

LAPAROSCOPIC SPLENECTOMY: OUTCOMES AND CONVERSION TRENDS FROM A 20-YEAR SINGLE-CENTER EXPERIENCE

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ABSTRACT

Background: Laparoscopic splenectomy has become the preferred approach for most elective splenic indications; however, conversion to open surgery remains a relevant concern, particularly in complex cases. Long-term institutional experiences provide valuable insight into outcomes, learning curves, and evolving indications.

Methods: A retrospective observational study was conducted at a tertiary referral center, including all consecutive patients who underwent laparoscopic splenectomy over a 20-year period. Demographic data, surgical indications, conversion to open surgery, and postoperative hospital stay were analyzed using descriptive statistics.

Results: A total of 125 patients underwent laparoscopic splenectomy during the study period. Hematologic diseases represented the predominant indication, while trauma, malignant conditions, infectious and parasitic diseases, and accessory spleen removal accounted for a smaller proportion of cases. Conversion to open surgery was required in 13 patients (10.4%). A temporal analysis demonstrated a reduction in conversion rates from the first decade to the second decade of the study, reflecting improved outcomes with increasing institutional experience. Postoperative recovery was generally favorable, with a short postoperative length of hospital stay.

Conclusion: Laparoscopic splenectomy is a safe and effective procedure for a broad range of splenic pathologies, most commonly hematologic disorders. Over a 20-year experience, acceptable conversion rates and favorable postoperative outcomes were achieved, with evidence of improvement over time. Careful patient selection, standardized surgical technique, and accumulated surgical experience remain key determinants of optimal outcomes.

Keywords: Conversion to open surgery, hematologic diseases, laparoscopic splenectomy, learning curve, minimally invasive surgery, splenectomy

INTRODUCTION

Laparoscopic splenectomy is a technically demanding procedure in which intraoperative challenges may necessitate conversion to an open approach. Identification of factors associated with conversion remains essential for appropriate patient selection, operative planning, and risk stratification.

Previous analyses have demonstrated that anatomical complexity, splenic size, and uncontrolled intraoperative bleeding are among the most significant determinants influencing the likelihood of conversion and overall surgical outcomes [1].

Multiple studies have established that laparoscopic splenectomy offers substantial advantages over open surgery, including reduced postoperative morbidity, shorter hospital stay, and faster recovery, while maintaining comparable therapeutic efficacy. Systematic evaluations comparing open and laparoscopic splenectomy have consistently confirmed the safety and effectiveness of the minimally invasive approach across a broad range of splenic indications [2].

Elective splenectomy is most frequently performed for hematologic disorders; however, advances in medical therapy have contributed to a gradual decline in its indication over time. Contemporary analyses have characterized elective splenectomy for hematologic disease as a diminishing but still relevant intervention, emphasizing the importance of careful patient selection and long-term outcome assessment [3].

Beyond elective settings, laparoscopic splenectomy has also been successfully applied in selected trauma patients. Reports focusing on hemodynamically stable individuals with blunt splenic injury have demonstrated that minimally invasive splenectomy can be safely performed in carefully selected emergency scenarios, expanding the scope of laparoscopic splenic surgery [4].

Early large clinical series were instrumental in establishing laparoscopic splenectomy as a standard surgical technique. Outcomes from foundational experiences demonstrated high efficacy and acceptable complication rates, providing the basis for widespread adoption of the laparoscopic approach and subsequent technical refinement [5].

The present study aims to analyze a 20-year single-center experience with laparoscopic splenectomy, focusing on surgical indications, gender distribution, conversion rates, and length of hospitalization, while reflecting the evolution of surgical practice and accumulated institutional experience over time.

MATERIALS AND METHODS

This study was designed as a retrospective observational analysis conducted at a tertiary referral center. All consecutive patients who underwent laparoscopic splenectomy over a 20-year period were identified and included in the study.

A total of 125 patients were analyzed. Demographic characteristics, indications for surgery,

intraoperative details, requirement for conversion to open splenectomy, and postoperative length of hospital stay were retrospectively extracted from medical records and operative reports.

