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ORIGINAL RESEARCH

Management of splenic injury in blunt abdominal trauma- A cross-sectional study

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Abstract
Background: Spleen is the most commonly injured solid organ following blunt trauma. Motor vehicle collision account for more than 75% of splenic injuries. In up to 60% of patients, the spleen is the only organ injured, with mortality rates of roughly 8.5%.Some studies quote that more than half of blunt splenic injuries can be managed by non operative management with morbidity similar to or less than that of operative management. The management of blunt splenic trauma has therefore shifted towards non operative management.
Objective: To study the management of splenic injury in blunt abdominal trauma.
Material and Methods: A Cross-sectional study was conducted in the department of Surgery, Rohilkhand Medical College and Hospital, Bareilly from 1st November 2020 to 31st October 2021. 36 patients of splenic trauma were included in the study.
Result: All grade I and II and 7 out of 10 grade III splenic injuries were managed conservatively. Three patients with grade III splenic damage underwent surgical intervention, with one undergoing splenectomy and two undergoing splenorrhaphy. In Grade IV splenic damage, 6 out of 7 patients were managed operatively, splenectomies were performed in 5 patients, and splenorrhaphy was performed in 1 patient. All patients with grade V injuries underwent a splenectomy
Conclusion: In our study, patients with Grade I and Grade II splenic trauma and the majority of Grade III trauma a total of 52.5% of patients could be managed conservatively.
Keywords: Spleen**,** splenorrhaphy, blunt abdominal truama

Introduction

Blunt trauma of the abdomen accounts for approximately 79% of all abdominal injuries and is one of the commonest causes of injuries due to road traffic accidents. Sudden increase in the cases of blunt abdominal trauma can be attributed to a rapid increase in the number of motor vehicles on the road. Other mechanisms of blunt injury of the abdomen include fall from a height, assault with blunt objects, industrial mishaps, sport injuries, bomb blast and fall from a bicycle[1].

The spleen is the most commonly injured solid organ following blunt trauma. Motor vehicle collision account for more than 75% of splenic injuries. In up to 60% of patients, the spleen is the only organ injured, with a mortality rate of roughly 8.5%.[1].

The target is immediate diagnosis with the help of physical examination, vital signs, diagnostic imaging and laboratory values that can be helpful in detection of injury and guiding appropriate management[2].

Focused assessment with sonography for trauma (FAST) is really useful in hemodynamically unstable patients who require emergency exploratory laparotomy. In many patients splenectomy is a life saving measure. In hemodynamically stable patients CT scan of the abdomen and pelvis is the procedure of choice[3].

American association for the surgery of trauma (AAST) splenic injury scale helps in grading splenic injury. Grade I-III are classified as injuries to the spleen upto laceration greater than 3cm of the parenchymal depth or involving trabecular vessels as well as subcapsular hematoma greater than 50% of the surface area or greater than 5cm or expanding[4]. Grades IV-V include lacerations involving segmental or hilar vessels resulting in devascularization (>25%) up to complete devascularization or shattered spleen[4]. Grades I-IIIcanbe managed non-operatively, while Grades IV-V are typically managed surgically[3].

Some studies quote that more than half of blunt splenic injuries can be managed by non operative management with morbidity similar to or less than operative management, the management of blunt splenic trauma has therefore

shifted towards non operative management[1].
The present study was conducted to see whether there is a change in the way we manage splenic trauma in the present era of advanced medical care.

Materials and methods
This was a Cross-sectional study done in the Department of General Surger, Rohilkhand Medical College and Hospital, Bareilly from November1, 2020, to October 31, 2021. 36patients with a history of blunt abdominal trauma and splenic injury who visited the casualty department of Rohilkhand Medical College were included in this study.
All the patients were first received in the casualty department for emergency management.
After securing the airway and breathing, an intravenous line was secured, and blood was drawn and sent for blood grouping, typing, cross-matching, creatinine, electrolytes, sugar and hemoglobin percentage. Initially, Ringer's lactate was infused for resuscitation. Depending on the severity of injury if the patient was not responding to initial crystalloids, compatible whole blood transfusion was given.
All the patients under went a chest X-ray PA view and FAST was done in the emergency room. Hemodynamically stable patients underwent contrast-enhanced computed tomography (CECT) scans to grade the splenic injury and identify other visceral injuries and chest injury.
Those who had moderate haemoperitoneum as per focused abdominal sonar for trauma (FAST) and were hemodynamically unstable despite resuscitation and those with clear signs of hollow viscus perforation were taken up for exploratory laparotomy without delay.
"Grading of splenic injury was done according to the injury description given by the American Association for the Surgery of Trauma (AATS) splenic Injury Scale.[5]

Table 1: Percentage of splenic injury as per AAST classification
- Grade I
  - Subcapsular hematoma <10% of surface area
  - Parenchymal laceration <1 cm depth
  - Capsular tear
- Grade II
  - Subcapsular hematoma 10-50% of surface area
  - Intraparenchymal hematoma <5 cm
  - Parenchymal laceration 1-3 cm in depth
- Grade III
  - Subcapsular hematoma >50% of surface area
  - Ruptured subcapsular or intraparenchymal hematoma ≥5 cm
  - Parenchymal laceration >3 cm in depth
- Grade IV
  - Any injury in the presence of a splenic vascular injury or active bleeding confined within the splenic capsule
  - Parenchymal laceration involving segmental or hilar vessels producing >25% devascularization
- Grade V
  - Shattered spleen
  - Any injury in the presence of splenic vascular injury with active bleeding extending beyond the spleen into the peritoneum"

