiyang, Guizhou, 550003, People's Republic of China, Tel +86-0851- 88955054, Email tangym120@163.com

Background: While upper gastrointestinal ulcers are a common condition in adults, with well-established surgical approaches such as Billroth I, Billroth II, and Roux-en-Y (RY) reconstruction, their occurrence in the pediatric population is markedly less common and presents distinct diagnostic and management challenges. Consequently, surgical intervention for pediatric ulcers remains relatively infrequent and less studied. Although procedures like Billroth I, Billroth II, and RY are technically feasible options, there is a notable lack of robust evidence and specific guidelines to inform optimal surgical management strategies tailored specifically for children.

Case Presentation: We report the treatment of a 13-year-old female patient with a duodenal bulbar ulcer leading to scar stenosis, who was managed with a laparoscopic subtotal gastrectomy and gastro-jejunal Roux-en-Y anastomosis. The patient demonstrated excellent growth and development over a three-year follow-up period, with no significant early or long-term complications.

Conclusion: Although severe complications of peptic ulcer disease (PUD) are uncommon in the pediatric population, gastric resection combined with Roux-en-Y anastomosis represents a safe and efficacious surgical strategy for refractory cases. In this report, we compare the Roux-en-Y procedure with other reconstructive methods, such as Billroth I and II, and discuss the indications and outcomes of various surgical therapies for upper gastrointestinal ulcers in children. We advocate for Roux-en-Y anastomosis as the preferred surgical method for treating complicated upper gastrointestinal ulcers in children, primarily due to its superior long-term outcomes in preventing bile reflux and residual gastritis.

Keywords: upper gastrointestinal ulcer, pediatric patients, gastrectomy, Roux-en-Y anastomosis

Background

Peptic ulcer disease (PUD), characterized by mucosal breaks in the stomach or duodenum, is a significant cause of morbidity worldwide. In the adult population, the etiology is predominantly linked to Helicobacter pylori (H. pylori) infection and the use of nonsteroidal anti-inflammatory drugs (NSAIDs). These ulcers can be classified as primary, often driven by H. pylori, or secondary, resulting from systemic stressors, medication use, or other underlying conditions such as foreign body ingestion. While medical management with proton-pump inhibitors and H. pylori eradication therapy is the cornerstone of treatment, surgical intervention becomes necessary for complications such as perforation, unmanageable hemorrhage, or gastric outlet obstruction.[1]

In contrast, PUD in the pediatric population is a relatively uncommon entity, and its management presents unique challenges. The indications for surgery are similar to those in adults, but the decision-making process is complicated by the potential long-term consequences of major abdominal surgery on a growing child. Standard surgical procedures for complicated PUD in adults include partial or subtotal gastrectomy with subsequent reconstruction of gastrointestinal continuity. The most common reconstructive techniques are the Billroth I (gastroduodenostomy), Billroth II (gastrojejunostomy), and Roux-en-Y (RY) gastrojejunostomy. Each of these techniques has been extensively studied in adults,

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with a wealth of literature comparing their respective advantages and disadvantages concerning nutritional outcomes, reflux complications, and quality of life.[2,3]

The advent of minimally invasive surgery has revolutionized the surgical treatment of gastric diseases. Laparoscopic gastrectomy, first introduced for early gastric cancer, has been shown to offer significant short-term benefits over open surgery, including reduced blood loss, less postoperative pain, and shorter hospital stays, without compromising oncologic outcomes in selected patients.[4–6] These benefits are particularly salient in the pediatric population, where cosmesis and rapid recovery are highly valued. However, the application of these advanced laparoscopic procedures for benign conditions like PUD in children is not well-documented, and there is a significant lack of evidence-based guidelines to direct the choice of surgical technique.

This case study presents the successful management of a 13-year-old female patient with a chronic duodenal bulb ulcer resulting in severe scar stenosis and gastric outlet obstruction. She was treated with a laparoscopic subtotal gastric resection and a gastrojejunal RY anastomosis. We report the clinical details, surgical technique, and three-year follow-up outcomes, focusing on her growth, development, and long-term gastrointestinal function. This case provides a valuable opportunity to discuss the rationale for choosing RY anastomosis over other reconstructive methods in the pediatric context and to review the existing, albeit limited, literature on major gastric surgery in children.

