ORIGINAL RESEARCH

Pattern, Management, and Outcomes of Splenic Injuries at Kenyatta National Hospital: A Retrospective Cross-Sectional Study

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Received: 28 Jan 2025; Revised: 30 Aug 2025; Accepted: 3 Sep 2025; Available online: ***

Abstract

Background: Traumatic splenic injury pattern and management determine its prognosis. In our context, management outcomes data are scarce. **Objective:** To determine the pattern, management, and outcomes among splenic trauma patients. **Methods:** A retrospective cross-sectional study of patients aged 13 years and older with traumatic splenic injuries from January 2015 to December 2022 was conducted, and data were analyzed. **Results:** The study enrolled 95 patients with a mean age of 29.4±11.8 years. Most (87.4%) were men. Isolated splenic injuries were present in 54.5% (52) of 95 patients, with head and chest injuries being most common. Most patients (94.7%) had blunt injuries, and approximately 62% of blunt trauma patients had multiple injuries. Splenic injuries were largely caused by falls from height (23.2%) and road traffic accidents (62.1%). Of 95 patients, 51.6% underwent surgery, with splenectomy accounting for 93.9% of procedures. Grade III–V splenic injuries were observed in 63% of patients. American Association of Surgery for Trauma grade significantly affected splenic injury management ($p = 0.01$). The overall mortality rate was 5.3%. Polytrauma was associated with intensive care unit admission ($p = 0.03$) and longer hospital stays ($p = 0.001$). **Conclusion:** The most common cause of splenic injury was blunt trauma from car accidents. Most grade III splenic injuries required splenectomy. Patients with polytrauma stayed longer in the hospital. Surgery remains the mainstay for high-grade splenic injuries and polytrauma, although conservative therapy for these injuries is improving.

Keywords: Conservative management, Outcomes, Spleen, Splenectomy, Splenic injury

Ann Afr Surg. 2026; 23(2): **-**
DOI: http://dx.doi.org/10.4314/aas.v23i2.2

Conflict of interest: None
Funding: None

Introduction

Splenic trauma often results in life-threatening conditions (1). Splenic damage is one of the most frequent injuries in abdominal trauma with an incidence of splenic injuries ranging between 1.7% and 6.15% (2, 3).

Injuries to the spleen frequently arise from either blunt or penetrating abdominal trauma, with blunt trauma

being more prevalent. Blunt splenic injury accounts for approximately 86.2% of all splenic injuries, while penetrating trauma constitutes 13.8% (4–6). The pattern and causes of injuries to the spleen vary from one geographical location to the other with road traffic accidents (RTAs) responsible for the majority of these injuries (3, 7).

Recent advancements in the management of splenic injury have shifted from emergency surgical interventions to selective non-operative approaches, facilitated by the development of diagnostic tools such as computed tomography and endovascular techniques (1, 8). Similarly, the increased incidence of overwhelming post-splenectomy infections shifted splenic injury management toward spleen-preserving modalities (1, 9). Up to 70–80% of all splenic injuries can be managed by either observation alone or with observation and angioembolization (4, 10). Management of high-grade injuries with angioembolization is achievable in about 95% of cases (11). Surgical intervention is required in approximately 18% of cases of splenic injuries (2, 12). In the western world, where a well-established healthcare system is available, successful non-operative management of selected splenic injuries has been reported as the standard of care although its safety and effectiveness are not globally established (13, 14). Nonetheless, the burden of splenic injuries remains significant in resource-limited countries. Our setup lacks sufficient data concerning the outcomes of non-operative and operative management of splenic injuries. Consequently, we conducted a study to ascertain the pattern, management, and outcomes of splenic injuries within our institution.

Materials and Methods

This research was conducted at the Kenyatta National Hospital in Nairobi, a facility that offers various specialized services. This hospital provides services to individuals from across the nation. This is a prominent trauma care center in the nation, specializing in the treatment of trauma patients. The facility utilizes a health information management system to maintain and retrieve patient records and data efficiently.

