








Evaluation of Patients with Postoperative Pancreatic Fistula After Isolated Splenectomy: A Retrospective Study

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Received: 2024-03-06

Accepted: 2024-05-09

Published Online: 2024-05-13

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ABSTRACT

Objective: Postoperative pancreatic fistula (POPF) is a potentially life-threatening complication. This complication occurs not only after pancreatic surgery but may also arise after other abdominal procedures. In this study, we aimed to determine the incidence and risk factors of POPF in patients undergoing isolated splenectomy.

Methods: Patients who underwent isolated splenectomy were identified. POPF was defined according to the 2016 update of International Study Group of Pancreatic Fistula classification and graded as biochemical leak (BL), grade B fistula, and grade C fistula. Characteristics and perioperative variables were compared between patients who had pancreatic fistula and those who have not.

Results: The study cohort consisted of 59 patients with median age 38.9 years, and 50.8% male. The indication was trauma in 18 (30.5%) patients. Twenty (33.9%) patients were operated upon emergently. Thirty-seven (62.7%) splenectomies were performed open. Out of all patients, 14 (23.7%) developed any sort of pancreatic fistula. BL occurred in 11 (18.6%) patients and 3 (5.1%) patients developed a grade B fistula. Comparison of patients with and without BL/POPF demonstrated no significant differences in demographics, surgical indication, operative method, surgical approach, or postoperative outcome.

Conclusions: Despite higher incidence of pancreatic leak, the rate of clinically relevant fistula is relatively low. In this study, we did not identify any factors associated with BL/POPF. Thus, further studies are needed on pancreatic fistula after splenectomy.

Keywords: complication, drainage, pancreatic fistula, splenectomy

INTRODUCTION

Splenectomy is performed for a variety of indications, such as an emergency procedure following trauma and the diagnosis and treatment of hematological disorders in elective settings. Recently, with the development of laparoscopic instruments,

surgical techniques, and advancing technology, laparoscopic splenectomy has been widely applied as a standard procedure for splenic surgery [1,2]. In the emergency setting, open splenectomy is the most commonly performed procedure [3]. Due to the anatomical proximity of the spleen to the pancreas

tail, mobilization of the spleen increases the risk of pancreatic injury and fistula [4].

Postoperative pancreatic fistula (POPF) is a serious complication after pancreas surgery and is associated with an increased risk of poor outcomes. This potentially life-threatening complication occurs not only after pancreatic resection but may also occur after other abdominal procedures, such as gastrectomy and splenectomy [5-7]. POPF prevalence after splenectomy ranges from 4.5% to 16%, some of which may have important clinical implications [5,6]. Despite well-established indications for performing splenectomy and approaches to managing splenic disorders, only limited data are available regarding pancreatic complications, especially POPF, after splenectomy. In this study, we aimed to determine the incidence of POPF in patients undergoing isolated splenectomy and to compare patients with and without POPF regarding clinical features.

MATERIALS AND METHODS

Study Design and Study Population

Following institutional review board approval from the Ethics Committee of Gulhane Training and Research Hospital (2022/15), we performed a single-center retrospective analysis of patients undergoing splenectomy between January 2016 and December 2022. Patients who underwent a splenectomy during another abdominal procedure, those who underwent multiple organ resections due to malignancy, or underwent any organ removal, resection, or repair other than a splenectomy after traumatic injuries were excluded from the study. We also excluded those patients who underwent partial splenectomy, patients younger

than 18 years at initial presentation, patients without surgical drains, and patients with missing data (Figure 1).

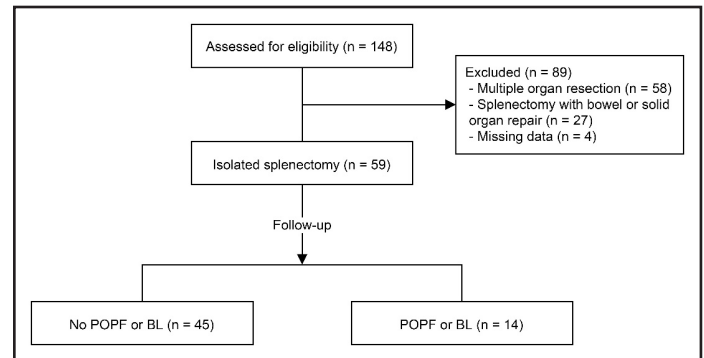


Figure 1. CONSORT flow diagram of study enrolment, allocation, follow-up, and analysis.

Data Collection

Data collected included patient characteristics, indication for splenectomy (trauma or non-traumatic), surgical procedure (elective or emergency), surgical approach (open or laparoscopic), spleen weight, length of hospital and intensive care unit stay, and 30-day outcomes.

