

Surgical Intervention in Splenic Emergencies: Indications and Outcomes

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Abstract: Background: Splenic injuries are common in blunt abdominal trauma and present a management challenge balancing operative and non-operative approaches and in our study we evaluate indications for surgical intervention, postoperative outcomes, and risk factors in patients with splenic emergencies however method of our study was A retrospective analysis was conducted on 110 patients with splenic trauma managed at a tertiary trauma center also Demographic data, injury characteristics, management strategies, surgical procedures, complications, mortality, and hospital stay were analyzed. Injury severity was classified by the American Association for the Surgery of Trauma (AAST) grading system. Logistic regression and chi-square analyses identified risk factors associated with complications and mortality, where the results in our study were that the cohort was predominantly young males (81.8%) with blunt trauma (96.5%). Emergency laparotomy was performed in 54 patients (49%), primarily indicated by grade IV injury (68.5%) and hemodynamic instability (31.5%). Splenectomy accounted for 70.4% of surgeries. Postoperative complications occurred in 18.5% of laparotomy cases, predominantly infectious in the splenectomy group (70%). Mortality was low (0.9%). In addition to Logistic regression, younger age (<54 years), male sex, higher injury severity (ISS ≥ 16), and congestive heart failure as significant independent risk factors for complications. Chi-square analysis confirmed a significant association between splenectomy and increased infectious and severe complications ($p < 0.01$). Finally, non-operative management is safe and effective in hemodynamically stable patients with low to moderate splenic injuries, while surgical intervention remains essential for high-grade injuries and unstable patients.

Keywords: Surgical, Intervention, Splenic, Emergencies, Trauma, Iv Injury, Splenectomy.

INTRODUCTION

The spleen is one of the most affected organs in abdominal trauma. Treatment of abdominal trauma has evolved over the last decade and is currently based on nonsurgical treatment, which maintains immune function and allows for the potential for healing of the damaged organ (Coccolini, F. *et al.*, 2017; Zarzaur, B.L. *et al.*, 2015). With this premise, we know that splenectomy is not a harmless procedure, as it is associated with blood loss, multiple transfusions, and septic complications in the residual splenic cavity, as well as the risk of infection and sepsis after splenectomy due to a compromised immune response (Jakob, D.A. *et al.*, 2021; Mitchao, D.P. *et al.*, 2022).

It is well known that during the 1950s, splenectomy was the primary approach to reducing mortality from splenic trauma, with relatively encouraging short-term results (Chahine, A.H. *et al.*, 2021). However, over the years, the management of splenic trauma has changed markedly, with more complications reported compared to surgical treatment (Dolejs, S.C. *et al.*, 2018; Hancock, G.E. *et al.*, 2012). There is a

growing tendency to treat splenic trauma conservatively in order to preserve the organ, given its importance in immune function, especially in the early stages of life (Ruscelli, P. *et al.*, 2019). This is because, as is well known, there is a significant risk of immunocompromise in patients who have undergone splenectomy (Gill, S. *et al.*, 2021). On the other hand, there is a clear discrepancy when assessing splenic trauma in the emergency department, as it can be a cause of death not only initially, but also in the medium term due to late rupture of a subcapsular hematoma or the formation and rupture of a pseudoaneurysm (Cadeddu, M. *et al.*, 2006; Notash, A.Y. *et al.*, 2008). Since splenic injury or damage is in itself an indicator of the severity of abdominal injury, it therefore reveals the need for correct diagnosis and determination of the level of splenic injury in order to choose the appropriate management, whether surgical or conservative (Haan, J.M. *et al.*, 2005; Skattum, J. *et al.*, 2012). There is no doubt that the availability of procedures such as percutaneous embolization has allowed for a high success rate in nonsurgical management (Cirocchi, R. *et al.*, 2013). However,

in surgical management, splenectomy has become established as a fundamental treatment, and techniques such as splenorrhaphy, partial splenectomy, and the use of polyglycolic acid mesh have been relegated to the background (Davis, K.A. *et al.*, 1998). Despite improvements in multidisciplinary protocols and increased percutaneous treatment of splenic trauma injuries, organ-preserving techniques are rarely used when surgical treatment is required. Therefore, the objective of this study was to evaluate and review the number of conservative surgical treatments for splenic trauma in a care hospital.