Case Presentation

A 13-year-old female was admitted to our hospital with a four-year history of recurrent upper abdominal pain and intermittent, non-bilious vomiting that provided temporary relief. Her symptoms had progressively worsened despite conservative medical management at local clinics. On admission, she presented with exacerbated abdominal pain and frequent vomiting containing bile-like material, suggesting a high-grade obstruction.

Physical examination revealed a frail adolescent, weighing 23 kg with a height of 144 cm, corresponding to a Body Mass Index (BMI) of 11.09 kg/m². This placed her significantly below for her age, indicating severe malnutrition. Laboratory investigations, including a urease breath test, were negative for H. pylori infection.

To delineate the anatomy of the upper gastrointestinal tract, an upper gastrointestinal angiography was performed. The study revealed significant dilatation of the stomach and the duodenal bulb, with a characteristic "bird's beak" sign and a thin, thread-like passage of contrast at the junction of the duodenal bulb and the descending duodenum, confirming high-grade gastric outlet obstruction (Figure 1A and B). Subsequent esophagogastroduodenoscopy (EGD) visualized a large, chronic-appearing ulcer with thick, mossy exudate on the greater curvature of the duodenal bulb. The bulb itself was severely deformed and scarred, leading to a tight stricture at the junction with the descending duodenum, with an estimated internal diameter of only 0.3 cm, which precluded the passage of the endoscope (Figure 1C–E).

Given the patient's severe malnutrition, a preoperative plan was formulated to improve her nutritional status. The initial strategy was to endoscopically place a jejunal feeding tube distal to the obstruction. However, this was technically impossible due to the severity of the stenosis. Consequently, the decision was made to proceed with surgical intervention.

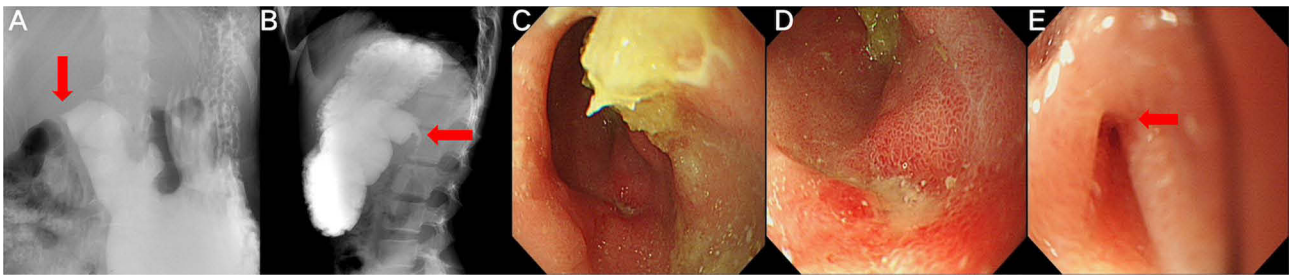

Figure 1 Preoperative Imaging and Endoscopy (**A** and **B**) Upper gastrointestinal angiography showing significant gastric and duodenal bulb dilatation. The red arrow in B points to the thin, line-like passage of contrast through the stenotic area.(**C–E**): Endoscopic views. The pylorus is deformed and patulous. A large, mossy ulcer is visible on the greater curvature of the duodenal bulb. The red arrows in E indicate the severe, scar-induced narrowing at the junction of the bulb and the descending duodenum, with an internal diameter of approximately 0.3 cm.

