BMC Surgery

RESEARCH Open Access

Postoperative outcomes after splenectomy: a 20-year single-center experience in Colombia

Carlos Eduardo Rey Chaves[1*], Sebastián Díaz[2], David Gómez Garnica[2], Oscar Cardenas[3], Paula Noguera[3], Manuela Ortíz Marín[3], Vanessa Velandia[3], Danny Conde[4], María Camila Rojas Gómez[5] and María Gómez Zuleta[2]

Abstract

Background Splenectomy indications are well documented; however, several infectious complications and potentially life-threatening conditions could arise after splenectomy. We aim to describe a 20-year single-center experience of postoperative outcomes after splenectomy and perform a subgroup analysis according to approach and surgical setting with a 30-day, 90-day, and 1-year follow-up.

Study design A retrospective cohort study was conducted between 2003 and 2023. We included all patients aged 18 years and older who underwent splenectomy. A description of clinical and operative variables with infectious outcomes was performed. Subgroup analyses were performed between open or laparoscopic approach and surgical setting.

Results A total of 134 patients were included. Female patients constituted 52.99% ($n=71$) of cases, with a mean age of 51.01 ± 20.79 years. The most frequent surgical indication for splenectomy was trauma in 31.34% ($n=42$), and a laparoscopic approach was indicated in 41.79% ($n=56$). Overwhelming post-splenectomy syndrome (OPSI) was evidenced in 2.24% ($n=3$) of the population. Surgical characteristics such as operative time, intraoperative blood loss, and intensive care requirement and unit length of stay were higher in open and trauma patients.

Conclusion Our data describe the demographic, clinical and operative characteristics of patients undergoing splenectomy in Colombia, providing a solid basis for future research. The results obtained on overwhelming postsplenectomy syndrome (OPSI) and postoperative complications are comparable with those reported in the international literature, reinforcing the validity of our findings. Further prospective studies in this population are needed to optimize management strategies and improve clinical outcomes, particularly in higher risk subgroups.

Keywords Splenectomy, Postoperative outcomes, Trauma-related splenectomy, Hematological disorders, Overwhelming post-splenectomy infection, Surgical complications

*Correspondence:
Carlos Eduardo Rey Chaves
carlosrey991@gmail.com
[1]Estudiante de posgrado Cirugía General, Facultad de Medicina, Pontificia Universidad Javeriana, Carrera 6A #51A-48, Bogotá, D.C. 111711, Colombia
[2]Cirujano General, Facultad de Medicina, Pontificia Universidad Javeriana, Bogotá, Colombia
[3]Estudiante de pregrado, Facultad de Medicina, Pontificia Universidad Javeriana, Bogotá, Colombia
[4]Cirugía Hepatobiliar y pancreática, Hospital Universitario Mayor - Méderi, Bogotá, Colombia
[5]Médica General, Facultad de Medicina, Universidad el Rosario, Bogotá, Colombia

Background

Since Quitenbaum first deliberately removed a spleen in 1826, the spleen has been regarded as a non-essential organ for sustaining life. The spleen is part of the reticuloendothelial system and has hematological and immunological functions. It receives 25% of the total cardiac output and plays a fundamental role in the immediate immune response to antigens transported by the blood [1–3].

Given the essential functions of the spleen, the indications for splenectomy are currently limited and well-established: splenic trauma, abscess, aneurysms of the splenic artery, and malignant conditions, such as part of radical oncologic surgery, angioma, or primary tumor. Additionally, there are relative indications for specific hematological disorders: idiopathic thrombocytopenic purpura and autoimmune hemolytic anemia [4–9]. Since 1991, splenectomy has been performed either open or laparoscopic; nevertheless, over the years, the laparoscopic technique has become the preferred approach with acceptable morbidity and mortality rates [10, 11].

Due to its immunologic functions, spleen removal carries risks of postoperative infectious complications, with overwhelming postsplenectomy syndrome (OPSI) being the most feared, with a lifetime risk of 5% and a mortality rate ranging from 30 to 70% [12, 13]. The microorganisms most frequently associated with OPSI include S. pneumoniae, N. meningitidis, H. influenzae type b, and influenza, with a peak incidence between 90 days and one year after the procedure, decreasing over time [12–14]. Therefore, vaccination is currently standardized for these patients and described in multiple guidelines [14, 15]. Postoperative outcomes after splenectomy have been evaluated in North America, Asia and Europe; however, there is a gap in the literature with respect to the Latin American population, which presents substantial differences in terms of nutrition, socioeconomic and access to health care, including Colombia. Therefore, our objective is to describe the experience of a Colombian center over 20 years in terms of postoperative outcomes after splenectomy and to analyze the factors associated with infectious complications.