Ethical approval was obtained from the ethical committee (reference number: P35/01/2023).

This was a retrospective cross-sectional study. We examined the medical records of patients diagnosed and treated for traumatic splenic injuries from January 2015 to December 2022. The study population included all patients aged 13 years and above within the 8-year study period who presented to our facility with documented isolated or polytrauma with splenic injury from imaging [FAST ultrasound or computed tomography (CT) scan] or as an intra-operative finding. Patients with iatrogenic splenic injuries, spontaneous splenic rupture, or splenic trauma who were operated out of our institution were excluded from our study. The sampling technique used in the study was a non-probability consecutive sampling. The variables included the patient's demographics, the pattern of injury, injury-arrival time, initial clinical presentation, imaging investigations (FAST ultrasound and computerized tomography), the grade of splenic injury, transfusion requirements, treatment options (operative or non-operative), and outcomes (length of hospital stay, in hospital mortality, sepsis, surgical site infection, hemorrhage).

The sample size was calculated using the Cochrane's formula shown below:

$$\mathrm{n} = \frac{Z^2 Pq}{e^2},$$

where n is the population size, P is the reported mortality rate of splenic trauma in Sudan (6.4%) (15), q=1−P, e is the error margin (0.05), and Z is the statistic for the level of confidence (95% confidence interval with Z value of 1.96).

$$\mathrm{n} = \frac{(1.96)^2 \times 0.064 \times 0.936}{0.05^2}$$

Therefore, the desired sample size was 92.

The collected data were analyzed using statistical software, specifically STATA version 18 (StataCorp LLC., College Station, TX, USA). Mean, standard deviation, and percentages were used to evaluate the data. Associations between continuous and categorical variables were analyzed using Mann–Whitney, chi-square (χ^2), or Fisher's exact tests as appropriate. Statistical significance was determined by a p-value of 0.05.

Results

This study included 95 patients hospitalized with splenic injury. The majority (87.4%) were men. The mean presentation age was 29.4 years (range: 13.0–79.0 years). Among the patients, 49.5% were married, and a similar percentage was single. Self-employed accounted for 31.6%, followed by unemployed (28.4%), students/minors (24.2%), and employment (15.8%) (Table 1).

The most prevalent type of injury was blunt abdominal trauma (94.7%), while penetrating injuries accounting for 5.3%.

Table 1. Demographic characteristics

Demographic characteristics	**Total (N=95, %)**
Sex, n (%)	
Female	12 (12.6)
Male	83 (87.4)
Age (years), mean±SD	29.4±11.8
Marital status, n (%)	
Divorced	1 (1.1)
Married	47 (49.5)
Single	47 (49.5)
Employment status, n (%)	
Self-employed	30 (31.6)
Employed	15 (15.8)
Unemployed	27 (28.4)
Student/minor	23 (24.2)

Table 2. Pattern, mechanism, and etiology of splenic injury

Pattern and mechanism of splenic injuries	**(N=95, %)**
Pattern of injury, n (%)	
Isolated	52 (54.5)
Polytrauma	43 (45.3)
Mechanism of injury, n (%)	
Blunt abdominal injury	90 (94.7)
Penetrating abdominal injury	5 (5.3)
Blunt abdominal injury, n (%)	
Polytrauma	42 (46.6)
Isolated splenic injury	48 (53.3)
Penetrating abdominal injury, n (%)	
Polytrauma	1 (20.0)
Isolated splenic injury	4 (80.0)
Etiology of injury, n (%)	
Fall from height	22 (23.2)
Motor vehicle accidents	59 (62.1)
Stabbing/assault	10 (10.5)
Gunshot	2 (2.1)
Sport injuries	1 (1.1)
Unknown	1 (1.1)

Isolated splenic injury occurred in the majority of blunt trauma cases (53.3%) and penetrating injuries (80%). The most common causes of injury were RTAs (62.1%) and fall from height (23.2%). Other causes included 10

incidents of attacks or stabbings, with the remaining being sports injuries and unknown as shown in Table 2.