Laparoscopic splenectomy was performed for a variety of indications, most commonly hematologic diseases. Additional indications included splenic trauma, malignant conditions, hydatid disease of the spleen, splenic abscesses, removal of accessory spleens following prior splenectomy, and other less frequent causes.

All procedures were carried out using a standardized laparoscopic technique. Patients were positioned either in the supine position with a slight right-sided tilt or in the right lateral decubitus position with elevation of the left side, according to surgeon preference and the need for optimal exposure of the splenic hilum. Three or four trocars were routinely used. Splenic mobilization was achieved through sequential dissection of the splenic ligaments, followed by secure control of the splenic hilum using clips or a vascular stapling device. The spleen was retrieved using an endoscopic specimen extraction bag.

The primary outcomes of interest included conversion to open surgery, distribution of surgical indications, gender distribution, and postoperative length of hospital stay. Data analysis was performed using descriptive statistics. Continuous variables were expressed as mean values, whereas categorical variables were reported as absolute numbers and percentages. Statistical analysis and graphical visualization were performed using R statistical software (RStudio, R Foundation for Statistical Computing, Vienna, Austria).

The study was conducted in accordance with the Declaration of Helsinki. Ethical approval was obtained from the institutional ethics committee, and the requirement for informed consent was waived due to the retrospective nature of the study.

RESULTS

A total of 125 patients underwent laparoscopic splenectomy over the 20-year study period. The study population included patients operated on for a broad spectrum of splenic pathologies, with hematologic diseases representing the predominant indication. Additional indications comprised traumatic, malignant, infectious, and parasitic splenic conditions, as well as accessory

spleen removal. An overview of patient demographics, indications, and overall surgical outcomes is provided in Table 1.

The mean operative time for laparoscopic splenectomy was 142 minutes across the entire cohort.

Table 1. Demographic characteristics, indications, and surgical outcomes of patients undergoing laparoscopic splenectomy ($n = 125$)

Variable	Value
Study period	20 years
Total patients	125
Sex	
Female	64 (51.2%)
Male	61 (48.8%)
Indications for splenectomy	
Hematologic diseases	101 (80.8%)
Trauma	3 (2.4%)
Malignant conditions	3 (2.4%)
Hydatid cysts	6 (4.8%)
Splenic abscesses	2 (1.6%)
Accessory spleen	2 (1.6%)
Other	9 (7.2%)
Conversion to open surgery	13 (10.4%)
Conversion rate by period	
First 10 years ($n = 74$)	9 (12.1%)
Second 10 years ($n = 51$)	4 (7.8%)
Mean hospital stay (days)	4.3

All procedures were performed using a standardized laparoscopic approach with sequential mobilization of the spleen and vascular control of the splenic hilum. Key operative stages, including ligamentous dissection, splenic mobilization, and hilar control, are illustrated in Figure 1.

Accessory spleens were identified and excised laparoscopically in selected cases. Representative intraoperative images demonstrating identification and removal of accessory splenic tissue are shown in Figure 2.

Conversion to open splenectomy occurred in a subset of patients. Analysis by study period demonstrated a lower conversion rate during the later years of the study compared with the early period. The temporal trend in conversion rates over the 20-year experience is depicted in Figure 3.

Postoperative recovery following laparoscopic splenectomy was generally favorable. Length of hospital stay and perioperative outcomes for the entire cohort are summarized in Table 1.

DISCUSSION

In this 20-year single-center experience, laparoscopic splenectomy was performed predominantly for hematologic indications and was associated with favorable perioperative outcomes and an acceptable conversion rate. Less common indications, including trauma, malignant disease, and accessory spleen removal, were also encountered, reflecting the gradual expansion of minimally invasive splenic surgery into selected non-elective and complex clinical scenarios [2,3].

Uncommon splenic conditions and anatomical variations continue to pose diagnostic and technical challenges during splenectomy. Careful intraoperative assessment, meticulous dissection, and individualized operative strategies are essential to ensure procedural safety in such cases [6]. Although certain rare entities represent distinct clinical conditions, the fundamental principles of atraumatic splenic mobilization and secure pedicle control remain universally applicable to laparoscopic splenectomy.