Methods

Study population

A retrospective cohort study was conducted with approval from the Institutional Review Board's approval, adhering to Health Insurance Portability and Accountability Act (HIPAA) guidelines for ethical compliance with the Helsinki Declaration and local legislation on research. The study included all patients over 18 years of age who underwent splenectomy between 2003 and 2023 at a single center. According to institutional protocol, all patients received antibiotic prophylaxis both during and after the procedure, along with postoperative anticoagulation with enoxaparin according to thrombotic risk scores. Missing data were addressed through imputation using the mean value. We include demographic and clinical characteristics such as gender, age, body mass index, and comorbidities: arterial hypertension, type 2 diabetes mellitus (T2DM), smoking habit, coronary arterial disease, and previous history of abdominal surgery. Preoperative laboratory analysis included white blood cell count, hemoglobin value, and platelet count. The surgical indications, approach (open vs. laparoscopic) and conversion rate were also evaluated. Intensive care unit requirements and length of stay were also described. Follow-up was defined as 30 days for assessing general postoperative morbidity and 90 days for evaluating OPSI and mortality.

A subgroup analysis was conducted to categorize the population into "Trauma-related" and "Hematological and spleen disorders" groups, given the inherent differences between these categories. Postoperative outcomes, including surgical and medical morbidity, were assessed at both 30 and 90 days of follow-up. Additionally, a separate analysis was performed to describe the patients based on surgical approach, either laparoscopic or open. Overwhelming post-splenectomy syndrome (OPSI) was evaluated using clinical signs of sepsis after splenectomy, blood cultures, and infectious disease specialist evaluations, with patients being monitored for at least one year.

Statistical analysis

Descriptive statistics were applied to all study parameters based on the nature of each variable. The distribution of the variables was evaluated according to the kurtosis/skewness test. Continuous variables were summarized as medians, standard deviations, or percentiles according to their nature and distribution. Categorical data were summarized as frequencies and proportions. A descriptive analysis was conducted for clinical and surgical variables, postoperative outcomes, and infectious complications. All analyses were performed using STATA 17 (licensed version).

Results

Demographic and clinical characteristics

A total of 134 patients were included in the study. Female patients represented 52.99% ($n=71$) of all patients. The mean age was 51.01±20.79 years old, and the mean body mass index (BMI) was 26.40±5.03 kg/m2. The most common comorbidity was arterial hypertension in 27.61% ($n=37$) of cases, and 26.87% ($n=36$) of the population had a smoking habit. The most frequent surgical indication for splenectomy was trauma in 31.34% ($n=42$), followed by idiopathic thrombocytopenic purpura in 21.64% ($n=29$) and splenic abscess in 8.96% ($n=12$). Preoperative laboratory analysis, when available, was

Table 1 Demographic and clinical characteristics

Variable	Result
Gender % (*n*)	
Female	52.99 (71)
Male	47.01 (63)
Age mean (SD)	51.01 (20.79)
BMI mean (SD)	26.40 (5.03)
Comorbidities % (n)	
Smoking habit	26.87 (36)
Type 2 Diabetes Mellitus	8.96 (12)
Arterial Hypertension	27.61 (37)
Coronary arterial disease	8.21 (11)
Previous abdominal surgery	42.11 (56)
Indications for surgery	
Trauma related	37.31 (50)
Hematological and Spleen disorders	62.69 (84)
Idiopathic thrombocytopenic purpura	21.64 (29)
Hereditary spherocytosis	1.49 (2)
Hypersplenism	8.96 (12)
Hodgkin Lymphoma	2.24 (3)
Hemolytic autoinmune anemia	7.46 (10)
Thrombocytopenic thrombotic purpura	5.22 (7)
Non-Hodgkin linfoma	5.22 (7)
Splenic cyst	1.49 (2)
Spontaneous rupture	4.48 (6)
Blunt trauma	31.34 (42)
Spleen abscess	8.96 (12)
Spleen hemangioma	0.75 (1)
Splenic artery aneurysm	0.75 (1)
Preoperative serum analysis	
White blood cell counts median (IQR)	9.700 (5.900; 23.500)
Platelet count median (IQR)	83.600 (87.000; 332.400)
Hemoglobin mean (SD)	11.81 (3.08)

