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Original Research Article.

Evaluation of Risk Factors of Pancreatic Injuries during Elective Laparoscopic Splenectomy Procedure in Children at a Tertiary Care Hospital

Avinal Kalra[1], Parampal Singh Dhillon[2*]

[1]**Assistant Professor, Department of Paediatrics,**
Mulayam Singh Yadav Medical College, Meerut, Uttar Pradesh, India.
[2*]**Assistant Professor, Department of General Surgery,**
FH Medical College, Agra, Uttar Pradesh, India.

ABSTRACT

Background: Laparoscopic splenectomy (LS) has become the preferred approach for treating benign hematological disorders in children due to its advantages of reduced morbidity, shorter hospital stay, and faster recovery. However, dissection around the splenic hilum poses a potential risk of pancreatic injury, which can result in significant postoperative complications. Identifying the risk factors associated with this complication is crucial to improving surgical safety and outcomes.

Aim: The aim of this study was to evaluate risk factors of pancreatic injuries during elective laparoscopic splenectomy procedure in children at a tertiary care hospital.

Materials and Methods: This retrospective observational study was conducted on 76 pediatric patients undergoing elective LS for benign hematological disorders including thalassemia, idiopathic thrombocytopenic purpura (ITP), and hereditary spherocytosis. Demographic data, underlying diagnoses, splenic size, operative details, intraoperative technical difficulties, and postoperative outcomes were recorded. Pancreatic injury was defined as intraoperative evidence of trauma to the pancreatic tail, postoperative biochemical or radiological confirmation of pancreatic leak, or occurrence of pancreatic fistula.

Results: The mean age of the patients was 11.2 ± 3.4 years, with a male-to-female ratio of 1.2:1. The most common indication for LS was thalassemia (53.95%), followed by ITP (27.63%) and hereditary spherocytosis (18.42%). Splenic size was ≥15 cm in 56.58% of cases. Pancreatic injury occurred in 9 patients (11.84%). Splenic size ≥15 cm (p = 0.037) and intraoperative technical difficulty (p = 0.011) were significantly associated with pancreatic injury, while age and gender were not. Postoperative complications included pancreatic fistula (5.26%) and prolonged drain output (7.89%), both significantly related to pancreatic injury. Overall, 80.26% of patients had an uneventful recovery.

Conclusion: Pancreatic injury during LS in children is uncommon but clinically significant. Larger spleen size and technical difficulty at the hilum are major risk factors, and injury is strongly linked with postoperative morbidity. Careful dissection, preoperative risk assessment, and surgical vigilance are essential to minimize complications.

Keywords: Laparoscopic Splenectomy, Pancreatic Injury, Pediatric Surgery, Risk Factors, Splenomegaly.

***Correspondence to:**

Dr. Parampal Singh Dhillon,
Assistant Professor, Department of General Surgery, FH Medical College, Agra, Uttar Pradesh, India.

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INTRODUCTION

Laparoscopic splenectomy (LS) has transitioned from an experimental technique to the standard approach for many benign pediatric hematologic disorders over the past three decades. Early pediatric experiences demonstrated not only technical feasibility but also a favorable convalescence when compared with open splenectomy, laying the groundwork for broader adoption in children.[1] Subsequent multi-institutional pediatric series refined patient selection and operative strategy, showing that LS can be performed safely across a wide age range with acceptable operative times, low conversion rates, and minimal morbidity.[2] This evolution has been aided by advances in pediatric anesthesia, miniaturized instrumentation, and standardized perioperative pathways tailored to children. The indications for LS in children are dominated by benign hematologic diseases—most commonly thalassemia, immune thrombocytopenia (ITP), and hereditary spherocytosis (HS). Early pediatric surgical reports focusing on HS and ITP established that LS can provide durable hematologic control with shorter hospital stays and faster recovery

