

Clinicopathological Presentation and Management of Splenic Trauma: A Hospital Based Study

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Abstract:

Background: The management of a traumatized spleen is primarily influenced by several factors.

Aims and Objectives: To assess the efficacy of different management procedures and outcomes.

Materials and Methods: A retrospective study on splenic trauma was conducted at S.L.N Medical College Koraput, between January 2022 and December 2023. Thirty-six patients with splenic injuries were admitted to the Department of General Surgery during this period.

Results: In this study, 36 patients (26.67%) were diagnosed with splenic injuries. All patients were between 6 and 62 years old. The age group with the most patients was 21-30 years old (10 patients, 27.78%). Additionally, 12 patients were from the pediatric age group, with an average age of 26.97 years. The gender distribution showed a male predominance: 26 males (72.22%) and 10 females (27.78%) with a male: female ratio of 2.6:1. Blunt abdominal trauma was the cause of splenic injury in 32 cases (88.89%), with road traffic accidents being the most common culprit (19 cases, 52.78%). A fall in hematocrit was observed in most cases (30 out of 36, 83.33%). Associated injuries were present in 17 patients, with the liver and kidney being the most frequently injured organs (4 cases each). Regarding injury severity, most cases fell into the grade III (13 cases) and grade II (11 cases) categories. Treatment breakdown revealed that 16 patients (44.44%) underwent splenectomy, 10 (27.78%) underwent splenorrhaphy, and 10 (27.78%) received conservative management. Non-operative management was preferred for low-grade (grade I) injuries in children with blunt trauma, while splenectomy was more common for high-grade injuries and in adults. Splenorrhaphy was used for some moderate-grade injuries, particularly penetrating trauma. Overall, non-operative management and splenorrhaphy had successful outcomes with minimal complications, while splenectomy resulted in more complications and higher mortality, especially for patients with severe injuries.

Conclusion: Non-operative care and splenic repair techniques are favored in stable patients, but splenectomy remains crucial for unstable or high-risk cases.

Keywords: Splenic Trauma, Splenectomy, Blunt Splenic Injury, Splenorrhaphy.

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Introduction

Trauma is a major cause of morbidity and mortality; in the developed world, road traffic accidents are one of the leading causes. [1] Polytraumas are commonly associated with abdominal injuries. They are potentially life threatening where early diagnosis and treatment is the primary goal. The spleen is the most common intra-abdominal organ injured in both blunt and penetrating abdominal trauma. [2] The spleen lies in the left hypogastrium, where its hilum sits in the angle between stomach and kidney and is in contact with tail of pancreas. Trauma to spleen occurs most commonly due to its precarious location and unsupported splenic pedicle. Due to its rich blood supply, receiving 5% of the total cardiac output, Injury to the spleen can lead to various complications, such as exsanguinations (massive

bleeding), spontaneous cessation of bleeding, delayed rupture of the spleen, formation of a pseudocyst (fluid-filled sac), or splenosis (auto transplantation of splenic tissue). [3] Diagnosing splenic trauma hinges on a careful history of trauma to the left upper quadrant, thorough clinical evaluation, high clinical suspicion, and radiological exams like abdominal ultrasound, pelvic ultrasound, CT scan of the abdomen, and diagnostic peritoneal lavage. [4]

The management of a traumatized spleen is primarily influenced by several factors, including the patient's age, hemodynamic stability, presence of associated intra-abdominal and extra-abdominal

injuries, and any existing pathological conditions affecting the spleen itself. [5]

Previously, splenectomy was the standard treatment for splenic injuries due to the mistaken belief that the spleen was not essential for life. However, the crucial role of the spleen in both cellular and humoral immunity has since been recognized. This recognition, coupled with the potential for serious complications like overwhelming post-splenectomy infection, intra-abdominal sepsis, post-operative wound infection, thromboembolic sequelae, pulmonary infection, and even fatal coronary artery disease, has led to a strong emphasis on spleen-preserving strategies.