Table 2 Causes of readmission in patients undergoing splenectomy: Open vs. Laparoscopic Approach

Variable	Number of patients	Open *n* = 78	Laparoscopic *n* = 56
Cause of Readmission % (*n*)			
Abdominal Collection	3	3.85% (3)	0% (0)
Surgical Site Infection	3	2.56% (2)	1.79% (1)
Intestinal Obstruction	1	1.28% (1)	0% (0)
Pleural Effusion	2	2.56% (2)	0% (0)
Hematological Disorders	4	2.56% (2)	3.57% (2)
Pancreatic Fistula	1	1.28% (1)	0% (0)
Deep Venous Thrombosis	1	0% (0)	1.79% (1)
Abdominal pain of non-surgical etiology	4	3.85% (3)	1.79% (1)
Total	**19**	17.95% (14)	10.71% (5)

retrieved. The median white blood cell count was 9.700 (IQR 5.900; 23.500), the mean hemoglobin value was 11.81 ± 3.08, and the median platelet count was 183.600 (IQR 87.000; 332.400). The characteristics of the sample are summarized in Table 1.

Surgical characteristics and postoperative outcomes

The laparoscopic approach was indicated in 41.79% ($n=56$) of the cases, with a conversion rate of 10.91% ($n=6$). The mean surgical time was 132.39 ± 53.77 min, and the median intraoperative blood loss was 700 ccs (IQR 200; 1300). Intensive care unit admission was required for 41.04% ($n=55$) of the patients, with a median ICU length of stay of 4 days (IQR 2;17). The median length of hospital stay was 9.5 days (IQR 4;38). Reintervention was required in 10.45% ($n=14$) of patients, while the readmission rate at 90 days of follow-up was 14.18% ($n=19$) (See Table 2 for causes of readmission). Mortality at 90 days was observed in 16.42% ($n=22$) of patients.

Postoperative morbidity was evaluated at 30 days of follow-up. Superficial surgical site infection occurred in 2.99% ($n=4$) of patients, while deep surgical site and organ space infections were noted in 2.24% ($n=3$) and 2.99% ($n=4$), respectively. Deep venous thrombosis was reported in 4.48% ($n=6$), and segmental pulmonary embolism was identified in 2.99% ($n=4$) of patients. Infectious complications included pneumonia in 6.72% ($n=9$) and urinary tract infections in 3.73% ($n=5$). Overwhelming post-splenectomy syndrome (OPSI) was observed in 2.24% ($n=3$) of patients.

In the three cases of OPSI, blood culture revealed different microorganisms: Streptococcus pneumonia in one case (hematologic and spleen disorders-laparoscopic), Proteus mirabilis the second case (trauma-open and Enterococcus faecalis in the third case (trauma open). The diagnosis of Streptococcus pneumoniae was made 7 days after splenectomy, while Proteus mirabilis and Enterococcus faecalis were diagnosed 33 days post-splenectomy. Mortality occurred in the case involving Streptococcus pneumoniae after 46 days of the splenectomy. The summarized data is displayed in Table 3.

Subgroup analysis

A subgroup analysis was performed. Indications were divided into two groups: trauma-related splenectomy (37.31% $n=50$) and splenectomy due to hematological and splenic disorders, including spleen abscess and cysts (62.69% $n=84$). Patients who underwent splenectomy due to trauma were older compared with the group of hematological and spleen disorders (mean 58.5 vs. mean 46.6 years old); in traumatic cases, male patients correspond to the majority of the population (64% $n=32$ vs. 36% $n=18$), and in the other group, female patients had a higher incidence of diagnosis in our population (63.09%