Identification and removal of accessory splenic tissue represent a critical determinant of surgical success, particularly in patients undergoing splenectomy for immune thrombocytopenia and other hematologic disorders. Failure to detect accessory spleens may compromise long-term therapeutic outcomes. Laparoscopic exploration allows reliable identification and safe excision of accessory splenic tissue, even following prior splenectomy [7]. In the present series, accessory spleens were identified and removed in a limited number of patients, supporting the effectiveness of systematic intraoperative exploration.

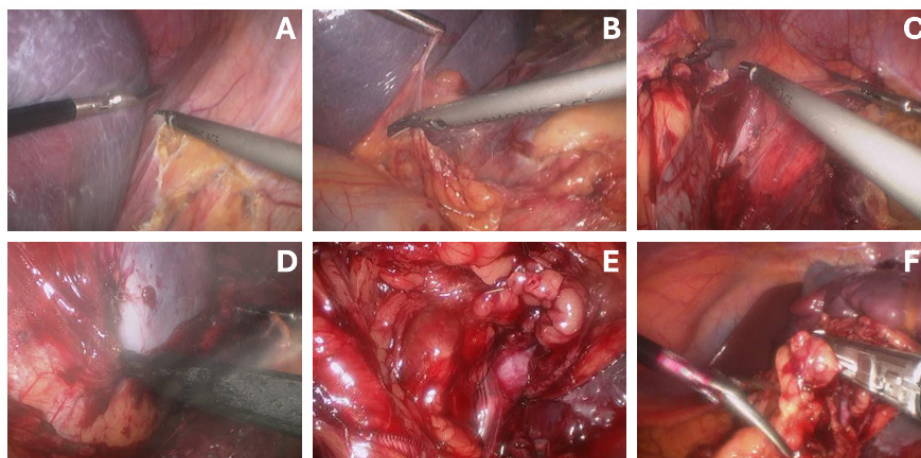


Figure 1. Composite laparoscopic images demonstrating representative operative stages of laparoscopic splenectomy.

(A) Initial exposure of the spleen and dissection of the splenophrenic ligament. (B) Dissection of the splenocolic ligament allowing inferior mobilization of the spleen. (C) Progressive mobilization of splenic attachments along the lateral abdominal wall. (D) Dissection of the gastrosplenic and splenorenal ligaments facilitating medial rotation of the spleen. (E) Advanced mobilization of the spleen with exposure of the splenic hilum. (F) Vascular control of the splenic hilum using a laparoscopic vascular stapling device.

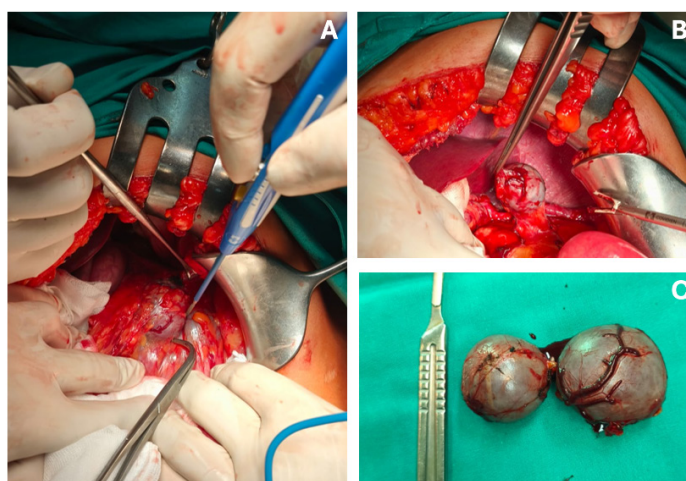


Figure 2. Composite images illustrating laparoscopic identification and removal of an accessory spleen. (A) Intraoperative identification of an accessory spleen during laparoscopic exploration. (B) Dissection and mobilization of the accessory spleen prior to excision. (C) Resected accessory spleen specimens following laparoscopic removal.

