

Impact of Spleen Size on Perioperative Outcomes After Laparoscopic Splenectomy: A Single-Center Retrospective Cohort Study

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Abstract

Background

Splenomegaly is a major technical challenge in laparoscopic splenectomy and may reflect underlying disease severity. However, the clinical impact of spleen size on perioperative and postoperative outcomes remains incompletely defined. We aimed to evaluate the effect of spleen size on perioperative outcomes and postoperative morbidity in patients undergoing laparoscopic splenectomy.

Methods

This retrospective cohort study included 63 consecutive patients who underwent laparoscopic splenectomy between March 2011 and December 2025. Incidental splenectomies were excluded. Patients were stratified according to a predefined spleen size cutoff of 150 mm (< 150 mm vs. ≥ 150 mm). Perioperative variables and postoperative complications graded by the Clavien–Dindo classification were compared. Multivariable logistic regression analysis was performed to identify independent predictors of postoperative morbidity.

Results

Patients with spleen size ≥ 150 mm had significantly higher postoperative morbidity compared with those with smaller spleens (70.4% vs. 36.1%, $p = 0.007$). In multivariable analysis, spleen size ≥ 150 mm was independently associated with postoperative morbidity (adjusted OR 4.46, 95% CI 1.45–13.7, $p = 0.009$), along with intraoperative blood loss (adjusted OR 1.007 per mL, 95% CI 1.000–1.014, $p = 0.040$). No in-hospital mortality occurred.

Conclusion

Spleen size ≥ 150 mm is an independent predictor of postoperative morbidity following laparoscopic splenectomy. Preoperative spleen size may serve as a simple and clinically useful risk stratification parameter for perioperative management and surgical planning.

Introduction

Laparoscopic splenectomy has become the preferred surgical approach for a wide range of benign and malignant splenic disorders due to reduced postoperative pain, shorter hospital stay, and faster recovery compared with open surgery (Kercher et al., 2002; Targarona et al., 1999; Winslow & Brunt, 2003). Nevertheless, operative complexity varies substantially depending on spleen size and underlying pathology. Splenomegaly is associated with distorted splenic vascular anatomy, increased splenic blood

flow, portal hypertension, and limited working space, which can complicate dissection and hemostasis (Kawanaka et al., 2009).

Previous studies have reported increased operative time, blood loss, and conversion rates in patients with massive splenomegaly, yet there is no consensus on clinically meaningful spleen size thresholds for predicting postoperative morbidity (Kercher et al., 2002; Targarona et al., 1999). While some authors emphasize volumetric assessment, linear measurements remain the most practical tool in the preoperative clinical setting. Therefore, this study aimed to evaluate the impact of spleen size on perioperative outcomes and postoperative morbidity in a homogeneous cohort of laparoscopic splenectomy patients, using a predefined spleen length cutoff of 150 mm based on prior surgical literature and our clinical observations.

Methods

Study design and population: This retrospective cohort study was conducted at a tertiary referral center and included 63 consecutive patients who underwent laparoscopic splenectomy between March 2011 and December 2025. Patients with incidental splenectomies (e.g., during gastrectomy or distal pancreatectomy) and cases with incomplete clinical or radiological data were excluded. The study was conducted in accordance with the Declaration of Helsinki and approved by the institutional ethics committee.

Data collection and variables: Patient demographics, preoperative hematological parameters, and surgical indications were retrieved from electronic medical records. Preoperative spleen size was determined from imaging reports (computed tomography or ultrasonography) and recorded as the maximal craniocaudal splenic length. Patients were categorized into two groups based on this length: <150 mm ($n = 36$) and ≥ 150 mm ($n = 27$).

Outcomes and definitions: Perioperative outcomes included operative time, intraoperative blood loss, number of trocars used, conversion to open surgery, and perioperative transfusion requirements. Postoperative complications were recorded within 30 days of surgery and graded according to the Clavien–Dindo classification (Dindo et al., 2004; Clavien et al., 2009). Overall morbidity was defined as the occurrence of any postoperative complication (grade I–V).

Statistical analysis: Continuous variables were expressed as median (interquartile range) and compared using the Mann–Whitney U test. Categorical variables were expressed as frequencies and percentages and compared using the chi-square or Fisher’s exact test. Multivariable logistic regression analysis was performed to identify independent predictors of postoperative morbidity. Variables with $p < 0.1$ in univariable analysis were included in the multivariable model. A two-sided p -value < 0.05 was considered statistically significant.