Table 3 Surgical and postoperative characteristics

Variable	Result
Surgical approach % (*n*)	
Open	58.21 (78)
Laparoscopic	41.79 (56)
Conversion rate	10.91(6)
Surgical time mean (SD) – Minutes-	132.39 (53.77)
Intraoperative blood loss median (IQR) – CC -	700 (200; 1300)
ICU Requirement	41.04 (55)
ICU length of stay – Days -	4 (2;17)
Overall length of stay – Days -	9.5 (4;38)
Postoperative outcomes % (*n*)	
Superficial surgical site infection	3.01 (4)
Deep surgical site infection	2.23 (3)
Organ space surgical site infection	2.99 (4)
Intra-abdominal collections	11.19 (15)
Deep venous thrombosis	4.48 (6)
Pulmonary embolism	2.99 (4)
Urinary tract infection	3.73 (5)
Pneumonia	6.72 (9)
OPSI	2.24 (3)
Reintervention rate	10.45 (14)
Readmission rate	14.18 (19)
Mortality	16.42 (22)

$n=53$ vs. 36.90% $n=31$). The median BMI was similar between groups (26 vs. 24 kg/m2). The laparoscopic approach was used most frequently in the hematological and splenic disorders group (58.33% $n=49$ vs. 14% $n=7$); nevertheless, conversion was higher in the trauma group (57.14% $n=4$ vs. 4.08% $n=2$). Surgical time was similar between the groups (median 120 vs. median 120 min); however, intraoperative blood loss was higher in the trauma group (mean 1371 vs. mean 697 cc). The ICU requirement was higher in the trauma group (64% $n=32$ vs. 27.38% $n=23$).

Regarding postoperative outcomes, the risk differences were minor, superficial, and deep surgical site infections were higher in the trauma group (6% $n=3$ vs. 1.19% $n=1$ and 4% $n=2$ vs. 1.19% $n=1$, respectively). Intra-abdominal collections were higher in the trauma group (12% $n=6$ vs. 10.71% $n=9$). In one patient, an abscess secondary to a pancreatic fistula was identified, requiring surgical reintervention for drainage of the affected cavity. No other complications related to the pancreatic fistula were identified. Deep venous thrombosis was observed in similar proportions between groups (4% $n=2$ vs. 4.76); nevertheless, pulmonary embolism was higher in the trauma group (6% $n=3$ vs. 1.19% $n=1$). Urinary tract infections were higher in the trauma group (6% $n=3$ vs. 2.3% $n=2$); pneumonia was similar between groups (6% $n=3$ vs. 7.14% $n=6$). Regarding OPSI incidence, patients who underwent splenectomy due to trauma had a higher rate of OPSI (4% $n=2$ vs. 1.19% $n=1$), as the reintervention rate was higher in the trauma group (4% $n=2$ vs. 1.19% $n=1$; see Table 4 for causes of reintervention), thus related with a higher mortality rate (28% $n=14$ vs. 9.52% $n=8$). The summarized data is displayed in Table 5.

Table 4 Causes of Reintervention in patients undergoing splenectomy: Open vs. Laparoscopic Approach

Variable	Number of patients	Open $n=78$	Laparoscopic $n=56$
Cause of Reintervention % (*n*)			
Hemodynamic Instability	1	1.28% (1)	0% (0)
Mesenteric Ischemia	2	2.56% (2)	0% (0)
Abdominal Collection	1	2.56% (2)	0% (0)
Hemoperitoneum	2	0% (0)	3.57% (2)
Evisceration	4	1.28% (1)	0% (0)
Other Causes	6	7.69 (6)	0% (0)
Total	**14**	17.95% (12)	3.57% (2)

As well, we performed a second subgroup analysis regarding the approach of the procedure.

Operative time was comparable between laparoscopic and open surgery (135.34 SD 56.83 vs. 127.92 SD 48.97 respectively), nevertheless blood loss was higher in the open group (1000 IQR 400;3000) compared with laparoscopic approach (300 IQR 100–1800). Patients who underwent the open approach required more frequent ICU stays, with a longer length of stay. Surgical site infection was more common in patients who underwent the open approach, regardless of the classification, as well as deep venous thrombosis and pulmonary embolism. (See Table 6). Mortality was most frequent in the open group compared with the laparoscopic approach. (20.51% vs. 10.71%). See Table 7 for detailed causes of mortality.

