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Pancreas-preserving Surgery in Duodenal Gastrointestinal Stromal Tumors and The Role of Pancreaticoduodenectomy

Duodenal Gastrointestinal Stromal Tümörlerde Pankreas Koruyucu Cerrahi ve Pankreatikoduodenektominin Rolü

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Abstract

Objectives: Duodenal gastrointestinal stromal tumors (GISTs) are rare and surgically challenging. This study evaluated the surgical management and outcomes of duodenal GISTs, focusing on the feasibility and oncological adequacy of pancreas-preserving approaches.

Material and Methods: We retrospectively analyzed 9 patients who underwent surgical resection for duodenal GIST between January 2017 and December 2025. Clinical, operative, and pathological data, including postoperative morbidity (Clavien-Dindo), recurrence, and survival, were evaluated.

Results: Nine patients (median age 60) were included. The median operative time was 200 minutes [interquartile range (IQR), 160-270], and the median hospital stay was 9 days (IQR, 9-15). Intraoperative tumor rupture occurred in 3 patients (33.3%). R0 resection was achieved in 7 patients (77.8%), while 2 patients (22.2%) had R1 resection. Postoperative complications occurred in 4 patients (44.4%), with major complications (Clavien-Dindo ≥III) observed in two cases. During a median follow-up of 49 months (IQR, 44-74), recurrence occurred in 2 patients (22.2%), both of whom had high-risk features, such as rupture or R1 margins. At the last follow-up, 6 patients (66.7%) were alive without disease, 1 (11.1%) was alive with disease, and 2 (22.2%) had died (one disease-related death).

Conclusion: Pancreas-preserving surgery is safe for selected duodenal GISTs without compromising long-term oncological outcomes. Surgical strategy should be individualized based on tumor characteristics rather than routinely favoring radical procedures, provided that oncological principles are maintained.

Keywords: Duodenum, gastrointestinal stromal tumor, limited resection, pancreaticoduodenectomy

Öz

Giriş / Amaç: Duodenal gastrointestinal stromal tümörler (GİST) nadir görülen ve cerrahi açıdan zorlayıcı kitlelerdir. Bu çalışma, duodenal GİST'lerin cerrahi yönetimini ve sonuçlarını, özellikle pankreas koruyucu yaklaşımların uygulanabilirliği ve onkolojik yeterliliğine odaklanarak değerlendirmeyi amaçlamıştır.

Gereç ve Yöntem: Ocak 2017 ile Aralık 2025 tarihleri arasında duodenal GİST nedeniyle cerrahi rezeksiyon uygulanan 9 hasta geriye dönük olarak analiz edildi. Klinik, operatif ve patolojik veriler ile postoperatif morbidite (Clavien-Dindo), nüks ve sağkalım durumları değerlendirildi.

Bulgular: Çalışmaya toplam 9 hasta (medyan yaş 60) dahil edildi. Medyan operasyon süresi 200 dakika [çeyrekler arası aralık (IQR), 160-270], medyan hastanede kalış süresi ise 9 gün (IQR, 9-15) olarak saptandı. Üç hastada (%33,3) intraoperatif tümör rüptürü meydana geldi.

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Yedi hastada (%77,8) R0 rezeksiyon sağlanırken, 2 hastada (%22,2) R1 rezeksiyon görüldü. Postoperatif komplikasyonlar 4 hastada (%44,4) gelişti; bunların ikisinde majör komplikasyonlar (Clavien-Dindo ≥III) gözlendi. Medyan 49 aylık (IQR, 44-74) takip süresince 2 hastada (%22,2) nüks gelişti; her iki nüks de rüptür veya R1 cerrahi sınır gibi yüksek riskli özelliklerle ilişkiliydi. Son takipte hastaların 6'sı (%66,7) hastalıksız hayattaydı, 1'i (%11,1) hastalıkla yaşıyordu ve 2'si (%22,2) ölmüştü (biri hastalıkla ilişkili).