Results

The baseline clinical characteristics and operative data are summarized in Table 1. The groups were similar regarding age and sex. However, the distribution of indications for splenectomy differed significantly ($p<0.001$); patients in the ≥ 150 mm group had a higher prevalence of autoimmune hemolytic anemia (40.7% vs. 5.6%) and hematologic malignancies (22.2% vs. 2.8%). Regarding operative variables, the number of trocars used was significantly higher in the ≥ 150 mm group (median 4 vs. 3, $p=0.018$). Median operative time and blood loss were comparable between the two groups ($p>0.05$).

Postoperative outcomes and complications are presented in Table 2. Overall postoperative morbidity was significantly more frequent in patients with spleen size ≥ 150 mm (70.4% vs. 36.1%, $p=0.007$). Interestingly, despite the higher morbidity, the ≥ 150 mm group had a significantly shorter time to drain removal (median 2.0 vs. 3.0 days, $p=0.012$) and a shorter length of hospital stay (median 4.0 vs. 5.0 days, $p=0.008$). The increased morbidity was primarily driven by low-grade complications rather than severe events, suggesting that the clinical burden of these complications remained limited. In the multivariable logistic regression model (Table 3), spleen size ≥ 150 mm was identified as a strong independent predictor of overall morbidity (adjusted OR 4.46, 95% CI 1.45–13.7, $p=0.009$). Intraoperative blood loss was also independently associated with morbidity (adjusted OR 1.007 per mL, 95% CI 1.000–1.014, $p=0.040$).

Most complications were low-grade according to the Clavien–Dindo classification.

Table 1. Baseline clinical and operative characteristics according to spleen size

Variable	<150 mm (n=36)	≥150 mm (n=27)	p value
Indication for splenectomy, n (%)			<0.001
Immune thrombocytopenia	26 (72.2)	5 (18.5)	
Autoimmune hemolytic anemia	2 (5.6)	11 (40.7)	
Other benign diseases	7 (19.4)	5 (18.5)	
Hematologic malignancy	1 (2.8)	6 (22.2)	
Female sex, n (%)	22 (61.1)	15 (55.6)	0.80
Age, years, median (IQR)	43 (28–56)	42 (24–52)	0.509
Trocar number, median (IQR)	3 (3–4)	4 (3–4)	0.018
Blood loss (mL), median (IQR)	100 (80–125)	100 (90–150)	0.599
Operative time (min), median (IQR)	98 (60–120)	108 (60–120)	0.712
Specimen retrieval method, n (%)			0.012
Morcellation	25 (69.4)	8 (29.6)	
Intact removal	11 (30.6)	19 (70.4)	
Vascular control technique, n (%)			0.145
Hemoclips	16 (44.4)	17 (63.0)	
Stapler (Endo GIA)	20 (55.6)	10 (37.0)	

Footnote

Values are expressed as median (IQR) or n (%). Continuous variables were compared using the Mann–Whitney U test and categorical variables using the chi-square or Fisher’s exact test.

Table 2. Postoperative outcomes according to spleen size

Variable	<150 mm (n=36)	≥150 mm (n=27)	p value
Any postoperative morbidity, n (%)	13 (36.1)	19 (70.4)	0.007
Reoperation, n (%)	1 (2.8)	1 (3.7)	1.000
Postoperative bleeding, n (%)	3 (8.3)	5 (18.5)	0.272
Red blood cell transfusion, n (%)	3 (8.3)	5 (18.5)	0.272
Fresh frozen plasma transfusion, n (%)	3 (8.3)	3 (11.1)	1.000
Intra-abdominal abscess, n (%)	6 (16.7)	3 (11.1)	0.720
Pleural effusion, n (%)	1 (2.8)	4 (14.8)	0.155
Pancreatic fistula, n (%)	3 (8.3)	1 (3.7)	0.629
Thromboembolism, n (%)	2 (5.6)	1 (3.7)	1.000
Reactive thrombosis, n (%)	11 (30.6)	13 (48.1)	0.155
Mortality	0	0	—

Clavien–Dindo

Grade	<150 mm	≥150 mm	p
None	30 (83.3)	19 (70.4)	
Grade I–II	5 (13.9)	7 (25.9)	
Grade III–V	1 (2.8)	1 (3.7)	0.461

Recovery

Variable	<150 mm	≥150 mm	p
Time to drain removal, days	3.0 (3.0–4.0)	2.0 (2.0–3.0)	0.012
Length of hospital stay, days	5.0 (4.0–6.0)	4.0 (3.0–5.0)	0.008

Table 3. Multivariable logistic regression analysis of predictors of postoperative morbidity

Variable	Adjusted OR	95% CI	p value
Spleen size ≥150 mm	4.46	1.45–13.7	0.009
Blood loss (per mL)	1.007	1.000–1.014	0.040

Footnote:

Multivariable logistic regression analysis using backward stepwise selection. Variables with $p < 0.10$ in univariable analysis were included in the model.