Discussion

Given the well-known function of the spleen and the lifetime risks after resection of the spleen, the indications for splenectomy are currently strict. Improving technical skills for splenectomy has reduced perioperative complications and mortality. However, the morbidity associated is around 41%, and this is mainly related to infectious complications [16, 17]. Patients without a spleen have a greater risk of death by approximately 200-fold from septicemia compared to those with a normally functioning spleen [16, 17]. OPSI is well known as the most feared complication after splenectomy. According to the literature, the prevalence of OPSI ranges between 0.23 and 0.42%, with a lifetime risk of 3–5% being the most frequent isolated microorganism Streptococcus pneumonia, accounting for at least 50–90% of the infections, reaching a mortality rate between 38 and 69% [16, 17]. Throughout the years, surgical teams have tried to implement multidisciplinary strategies like new protein conjugate vaccines, antibiotic prophylaxis, and increased vigilance to

Table 5 Subgroup analysis

Variable	Trauma related *N* = 50	Hematological and Spleen disorders *N* = 84
Gender % (*n*)		
Female	36 (18)	63.09 (53)
Male	64 (32)	36.90 (31)
Age mean (SD)	58.5 (22.23)	46.55 (18.64)
BMI median (IQR)	26 (23.1;33.7)	24(18.2;30.4)
Comorbidities % (n)		
Smoking habit	40 (21)	17.85 (15)
Type 2 Diabetes Mellitus	6 (3)	10.71 (9)
Arterial Hypertension	34 (17)	23.80 (20)
Coronary arterial disease	14 (7)	4.76 (4)
Previous abdominal surgery	36 (18)	45.23 (38)
Preoperative serum analysis		
White blood cell count median (IQR)	12.250 (6.205;24.330)	7.000(3.380;32.500;)
Platelet count median (IQR)	219.000 (93.000;360.000)	128.000 (21.000;622.800)
Hemoglobin mean (SD)	12.18 (2.79)	11.58 (3.24)
Surgical approach %(n)		
Open	86 (43)	41.66 (35)
Laparoscopic	14 (7)	58.33 (49)
Conversion rate	8 (4)	2.38 (2)
Surgical time median (SD)	120 (60;200)	120 (70;210)
Intraoperative blood loss mean (SD)	1371 (1175)	697 (899)
ICU Requirement	64 (32)	27.38 (23)
ICU length of stay median (IQR)	3 (2;20)	2 (1;14)
Overall length of stay	12 (4;48)	8(3;38)
Postoperative outcomes %(n)		
Superficial surgical site infection	6 (3)	1.19 (1)
Deep surgical site infection	4 (2)	1.19 (1)
Organ space surgical site infection	4 (2)	2.38 (2)
Intra-abdominal collections	12 (6)	10.71 (9)
Deep venous thrombosis	4 (2)	4.76 (4)
Pulmonary embolism	6 (3)	1.19 (1)
Urinary tract infection	6 (3)	2.38 (2)
Pneumonia	6 (3)	7.14 (6)
OPSI	4 (2)	1.19 (1)
Reintervention rate	20 (10)	4.76 (4)
Readmission rate	12 (6)	15.47 (13)
Mortality	28 (14)	9.52 (8)

reduce the risk of OPSI. However, their implementation is inconsistent and limited to encapsulated microorganisms; nevertheless, this flora is not the only one responsible for OPSI, and other bacteria should be investigated [16, 17]. The risk of developing OPSI is lifelong, but the highest incidence is described in the first two years post-splenectomy in a range between 1 and 7% [16, 17].

Table 6 Subgroup analysis – Approach

Variable	Open *n* = 78	Laparoscopic *n* = 56
Surgical indication % (*n*)		
Trauma related	55.12 (43)	12.5 (7)
Hematological and Spleen disorders	44.87 (35)	87.5 (49)
Surgical time mean (SD) – Minutes-	135.34 (56.83)	127.92 (48.97)
Intraoperative blood loss median (IQR) – CC -	1000 (400;3000)	300 (100;1800)
ICU Requirement	48.71 (38)	30.35 (17)
ICU length of stay – Days -	4.14 (7.02)	2.44 (6.04)
Overall length of stay – Days -	9.5 (4;35)	9 (3;28)
Superficial surgical site infection	5.12 (4)	0 (0)
Deep surgical site infection	2.56 (2)	1.78 (1)
Organ-site surgical site infection	2.56 (2)	3.57 (2)
Intra abdominal collections	12.82 (10)	8.92 (5)
Deep venous thrombosis	5.12 (4)	3.57 (2)
Pulmonary embolism	3.84 (3)	1.78 (1)
Urinary tract infection	3.84 (3)	3.57 (2)
Pneumonia	6.41 (5)	7.14 (4)
OPSI	2.56 (2)	1.78 (1)
Re - intervention	15.38 (12)	3.57 (2)
Re - admission	17.94 (14)	8.92 (5)
Mortality	20.51 (16)	10.71 (6)