For stable patients with normal, uninjured spleens and no other organ damage, splenic preservation is now the preferred treatment approach. This shift is driven by advancements in organ-specific imaging, recognition of individual splenic segment importance, and development of newer interventional techniques like selenography. In this study we aimed to assess the efficacy of different management procedures and outcomes

Materials and Methods

A retrospective study on splenic trauma was conducted at SLN Medical College, Koraput between January 2022 and December 2023. Thirty-six patients with splenic injuries were admitted to

the Department of General Surgery during this period.

Detailed records were collected for each patient, including name, age, sex, and date of admission. The mechanism of injury and patient symptoms was assessed. A thorough clinical examination was performed to evaluate for associated injuries to other organs. Based on these findings, clinical diagnoses of splenic trauma were inferred.

Relevant hematological and radiological investigations were performed, including ultrasound of the abdomen and pelvis and four-quadrant peritoneal lavage. In a select group of patients, a CT scan was also performed. Based on these investigations, a definitive diagnosis of splenic trauma was established.

A defined management protocol is strictly followed. Postoperative follow-up and long-term surveillance for up to one year was conducted through mailed questionnaires. The study compares various management methods, with a particular focus on the advantages of splenic conservation. The significance of findings is statistically evaluated using the Chi-square test when appropriate.

Results

A total 135 patients admitted with abdominal trauma during this period, 36 (26.67%) were diagnosed with splenic injury (**Table 1**).

Table 1: Distribution of Cases According To Age (n=36).

Age groups in years	Number of cases	Percentage
<20	12	33.33
21-40	16	44.45
41-60	7	19.45
61-80	1	2.78
>81	0	0
Total	36	100

All the patients were between 6 and 62 years of age. The maximum of 10 patients were between 21 and 30 years of age (27.78%) and 12 patient were from pediatric age group with a mean age of 26.97 years. In this study, 26 cases were males (72.22%) and 10 cases were females (27.78%) and male: female ratio was 2.6:1.

Out of 36 cases admitted with splenic injury, 32 cases were due to blunt trauma of abdomen out of which 19 cases (52.78%) were due to road traffic accident (**Figure 1**).

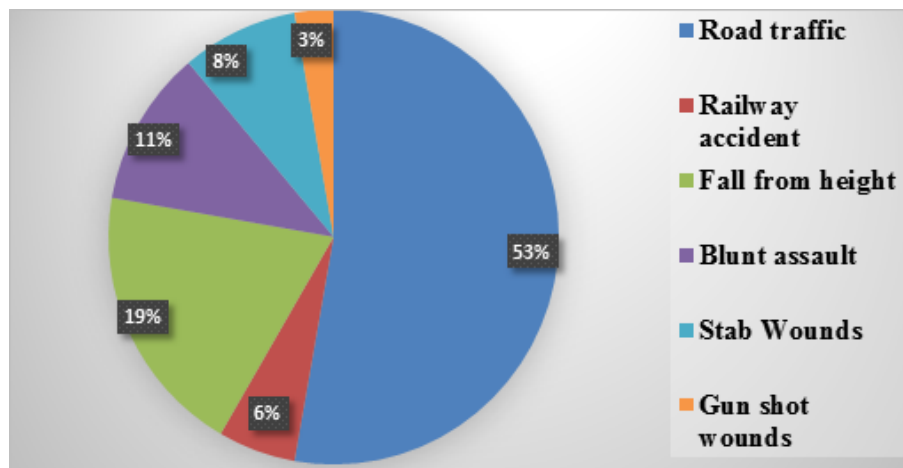


Figure 1: Distribution of cases according to mechanism of injury

Clinical evaluation identified splenic trauma in 85% of patients. The most common presenting signs were tenderness and rigidity in the left hypochondrium or diffuse tenderness (88.89%), followed by shifting dullness (50%). Kehr's sign was positive in 47.22% of cases, while Balance's sign was positive in 25%. Serial hematocrit showed a decrease in 30 out of 36 patients (83.33%). Paracentesis with four-quadrant peritoneal tap yielded positive results in 88.89% of

cases. Plain abdominal X-ray had a diagnostic accuracy of 47.22%, while ultrasound of the abdomen and pelvis was accurate in 69.44%. CT scan, performed in only 9 cases, was 100% accurate in diagnosing splenic trauma.