Tartışma / Sonuç: Pankreas koruyucu cerrahi, uygun seçilmiş duodenal GİST hastalarında, uzun dönem onkolojik sonuçlardan ödün vermeksizin güvenle uygulanabilir. Cerrahi strateji, onkolojik prensipler korunduğu sürece, rutin olarak radikal prosedürleri tercih etmek yerine tümör özelliklerine göre bireyselleştirilmelidir.

Anahtar Kelimeler: Duodenum, gastrointestinal stromal tümör, sınırlı rezeksiyon, pankreatikoduodenektomi

Introduction

Gastrointestinal stromal tumors (GISTs) are the most common mesenchymal neoplasms of the gastrointestinal tract, most frequently arising in the stomach (approximately 50-60%) and small intestine (20-30%). However, only a small proportion of GISTs originate from the duodenum, accounting for approximately 3-5% of all cases, making them a rare clinical entity (1,2). Despite their low incidence, duodenal GISTs are of particular clinical importance due to their unique anatomical location and heterogeneous clinical presentation, ranging from gastrointestinal bleeding to incidental detection.

The optimal surgical approach for duodenal GISTs remains controversial due to their complex anatomical location and the need to balance oncological adequacy with surgical morbidity. While pancreaticoduodenectomy has historically been preferred for anatomically challenging tumors, it is associated with higher morbidity. In contrast, recent studies suggest that limited resection can achieve comparable oncological outcomes when negative margins are obtained, supporting a more conservative approach in appropriately selected patients (3). Similarly, oncological outcome analyses have demonstrated that the extent of resection should be tailored according to tumor characteristics rather than routine use of radical procedures (4,5)

Current management strategies for GISTs are largely guided by international consensus recommendations, including those from European Society for Medical Oncology and National Comprehensive Cancer Network which emphasize complete surgical resection with negative margins as the cornerstone of treatment. However, these guidelines provide limited specific recommendations for duodenal GISTs due to their rarity and anatomical complexity (6).

Despite an increasing number of studies on duodenal GISTs, most available data derive from retrospective series with heterogeneous patient populations and significant selection bias, particularly regarding tumor location and surgical indications. In many reports, direct comparisons between surgical techniques are limited by imbalance in baseline characteristics, making it difficult to draw definitive conclusions about the optimal operative strategy (7). Furthermore, due to the rarity of duodenal GISTs, high-quality evidence remains scarce, and individualized surgical decision-making continues to rely largely on institutional experience rather than standardized criteria (8).

This study evaluates the surgical management of duodenal GISTs through analysis of operative approaches and outcomes in our cohort, with particular emphasis on the feasibility and oncological adequacy of limited resection compared with more radical procedures.

Materials and Methods

Study Design and Patient Selection

This study was approved by the Aydın Adnan Menderes University Local Ethics Committee (approval no: 2026/88-15, date: 26.02.2026). Written informed consent was obtained from all participants.

This retrospective study included patients who underwent surgical treatment for duodenal GISTs at a single tertiary referral center between January 2017 and December 2025. All consecutive patients with histopathologically confirmed GIST originating from the duodenum were included in the analysis.

Patients who lacked definitive pathological confirmation or had incomplete clinical records were excluded. Clinical, radiological, operative, and pathological data were obtained from a prospectively maintained institutional database and electronic medical records.

Preoperative Evaluation

All patients underwent preoperative assessment with contrast-enhanced abdominal computed tomography. Endoscopic evaluation was performed when clinically indicated. Tumor location was classified by duodenal segment (D1-D4), and its relationship to the ampulla of Vater was assessed using preoperative imaging and intraoperative findings.

Preoperative diagnoses were recorded and later compared with final pathological results.

Surgical Approach

The surgical approach was determined individually based on tumor location and size, and on its relationship to adjacent structures, particularly the ampulla and the

pancreatic head. Surgical procedures included segmental duodenectomy, pancreas-preserving duodenectomy, and pancreaticoduodenectomy.

Pancreas-preserving procedures were preferred whenever oncologically feasible. Pancreaticoduodenectomy was reserved for cases in which safe resection could not be achieved due to tumor proximity to the ampulla or suspected involvement of critical structures.

Among D2-located tumors, pancreas-preserving surgery was considered feasible in selected patients in whom direct ampullary invasion was excluded by preoperative imaging and intraoperative assessment.