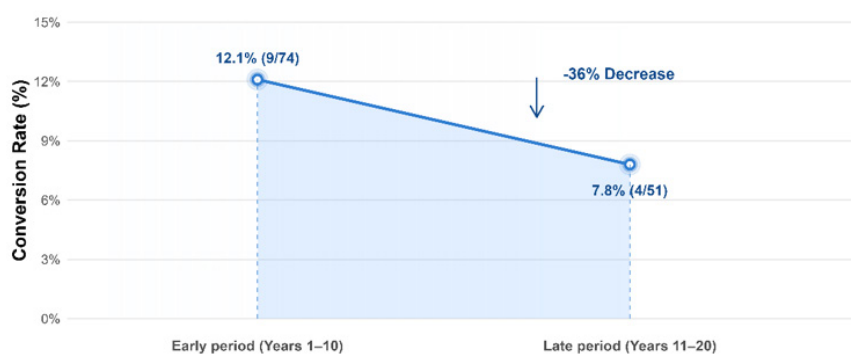


Figure 3. Temporal trend in conversion rates during laparoscopic splenectomy

Several reviews and comparative analyses have established laparoscopic splenectomy as the preferred approach for most elective splenic indications when performed by experienced surgical teams. Advantages over open surgery include reduced postoperative morbidity, shorter hospitalization, and faster functional recovery, without compromising efficacy [2, 8]. The mean hospital stay observed in the present study is consistent with values reported in contemporary series.

Recent institutional experiences from diverse healthcare settings have further confirmed the safety, reproducibility, and generalizability of laparoscopic splenectomy when standardized techniques are applied [9]. Despite variations in case volume, indication profiles, and resource availability, outcomes reported across centers remain broadly comparable.

The role of splenectomy in immune thrombocytopenia has evolved alongside advances in

pharmacologic therapy; however, it continues to represent an important definitive option in selected refractory cases [10]. In the present study, hematologic disorders remained the dominant indication for splenectomy.

Although perioperative anesthetic management was not specifically analyzed, advances in perioperative care have contributed substantially to the overall safety of laparoscopic procedures. Optimized perioperative strategies, particularly in technically demanding or resource-limited settings, have been shown to enhance procedural safety and improve outcomes [11].

Splenectomy also retains clinical relevance in selected malignant hematologic conditions, where it may provide both diagnostic and therapeutic benefit. Minimally invasive techniques allow effective splenic removal while minimizing surgical trauma, even in complex oncologic settings [12]. Splenectomy therefore remains a

Table 2. *Comparative outcomes of major laparoscopic splenectomy*

Study	Study design / period	No. of patients	Mean operative time (min)	Mean hospital stay (days)	Conversion rate (%)	Notes
Our study	Retrospective, single-center; 20-year experience	125	142	4.3	10.4	Mixed indications (hematologic, trauma, others)
Pattenden et al. [20]	Retrospective, single surgeon, single center; 1994–2006	140	100	3.0	2.1	Includes large splenomegaly subgroup
Fu et al. [21]	Retrospective cohort, single center; Nov 2002–Dec 2018	486	149.4	6.7	1.9	Largest elective LS series
Aly et al. [22]	Retrospective, single center; Oct 2011–Mar 2019	25	150	3.0	12.0	Early institutional experience
Park et al. [17]	Prospective observational study; Nov 1993–Mar 2000	203	145.5	2.7	3.0	Learning-curve effect; outcomes improved over time

Notes: Conversion rate refers to conversion from laparoscopic to open splenectomy. Differences between studies may reflect variation in case mix, indication spectrum, surgeon experience, and institutional volume. Mean operative time refers to skin-to-skin operative duration where reported.

Abbreviations: LS, laparoscopic splenectomy

valid therapeutic option in appropriately selected hematologic malignancies [13].