At the time of admission hemoglobin was measured. Fall in hematocrit was seen in most cases i.e. 30 out of 36 cases (83.33%) (Table 2).

Table 2: Distribution of cases according to fall in haematocrit.

Hemoglobin (gm %)	At the time of admission	At 2 hrs.	At 4 hrs.	At 6 hrs.
>10	18	7	6	6
7-10	15	19	18	17
<7	3	10	12	13

Associated injuries were present in 17 cases, liver and kidney being the most common injured (4 each). Other injuries included intestines (3 patients, 8.33%), retroperitoneal hematoma (3 patients, 8.33%), and mesentery (2 patients, 5.56%). Rib fractures were present in 8 patients (22.22%) (Table 3).

Table 3: Distribution of cases according to associated injury (n=36)

Associated organ injury	Number of cases	Percentage
Blunt trauma	32	88.89
Retroperitoneal hematoma	3	8.33
Liver	4	11.11
Mesentery	2	5.56
Kidney	4	11.11
Intestine	2	5.56
No associated injuries	16	44.44
Penetrating trauma	4	11.11
Stomach	0	0
Intestine	1	2.78
No associated injuries	3	8.33
Total	36	100

In our study most of the cases belonged to grade-III (13 cases) and grade-II (11 cases) severity. None of the cases were of grade V severity (Table 4).

Table 4: Classification of splenic injuries based on (CT scan/ laparotomy) findings.

Grades of injury	Number of cases	Percentage
I	10	27.78
II	11	30.56
III	13	36.11
IV	2	5.56
V	0	0

Analysis of 36 patients revealed that 16 (44.44%) underwent splenectomy, 10 (27.78%) underwent splenorrhaphy, and 10 (27.78%) were managed conservatively (**Table 5**).

Table 5: Mechanism of splenic injury versus treatment

Mechanism of injury	Splenectomy	Selenography	Non-operative management	Autotrans Plantation
Penetrating trauma	2	2	0	0
Blunt splenic trauma	14	8	10	2

Non-operative management was preferred for grade I injuries, while splenectomy was performed for all grade II and grade IV injuries. Notably, all conservatively managed patients were pediatric (Table 6). Interestingly, penetrating injuries, though less frequent, were more often managed with repair (60%) compared to blunt trauma (24%). Furthermore, isolated blunt splenic injuries (BSI) were significantly less severe than those associated with polytrauma, with a conservation rate of 84.61% compared to 0% in polytrauma cases. Hemodynamic instability was defined as a systolic blood pressure below 90 mmHg, regardless of fluid resuscitation response. Among patients undergoing splenectomy, only 20% were hemodynamically stable, while all patients in the splenorrhaphy and non-operative groups were stable. Compared to patients undergoing early laparotomy, the non-operatively managed group had significantly less severe injuries overall. This was evidenced by lower rates of associated intra-abdominal injuries, reduced transfusion requirements, and a higher incidence of hemodynamic stability.

Twenty-eight percent (10 patients) underwent non-operative management, with most being pediatric patients (under 17 years old). Notably, all these patients had CT scans, which were highly accurate (100%) in guiding their follow-up care. Importantly, they remained hemodynamically stable and required minimal blood transfusions (average of 1.3 units). No associated organ injuries were subsequently detected in this group. However, this selection bias likely explains the difference in outcomes. Only grade I injuries were chosen for non-operative management, excluding potential cases of polytrauma (multiple injuries). Patients in our study resumed normal activities after 6 weeks, with normalization of their blood counts (including platelets) at the same time. This study observed a 0% failure rate, likely due to two factors: first, the exclusion of adults, and second, the selection of only grade I injuries for non-operative management.