Table 7 Causes of mortality in patients undergoing Open vs. laparoscopic surgery

Variable	Number of patients	Open *n* = 78	Laparoscopic *n* = 56
Cause of mortality % (*n*)			
Hypovolemic Shock	4	3.85% (3)	1.79% (1)
Septic Shock	4	8.97% (7)	3.57% (2)
Multiple Organ Failure	5	5.13% (4)	1.79% (1)
Myocardial Infarction	2	1.28% (1)	1.79% (1)
Other Complications	2	1.28% (1)	1.79% (1)
Total	**22**	20.51% (16)	10.71% (6)

In our cohort, 2.25% of patients developed OPSI, and the diagnosis was performed between days 7 and 33 of the splenectomy and the main microorganisms involved were Streptococcus pneumoniae, Proteus mirabilis, and Enterococcus faecalis. One of the OPSI cases died, consistent with the literature, which describes a fatality rate of 46% for OPSI (7). Other infectious complications in our cohort were superficial surgical site infection (2,99%), deep surgical site infection (2,44%), urinary tract infection (3.73%), and pneumonia (6.72%).

Despite the most feared complications being related to infection, there is a high risk of other non-infectious complications after splenectomy [16–18]. Vascular complications involve the venous and arterial sides of the circulation. The thromboembolic disease has been most frequently reported after splenectomy, and its mechanisms are believed to be the activation of thrombocytes and some grade of hypercoagulability [7]. The underlying

condition is highly related to the vascular complications associated with it; for example, patients suffering from hereditary spherocytosis (HS) are seven times more likely to suffer thrombotic events, according to Schilling et al. [3, 16–19]. The rates of DVT and PE were significant in our population (4.48% and 2.99%, respectively), and in line with the literature, we evidenced a higher proportion of DVT in the group of spleen or hematologic disorders compared with trauma; however, the mechanisms for these complications are complex and, in some cases, multifactorial [16–19].

There are apparent differences between trauma-related and nontraumatic indications. All grade IV-V splenic injuries should undergo splenectomy due to the high risk of failure of non-operative management, with or without splenic embolization [20]. Most of the time, trauma conditions lead to higher mortality and morbidity. In our series, splenectomy for trauma shows with higher intraoperative blood loss, ICU requirement, and complications, including all-grade postoperative surgical site infections and mortality; additionally, two of the OPSI cases were trauma patients. Our data indicates that trauma significantly contributes to most of the morbidity and mortality associated with splenectomy, which is consistent with findings reported in the existing literature [20, 21].

The use of laparoscopy (LS) for splenectomy is the gold standard, as it has been associated with reduced postoperative pain, shorter hospital stays, decreased intraoperative blood loss, and overall lower morbidity compared to open surgery (OS). Its impact on infection rates remains debated; however, there is theoretical evidence suggesting that laparoscopy attenuates immunosuppression [22]. In our cohort, the laparoscopic approach demonstrated shorter surgical times, less intraoperative blood loss, reduced ICU admissions and shorter length of stay. Furthermore, our data indicate lower rates of postoperative complications, including surgical site infections, DVT, PE and mortality, which can be attributed, in most cases, to the less compromised condition of the patients undergoing laparoscopic procedures. The application of LS in trauma cases is even more limited. Although literature on the use of LS in trauma is sparse, there are published reports demonstrating successful outcomes in trauma patients managed with laparoscopy. Its use should be limited to hemodynamically stable patients, those with failed initial non-surgical management or previous embolization, and other factors such as the surgeon's expertise and specific trauma conditions [2, 23].

Among the limitations of our study are its retrospective nature and the small sample size regarding the indications for splenectomy. However, our study includes a single-center long-term follow-up of patients who underwent splenectomy in Colombia.