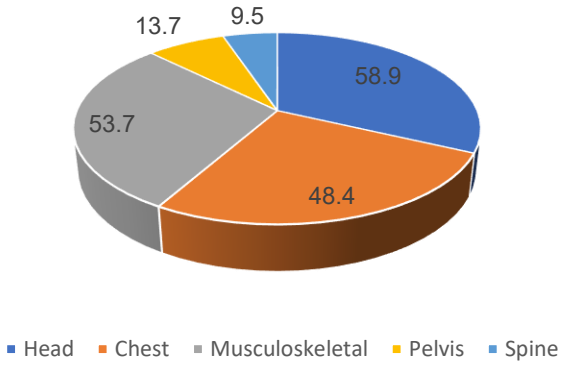

Figure 1. Associated injuries.

The three most common associated injuries among these patients were head injuries (58.9%), chest injuries (48.4%), and musculoskeletal injuries (53.7%) (Figure 1). Chest injuries predominantly impacted the pleural space, accounting for 44.4% of cases, with pneumothorax, hemothorax, and pneumohemothorax being the most common. Lung contusion followed at 24.4% (see Table 3). Almost all patients arrived at the facility within 24 hours post-injury, with 44.2% presenting within 6 hours. Ambulances constituted the predominant mode of transport at 58.1%, followed by private cars at 36.6%, while 5 patients arrived at the hospital on foot (Table 3).

Table 3. Chest injury type, time to presentation, and mode of transport

Associated chest injury, time to presentation, and mode of transport	**Total (N=95, %)**
Chest (n=45)	
Contusion	11 (24.4)
Hemothorax	5 (11.1)
Pneumothorax	10 (22.2)
Pneumohemothorax	5 (11.1)
Other	14 (31.1)
Time to presentation, n (%)	
Within 6 hours	42 (44.2)
Within 24 hours	49 (51.6)
More than 24 hours	4 (4.2)
Mode of transport, n (%)	
Ambulance	55 (58.1)
Private car	35 (36.6)
Walked in	5 (5.4)

Table 4. General examination

General examination	**(N=95, %)**
Normotensive, n (%)	74 (77.9)
Hypotensive < 90 mmHg, n (%)	21 (22.1)
Tachycardia > 100, n (%)	41 (43.2)
Confusion/agitation, n (%)	73 (76.8)
Pallor, n (%)	23 (24.2)
Cyanosis, n (%)	0
Intubated, n (%)	2 (2.1)

In the general examination, 77.9% were normotensive, 22.1% hypotensive, 43.2% had tachycardia, 76.8% were confused, and 24.2% had pallor. Two patients were intubated (Table 4). The predominant Glasgow Coma Scale observed upon admission was mild, accounting for 89.5%, as illustrated in Figure 2.

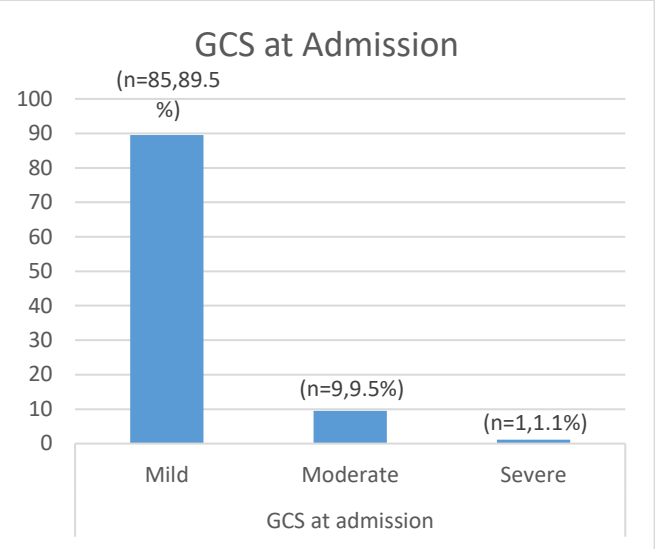

Figure 2. Glasgow Coma Scale at admission.