Pathological Evaluation

All surgical specimens were evaluated by experienced gastrointestinal pathologists. Tumor size, histological subtype, mitotic index, and immunohistochemical markers, including CD117 and DOG1, were recorded.

Resection margins were classified as R0 for negative margins and R1 for microscopically positive margins. Intraoperative tumor rupture was also documented.

Postoperative Outcomes and Follow-up

Postoperative complications were graded according to the Clavien-Dindo classification. Operative time, length of hospital stay, and intraoperative blood transfusion were recorded.

Patients were followed with regular clinical and radiological evaluations. Follow-up duration was calculated from the date of surgery to the last follow-up visit or death. Recurrence was defined as radiologically or histologically confirmed disease after curative-intent resection.

Statistical Analysis

Statistical analyses were performed using SPSS version 29 (IBM Corp., Armonk, NY, USA). Due to the limited sample size, only descriptive statistics were applied. Continuous variables were expressed as mean ± standard deviation or median with interquartile range (IQR), as appropriate, while categorical variables were presented as frequencies and percentages. No formal comparative statistical analysis was conducted.

Results

Nine patients who underwent surgical treatment for duodenal GISTs were included in the study. The mean age was 61.8±15.9 years, and the median age was 60 years (range, 40-82). There were 5 female patients and 4 male patients. The most common presenting symptom was abdominal pain, occurring in 5 patients (55.6%), followed by incidental detection in 3 patients (33.3%), and gastrointestinal bleeding in 1 patient (11.1%) (Table 1).

Tumors were most frequently located in the second portion of the duodenum (n=4, 44.4%), followed by the fourth portion (n=3, 33.3%). One tumor was located in the first portion and another in the third. Ampullary involvement was present in 4 patients (44.4%); none had radiological or intraoperative evidence of pancreatic invasion (Table 1).

Preoperative diagnosis was consistent with GIST in 6 patients (66.7%). However, 2 patients (22.2%) were initially suspected of having pancreatic tumors, and 1 patient (11.1%) was preoperatively evaluated as having lymphoma (Table 1).

Surgical treatment included segmental duodenectomy (4 patients, 44.4%), pancreas-preserving duodenectomy (3 patients, 33.3%), and pancreaticoduodenectomy (2 patients, 22.2%). Among patients with tumors in the second portion of the duodenum, pancreas-preserving duodenectomy was performed in 3 out of 4 patients, whereas only one patient required pancreaticoduodenectomy.

Table 1: Baseline characteristics

Variable	Value
Number of patients	9
Age, years (mean ± SD)	61.8±15.9
Age, years (median, range)	60 (40-82)
Sex (female/male)	5/4
Presentation	
Abdominal pain	5 (55.6%)
Gastrointestinal bleeding	1 (11.1%)
Incidental	3 (33.3%)
Acute presentation	6 (66.7%)
Preoperative anemia	6 (66.7%)
Preoperative diagnosis	
GIST	6 (66.7%)
Pancreatic tumor	2 (22.2%)
Lymphoma	1 (11.1%)
Tumor location	
D1	1 (11.1%)
D2	4 (44.4%)
D3	1 (11.1%)
D4	3 (33.3%)
Ampullary involvement	4 (44.4%)
Pancreatic invasion	0 (0%)
Histological subtype	
Spindle	6 (66.7%)
Epithelioid	3 (33.3%)
CD117 positivity	8 (88.9%)
DOG1 positivity	8 (88.9%)

SD: Standard deviation, GIST: Gastrointestinal stromal tumor

The median operative time was 200 minutes (IQR, 160-270), and the median length of hospital stay was 9 days (IQR, 9-15). Intraoperative tumor rupture occurred in 3 patients (33.3%), and intraoperative blood transfusion was required in 5 patients (55.6%). R0 resection was achieved in 7 patients (77.8%), while 2 patients (22.2%) had microscopically positive margins (Table 2). Both patients who underwent R1 resection had tumors located in the second portion of the duodenum, which were considered surgically challenging because of their close proximity to periampullary structures. Intraoperative tumor rupture occurred in 3 patients, all of whom had large and fragile tumors. Recurrence was observed in patients with high-risk features, including tumor rupture and positive surgical margins.