Conclusion

Our study offers a descriptive analysis of patients who have undergone splenectomy in Colombia, taking into account the distinction of traumatic from non-traumatic indications and laparoscopic versus open approaches. Laparoscopy was more common in hematologic conditions, while open surgery predominated in trauma cases. The conversion rate from laparoscopy to open surgery was significantly higher in trauma cases (57.14% vs. 4.08%), highlighting the challenges of laparoscopic management in the trauma setting.

Postoperative outcomes were better with laparoscopy, requiring less ICU admission, reduced blood loss and fewer postoperative complications. Although limited by the retrospective design and small sample size, our findings illustrate the advantages of laparoscopy in terms of lower morbidity. However, its application in trauma cases remains limited due to the complexity of these patients. This study underscores the relevance of careful selection of the surgical approach in patients with splenic trauma, and highlights the need for prospective studies to develop effective strategies to improve clinical outcomes, reduce the conversion rate, and minimize postoperative complications.

Abbreviations

OPSI	Overwhelming post
HIPAA	Health Insurance Portability and Accountability Act
T2DM	Type 2 diabetes mellitus
BMI	Body Mass Index
ICU	Intensive care unit
OS	Open Surgery
LS	Laparoscopy
DVT	Deep Venous Thrombosis
PE	Pulmonary Embolism

Acknowledgements

To our patients.

Author contributions

C.E.R.C, S.D, And M.G. Z: Research idea, protocol creation, data analysis, manuscript writing, edition and final revision D.C, O.C, P.N, M.O.M, and V.V: Protocol creation, data recollection, manuscript drafting.

Funding

This research received no specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Data availability

The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Declarations

Ethics approval and consent to participate

Following approval of our Institutional Review Board and ethical committee, all procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. Informed consent was obtained from all individual participants included in the study.

Consent for publication
Does not apply.

Competing interests
The authors declare no competing interests.

Received: 1 May 2024 / Accepted: 15 October 2024
Published online: 16 November 2024