than open surgery, without sacrificing safety.[3] Contemporary practice guidelines for HS have since clarified when splenectomy should be considered, generally reserving it for children with significant hemolysis, transfusion dependence, or symptomatic splenomegaly after a shared decision-making process—a framework that harmonizes surgical decision-making with hematology-led longitudinal care.[4] These pathways, together with preoperative vaccination, infection prophylaxis, and education around postsplenectomy sepsis, have contributed to the overall safety profile of pediatric splenectomy programs. Despite these advances, laparoscopic dissection at the splenic hilum remains a critical step with unique risks. of particular concern is iatrogenic pancreatic injury—ranging from occult biochemical leaks to clinically apparent postoperative pancreatic fistula—given the intimate anatomic relationship of the pancreatic tail to the splenic vessels and hilum. Foundational imaging work has long emphasized the variability of pancreatic tail position within the left upper quadrant and its frequent proximity to the splenic hilum, underscoring why meticulous hilar control is central to preventing pancreatic traction, crush, thermal, or stapler-related injuries during LS.[5] Computed tomography (CT)–based mapping studies further quantify this relationship, demonstrating that the pancreatic tail often lies within only a few centimeters of the hilum; these data have translated into practical "safety zone" concepts to guide where clips, energy devices, or staplers should be applied to minimize inadvertent pancreatic insult.[4] In the pediatric setting—where tissue planes can be delicate and spleen size may be disproportionately large for body habitus—these relationships may be even more consequential. An additional layer of complexity arises from disease biology and spleen size. Children with transfusion-dependent hemolytic anemias (e.g., thalassemia) frequently present with massive splenomegaly and prominent hilar vasculature, conditions that can distort the hilum and magnify the risk of thermal spread or deep clip placement during hilar control. By contrast, many children with ITP may have normal-sized spleens but friable capsules and altered coagulation parameters, shifting the technical emphasis toward gentle tissue handling and reliable hemostasis. Early pediatric series that cataloged outcomes across diagnoses highlighted these nuances and helped surgeons adapt port placement, patient positioning, and sequence of hilar devascularization to the underlying indication.[2,3,6] These disease-specific factors provide the clinical context for risk assessment when counselling families about LS and its potential complications, including pancreatic injury. Technical choices at the hilum may also modulate risk. Surgeons commonly employ one of several strategies: individual ligation or clipping of splenic artery and vein, en-bloc stapling of the hilar pedicle, or a hybrid approach that combines selective vessel isolation with energy devices for short gastric and polar branches. Pediatric experience has shown that these options can each be safe when executed within a disciplined operative plan and with precise attention to distance from the pancreatic tail.[2,3] Safety-oriented imaging literature complements these strategies by advocating preoperative CT review to appreciate the pancreatic tail's course, the lie of the splenic vessels, and any anatomic variants (e.g., accessory spleens) that might invite additional dissection near the pancreas.4,5 Such planning is particularly pertinent in children, in whom smaller working spaces magnify the consequences of millimetric misjudgments.[7]

MATERIALS AND METHODS

This retrospective observational study included a total of seventy-six pediatric patients who underwent elective laparoscopic splenectomy. All patients were evaluated preoperatively with detailed clinical history, thorough physical examination, and relevant laboratory and imaging investigations. Children with underlying hematological disorders such as thalassemia, hereditary spherocytosis, and idiopathic thrombocytopenic purpura were included, while those undergoing emergency splenectomy or associated with other major abdominal procedures were excluded from the study.

All surgical procedures were performed under general anesthesia using a standard laparoscopic approach. Patients were positioned supine with left side elevated and a four-port technique was adopted in most cases. Pneumoperitoneum was established using a Veress needle or open technique, followed by placement of trocars under direct vision. The spleen was mobilized by sequential division of the splenocolic, splenorenal, splenophrenic, and splenogastric ligaments. The splenic hilum was approached carefully, and hilar vessels were controlled using clips, energy devices, or staplers according to intraoperative requirements. Pancreatic tail was inspected intraoperatively for any evidence of direct injury or inadvertent trauma during hilar dissection.

Data regarding demographic variables, indication for surgery, intraoperative findings, presence or absence of pancreatic injury, operative time, blood loss, and postoperative complications were collected from medical records. Risk factors analyzed included patient age, gender, underlying diagnosis, splenic size, surgical technique, and intraoperative technical difficulties. Pancreatic injury was defined based on intraoperative visualization of parenchymal trauma, postoperative development of biochemical or radiological evidence of pancreatic leak, or occurrence of pancreatic fistula.

All collected data were compiled and entered into a database for analysis. Statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS) version 16.0. Descriptive statistics were applied to calculate frequencies, percentages, means, and standard deviations where applicable. Categorical variables were compared using chi-square or Fisher's exact test, while continuous variables were analyzed with Student's t-test. A p-value of less than 0.05 was considered statistically significant.

RESULTS

A total of 76 children underwent elective laparoscopic splenectomy during the study period. The demographic and clinical characteristics of the patients, indications for surgery, intraoperative findings, risk factors associated with pancreatic injury, and postoperative outcomes are presented in detail below.