Outcome Variables

The primary outcome of interest was the development of a postoperative BL or pancreatic fistula after splenectomy. POPF was defined according to the 2016 update of International Study Group of Pancreatic Fistula (ISGPF) classification [8]. While pancreatic leak which has no clinical impact on the patient's hospital course was defined as BL (formerly grade A POPF), grade B and grade C POPFs were considered clinically relevant fistulas. The Clavien–Dindo classification was used to grade complications [9]. Clinical characteristics and perioperative variables were compared between patients who had BL or POPF and those who had not.

Statistical Analysis

Examinations of normal distribution assumptions for continuous data were assessed with quantile-quantile plots, histograms, and the Shapiro-Wilk test. Categorical data were presented as number (n) and percentage (%), and continuous data as median with range values. Associations between variables were evaluated using the Wilcoxon Mann Whitney U test (for continuous variables) and the Pearson χ^2 or Fisher exact tests (for categorical variables),

Main Points;

- Splenectomy carries the potential risk of complications, either during surgery or in the postoperative period.
- Postoperative pancreatic fistula (POPF), which is also a major complication of splenectomy, is associated with a higher risk of unfavorable outcome.
- Notwithstanding the higher incidence of pancreatic leak (23.7%), the rate of clinically relevant fistula is comparatively low (5.1%) in this study.
- No factors were identified that were associated with biochemical leak or POPF. Consequently, further studies are required to elucidate the relationship between pancreatic complications and splenectomy.

where appropriate. All tests were two-sided, and p-values < 0.05 were considered statistically significant. Statistical analyses were performed using Jamovi, version 2.3.2.0 (The Jamovi project, Sydney, Australia) [10].

RESULTS

Of the 148 patients who underwent a splenectomy, the records of 59 patients were analyzed in this study after excluding patients who had multiple organ resections (n = 58), patients undergoing splenectomy with any bowel or solid organ repair (n = 27), and patients with missing data (n = 4) (Figure 1). The median age was 38.9 (range, 19.1–76.9) years, and 50.8% were male. The indications for splenectomy were trauma (30.5%), immune thrombocytopenia (ITP) (18.6%), splenic mass (18.6%), hypersplenism (13.6%), autoimmune hemolytic anemia (5.1%), lymphoma (5.1%), hereditary spherocytosis (1.7%), splenic abscess (3.4%), and splenic hydatid cyst (1.7%). 22 (37.3%) cases were completed laparoscopically, 4 (6.8%) were converted to open surgery, and 33 (55.9%) splenectomies were performed open.

Out of all patients, 14 (23.7%) developed any sort of pancreatic leak. A BL occurred in 11 (18.6%) patients, whereas 3 (5.1%) patients developed a grade B fistula. There were no patients with grade C fistula. Table 1 presents a comparison between patients who underwent isolated splenectomy having pancreatic fistula or BL and patients without any sort of POPF regarding demographic and clinical data. Comparison of the two groups demonstrated no significant differences in age, gender, surgical indication, operative method, surgical approach, and postoperative short-term outcomes. Not surprisingly, the rate of discharge with a drain was significantly higher in patients with BL or POPF than in those without a pancreatic leak (28.6% versus 6.6%, p = 0.026).

In the subgroup analysis, when compared to BL, patients with grade B fistula had a longer length of hospitalization (8.2 days versus 32.3 days, p = 0.046). In addition, patients who underwent emergency splenectomy because of a traumatic injury had a higher rate of grade B fistula (p = 0.031). There were no significant differences between patients with BL and patients with grade B fistula regarding demographic variables, other perioperative data, and postoperative outcomes.

Table 1. Comparison of patients having biochemical leak or postoperative pancreatic fistula and patients without any leaks

	Non-POPF/ BL (n = 45)	POPF or BL (n = 14)	p
Age, years	39.5 (19.1–76.9)	30.5 (20.2–73.8)	0.318
Male gender, n (%)	22 (48.9%)	8 (57.1%)	0.590
Indication for splenectomy, n (%)			0.516
Non-trauma indications	30 (66.7%)	11 (78.6%)	
Trauma	15 (33.3%)	3 (21.4%)	
Operative method, n (%)			0.342
Elective	28 (62.2%)	11 (78.6%)	
Emergency	17 (37.8%)	3 (21.4%)	
Surgical approach, n (%)			0.260
Open	30 (66.7%)	7 (50.0%)	
Laparoscopic	15 (33.3%)	7 (50.0%)	
Spleen weight, g	216 (110–4000)	250 (160–2330)	0.497
ICU stay, n (%)	29 (64.4%)	10 (71.4%)	0.753
Length of hospital stay, days	6 (2–24)	8 (3–63)	0.316
Discharge with drain, n (%)	3 (6.6%)	4 (28.6%)	0.026
Postoperative 30-day complication, n (%) [†]	4 (8.9%)	2 (14.3%)	0.559