Ninety percent of patients had abdominal tenderness. Bowel sounds were normal in 88.4% and abdominal distension in 25.3% as shown in Table 5.

FAST ultrasound was performed on 94 patients to assess free intraperitoneal fluid. FAST positivity was 90% and negativity 4%. One hemodynamically unstable patient went straight to surgery. CT scan was performed in 92 (96.8%) patients. Patients' injuries were categorized based on the American Association of Surgery for Trauma Organ Injury Scale (AAST-OIS) grade. More than 50% of splenic injuries were grade III (30.5%) and grade II (23.2%) (Figure 3).

Out of 49 patients who had surgery, 32 (65.3%) were found to have related intra-abdominal injuries. Figure 4 shows that 28.1% of the cases had liver injuries, 25% had bowel (small and large) injuries, 18.8% had stomach damage, 15.6% had diaphragmatic injuries, 3 had kidney injuries, and 1 had pancreatic trauma.

Approximately, 51.6% (49) were managed operatively, with splenectomy accounting for 93.9% of the surgical procedures, and 3 patients were managed by splenorraphy.

Table 5. Abdominal examination findings and admission hemoglobin

Abdominal examination findings	**(N=95, %)**
Abdominal distension	24(25.3)
Abdominal tenderness	86(90.5)
Normal bowel sounds	84(88.4)
Rigidity	11(11.6)
Abdominal wall hematoma	3(3.2)
Admission hemoglobin	**(N=95, %)**
≤9 g/dL	13 (13.7)
>9 g/dL	82 (86.3)

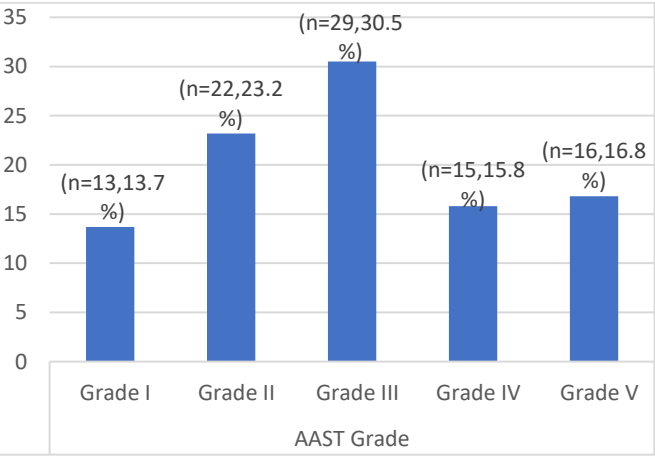

Figure 3. The American Association of Surgery for Trauma (AAST) splenic injury grades.

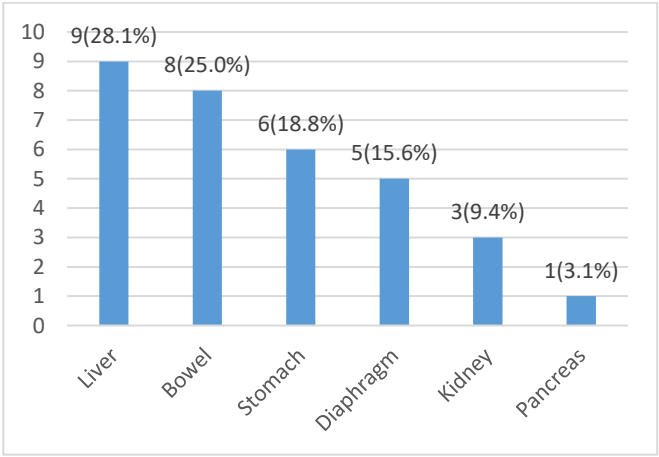

Figure 4. Associated intra-abdominal injuries.