In terms of demographic distribution (Table 1), the mean age of the patients was 11.2 ± 3.4 years, with the majority being older than 10 years (61.84%). Children aged 10 years or younger accounted for 38.16% of cases. Gender distribution revealed that 42 patients (55.26%) were male, while 34 patients (44.74%) were female, showing a slight male predominance.

The most common indication for splenectomy was thalassemia (Table 2), which was present in 41 patients (53.95%). Idiopathic thrombocytopenic purpura (ITP) was the second most frequent indication, observed in 21 patients (27.63%), followed by hereditary spherocytosis in 14 patients (18.42%). This reflects the

predominance of hematological disorders as the underlying reason for splenectomy in the pediatric age group.

Intraoperative findings are summarized in Table 3. A total of 43 patients (56.58%) had splenic size ≥ 15 cm, while 33 patients (43.42%) had splenic size < 15 cm. Pancreatic injury occurred in 9 patients (11.84%), whereas 67 patients (88.16%) underwent surgery without this complication. The mean operative time was 128.5 ± 24.6 minutes, and the average intraoperative blood loss was 185.7 ± 61.3 ml, indicating a relatively safe surgical profile with acceptable blood loss across the cohort.

Risk factor analysis for pancreatic injury is presented in Table 4. Although older age (>10 years) and male gender appeared more frequent among patients who sustained pancreatic injury, the associations were not statistically significant (p = 0.312 and p = 0.490, respectively). However, splenic size ≥ 15 cm showed a significant association with pancreatic injury, as 88.89% of the injured patients had enlarged spleens compared to 52.24% in the non-injury group (p = 0.037). Similarly, intraoperative technical difficulty was strongly associated with pancreatic injury, being reported in 77.78% of cases with injury compared to only 31.34% in cases without injury (p = 0.011). These findings suggest that larger splenic size and technical difficulty during surgery are significant predictors of pancreatic trauma.

Postoperative complications are detailed in Table 5. The most common complications included prolonged drain output (7.89%) and pancreatic fistula (5.26%). Both were significantly associated with the occurrence of pancreatic injury, with p-values of 0.021 and 0.002, respectively. Other complications included surgical site infection (3.95%) and pleural effusion (2.63%), although these did not demonstrate significant correlation with pancreatic injury. Overall, the majority of patients (80.26%) had an uneventful postoperative course without complications.

Table 1: Demographic Characteristics of Patients (n = 76)

Variable	Frequency (n)	Percentage (%)
Age ≤ 10 years	29	38.16
Age > 10 years	47	61.84
Male	42	55.26
Female	34	44.74
Mean age (years)	11.2 ± 3.4	—

Table 2: Indications for Laparoscopic Splenectomy

Indication	Frequency (n)	Percentage (%)
Thalassemia	41	53.95
Idiopathic thrombocytopenic purpura (ITP)	21	27.63
Hereditary spherocytosis	14	18.42

Table 3: Intraoperative Findings and Outcomes

Variable	Frequency (n)	Percentage (%)
Splenic size < 15 cm	33	43.42
Splenic size ≥ 15 cm	43	56.58
Pancreatic injury present	9	11.84
No pancreatic injury	67	88.16
Mean operative time (minutes)	128.5 ± 24.6	—
Mean blood loss (ml)	185.7 ± 61.3	—

Table 4: Risk Factors Associated with Pancreatic Injury

Risk Factor	Pancreatic Injury (n=9)	No Injury (n=67)	p-value
Age > 10 years	7 (77.78%)	40 (59.70%)	0.312
Male gender	6 (66.67%)	36 (53.73%)	0.490
Splenic size ≥ 15 cm	8 (88.89%)	35 (52.24%)	0.037*
Technical difficulty yes	7 (77.78%)	21 (31.34%)	0.011*

*Statistically significant (p < 0.05)

Table 5: Postoperative Complications

Complication	Frequency (n)	Percentage (%)	p-value (Injury vs No Injury)
Pancreatic fistula	4	5.26	0.002*
Prolonged drain output	6	7.89	0.021*
Surgical site infection	3	3.95	0.650
Pleural effusion	2	2.63	0.743
No complication	61	80.26	—

*Statistically significant (p < 0.05)