BL, biochemical leak; ICU, intensive care unit; POPF, postoperative pancreatic fistula

[†] postoperative ≥ grade 3a complications other than pancreatic fistula

DISCUSSION

Splenectomy is a commonly performed procedure in general surgical practice [3,4,11]. While splenectomy can be performed as a multi-organ resection during another abdominal procedure due to malignancy or trauma, it can also be performed as an isolated procedure in patients with trauma or those with hematological disorders [1,2]. Regardless of the surgical technique performed, it carries the potential risk of complications, either during surgery or in the postoperative period [12,13]. Although splenectomy remains a frequently performed procedure, studies on pancreatic complications after splenectomy are limited. Especially, the incidence of POPF after isolated splenectomy and the effects of pancreatic fistula on short-term clinical outcomes is unclear [2,5–7]. This single-center retrospective study showed that pancreatic leak is not a rare complication and occurs in 23.7% of patients

undergoing isolated splenectomy. In the present study, most pancreatic leaks were BL with no clinical impact on patients' short-term outcomes

Splenectomy is an independent risk factor for POPF in patients who have had a gastrectomy or those undergoing multiple resections such as cytoreductive surgery [14-16]. It is also well known that POPF occurs more often in patients who have undergone splenectomy for oncological indications or technical difficulties during the course of other surgical procedures [5]. With the realization that there is limited data, this study focused on the incidence and clinical outcomes of POPF, especially in patients who underwent isolated splenectomy. In addition, to evaluate the true incidence of the pancreatic leak, especially BL, we only included in the study patients who had an operatively placed drain after splenectomy. In a recent study evaluating POPF after splenectomy with multi-organ resection, traumatic splenectomy, and isolated splenectomy, the incidence of POPF was reported as 14.6% [5]. Because surgical drains were placed according to surgeons' preference, there is no information in this study about how many patients had a drain placed. Therefore, the low incidence of POPF may be due to the comparatively rare use of intraperitoneal drains, especially in patients who underwent an elective isolated splenectomy. In another study, the total incidence of clinically relevant POPF was reported to be 4.2% [7]. However, in contrast to this study, we included BL in the analysis and hence report a higher rate of pancreatic fistula. When excluding BL to focus entirely on grade B and grade C fistula, we found an incidence of 5.1%, which is comparable to rates reported in the literature [2,5-7,17].

In the present study, comparison of patients with and without BL/POPF following isolated splenectomy demonstrated no significant differences in demographic variables, surgical indication, operative method, surgical approach, and postoperative short-term outcomes. One of the rare studies that investigated the risk factors for POPF after splenectomy showed that secondary splenectomy (splenectomy for other organ pathologies or technical reasons) and the use of energy-based devices were to be independent risk factors in multivariate analysis [5]. In a recent study investigating 167 patients who underwent splenectomy due to hepatolenticular degeneration and hypersplenism, degree of splenomegaly, pancreatic texture, and operative method were found to be independently associated with POPF [7].

Laparoscopic splenectomy is a safe procedure and has a low

complication rate [2,4,12,18]. Up to 15% of laparoscopic splenectomies have reported pancreatic complications (either an isolated hyperamylasemia or a pancreatic injury) [2]. However, the true impact of surgical approach on the incidence of the pancreatic fistula is unclear [12]. Due to the close contact of the splenic hilum with the pancreatic tail, intraoperative trauma of the pancreas during dissection of the splenic hilum may cause POPF [19]. In a meta-analysis that evaluated the clinical efficacy of surgical technique (laparoscopic or open) in the treatment of ITP, it was not found a significant difference in the incidence of pancreatic fistula between laparoscopic and open splenectomy [17]. In the present study, BL/POPF was found to be higher in laparoscopic splenectomy, but there was no statistical difference compared with the open group (31.8% versus 18.9%, $p = 0.260$). Other factors that might play a role in POPF are the operative setting (elective or emergency) and splenic hilum ligation technique. Emergency splenectomies, including patients who had trauma and patients who underwent additional abdominal procedures or multiple resections, are associated with higher postoperative complications and mortality rates [20]. In our study, no statistically significant difference was determined between elective and emergency splenectomy in respect of BL/POPF rate (28.2% versus 15.0%, $p = 0.342$). This result is similar to that reported by Mehdorn et al. [5] using both univariate and multivariate analyses. However, in the subgroup analysis, compared to elective splenectomy, patients who underwent emergency splenectomy because of a traumatic injury had a higher rate of grade B fistula. During splenectomy, there are various techniques used to ligate splenic vessels such as sutures, staples, clips, ultrasonic shears, and bipolar-sealing devices. There is no splenic hilum ligation technique that has been proven to reduce POPF development [21].