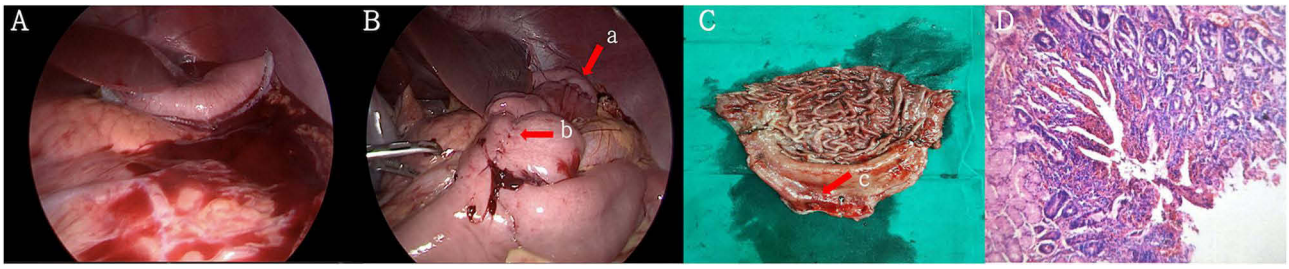

Figure 2 Surgical Specimen and Pathology (**A**) The resected residual stomach. (**B**): The completed Roux-en-Y reconstruction (a: gastroenteric anastomosis; b: jejunojejunal anastomosis). (**C**) The gross surgical specimen showing the area of keloid-like stenosis (c). (**D**) A representative pathological section showing chronic inflammation and mucosal changes.

The chosen procedure was a laparoscopic subtotal gastrectomy to remove the acid-producing antrum and a Roux-en-Y gastrojejunostomy to bypass the obstructed duodenum and restore intestinal continuity.

The resected distal stomach and proximal duodenum were sent for histopathological examination. The report described chronic inflammatory changes in the stomach, duodenum, and their respective surgical margins, with areas of mucosal degeneration, necrosis, and detachment consistent with chronic peptic ulceration. The surrounding lymph nodes showed reactive hyperplastic changes (Figure 2A–D).

The patient's postoperative course was monitored closely. We compared her nutritional and hematological parameters at baseline, one week, and one month postoperatively (Table 1). A slight decrease in weight and BMI was noted at one week, and Hemoglobin levels are still low, likely attributable to the catabolic stress of surgery, postoperative fasting, and altered iron absorption dynamics. Iron absorption is highly dependent on an acidic gastric environment for the reduction of dietary Fe^{3+} to the absorbable Fe^{2+} form. Post-gastrectomy states can lead to reduced gastric acid secretion and impaired mixing of food with gastric juices, potentially contributing to lower hemoglobin levels. However, by one month post-surgery, the patient had achieved a substantial weight gain, and her BMI was trending towards the normal range. Her hemoglobin and albumin levels showed a steady and continuous increase. Importantly, she experienced no early postoperative complications, such as delayed gastric emptying or anastomotic obstruction.

Over a three-year follow-up period, the patient's growth and development were remarkable. Her weight and height increased significantly, and her BMI normalized. She tolerated a regular diet without any symptoms of dumping syndrome or significant digestive complaints. Her overall health and quality of life were excellent.

A follow-up EGD was performed three years postoperatively to assess the long-term status of the reconstruction. The examination revealed mild reflux esophagitis (LA-A Grade), characterized by a small, 0.2 cm mucosal break in the distal esophagus. The residual gastric body, the gastrojejunal anastomosis, and the distal jejunal limb appeared normal and healthy. Interestingly, scattered, small, healing-stage ulcers (A2 stage) were noted in the blind-ended duodenal stump (Figure 3). We postulate that these ulcers may be related to the direct exposure of the jejunal mucosa in the blind loop to gastric acid, as the jejunum lacks the robust alkaline-secreting capacity of the duodenal bulb. Despite this endoscopic finding, the patient remained completely asymptomatic.

Table 1 Nutritional and Hematological Parameters Pre- and Postoperatively

	Height (m)	Weight (Kg)	BMI (Kg/m^2)	Hemoglobin (g/L)	Albumin (g/L)
Preoperative	1.44	23	11.09	93	31.9
One week after surgery	1.44	21	10.12	98	34.7
One month after surgery	1.44	29	13.98	128	42.0
Three years after surgery	1.56	46	18.90	131	49.7

Abbreviation: BMI, Body Mass Index.