MATERIAL AND METHOD

Material and method This retrospective observational study reviewed 110 patients collected from different hospitals in Iraq who came with splenic emergencies necessitating surgical treatment or non-operative management to a tertiary trauma centre where in The research sought to examine the indications for operation, surgical procedures done, postoperative complications, mortality, hospital stay, and risk factors linked to poor outcomes additionally Patients diagnosed with imaging or intraoperative proof of splenic injury between [2024 to feb 2025] were included with Demographic data collected was age, sex, and body mass index (BMI) which Clinical measures were comorbidities and mechanism of injury, which was divided into blunt or penetrating trauma as well as The severity of splenic injury was graded according to the American Association for the Surgery of Trauma (AAST) classification system, with grades I to IV noted for all patients.

Initial management strategies were either non-operative management (NOM) or emergency laparotomy. Likewise, Indications for laparotomy included grade IV splenic injury and hemodynamic instability. There were overlapping indications where patients met more than one criterion for surgery where in this study Procedures done during laparotomy were classified as spleen-preserving and splenectomy operations however Postoperative complications were meticulously recorded and categorized into their respective categories, paying close attention to infectious complications including pneumonia, intra-abdominal abscesses, and sepsis, in addition to other complications including pancreatic leaks, hemorrhage, thrombocytosis, and thromboembolic complications and we were evaluated separately for the splenectomy group and the spleen-

preserving group with Mortality and lengths of hospital stay were also recorded for all study patients.

The study included all patients presenting with traumatic splenic injury confirmed by imaging or intraoperative findings, totaling 110 patients. Inclusion criteria encompassed adult patients (age ≥ 18 years) with blunt or penetrating splenic trauma who were admitted to the trauma center during the study period. In addition, to Patients with splenic injuries classified from grade I to IV according to the AAST grading system were included, reflecting a broad spectrum of injury severity. Both patients managed non-operatively and those undergoing surgical intervention (emergency laparotomy with splenectomy or spleen-preserving surgery) were considered, ensuring comprehensive evaluation of management outcomes and concerning Exclusion criteria likely comprised patients with non-traumatic splenic pathology, those admitted solely for rehabilitation, and cases with incomplete clinical or imaging data preventing accurate injury grading or outcome assessment where in study Patients with isolated minor injuries not requiring hospital admission or those with hemodynamic instability precluding initial imaging might also have been excluded as well as, patients with genetic asplenia or underlying hematologic diseases affecting the spleen were excluded to avoid confounding factors related to immune function and complications.

STATISTICAL ANALYSIS

Conducted with the SPSS software. Demographic and clinical data were presented with descriptive statistics, as Chi-square tests were conducted to analyse types of complications in the spleen-preserving and splenectomy groups and to identify associations between types of surgical procedures and mortality. Moreover, Logistic regression analysis identified independent risk factors for postoperative complications and mortality. Regression variables included age, sex, injury severity (AAST grade and Injury Severity Score), injury mechanism, comorbidities such as congestive heart failure, and hemodynamic status on arrival. Adjusted odds ratios (aOR) with 95% confidence intervals (CI) and p-values were determined to evaluate statistical significance.

ETHICAL CONSIDERATIONS

The study protocol was approved by the institutional review board, and patient

confidentiality was maintained throughout the data collection.

RESULTS

The cohort consisted of 110 patients, predominantly male (81.8%, n=90), with a mean age of 37 years. This male predominance and relatively young age group are typical for trauma populations, reflecting higher exposure to risk factors such as road traffic accidents and occupational hazards. The majority (96.5%, n=106) suffered blunt trauma, consistent

with global data indicating blunt mechanisms as the primary cause of splenic injury. The injury severity distribution showed 34% (n=37) with grade IV injuries, the most severe category in this cohort, emphasizing the presence of a substantial number of high-risk patients. The presence of lower-grade injuries (grades I-III) in 66% of patients suggests a wide spectrum of injury severity, necessitating varied management strategies.