Three patients experienced failure of non-operative management. Forty-six patients (48.4%) were managed conservatively. All patients managed conservatively did not undergo angioembolization. The hematocrit level at admission was higher in patients managed non-operatively compared to those managed operatively (34.90 vs. 33.30, p = 0.35). The majority of patients managed operatively required blood transfusion compared to patients managed non-operatively (73.5% vs. 28.3%, p = 0.01).

Table 6. Multivariate analysis for predictors of management

Management	**Non-operative management (n=46, 48.4%)**	**Operative management (n=49, 51.6%)**	**Total (N=95, %)**	***p*-value**
Admission hematocrit, median	34.90 (31.48–39.65)	33.30 (28.95–40.15)	34.80 (30.30–39.40)	0.35
Blood transfusion, n (%)				0.001
Yes	13 (28.3)	36 (73.5)	49 (51.6)	
No	33 (71.7)	13 (26.5)	46 (48.4)	
Blood unit, n (%)				0.75
>2 units	3 (23.1)	10 (27.8)	13 (26.5)	
2–4 units	9 (69.2)	21 (58.3)	30 (61.2)	
>4 units	1 (7.7)	5 (13.9)	6 (12.2)	
Hemoglobin level, n (%)				0.05
≤9 g/dl	3 (6.5)	10 (20.4)	13 (13.7)	
>9 g/dl	43 (93.5)	39 (79.6)	82 (86.3)	
Hemoperitoneum, n (%)				0.36
<500 m/s	0 (0.0)	12 (30.0)	12 (26.7)	
500–1000 m/s	2 (40.0)	12 (30.0)	14 (31.1)	
More than 1000 m/s	3 (60.0)	16 (40.0)	19 (42.2)	
Pattern, n (%)				0.73
Isolated	26 (50.0)	26 (50.0)	13 (13.7)	
Polytrauma	20 (46.5)	23 (53.5)	82 (86.3)	
Mechanism, n (%)				0.59
Blunt	43 (93.5)	47 (95.9)	90 (94.7)	
Penetrating	3 (6.5)	2 (4.1)	5 (5.3)	
Gender, n (%)				0.22
Male	38 (45.8)	45 (54.2)	83 (87.4%)	
Female	8 (66.7)	4 (33.3)	12 (12.6%)	

Table 7. Relationship between AAST grade and mode of management

AAST grade, n (%)	**Management**		**Total (N=95, %)**	***p*-value**
	Non-operative (n=46, 48.4%)	**Operative (n=49, 51.6%)**		
Grade I	10 (21.7)	3 (6.1)	13 (13.7)	
Grade II	13 (28.3)	9 (18.4)	22 (23.2)	
Grade III	17 (37.0)	12 (24.5)	29 (30.5)	0.001
Grade IV	2 (4.3)	13 (26.5)	15 (15.8)	
Grade V	4 (8.7)	12 (24.5)	16 (16.8)	

AAST (The American Association for the Surgery of Trauma)