Early clinical experiences were instrumental in establishing the feasibility and safety of laparoscopic splenectomy in both adult and pediatric populations [14]. Subsequent long-term follow-up studies have confirmed the durability of splenectomy outcomes, particularly in pediatric patients with chronic hematologic disease [15]. When compared with major published laparoscopic splenectomy series, the outcomes observed in the present study fall within the reported range (Table 2).

Technical refinements, increasing surgical experience, and institutional learning curves have played a central role in improving outcomes over time. Accumulated evidence demonstrates that higher procedural volumes and standardized operative strategies are associated with reduced complication and conversion rates [16–18]. The conversion rate observed in the present study likely reflects the extended study period, inclusion of early learning-curve cases, heterogeneous indications, and the inclusion of technically demanding cases such as trauma and parasitic disease.

Postoperative management remains an important consideration following laparoscopic splenectomy. The routine use of surgical drains remains controversial, and evidence suggests that selective rather than routine drainage is appropriate after uncomplicated procedures [19].

Several limitations should be acknowledged. The retrospective design and single-center nature of this study may limit the generalizability of the findings. In addition, the absence of a contemporaneous open splenectomy control group precludes direct comparative analysis. Nevertheless, the extended study period and inclusion of a broad spectrum of indications provide a comprehensive overview of real-world laparoscopic splenectomy practice. Despite these limitations, the present experience supports laparoscopic splenectomy as a safe and effective approach for a wide range of indications when performed by experienced teams using standardized techniques.

CONCLUSION

Laparoscopic splenectomy is a safe and effective approach for splenic diseases, most commonly hematologic disorders. In our 20-year experience, the procedure demonstrated acceptable conversion rates and short hospital stay, with improved outcomes over time reflecting surgical experience. Careful patient selection, standardized technique, and identification of accessory spleens are essential for optimal results.

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Резиме

ЛАПАРОСКОПСКА СПЛЕНЕКТОМИЈА: РЕЗУЛТАТИ И ТРЕНДОВИ НА КОНВЕРЗИЈА ОД 20-ГОДИШНО ИСКУСТВО ВО ЕДЕН ЦЕНТАР

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Вовед: Лапароскопската спленектомија стана претпочитан хируршки пристап за повеќето елективни индикации за слезината; сепак, конверзијата во отворена хирургија останува релевантна загриженост, особено кај комплексните случаи. Долгорочните институционални искуства обезбедуваат значаен увид во исходите, во кривата на учење и во еволуцијата на хируршките индикации.

Методи: Спроведена е ретроспективна опсервациска студија во терцијарен референтен центар, во која беа вклучени сите последователни пациенти подложени на лапароскопска спленектомија во период од 20 години. Анализирани беа демографските податоци, хируршките индикации, конверзијата во отворена спленектомија и постоперативната должина на хоспитализацијата, користејќи дескриптивна статистика.

Резултати: Вкупно 125 пациенти беа подложени на лапароскопска спленектомија во текот на студискиот период. Хематолошките заболувања претставуваа доминантна индикација, додека трауматските, малигните, инфективните и паразитарните заболувања на слезината, како и отстранувањето на акцесорна слезина, беа застапени во помал процент. Конверзија во отворена хирургија беше потребна кај 13 пациенти (10,4 %). Временската анализа покажа намалување на стапката на конверзија од првата кон втората деценија од студијата, што укажува на подобрување на исходите со зголемување на институционалното искуство. Постоперативното закрепнување беше генерално поволно, со кратка постоперативна должина на болничкиот престој.

Заклучок: Лапароскопската спленектомија е безбедна и ефикасна процедура за широк спектар заболувања на слезината, најчесто хематолошки нарушувања. Во рамките на 20-годишното искуство беа постигнати прифатливи стапки на конверзија и поволни постоперативни исходи, со јасни индикации за подобрување со текот на времето. Внимателната селекција на пациенти, стандардизираната хируршка техника и акумулираното хируршко искуство остануваат клучни фактори за оптимални резултати.

Клучни зборови: конверзија во отворена хирургија, хематолошки заболувања, лапароскопска спленектомија, крива на учење, минимално инвазивна хирургија, спленектомија