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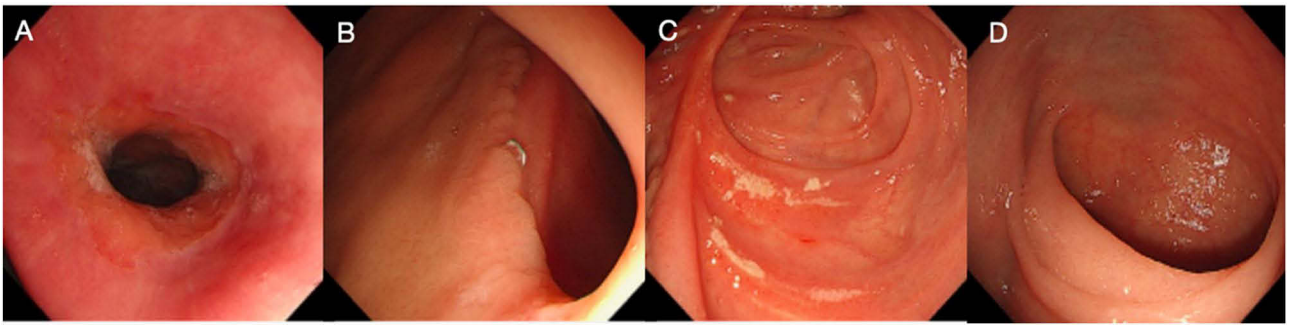

Figure 3 Three-Year Follow-up Endoscopy. (**A**) Mild erythema of the esophageal mucosa, consistent with Grade A reflux esophagitis. (**B**) The patent and healthy-appearing gastroenteric anastomosis. (**C**) Small, healing-stage (A2) ulcers observed at the blind end of the jejunum. (**D**) Normal appearance of the distal jejunal limb.

Surgical Technique

Laparoscopic subtotal gastrectomy (<50% resection) with Roux-en-Y reconstruction was performed. The jejunal limb length was standardized at 40 cm. Nutritional status (weight, BMI, Hb, Alb) was monitored preoperatively, at 1 week, 1 month, and annually postoperatively.

Discussion and Conclusions

The surgical management of complicated peptic ulcer disease in children is a rare clinical scenario, and as such, lacks a standardized, evidence-based protocol. Treatment strategies are often extrapolated from the extensive experience in adult surgery, without full consideration for the unique physiological and developmental needs of a growing child. While conservative management is effective for the majority of pediatric PUD cases, surgical intervention is unavoidable in the face of severe complications like the gastric outlet obstruction seen in our patient. This case highlights the successful application of a laparoscopic subtotal gastrectomy with Roux-en-Y reconstruction and provides a platform to discuss the surgical options in this specific population.

The choice of reconstructive procedure following gastrectomy is a critical determinant of long-term postoperative outcomes. The three primary options—Billroth I, Billroth II, and Roux-en-Y—each present a distinct profile of benefits and drawbacks. The Billroth I anastomosis is often considered the most physiological, as it restores the natural path of food through the duodenum. However, its application is limited by the need for a tension-free anastomosis, which can be difficult to achieve after a substantial gastric resection or in the presence of duodenal scarring, and it may be associated with a higher risk of ulcer recurrence. The Billroth II reconstruction overcomes the issue of anastomotic tension but at a significant cost: the diversion of bile and pancreatic secretions directly into the gastric remnant. This anatomical arrangement is a well-established cause of alkaline reflux gastritis, esophagitis, and an increased long-term risk of gastric stump carcinoma.[7,8]

The Roux-en-Y anastomosis was specifically designed to mitigate the problem of duodenal content reflux. By diverting the biliopancreatic secretions downstream from the gastrojejunostomy, it effectively protects the gastric remnant and esophagus from the caustic effects of bile and pancreatic enzymes.[9] Numerous studies in adults have demonstrated the superiority of RY reconstruction over Billroth II in preventing bile reflux and reflux gastritis.[2,3] While the procedure is technically more complex, involving an additional anastomosis, the long-term benefits, particularly in a young patient with a long life expectancy, are compelling. In children, whose tissues have a greater capacity for healing, the risk of anastomotic complications is low, making the prevention of chronic reflux-related morbidity a primary concern.

The use of a laparoscopic approach in this case aligns with the modern principles of minimally invasive surgery. The benefits of laparoscopy, including reduced postoperative pain, faster recovery, shorter hospital stays, and improved cosmesis, are well-established.[10] These advantages are arguably even more significant in pediatric patients. In recent years, robotic-assisted surgery has emerged as another minimally invasive platform, offering potential advantages such as enhanced 3D visualization and articulated instruments, though it is associated with longer operative times and higher

costs.[11–13]While conventional laparoscopy was sufficient and effective in this case, robotic surgery may play an increasing role in complex pediatric reconstructions in the future.