Additionally, since no patients underwent exploratory surgery (laparotomy), information on splenosis and adhesions that might occur during a second surgery is unavailable.

Of the ten cases (27.78%), all underwent suture repair with omental buttressing. These patients were hemodynamically stable, required an average of only 2 units of blood transfusion, and had no associated injuries. All ten cases involved grade II injuries and were repaired with Vicryl 1-0 sutures, achieving a 0% re-exploration rate. Length of hospital stay ranged from 4 to 11 days, with an average of 13.4 days. There were no deaths. Morbidity was minimal, with only one case each of left lower lobe atelectasis and wound infection. All patients returned to normal activity within 6 weeks, and their blood counts normalized as well.

Sixteen patients (44.44%) underwent splenectomy. Notably, 75% of these patients were hemodynamically unstable, requiring an average of 3 units of blood transfusion. Splenic injury grades in this group included II, III, and IV, suggesting that splenectomy was reserved for more severe injuries. Additionally, 87% of patients who underwent splenectomy had associated polytrauma.

Reassuringly, the re-exploration rate was 0%. The most common postoperative complications were atelectasis (16.67%), pneumonia (8.33%), and wound infection (22.22%). Among more serious complications, 5.56% of patients developed systemic sepsis. Fortunately, no cases of coagulopathy, ARDS, pancreatitis, or gastric fistula were encountered in this series.

Regarding mortality, two patients (5.56%) in the splenectomy group died directly as a result of their splenic injury, both being high-risk adults who also developed systemic sepsis. This aligns with the reported 0-11% mortality rate in splenectomy patients. No deaths occurred beyond 2 weeks, possibly due to a combination of comprehensive patient counseling regarding post-splenectomy

infection risks, broad-spectrum antibiotic prophylaxis, and pneumococcal vaccinations. This approach likely mitigated the lifelong risk of opportunistic infections. However, follow-up for this group remains incomplete, with data spanning only 6 months to 1 year.

All splenectomy patients received pneumococcal vaccination within the first postoperative week. Notably, none of these patients developed subsequent pneumonia. This study, however, cannot shed light on several aspects:

- The efficacy of post-operative vaccination compared to pre-operative administration.
- The effectiveness in children under 4 years old.
- The potential impact on other types of infections.

Autotransplantation was performed in two patients (5.55%), one with a grade III injury and the other with a grade IV injury. Both patients had associated organ injuries. Postoperatively, peripheral blood smears and total platelet counts were within normal limits at 6 weeks. However, this study cannot assess the long-term impact of revascularized splenic tissue on preventing sepsis.

Comparing non-operative management and splenorrhaphy in the pediatric group revealed excellent outcomes for grade-I splenic injuries identified by CT scan. These patients required only 1-2 units of blood transfusion and had no associated polytrauma. Non-operative management offers several advantages over splenorrhaphy, including:

- Avoiding laparotomy-related morbidity and postoperative complications.
- Reducing hospital stay duration.

However, concerns exist regarding non-operative management, such as:

- Potential delayed rupture.
- Rebleeding.
- Increased morbidity in case of failure.

Comparing splenorrhaphy and splenectomy in young adults revealed excellent outcomes for hemodynamically stable patients with grade II injuries, particularly in penetrating trauma. Additionally, patients who underwent splenorrhaphy experienced:

- Reduced blood transfusion requirements.
- Shorter hospital stays.
- Minimal rates of re-exploration, rebleeding, and mortality.

Importantly, splenic function and immune status were better preserved in these patients compared to those who underwent splenectomy. Patients who underwent splenectomy typically had more severe injuries, predominantly caused by blunt trauma. They frequently presented with associated polytrauma, leading to:

- Higher blood transfusion requirements.
- Longer hospital stays.