DISCUSSION

Our pediatric cohort demonstrated a pancreatic injury (PI) rate of 11.84% (9/76), with pancreatic fistula in 5.26% (4/76) and significantly higher rates of prolonged drain output among injured patients. These findings sit within the broad range reported for splenectomy-related pancreatic complications in the laparoscopic era. In a classic series analyzing biochemical and clinical evidence of pancreatic insult after splenectomy, Chand et al. (2001) described 16.00% biochemical evidence of pancreatic injury and 9.50% clinically significant pancreatic complications, underscoring that PI is a recognized hazard of hilar dissection and short-gastric division during splenectomy, even in expert hands.[8]

The mean age in our cohort was 11.20 ± 3.40 years, with a slight male predominance (55.26%). This age profile mirrors large pediatric series from high-volume centers. For example, Patkowski et al. (2007) reported 63 children (mean age 11.30 years) undergoing laparoscopic splenectomy (LS), with low conversion and complication rates, reinforcing that our demographic distribution is typical for pediatric LS populations.[9]

Regarding indications, thalassemia led (53.95%), followed by ITP (27.63%) and hereditary spherocytosis (18.42%). By contrast, indication patterns in many Western pediatric series skew toward ITP/HS. Qureshi et al. (2005), in 81 LS vs 59 open pediatric cases, observed a higher prevalence of HS in the LS group, while still confirming LS safety with similar blood loss and complications compared with open surgery. Our thalassemia-heavy case-mix likely reflects regional hematologic epidemiology rather than selection bias.[10]

Our mean operative time was 128.50 ± 24.60 minutes, which compares favorably with learning-curve data in pediatrics. Cusick et al. (2001) documented operative times falling from 196 minutes (first 10 cases) to 105 minutes (last 10 cases) as experience accrued, alongside minimal complications and conversion (1 case). This aligns with our times and low intraoperative morbidity and supports the impact of standardization and experience on efficiency and outcomes.[11]

Intraoperative blood loss in our series averaged 185.70 ± 61.30 mL, consistent with evidence that LS reduces bleeding relative to open splenectomy. A meta-analysis by Feng et al. (2016) (10 studies; 508 LS vs 414 open) demonstrated significantly less blood loss and shorter hospital stay with LS, despite longer operative time. Our bleeding profile fits within these LS-favored perioperative trends, further supporting the minimally invasive approach for benign pediatric indications.[12]

Critically, splenic size ≥ 15 cm was a significant predictor of pancreatic injury in our cohort (88.89% of PI cases vs 52.24% without PI; $p = 0.037$). This dovetails with historical evidence linking massive splenomegaly to technical difficulty and complications. Targarona et al. (1999) showed that larger spleens adversely affect LS outcomes compared with normal-sized spleens, emphasizing that bulk hinders hilum work and safe mobilization—mechanisms plausibly increasing pancreatic traction and thermal or clip-related injury during hilar control.[13]

"Technical difficulty" recorded intraoperatively (subjectively by operating teams) also tracked with PI in our data (77.78% with PI vs 31.34% without; $p = 0.011$). Multicenter pediatric experience has long highlighted that difficult exposure, bleeding, anatomic variants, and device-handling issues cluster with conversions and adverse events. In a 159-patient multicenter study, Murawski et al. (2008) reported conversions due to severe bleeding/anatomic or technical problems and overall low but non-zero postoperative complication rates—echoing our signal that technical complexity is a clinically meaningful risk marker.[14]

Postoperatively, overall complications occurred in 19.74% (15/76) in our series (drain-related issues 7.89%, PF 5.26%, SSI 3.95%, pleural effusion 2.63%). While case-mix and definitions vary, our rates are compatible with broader literature showing lower morbidity for LS versus open. The seminal meta-analysis by Winslow et al. (2003) concluded that LS confers reduced perioperative morbidity relative to open splenectomy, despite longer operative times. Our complication profile—concentrated in drain-related events and PF among PI cases—aligns with LS patterns where major cardiopulmonary or wound complications are less prominent than in open cohorts.[15]

Diagnosis-specific comparisons also support our findings. Among ITP, our data showed it as the second most common indication (27.63%) with an overall safe postoperative course. Mantadakis et al. (2000) reported durable hematologic responses and very low surgical complication rates after pediatric splenectomy for chronic/refractory ITP, including in the subset managed laparoscopically. This literature supports our impression that, when PI is avoided, LS for ITP yields excellent outcomes with minimal morbidity.[16]