A critical consideration in pediatric gastrectomy is the extent of resection and its impact on future growth and development. Early reports, such as the one by Tsuchida et al,[14] raised concerns about the long-term consequences of subtotal gastrectomy in infancy. However, the stomach possesses a remarkable compensatory capacity. Our decision to perform a subtotal gastrectomy, resecting less than 50% of the stomach, was guided by the principle of preserving as much functional gastric reservoir as possible. The excellent growth and development of our patient over the three-year follow-up period, with her BMI normalizing, supports the notion that a residual stomach of adequate size can support normal nutritional status and physical development.

Despite the overall positive outcome, the follow-up endoscopy revealed findings that warrant discussion. The presence of mild reflux esophagitis and, more notably, ulcers in the blind jejunal loop, highlights potential long-term sequelae of the RY reconstruction. The jejunal ulcers are likely a consequence of the jejunal mucosa's inadequate defense mechanisms against direct exposure to gastric acid, a phenomenon sometimes referred to as marginal ulceration. Although the patient was asymptomatic, this finding suggests that long-term or intermittent acid suppression therapy with proton-pump inhibitors might be a prudent consideration in these patients.

Another potential, though rare, complication of RY anastomosis is Roux stasis syndrome, characterized by post-prandial nausea, vomiting, and abdominal pain due to dysmotility of the Roux limb.[15] This is thought to result from the disruption of normal intestinal pacing and the vagal nerve pathways. While our patient did not exhibit symptoms of this syndrome, it remains a long-term risk that requires clinical vigilance.

Finally, any major gastric surgery in a child necessitates a commitment to lifelong follow-up. The altered anatomy can lead to nutritional deficiencies, most commonly iron-deficiency anemia due to the bypass of the duodenum and the reduced gastric acidity. Malabsorption of calcium and vitamin D can also occur, predisposing the patient to metabolic bone disease in the long term. Regular monitoring of hematological and nutritional parameters is therefore essential.

In conclusion, this case report demonstrates that laparoscopic subtotal gastrectomy with Roux-en-Y anastomosis is a safe, feasible, and effective treatment for severe, complicated peptic ulcer disease in the pediatric population. The procedure successfully resolved the patient's obstructive symptoms and allowed for excellent catch-up growth and development over a three-year period. The RY reconstruction is theoretically and practically superior to Billroth I and II anastomoses in this context, primarily due to its effective prevention of debilitating bile reflux. However, the potential for long-term complications, such as marginal ulceration and nutritional deficiencies, underscores the critical importance of lifelong, multidisciplinary follow-up. This case contributes to the sparse literature on this topic and supports the use of this advanced laparoscopic technique in specialized pediatric surgical centers. Further research, ideally in the form of multicenter registries or comparative studies, is needed to establish definitive guidelines for the surgical management of PUD in children.

Limitations & Long-Term Concerns

This report is based on the experience of a single patient, which inherently limits the generalizability of our findings. The long-term outcomes of RY reconstruction in children are not fully understood. The procedure may predispose patients to Roux stasis syndrome and jejunal ulceration. While our patient showed no growth impairment at the 3-year follow-up, lifelong monitoring is advised for potential complications, including: (1) Anemia due to reduced iron absorption from the bypassed duodenum and altered gastric pH; and (2) Alterations in bone metabolism resulting from potential vitamin D and calcium malabsorption.

Clinical Trial Number

Ethical Clearance (Research) 2024-150.

Abbreviations

RY, Roux-en-Y anastomosis; BMI, Body Mass Index; PUD, Peptic Ulcer Disease; EGD, Esophagogastroduodenoscopy.

Data Sharing Statement

All data generated or analysed during this study are included in this published article. Please refer to the reference list for citations.

Ethics Approval and Consent to Participate

Ethical approval was obtained from the Ethics Committee of Guizhou Provincial People's Hospital (Approval No. 2024-150). Written informed consent was obtained from the patient's parents for the publication of this case report and any accompanying images.

Consent for Publication

Written informed consent was obtained from the patient's parents, including approval for the write-up and publication of this case report.

Acknowledgments

All authors have contributed to the direct care of the patient and the writing of the case report.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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Disclosure

None of the authors have any conflicts of interest to disclose in this work.

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