Postoperative morbidity and mortality were also significantly higher in this group. Additionally, they experienced:

- An increased incidence of respiratory infections.
- A definite risk of long-term sepsis during the observed period.

This study performed autotransplantation in two cases, suggesting a potential reduction in the risk of sepsis, although complete elimination was not achieved (**Table 6**).

Table 6: Comparison between major modes of management of splenic injuries

	Non-operative management	Splenorrhaphy	Splenectomy	Autotransplantation
Number of patients	10	10	16	2
Mean age				
Haemodynamically stable	10	10	4	1
Grade of injury				
I	10	0	0	0
II	0	10	1	0
III	0	0	13	1
IV	0	0	2	1
V	0	0	0	0
Type of injury				
Blunt	10	8	14	2
Penetrating	0	2	2	0
Associated abdominal injury	0	1	11	2
Diagnosis				
CT scan accuracy	100%			

Unit of blood transfused (mean)	1.3	2	3.06	3.5
Results				
Re-exploration	0	0	0	0
Re-bleeding	0	0	0	0
salvage rate	100%	100%		
Lenth of hospitalization in days (mean)	11.6	13.4	14.79	15
Morbidity				
Wound infection	0	2	6	0
Atelectasis	0	1	4	1
Pneumonia	0	0	3	0
Systemic sepsis	0	0	2	0
Mortality	0	0	1	0
Follow up				
Blood smear (at 6 wks)	Normal	Normal	Abnormal	Abnormal
Total platelet count (at 6 wks)	Normal	Normal	Abnormal	Abnormal
Long term surveillance (up to 1 year)				
OPSI	0	0	0	0
Respiratory infection	0	0	8	0
Pneumonia	0	0	3	0
Systemic sepsis	0	0	2	0
Mortality	0	0	1	0
Follow up				
Blood smear (at 6 wks)	Normal	Normal	Abnormal	Abnormal
Total platelet count (at 6 wks)	Normal	Normal	Abnormal	Abnormal
Long term surveillance (up to 1 year)				
OPSI	0	0	0	0
Respiratory infection	0	0	8	0
Blood smear (at 6 wks)	Normal	Normal	Abnormal	Abnormal

Discussion

Spleen injuries are among the most frequent trauma-related injuries. At present, they are classified according to the anatomy of the injury. In this study a total 36 patients were included over a period of three years. The age of the patients ranged from 6 to 62 years, with an average age of 26.97 years. The most frequent age group was 21-30 years, accounting for 10 patients (27.78%). Additionally, 12 patients (33.89%) belonged to the pediatric age group (<17 years). Males comprised 72.22% of the study population, which was in consistent with the previous study reports. [7-8]

Splenic trauma constituted 26.67% of all abdominal trauma cases in this study. Blunt trauma was the predominant cause (88.89%), with road traffic accidents accounting for the majority (52.78%), followed by falls from height (19.44%) and railway accidents (5.55%). Penetrating trauma comprised 11.11% of cases, with stab wounds being more common (8.33%) compared to gunshot wounds (2.78%). These findings align with previous study by Dehli et al. [9], who reported a total of 109

patients with splenic injury. Of the 88 men and 21 women with a mean age of 32 years, 97% had sustained a blunt trauma and 3% a penetrating trauma. Injuries related to traffic accidents accounted for 55 % of cases, falls 31%, 6% were injured in accidents with snowmobiles, 5% were hit by a blunt object, and 2% were penetrating trauma.