Postoperative complications occurred in 4 patients (44.4%). According to the Clavien-Dindo classification, most complications were low-grade, including grade I in 2 patients (22.2%) and grade II in 1 patient (11.1%). One patient (11.1%) required radiologic intervention (grade IIIa) (Table 2).

During a median follow-up of 49 months (IQR, 44-74), recurrence was observed in 2 patients (22.2%). One patient developed liver metastasis at 24 months, and another developed peritoneal recurrence at 56 months. Both recurrences occurred in patients with high-risk features, including intraoperative tumor rupture or positive resection margins. The patients who underwent R1 resection had periampullary tumors located in D2, with technically challenging dissection planes. Adjuvant imatinib therapy was administered to 4 patients (44.4%) (Table 3).

At the last follow-up, 6 patients (66.7%) were alive without disease, 1 (11.1%) was alive with disease, 1 (11.1%) died from disease progression, and 1 (11.1%) died from non-disease-related causes (Table 3).

Table 2. Operative and postoperative outcomes

Variable	Value
Operative time, min (median, IQR)	200 (160-270)
Length of stay, days (median, IQR)	9 (9-15)
Intraoperative tumor rupture	3 (33.3%)
Intraoperative transfusion	5 (55.6%)
R0 resection	7 (77.8%)
R1 resection	2 (22.2%)
Postoperative complications	4 (44.4%)
Clavien-Dindo classification	
Grade	n (%)
I	2 (22.2%)
II	1 (11.1%)
IIIa	1 (11.1%)
IQR: Interquartile range	

Table 3. Oncological outcomes

Variable	Value
Follow-up, months (median, IQR)	49 (44-74)
Adjuvant imatinib	4 (44.4%)
Recurrence	2 (22.2%)
Time to recurrence	24 and 56 months
Recurrence site	Liver (1), peritoneum (1)
Disease-free	6 (66.7%)
Alive with disease	1 (11.1%)
Disease-related death	1 (11.1%)
Non-disease death	1 (11.1%)
IQR: Interquartile range	

Discussion

Duodenal GISTs are rare and surgically challenging due to their proximity to the pancreas, bile duct, and major vascular structures. This complexity has often led to a preference for more aggressive procedures such as pancreaticoduodenectomy, even when less extensive surgery may be feasible. However, our findings demonstrate that pancreas-preserving surgery can be safely performed in a substantial proportion of patients without compromising oncological outcomes. In our series, limited resection achieved satisfactory surgical and early oncological results, supporting a more conservative and individualized surgical approach.

The biological behavior of GISTs is a key determinant of surgical strategy. Unlike epithelial gastrointestinal malignancies, lymph node metastases are rare, and routine lymphadenectomy is not required. This allows limited resections when complete tumor removal is achievable. In our cohort, pancreas-preserving procedures predominated and resulted in successful R0 resections in nearly all patients without the need for extended surgery. These findings are consistent with studies showing that surgical extent does not independently affect long term survival (9), and that local resection is oncologically sufficient when negative margins are obtained (10).

The choice between limited resection and pancreaticoduodenectomy remains a key issue in duodenal GIST management. Limited resection is reported in approximately 60-70% of cases, while pancreaticoduodenectomy is reserved for a smaller subset of patients. Importantly, several studies have shown comparable survival outcomes between these approaches when complete resection is achieved (11,12). In our series, pancreas-preserving techniques were used in most patients, and pancreaticoduodenectomy was required in only a few cases. Despite this conservative approach, oncological

outcomes were not compromised, supporting the concept that surgical extent should be guided by tumor characteristics rather than anatomical location alone. Nevertheless, pancreas-preserving surgery requires meticulous surgical technique and careful oncological judgment, particularly in patients with friable tumors or technically challenging periampullary dissection planes. In our series, recurrence was observed in patients with high-risk features, such as intraoperative tumor rupture and positive resection margins, emphasizing the importance of careful tumor handling and complete oncological resection whenever feasible. Despite two patients with R1 resections in our series, the median follow-up of 49 months demonstrates that acceptable oncological outcomes can still be achieved. This suggests that the biological behavior of duodenal GISTs, combined with tailored adjuvant therapy, may mitigate the risks associated with microscopic positive margins in selected cases.