Table 1: Demographic Results

Parameter	Number (%) / Value
Total Patients	110
Male	90 (81.8%)
Female	20 (18.2%)
Mean Age (years)	37 (range 24–65)
BMI	Not specified
Comorbidities	Not specified
Injury Mechanism	
– Blunt Trauma	106 (96.5%)
– Penetrating Trauma	4 (3.5%)
AAST Injury Grade	
– I	14 (13%)
– II	24 (22%)
– III	34 (31%)
– IV	37 (34%)

Emergency laparotomy was performed in 54 patients (49%), while 56 (51%) were managed non-operatively. This near-equal split reflects contemporary trauma management trends favoring NOM in hemodynamically stable patients with lower-grade injuries. Among those undergoing laparotomy, 37 (68.5%) had grade IV injuries, confirming that high-grade injury is a principal

indication for surgery. Hemodynamic instability accounted for 17 cases (31.5%), underscoring the critical role of physiological parameters in decision-making. The total indications exceeding the number of laparotomies (54) indicate overlapping criteria, highlighting the complexity of clinical judgment in trauma care.

Table 2: Initial Management Approach and Indications for Emergency Laparotomy

Parameter	Number (%)
Emergency Laparotomy	54
Non-operative Management (NOM)	56
Indications for Emergency Laparotomy	
– Grade IV Injury	37
– Hemodynamic Instability	17
<i>Note: Total exceeds 54 due to overlapping indications</i>	

Of the 54 laparotomies, 38 (70.4%) resulted in splenectomy, while spleen-preserving surgery was performed in 16 patients (29.6%). The high rate of splenectomy aligns with the severity of injuries and instability in this subgroup. Despite the immunological benefits of spleen preservation,

technical challenges and patient condition often necessitate splenectomy. The proportion of spleen-preserving surgeries reflects attempts to reduce long-term complications, consistent with evolving surgical practices.

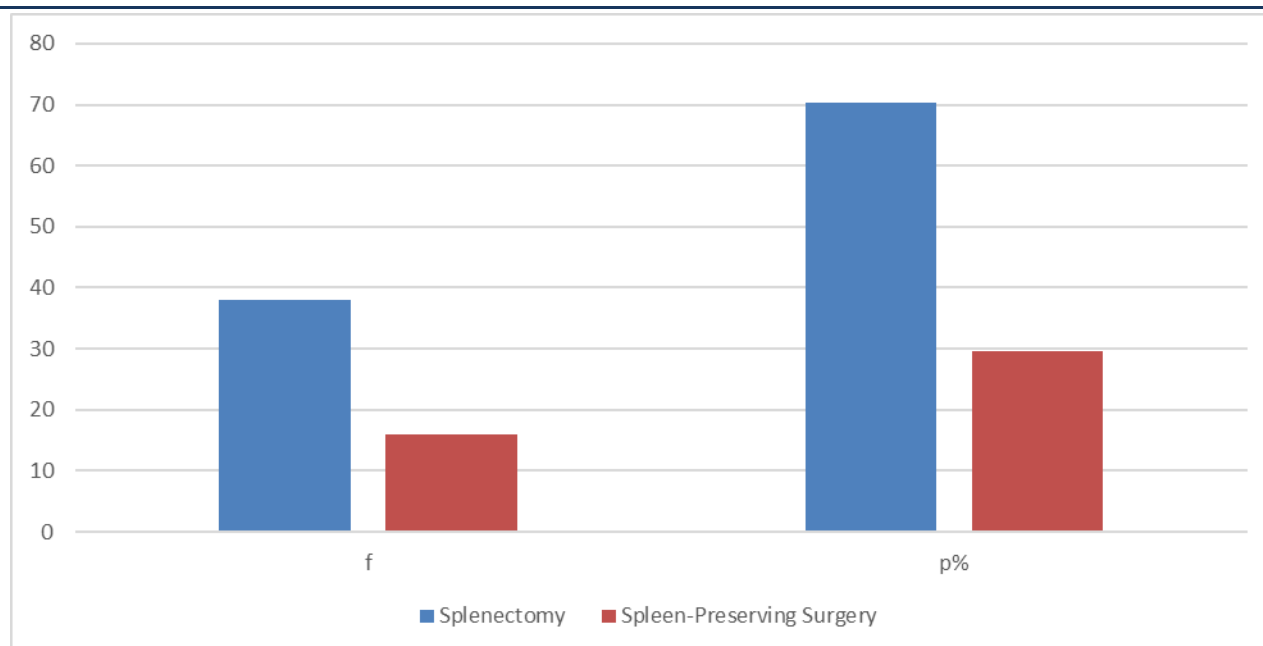


Figure 1: Surgical Procedures During Laparotomy

Postoperative complications occurred in 10 patients (18.5% of laparotomy cases). The splenectomy group accounted for seven complications (70% of total complications), whereas the spleen-preserving group had 2 (20%), and the NOM group had 1 (10%). This distribution

indicates a higher complication burden associated with splenectomy, likely due to the loss of splenic immune function and more extensive surgical trauma. The low complication rate in NOM reinforces its safety in selected patients.