References

1. Bonnet S, Guedon A, Ribeil J-A, Suarez F, Tamburini J, Gaujoux S. Indications and outcome of splenectomy in hematologic disease. J Visc Surg. 2017;154(6):421–9.
2. Ciftciler R, Pasayeva A, Aksu S, Ozcebe O, Sayınalp N, Malkan UY, Buyukasık Y, Haznedaroglu IC. Indications and outcomes of Splenectomy for Hematological disorders. Open Med (Wars). 2019;14:491–6. https://doi.org/10.1515/med-2019-0054. PMID: 31259254; PMCID: PMC6592149.
3. Lewis SM, Williams A, Eisenbarth SC. Structure-function of the immune system in the spleen. Sci Immunol. 2019;4(33):eaan6085.
4. Weledji EP. Benefits and risks of splenectomy. Int J Surg. 2014;12(2):113-9. https://doi.org/10.1016/j.ijsu.2013.11.017. Epub 2013 Dec 3. PMID: 24316283.
5. Camejo L, Nandeesha N, Phan K, Chharath K, Tran T, Ciesla D, Velanovich V. Infectious outcomes after splenectomy for trauma, splenectomy for disease and splenectomy with distal pancreatectomy. Langenbecks Arch Surg. 2022;407(4):1685–91. https://doi.org/10.1007/s00423-022-02446-3. Epub 2022 Jan 24. PMID: 35075620; PMCID: PMC8786199.
6. Vercellati C, Zaninoni A, Marcello AP, Fermo E, Fattizzo B, Giannotta JA, Bianchi P, Zanella A, Barcellini W. Changing trends of splenectomy in hereditary spherocytosis: The experience of a reference Centre in the last 40 years. Br J Haematol. 2022;198(5):912–915. https://doi.org/10.1111/bjh.18106. Epub 2022 Mar 11. PMID: 35277856.
7. Lu Y, Li Y, Yang Y, Shi L, Ding W, Cai H, Duan Y, Chen X, Zhang Y, Nong K. Clinical effect of laparoscopic partial splenectomy for both benign tumours and trauma-10 years of experience at a single institution. ANZ J Surg. 2022;92(3):471–6. https://doi.org/10.1111/ans.17518. Epub 2022 Feb 10. PMID: 35146892.
8. Jesani H, Jesani L, Rangaraj A, Rasheed A. Splenic trauma, the way forward in reducing splenectomy: our 15-year experience. Ann R Coll Surg Engl. 2020;102(4):263–70. https://doi.org/10.1308/rcsann.2019.0164. Epub 2020 Jan 7. PMID: 31909638; PMCID: PMC7099152.
9. Katz SC, Pachter HL. Indications for splenectomy. Am Surg. 2006;72:565–80.
10. Carr JA, Shurafa M, Velanovich V. Surgical indications in idiopathic splenomegaly. Arch Surg. 2002;137:64–8.
11. Delaitre B, Maignien B. Splenectomy by the laparoscopic approach. Report of a case. Presse Med. 1991;20:2263.
12. Cheng J, Tao K, Yu P. Laparoscopic splenectomy is a better surgical approach for spleen-relevant disorders: a comprehensive meta-analysis based on 15-year literatures. Surg Endosc. 2016;30:1–4.
13. Sinwar PD. Overwhelming post-splenectomy infection syndrome—a review study. Int J Surg. 2014;12:1314–6.
14. Okabayashi T, Hanazaki K. Overwhelming postsplenectomy infection syndrome in adults—a clinically preventable disease. World J Gastroenterol. 2008;14:176–9.
15. Newland A, Provan D, Myint S. Preventing severe infection after splenectomy. BMJ., Di Sabatino A, Lenti MV, Tinozzi FP, Lanave M, Aquino I, Klersy C, Marone P, Marena C, Pietrabissa A, Corazza GR. Vaccination coverage and mortality after splenectomy: results from an Italian single-centre study. Intern Emerg Med. 2017;12(8):1139–1147. https://doi.org/10.1007/s11739-017-1730-9. Epub 2017 Aug 10. PMID: 28799083.
16. Rodeghiero F, Ruggeri M. Short- and long-term risks of splenectomy for benign haematological disorders: should we revisit the indications? Br J Haematol. 2012;158(1):16–29. https://doi.org/10.1111/j.1365-2141.2012.09146.x. Epub 2012 May 10. PMID: 22571181.
17. Browning MG, Bullen N, Nokes T, Tucker K, Coleman M. The evolving indications for splenectomy. Br J Haematol. 2017;177(2):321–4. https://doi.org/10.1111/bjh.14060. Epub 2016 Mar 28. PMID: 27018168.
18. Crary SE, Buchanan GR. Vascular complications after splenectomy for hematologic disorders. Blood. 2009;114(14):2861–8. https://doi.org/10.1182/blood-2009-04-210112. Epub 2009 Jul 27. PMID: 19636061; PMCID: PMC2756197.
19. Schilling RF, Gangnon RE, Traver MI. Delayed adverse vascular events after splenectomy in hereditary spherocytosis. J Thromb Haemost. 2008;6(8):1289–95. https://doi.org/10.1111/j.1538-7836.2008.03024.x. Epub 2008 May 15. PMID: 18485083.
20. Stockinger Z, Grabo D, Benov A, Tien H, Seery J, Humphries A. Blunt Abdominal Trauma, Splenectomy, and Post-Splenectomy Vaccination. Mil Med. 2018;183(suppl_2):98–100. https://doi.org/10.1093/milmed/usy095. PMID: 30189065.
21. Davis JW, Chung R, Juarez DT. Prevalence of comorbid conditions with aging among patients with diabetes and cardiovascular disease. Hawaii Med J. 2011;70:209–13.
22. Huang GS, Chance EA, Hileman BM, Emerick ES, Gianetti EA. Laparoscopic Splenectomy in Hemodynamically Stable Blunt Trauma. JSLS. 2017 Apr-Jun;21(2):e2017.00013. https://doi.org/10.4293/JSLS.2017.00013. PMID: 28584502; PMCID: PMC5444560.
23. Shamim AA, Zafar SN, Nizam W, Zeineddin A, Ortega G, Fullum TM, Tran DD. Laparoscopic Splenectomy for Trauma. JSLS. 2018 Oct-Dec;22(4):e2018.00050. https://doi.org/10.4293/JSLS.2018.00050. PMID: 30607102; PMCID: PMC6305065.

Publisher's note