Pancreaticoduodenectomy remains necessary in selected patients and accounts for approximately 20-40% of cases in reported series. It is generally indicated for tumors larger than 5-10 cm, those located near the ampulla of Vater, or when there is involvement of the pancreatic head or biliary tract, where achieving negative margins with limited resection may not be feasible (13). These findings suggest that, while pancreaticoduodenectomy is an important option, it should be used selectively rather than routinely. In our cohort, intraoperative tumor rupture occurred in three patients (33.3%). Although rupture is a known risk factor for recurrence, these cases were managed with adjuvant imatinib therapy. We observed that recurrences in our series were closely associated with both high-risk features and intraoperative events.

Tumors in the second portion of the duodenum are considered more challenging due to their proximity to the ampulla of Vater and the pancreatic head, often necessitating more aggressive surgical management. However, evidence suggests that limited resection may be feasible in selected cases. When the tumor does not involve the ampulla, pancreas-preserving surgery can achieve adequate oncological outcomes (14,15). These findings indicate that anatomical location alone should not determine surgical extent, and that individualized assessment may allow less invasive approaches without compromising oncological safety.

Consistent with the literature, our study demonstrated lower morbidity in the limited-resection group. Major complications (Clavien-Dindo ≥III) were rare, occurring in only two patients, which further supports the safety of pancreas-preserving approaches over radical surgery. Pancreaticoduodenectomy is associated with higher morbidity, longer operative time, and prolonged recovery compared to limited resections, raising concerns about potential overtreatment in selected patients. Previous studies have shown that more extensive resections do not provide additional survival benefit when complete tumor removal can be achieved with limited surgery (16). Given that tumor biology and margin status are the main determinants of prognosis, unnecessarily extensive surgery should be avoided whenever feasible. Clinical presentation may also influence surgical decision making, particularly in patients presenting with bleeding or symptomatic disease requiring urgent intervention (17). In this context, an individualized approach based on tumor characteristics and intraoperative findings is essential. Although minimally invasive techniques such as laparoscopic and robotic surgery have been increasingly reported, the primary goal remains the achievement of an R0 resection rather than the choice of surgical approach (18,19).

Importantly, our findings contribute to the existing literature by demonstrating that pancreas-preserving surgery can be successfully applied even to anatomically challenging duodenal GISTs, thereby supporting a more conservative and individualized surgical strategy.

Study Limitations

This study has several limitations. First, its retrospective design may introduce selection bias. Second, the relatively small sample size reflects the rarity of duodenal GISTs and limits the generalizability of the findings. Third, the absence of a direct comparison between limited resection and pancreaticoduodenectomy precludes definitive conclusions regarding the superiority of one surgical approach over another. In addition, long-term oncological outcomes could not be fully evaluated in all patients. Despite these limitations, the study provides clinically relevant insights into surgical decision-making in a rare and challenging disease.

Conclusion

Pancreas-preserving surgery is a feasible and oncologically safe option for selected patients with duodenal GISTs. Pancreaticoduodenectomy should be reserved for cases in which negative margins cannot be achieved with limited resection. Surgical decision-making should be individualized based on tumor characteristics and anatomical relationships, rather than on anatomical location alone. These findings suggest that even selected D2-located tumors may be managed with pancreas-preserving approaches without routine pancreaticoduodenectomy.

Ethics

Ethics Committee Approval: This study was approved by the Aydın Adnan Menderes University Local Ethics Committee (approval no: 2026/88-15, date: 26.02.2026).

Informed Consent: Written informed consent was obtained from all participants.

Footnotes

Authorship Contributions

Concept/Design: A.E., E.B.C., Data Collection or Processing: M.E., Analysis or Interpretation: A.E., O.A., E.B.C., Literature Review: A.E., O.A., Writing, Reviewing and Editing: A.E., E.B.C.

Conflict of Interest: No conflict of interest was declared by the authors.

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