The current study as well as earlier studies that showed higher involvement of young males in MVC-related BSI. [10] The present study observed associated injuries in 22% cases, liver and kidney being the most common injured. In other studies chest and head regions as the most frequent concomitant extra-abdominal injuries. [10] Some authors suggested increased risk of worse outcomes in polytrauma patients due to missed or delayed diagnosis of BSI. High ISS suggestive of multiple trauma is considered as a prognostic factor for failed NOM in adults with BSI. [11]

The optimal treatment strategy, however, should keep into consideration the hemodynamic status, the anatomic derangement, and the associated injuries. The management of splenic trauma patients aims to

restore the homeostasis and the normal physiopathology especially considering the modern tools for bleeding management. Thus, the management of splenic trauma should be ultimately multidisciplinary and based on the physiology of the patient, the anatomy of the injury, and the associated lesions. Lastly, as the management of adults and children must be different, children should always be treated in dedicated pediatric trauma centers. In fact, the vast majority of pediatric patients with blunt splenic trauma can be managed non-operatively. [12]

Usually, NOM is considered for patients with low-grade splenic injuries, unless operated upon for other associated injuries. In fact, higher-grade injuries could also be managed non-operatively with the liberal use of angioembolization. [13] Splenic angioembolization of bleeding vessels increases the success rate of NOM in hemodynamically stable patients, which could eliminate the need for operative management (OM) regardless of the splenic injury grade. [14] To increase the success rate of NOM, angioembolization could be considered in hemodynamically stable high-grade (IV–V) injury patients in the absence of blush. [15]

Splenectomy should be considered for clinically unstable patients with devascularization, coagulopathy, associated injuries, and significant bleeding. [16] In our series, splenectomy was performed in one-quarter of the cases; they had hypotension, low hemoglobin levels, and higher ISS and INR and only 1 patient underwent splenorrhaphy. The rate of operative management was non-significantly higher among adults. However, an earlier study reported a higher rate of surgical management (44%) in adults. [17]

Interestingly, the degree of successful NOM in adult and children varies due to intrinsic anatomic differences or involvement of other factors. [18] In children, NOM has become the standard of care, with a high success rate (75–93%), [19, 20] and the reported frequency of NOM in adults is around 60%. [21] Consistent with earlier studies, children were more likely to be treated successfully with NOM than adults in our series. Di Saverio et al. [21] reported a lower rate of failed NOM in children (2%) as compared to adults (17%) with BSI, which is in agreement with our findings, as only 1 adult patient had failed NOM. Similar to our findings, an earlier study demonstrated higher injury severity in adults who sustained traffic-related accidents injuries. This could be explained by the greater possibility of kinetic energy transmission as compared to children, who have smaller body mass and lower impact. [16] Notably, Lippert et al. [20] observed an association between higher injury severity and prolonged hospitalization in adults, which could be attributed to other concomitant injuries rather than to NOM. Consistently, in our study, adults who sustained

severe injuries required more units of transfused blood and had prolonged ICU stay. The overall mortality for splenic lesions with other associated injuries varies from 6% to 7%. [22] A recent study of splenic injury patients reported an overall mortality rate of 6%. [23] It has been suggested that the higher rate of mortality was mainly attributable to the associated injuries and post-traumatic complications. [16] In line with these findings, the overall mortality rate in our study was 7.9%; most deaths were due to severe traumatic brain injury or exsanguination from different sources. Recently, Frandon et al. [23] reported a lower mortality (3%) in the operative group, which is proportional to the overall injury severity.

Conclusion

Recent years have seen a significant shift in splenic trauma management, driven by the growing recognition of the spleen's vital role in immunity. Splenic salvage has become the primary goal, with several options available: non-operative management, conservative surgery (repair), and splenectomy. However, these approaches must balance the immediate risk of bleeding (exsanguination) with the potential for delayed, serious post-splenectomy infections. In well-equipped centers with close monitoring, emergency surgery capabilities, and thorough follow-up, non-operative treatment can be successful for select patients, particularly those who are hemodynamically stable and have isolated blunt splenic injuries. Additionally, splenic salvage is only considered when both the patient's condition and the spleen's condition are favorable. Techniques like splenorrhaphy, partial splenectomy, and splenic transplantation aim to preserve splenic function and should be prioritized whenever possible. Conversely, splenectomy remains necessary for patients who are hemodynamically unstable, have polytrauma, severe peritoneal contamination, significant splenic damage, or traumatized pathological spleens.

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