Table 8. Outcome measurements of splenic injuries

	ICU stay, n (%)		*p*-value	Length of ICU stay, mean (SD)	*p*-value	Length of hospital stay, median (IQI)	*p*-value	Died/alive, n (%)		*p*-value
	Yes	No						Alive	Died	
Management										
Non-operative	2 (28.6)	44 (50.0)	0.43	0.33 (1.93)	0.31	12.00 (6.50–22.00)	0.18	43 (47.8)	3 (60.0)	0.59
Operative	5 (71.4)	44 (50.0)		0.80 (2.53)		18.00 (8.00–30.00)		47 (52.2)	2 (40.0)	
Pattern of injury										
Polytrauma	6 (85.7)	37 (42.0)	0.03	0.95 (2.69)	0.13	22.00 (10.00–30.00)	0.001	42 (46.7)	1 (20.0)	0.24
Isolated	1 (14.3)	51 (58.0)		0.25 (1.80)		10.00 (6.00–19.00)		48 (53.3)	4 (80.0)	
Grade of injury										
Grade I	1 (14.3)	12 (13.6)		1.08 (3.88)		10.00 (4.00–24.00)		11 (12.2)	2 (40)	
Grade II	2 (28.6)	20 (22.7)		0.45 (1.74)		22.00 (7.00–30.00)		22 (24.4)	0 (0.0)	
Grade III	0 (0.0)	29 (33.0)	0.24	0.17 (0.93)	0.59	16.00 (8.00–27.50)	0.34	28 (31.1)	1 (20.0)	0.16
Grade IV	1 (14.3)	14 (15.9)		0.40 (1.55)		19.00 (8.00–30.00)		15 (16.7)	0 (0.0)	
Grade V	3 (42.9)	13 (14.8)		1.19 (3.31)		10.00 (8.25–17.50)		14 (15.6)	2 (40.0)	
Mechanism of injury										
Blunt	7 (7.8)	83 (92.2)	0.52	0.60 (2.32)	0.57	14.00 (7.50–29.50)	0.91	85 (94.4)	5 (5.6)	0.59
Penetrating	0 (0.0)	5 (100.0)		0.00 (0.00)		15.00 (10.50–21.50)		5 (100.0)	0 (0.0)	

Most operative (79.6%) and non-operative (93.5%) patients had hemoglobin (Hb) above 9 g/dL with most requiring 2–4 units of blood. The difference in hematocrit (p = 0.35), Hb level (p = 0.05), blood transfusion units (p = 0.75), and hemoperitoneum (p = 0.36) was not significantly associated with the mode of management. However, the need for blood transfusion (p = 0.001) was significantly associated with the mode of management. The pattern of abdominal injury was not significantly associated with the mode of management (p = 0.73) (Table 6).

Seventy-five percent of patients managed operatively were AAST grade III to V compared to 50% of patients managed non-operatively. The mode of splenic injury management was statistically significant with AAST grade (p = 0.01) (Table 7).

Blunt abdominal injuries (94.7%) were the most common type of injuries among these patients. More than half of patients with blunt abdominal injuries were managed operatively. Of the five patients with penetrating abdominal injuries, three were managed non-operatively. Hemorrhage caused four (81.6%) of

the five post-operative complications, while sepsis caused one.

No patient with penetrating abdominal injuries was admitted to the intensive care unit (ICU), and no deaths were reported (Table 8). Five out of seven ICU patients were operated on, resulting in a longer stay (0.8 vs. 0.3 days, $p = 0.27$). Operated patients stayed in the hospital longer (18 vs. 12 days, $p = 0.18$). The overall mortality rate for splenic injury patients was 5.3%, with 3 non-operative deaths and 2 operative deaths. Mortality ($p = 0.59$), admission to ICU ($p = 0.27$), length of ICU ($p = 0.31$), and hospital stay ($p = 0.18$) were not statistically significant with the mode of management, as indicated in Table 8.

Forty-three (45.3%) patients presented with polytrauma, six of these patients were admitted to ICU. Admission to the ICU was significantly associated with patients having polytrauma ($p = 0.03$). Patients with polytrauma had a longer ICU stay (0.95 days) compared to patients without polytrauma (0.25 days). Similarly, patients with polytrauma had a longer hospital stay (22 days) compared to patients who did not have polytrauma (10 days). Length of hospital stay was significantly associated with polytrauma ($p = 0.001$). However, length of ICU stay was not significantly associated with polytrauma ($p = 0.13$) (Table 8).

Three of seven ICU patients had grade V injuries, one had grade IV. AAST grade did not significantly affect ICU admission, ICU stay, hospital stay, or mortality (Table 8).