There is conflicting evidence in studies evaluating the relationship between splenomegaly and postoperative complications. While in a study by Targarona et al. [22], multivariate analysis revealed that spleen weight was a predictive factor for complications, Rodríguez-Luna et al. [23] and Alobuia et al. [24] did not find an association between spleen size and postoperative complications. Similarly, we could not show an influence of spleen weight on the development of BL/POPF.

Despite the higher incidence of pancreatic leaks, the rate of clinically relevant POPF is relatively low. Therefore, in recent studies, BL (formerly grade A POPF) is no longer considered to be a true pancreatic fistula or complication [8]. Moreover,

detection of BL is also only possible when a drain is placed. When surgeons do not place a surgical drain at the time of splenectomy, the presence of increased amylase levels in the abdominal fluid is not even detected [8,25]. A recently published evidence-based guideline from the Society of American Gastrointestinal and Endoscopic Surgeons (SAGES) suggests that selective drain placement should be considered instead of routine placement based on patient- or procedure-related factors during minimally invasive splenectomy [11]. In a prospective study aiming to evaluate risk factors and effective prophylactic treatment strategies for preventing the development of pancreatic fistula after laparoscopic splenectomy in patients with hypersplenism due to liver cirrhosis, it was found that combined use of fibrin glue and polyglycolic acid (PGA) felt on the staple line and dissected area after laparoscopic splenectomy reduced pancreatic fistula [6]. In this study, which used a routine closed suction drain after laparoscopic splenectomy, while 21.7% of patients who used a fibrin sheet after the operation presented with pancreatic fistula, patients using PGA felt and fibrin glue had not experienced any cases of pancreatic fistula. In addition, the authors emphasized the importance of prophylactic strategies to reduce pancreatic fistula after splenectomy for patients at high risk. However, neither the present study nor the study mentioned above could identify a predictive factor of POPF after splenectomy from the patients' demographic variables and clinical characteristics.

Limitations

There are several limitations to this study, which should be highlighted. This is a retrospective analysis and is subject to all potential biases associated with such an approach. It was carried out in a single center, limiting the generalizability of our findings. In addition, the number of patients in the present study was relatively low because of strict inclusion criteria aiming to evaluate the true incidence of POPF. Despite these limitations, this study provides evidence for the understanding and identification of the true incidence of POPF after isolated splenectomy and presents clinical outcomes of patients with and without pancreatic fistula.

CONCLUSION

Pancreatic fistula is a potentially life-threatening and morbidity-increasing complication. It is important to identify factors that can be addressed perioperatively to reduce the possibility of POPF and to ensure optimal clinical outcomes in patients undergoing splenectomy. While there are various risk factors for the

development of POPF, we did not identify any factor associated with BL/POPF after isolated splenectomy. Thus, further studies are needed on pancreatic complications after splenectomy.

Declaration of conflicting interest: The authors declare that there is no conflict of interest.

Funding: The authors declared that this study has received no financial support.

Authorship: All authors had access to the relevant data and a role in writing the manuscript.

Ethics Committee Approval: Ethical approval was obtained from the Ethics Committee of Gulhane Training and Research Hospital (approval no: 2022/15).

Author Contributions

Conception: SUC, MBD, YG, HEP, MMH, MO, SAK; Design: SUC, SAK; Supervision: SUC, SAK; Fundings: SUC, SAK; Materials: SUC, MBD, YG, HEP, MMH, MO, SAK; Data Collection and/or Processing: MBD, YG, HEP, MMH, MO; Analysis and/or Interpretation: SUC, SAK; Literature Review: SUC, MBD, YG, HEP, MMH, MO, SAK; Writing: SUC, MBD, YG, HEP, MMH, MO, SAK; Critical Review: SUC, MBD, YG, HEP, MMH, MO, SAK.

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How to Cite;

Celik S, Demir MB, Gulap Y, Polat HE, Hidiroglu MM, Ozkara M, Kesikli SA (2024) Evaluation of Patients with Postoperative Pancreatic Fistula After Isolated Splenectomy: A Retrospective Study. Eur J Ther. 30(3):285-291. <https://doi.org/10.58600/eurjther2081>