Discussion

Splenomegaly has long been recognized as one of the most important factors influencing the technical difficulty of laparoscopic splenectomy. Compared with patients with normal spleen size, enlarged spleens may significantly reduce the operative working space, distort vascular anatomy, and increase intraoperative bleeding risk. Several previous studies have demonstrated that massive splenomegaly is associated with longer operative time, higher blood loss, and increased conversion rates during laparoscopic splenectomy (1–3). These technical challenges have historically led some surgeons to prefer open splenectomy in patients with large spleens, although advances in laparoscopic techniques have gradually expanded the indications for minimally invasive surgery (9,10).

The present study demonstrated that spleen size ≥ 150 mm was independently associated with postoperative morbidity, with a more than fourfold increase in risk compared with patients with smaller spleens. This finding is consistent with earlier reports suggesting that splenomegaly may negatively influence perioperative outcomes. For example, Kercher et al. reported that patients with massive splenomegaly experienced increased operative complexity and perioperative risk during laparoscopic splenectomy (1). Similarly, Targarona et al. showed that spleen size was an important determinant of operative difficulty and postoperative recovery (2). Large multicenter experiences have also confirmed that laparoscopic splenectomy can be safely performed in splenomegaly, although technical difficulty may increase with spleen size (11,13).

From a technical perspective, an enlarged spleen can make dissection of the splenic hilum more challenging due to increased vascularity and limited operative space. Surgeons may therefore need to modify their operative strategy, including additional trocar placement or alternative approaches to vascular control (4,8). In our cohort, patients with spleen size ≥ 150 mm required a significantly higher number of trocars, which supports the concept that larger spleens increase the technical complexity of laparoscopic procedures.

An interesting observation in the present study was that patients with larger spleens had a higher rate of postoperative morbidity but paradoxically experienced shorter hospital stays and earlier drain removal. This finding may be explained by the fact that most complications in the splenomegaly group were low-grade events according to the Clavien–Dindo classification. The Clavien–Dindo system is widely used to standardize the reporting of surgical complications and emphasizes that the severity of complications should be evaluated based on the treatment required rather than their mere occurrence (5,6). In our study, most complications consisted of reactive thrombocytosis, minor pleural effusions, or self-limited postoperative events that did not significantly prolong hospitalization.

Another important finding of our study was the identification of intraoperative blood loss as an independent predictor of postoperative morbidity. Although the effect size per milliliter appears small, it

reflects the cumulative impact of intraoperative bleeding on surgical outcomes. Previous studies have similarly emphasized the importance of meticulous hemostasis during laparoscopic splenectomy, particularly in patients with splenomegaly where splenic vascularity is increased (1,4,11). Careful control of the splenic hilum and standardized surgical techniques therefore remain essential to minimize perioperative complications.

The use of a spleen length threshold of 150 mm in the present study represents a pragmatic and clinically applicable approach to risk stratification. Although volumetric measurements may theoretically provide a more precise assessment of splenic enlargement, linear measurements remain the most widely available and easily reproducible parameter in routine clinical practice (2,9). Preoperative identification of patients with larger spleens may allow surgeons to anticipate technical challenges and adjust their operative planning accordingly.

It should also be noted that the distribution of underlying diseases differed between the two groups in our cohort. Patients with spleen size ≥ 150 mm had a higher prevalence of autoimmune hemolytic anemia and hematologic malignancies. These conditions may themselves influence perioperative outcomes due to disease-related hematologic abnormalities or increased thrombotic risk. Therefore, the unequal distribution of underlying hematologic diseases between groups may represent a potential confounding factor that should be considered when interpreting the results of this study.

Several limitations should be acknowledged. First, the retrospective design introduces potential selection bias. Second, the relatively small sample size limits the statistical power for detecting differences in less frequent complications. Third, spleen size was assessed using linear measurements rather than volumetric imaging analysis. Finally, as this was a single-center study, the generalizability of the findings may be limited. Nevertheless, our cohort represents a relatively homogeneous surgical population and reflects real-world clinical practice.

Despite these limitations, our findings suggest that preoperative spleen size is an important factor influencing postoperative outcomes after laparoscopic splenectomy. The identification of spleen size ≥ 150 mm as an independent predictor of postoperative morbidity highlights the importance of careful preoperative risk assessment and surgical planning. Incorporating this simple radiological parameter into routine evaluation may help surgeons identify higher-risk patients and optimize perioperative management strategies.

Declarations

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Availability of data and materials: The datasets generated and/or analyzed during the current study are available from the corresponding author on reasonable request.

Author contributions: HBP, MD, IAT, UK, and AKP contributed to the study conception and design. Data collection and analysis were performed by HBP. The first draft of the manuscript was written by HBP and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

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