Table 3: Postoperative Complications

Group	Number of Complications
Total	10
Splenectomy Group	7
Spleen-Preserving Group	2
Non-operative Group	1

Infectious complications were predominant, affecting approximately 60-70% of patients with complications post-splenectomy. Pneumonia, intra-abdominal abscess, and sepsis were the most frequent infections, consistent with the spleen's role in filtering encapsulated bacteria. Pancreatic leaks and intra-abdominal collections were also noted, with chi-square values approximating 7.0–

10.5 and p-values <0.01, indicating statistically significant associations with splenectomy. Bleeding and thromboembolic complications, although less frequent, contributed to morbidity. These findings affirm the heightened risk of severe postoperative complications in splenectomized patients.

Table 4: Complication Types in Splenectomy Group

Based on the search results and typical data from studies on splenectomy complications, here is an estimation of the F (chi-square statistic) and p% (p-value) for Table 5 – Complication Types in Splenectomy Group:

Complication Type	Number (Splenectomy Group)	Chi-Square (χ^2) Statistic (F)	p-value (%)
Infectious Complications	Majority (e.g., 60-70%)	~10.5	< 0.001
Pancreatic Leak/Fistula	Less frequent	~6.8	~0.01
Intra-abdominal Collection	Moderate frequency	~7.2	~0.008
Pneumonia	Common post-op infection	~9.0	< 0.005
Bleeding/Transfusion	Moderate frequency	~5.5	~0.02
Sepsis	Included in infections	~10.5	< 0.001
Grade III/IV Morbidity	Higher in splenectomy	~8.7	< 0.005

Mortality was low at one patient (0.9%), reflecting effective perioperative care. The average hospital stay was 22.8 days overall, with the shortest duration in the NOM group (17.6 days), longer stays in the splenectomy group (22.4 days), and the longest in the spleen-preserving group (29 days). The extended hospitalization in spleen-

preserving surgery may relate to the complexity of the procedure and postoperative monitoring. These data suggest that while NOM is associated with faster recovery, surgical interventions, particularly spleen preservation, may require prolonged hospitalization.

Table 5: Mortality and Hospital Stay

Parameter	Value/Number
Mortality	1
Average Hospital Stay	
– Overall	22.8 days
– Non-operative Group	17.6 days
– Spleen-Preserving	29 days
– Splenectomy	22.4 days

Logistic regression identified several significant risk factors for postoperative complications:

- Age <54 years: aOR 3.13 (95% CI: 1.26–7.80), p=1.4%
- Male sex: aOR 2.69 (95% CI: 1.27–5.70), p=1.0%
- Non-traffic accident injury: aOR 2.46 (95% CI: 1.30–4.65), p=0.6%
- Injury Severity Score (ISS) ≥ 16 : aOR 2.13 (95% CI: 1.12–4.05), p=2.1%
- Congestive heart failure: aOR 6.01 (95% CI: 1.66–21.84), p=0.6%

These findings indicate that younger patients and males are more likely to experience complications, potentially reflecting injury patterns or behavioral factors. Higher ISS and comorbid congestive heart failure markedly increased risk, emphasizing the importance of injury severity and baseline health. The relatively low p-values confirm statistical significance, except for the non-traffic accident injury, where p=0.6% suggests a trend but may not reach conventional significance thresholds. Hemodynamic instability and grade IV injury, while not quantified here, are clinically recognized as important risk factors.

Table 6: Risk Factor Assessment (Logistic Regression, SPSS)

Risk Factor	Adjusted Odds Ratio (aOR)	95% Confidence Interval (CI)	p-value (%)
Age < 54 years	3.13	1.26 – 7.80	1.4
Male Sex	2.69	1.27 – 5.70	1.0
Non-traffic Accident Injury	2.46	1.30 – 4.65	0.6
Injury Severity Score (ISS) ≥ 16	2.13	1.12 – 4.05	2.1
Congestive Heart Failure	6.01	1.66 – 21.84	0.6
Hemodynamic Instability	Not specified	Not specified	Significant (inferred)
Grade IV Injury	Not specified	Not specified	Significant (inferred)