Discussion

Splenic injuries are one of the most frequently damaged organs following abdominal trauma (16). Given the increased risk of infections following splenectomy, current practice emphasizes splenic conservation following trauma (16). The average age of patients was 29.4±11.8 years, with a higher proportion of males than females. The average age of the patients in this study is consistent with previous studies (7, 17), but contrasts with findings where the mean age was reported as 37 years (6, 12, 18).

The male preponderance in our study is consistent with other traumatic splenic injury studies (6, 7). In our study, the majority of splenic trauma cases were isolated. The majority of patients in this study presented within 24 hours post-injury. The majority of patients in this study experienced blunt isolated splenic trauma resulting from motor vehicle accidents and falls from heights. This aligns with findings from other studies (6, 19). The growing motorization, poor road infrastructure, urbanization, and noncompliance with road safety rules increase the likelihood of blunt abdominal trauma and motor vehicle accidents in our setting (6, 20).

Our study demonstrated that the most prevalent grade of splenic injury was grade III, and more than half of the patients had operative management with splenectomy being the most common procedure. These findings are similar to other study reviews (7, 12, 14); however, there is an increasing trend toward non-operative management across several studies, as evidenced (13, 21). Non-operative treatment of splenic injury is now the standard of care provided that patient selection is thorough (11). Splenectomy remains the main treatment option when the spleen is unsalvageable (22, 23). Our study found that low Hb, transfusion requirement, and high-grade splenic injury were predictors for surgical intervention. This matches research that showed high-grade splenic injuries required surgery (16). The need for surgery in these patients may have been due to hemodynamic instability. Other confounders including intra-abdominal injuries and other factors (pH, lactate levels) not evaluated in this study may have influenced therapeutic choice.

Five patients who received surgical intervention encountered complications, with four suffering from hemorrhage and one developing a surgical site infection and sepsis. The complications identified in this study align with those reported in previous research, which indicated that surgical site infection and hemorrhage are the most prevalent post-operative complications following splenectomy (6). Early recognition and management of complications following splenic injury is essential for reducing the morbidity and mortality resulting from these injuries. In this study, patients who underwent operative management had longer hospital stays compared to those managed non-operatively. The data in our study showed an overall longer length of

hospital stay compared to other findings reported (6, 7, 15). The length of hospital stay is an important measure of morbidity among trauma patients (14). The presence of severe trauma patients and a large number of patients with associated injuries may explain the prolonged hospital stays. The overall mortality rate was 5.3% among the patients, with those managed operatively having a higher mortality rate compared to those managed non-operatively. The overall mortality rate in this study was lower compared to studies that reported mortalities of 13.7–19.1% (7, 18). Other studies showed an overall mortality following splenic trauma to be 4%, which is comparable with data from our study (6). The high mortality rates observed in the above studies could be related to the fact that the majority of the patients were given operative treatment, which is associated with increased morbidity and mortality. Mortality following treatment of splenic injuries varies greatly and can depend on the age, the grade of injury, cohort of patients, injury severity, volume of blood transfusions, and state of the patient at presentation (7, 13).

The study design employed in our research was unable to assess the risk factors associated with the failure of non-operative management, which is a critical component in the treatment of these patients. This research constituted a single-center retrospective cross-sectional analysis. The inability to adjust for confounding variables in identifying outcome predictors constrained this study. This study concentrated on in-hospital complications; therefore, long-term complications were not evaluated. A multi-center prospective cohort study evaluating short- and long-term outcomes is recommended in this field. This study, however, provides local data on the feasibility, effectiveness, and outcomes of conservative treatment of splenic injury.

Conclusion

The most common cause of splenic injuries in our setting is blunt trauma resulting from RTAs. The majority of the splenic injuries were Grade III and IV, leading to splenectomy in most cases. Polytrauma patients are more likely to require a longer period of hospital stay. Although non-operative management of splenic injuries is gaining traction with good outcomes, operative management remains the mainstay in high-grade splenic injuries and in polytrauma patients.

Author contributions

ES led in conceptualization, formal analysis, investigation, methodology and in writing, reviewing & editing of the original draft. All other authors equally contributed.

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