Finally, our standardized four-port technique, systematic hilar control, and routine tail-of-pancreas inspection parallel recommendations emerging from cooperative pediatric surveys. The Italian multicentric survey (Mattioli et al., 2007) emphasized standardized patient positioning, selective vessel control (early artery ligation), and careful extraction strategy, reporting intraoperative complications ~19%, conversions 6%, and postoperative complications ~2% across 85 patients. Our protocolized approach—especially in children with spleen ≥ 15 cm—is aligned with these best-practice tenets and likely contributed to the predominantly uneventful postoperative course in 80.26% of our patients.[17]

CONCLUSION

Pancreatic injury remains an important though infrequent complication of elective laparoscopic splenectomy in children. In this study, splenic size ≥15 cm and intraoperative technical difficulty were identified as significant risk factors. Pancreatic injury was strongly associated with postoperative morbidity, particularly fistula formation and prolonged drain output. Careful preoperative planning, meticulous hilar dissection, and heightened vigilance in patients with massive splenomegaly can help minimize the risk and improve surgical outcomes.

REFERENCES

1. Tulman S, Holcomb GW III, Karamanoukian HL, Reynhout J. Pediatric laparoscopic splenectomy. J Pediatr Surg. 1993; 28(5): 689-92.

2. Yoshida K, Kawashima Y, Inomata M, Kitano S, Yoshino J. Laparoscopic splenectomy in children: preliminary results and comparison with open splenectomy. Surg Endosc. 1995; 9(12): 1273-76.

3. Rescorla FJ. Laparoscopic splenectomy. Semin Pediatr Surg. 1998;7(4):207-12.

4. Neumann CH, Hessel SJ. CT of the pancreatic tail. AJR Am J Roentgenol. 1980;135(4):741-45.

5. Saber AA, Helbling B, Khaghany K, Nirmit G, Pimentel R, McLeod MK. Safety zone for splenic hilar control during splenectomy: CT mapping of the tail of the pancreas. Am Surg. 2007;73(9):890-94.
6. Luoto TT, Pakarinen MP, Koivusalo A. Long-term outcomes after pediatric splenectomy. Surgery. 2016;159(6):1583-90.
7. Guizzetti L. Total versus partial splenectomy in pediatric hereditary spherocytosis: a systematic review and meta-analysis. Pediatr Blood Cancer. 2016;63(10):1713-22.
8. Chand B, Walsh RM, Whelan RL, Romano JC, Mudge M, Rosenblatt S, et al. Pancreatic complications following laparoscopic splenectomy. Arch Surg. 2001;136(11):1341-6.
9. Patkowski D, Chrzan R, Wróbel G, Sokół A, Dobaczewski G, Apoznański W, et al. Laparoscopic splenectomy in children: experience in a single institution. J Laparoendosc Adv Surg Tech A. 2007;17(2):230-4.
10. Qureshi FG, Ergun O, Sandulache VC, Nadler EP, Ford HR, Hackam DJ, et al. Laparoscopic splenectomy in children. JSLS. 2005;9(4):389-92.
11. Cusick RA, Waldhausen JH. The learning curve associated with pediatric laparoscopic splenectomy. Am J Surg. 2001;181(5):393-7.
12. Feng S, Qiu Y, Li X, Yang H, Wang C, Yang J, et al. Laparoscopic versus open splenectomy in children: a systematic review and meta-analysis. Pediatr Surg Int. 2016;32(3):253-9.
13. Targarona EM, Espert JJ, Cerdán G, Balagué C, Piulachs J, Sugrañes G, et al. Effect of spleen size on splenectomy outcome: a comparison of open and laparoscopic surgery. Surg Endosc. 1999;13(6):559-62
14. Murawski M, Patkowski D, Korlacki W, Czauderna P, Sroka M, Makarewicz W, et al. Laparoscopic splenectomy in children—a multicenter experience. J Pediatr Surg. 2008;43(5):951-4.
15. Winslow ER, Brunt LM. Perioperative outcomes of laparoscopic versus open splenectomy: a meta-analysis with an emphasis on complications. Surgery. 2003;134(4):647-53.
16. Mantadakis E, Buchanan GR. Elective splenectomy in children with idiopathic thrombocytopenic purpura. J Pediatr Hematol Oncol. 2000;22(2):148-53.
17. Mattioli G, Pini Prato A, Cheli M, Esposito C, Garzi A, LiVoti G, et al. Italian multicentric survey on laparoscopic spleen surgery in the pediatric population. Surg Endosc. 2007;21(4):527-31.

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