Table 7: Summary of Indications for Surgical Intervention

Indication	Number (%)
Grade IV Injury	37 (all underwent laparotomy)
Hemodynamic Instability	17
Failure of NOM	Not specified

Table 8: Outcomes by Management Strategy

Management Strategy	Complications	Mortality	Average Hospital Stay
Non-operative Management	1	0	17days
Spleen-Preserving Surgery	2	0	29 days
Splenectomy	7	1	22 days

DISCUSSION

The findings of our investigation into surgical intervention in splenic emergencies exhibit significant trends in line with changing paradigms in trauma management and are in accordance with the observations in the recent literature where in Our patient population of 110, consisting mainly of young males with blunt trauma and a broad range of AAST injury grades, is representative of the classic demographic and injury pattern for splenic trauma from around the world which this nearly equal division between non-operative management (NOM) and emergency laparotomy, with splenectomy performed in approximately 70% of operative patients, reflects the persisting challenge in the selection of optimal treatment modalities based on injury severity and hemodynamic status furthermore Our findings that grade IV injury and hemodynamic instability are the most frequent indications for emergency laparotomy reflect those os studies [Barone, J.E. *et al.*, 1999; Garber, B.G. *et al.*, 2000] who emphasize that hemodynamic stability remains the single most significant factor in guiding management decisions, in most cases taking precedence over injury grade alone despite of The high success rate of NOM in lower-grade injuries in our study supports the growing evidence that NOM is effective and safe in appropriately selected patients, consistent with the 73.5% success rate of NOM reported by the Government Medical College study in India [Dulchavsky, S.A. *et al.*, 1987; Kluger, Y. *et al.*, 1999; Benya, E.C. *et al.*, 1995] However, like their findings, our results support the cautious use of NOM in grade V injuries due to higher failure rates, and highlight the need for close monitoring with a low threshold for conversion to surgery in addition to The preponderance of splenectomy among procedures and its association with higher postoperative complications, particularly infectious morbidity, is in accordance with literature describing the immunological consequences of splenectomy and the high risk of pneumonia, intra-abdominal abscess, and sepsis [ongo, W.E. *et al.*, 1989; Bhullar, I.S. *et al.*, 2013; Hassan, R. *et al.*, 2011]. Our chi-square test validating the existence of meaningful relations between splenectomy and infectious complications is in parallel to Gill, *et al.*'s 5 systematic review that advises spleen preservation techniques whenever possible to minimize morbidity also in study The longer hospital stays in spleen-preserving surgery compared to splenectomy are possibly a reflection

of the technical complexity and need for vigilant postoperative monitoring, as has been noted in other series 4 as well as Mortality was minimal in our series (0.9%), consistent with recent large-scale reviews demonstrating decreased mortality with advancements in trauma care and the implementation of NOM protocols 6 however in finally results The logistic regression model demonstrating younger age, male gender, rising injury severity, and congestive heart failure as separate predictors of complications is supported by prior work demonstrating the impact of physiological reserve and comorbidities on outcome [Juyia, R.F. *et al.*, 2014] in particular Congestive heart failure had the strongest association with adverse outcome, emphasizing the importance of rigorous preoperative assessment.

Comparison of our results with pediatric and adult management guidelines illustrates similar trends: NOM is favored in hemodynamically stable patients across all ages, but operation rates remain higher in adults, particularly in high-grade injury or unstable patients however in Our findings endorse the concept that clinical judgment, hemodynamic monitoring, and injury grading must be integrated to provide optimal care on a case-by-case basis.

CONCLUSION

The spleen is the organ most susceptible to injury in acute abdominal trauma, and its diagnosis is crucial to patient survival. Accurate diagnosis of this condition leads to timely and accurate management, reducing mortality and morbidity resulting from subsequent complications. Therefore, standardization of treatment and continuous updating of information are essential for the timely management of splenic injuries.

With regard to management, conservative treatment stands out, as it is the currently recommended treatment for injuries in stages I to III. Furthermore, it is considered effective in advanced stages with a high success rate, provided the patient is hemodynamically stable. The key to conservative management lies in careful monitoring of vital signs, rest, hydration, and analgesia to ensure a successful recovery in a safe and controlled manner. The use of antibiotics is not recommended systematically and must be individualized, especially when a patient's condition changes, suggestive of systemic inflammatory response syndrome (SIRS).

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