Hemodynamically stable patients with grade 1 to 3 splenic injuries with no other intra-abdominal injuries necessitating exploratory laparotomy were chosen for Non-Operative Management. Others were subjected to exploratory laparotomy and splenectomy if required. Non-Operative Management patients were monitored clinically and with ultrasonography (USG) of the abdomen every day for a period of 2 weeks. Those patients while on non-operative management who subsequently developed internal bleeding underwent splenectomy.[6]
Injuries to the head, thorax, bowel, bones, or other solid organs that were also present were treated in accordance with their respective guidelines..
Due to the lack of interventional radiologists and endovascular surgeons in our institute, splenic artery embolisation was not used to treat splenic injuries in this study.

Inclusion Criteria
36 patients of blunt injury to the abdomen with splenic trauma.

Exclusion Criteria
Penetrating abdominal injuries
Results
This study included 36 patients of blunt splenic trauma admitted in the surgical units of Rohilkhand Medical College and Hospital, Bareilly. The majority of study participants were between the ages 21 and 30 (27.78%). Those in the age group 31-40 years accounted for 22.2% patients.

27 (75%) of the cases were men and 9 (25%) were females. Road traffic accidents accounted for the majority of cases (52.8%), followed by industrial accidents accounting for 19% of the patients. 30% of the injuries were grade I or II, and about a quarter each were grade III (27.8%), IV (20.6) and V (22.0%), respectively (Table 1).We observed that splenic injuries were commonly seen in road traffic accidents (19 cases) with a correlation coefficient of 1.

Abdominal pain and tenderness were the most common clinical presentationsupto grade III splenicinjuries whereas shock, guarding and rigidity (85% to 100 %) were seen in grade IV and V injuries.Totalnumbers of stable and resuscitated patients were 94.4% and 5.6% were unstable.

We discovered that 72.3% of splenic injuries were related with other injuries. Left sided thoracic injurywas the most common related injury (30.2%), followed by head injury (24.4%). The proportions of associated orthopedic injury, solid organ injury, and intestinal injury was 21.2%, 15.1%, and 9.1%, respectively.99% of patients had a CT scan of the abdomen and pelvis either before surgery or after resuscitation. In our study, the sensitivity and specificity of CT scans was 90.20% and 92.40%, respectively in diagnosing splenic injury and their grade correctly.

All grade I and II splenic injuries were managed conservatively. Conservative or operative management for Grade III injuries was case specific. Grade IV and V required surgical intervention. Three out of ten patients with grade III splenic damage underwent surgical intervention, with one undergoing splenectomy and two undergoing splenorrhaphy. In Grade IV splenic damage, 6 out of 7 patients were managed operatively, splenectomies were performed in 5 patients, and splenorrhaphy was performed in 1 patient. All patients with grade V injuries underwent a splenectomy (P value 0.001).

Associated Injuries		**Grade of Splenic Injury (AAST)**					**Total**
		I	**II**	**III**	**IV**	**V**	
No. of patients		n=3	n=8	n=10	n=7	n=8	**36**
Isolated splenic injury	N	2	5	5	1	0	13
Head Injury	N	1	2	2	2	1	8
Solid organ injury	N	0	0	1	2	2	5
Bowel injury	N	0	0	2	1	0	3
Orthopedic injury	N	0	0	2	2	3	7
Thoracic injury	N	0	0	2	4	5	11

Early Complications werepleural effusion (19.4%) and surgical site infections (5.5%) following operative management. Late complications weresubphrenic abscess (11.1%), Pneumonia (5.5%), significantly higher in the operative group than in the non operative group.

Mortality rate was 8.33% (3 out of 36). 91.7% patients (33 out of 36) managed both surgically and conservatively improved after treatment. There was a significant survival rate amongst the patient who presented with less severe grade of splenic injury compared to higher grade (IV and V).

Discussion

This study included 36 patients admitted in the surgery department with splenic injury from blunt abdominal trauma

Figure 1: Intra operative image of splenorrhaphy in GradeIV splenic injury

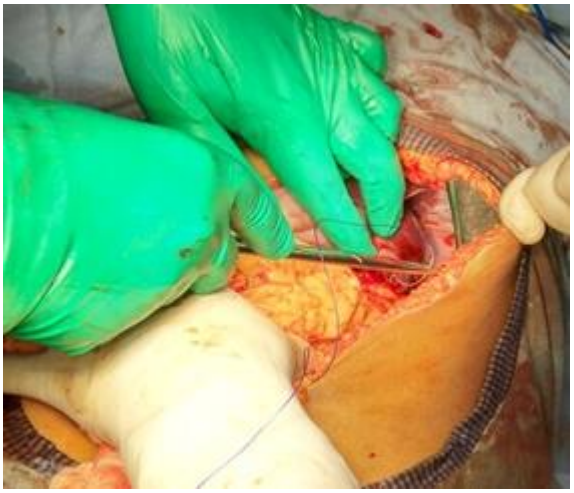

Figure 2: Post operative imaging of Shatteredspleen

Abdominal trauma is the leading cause of morbidity and mortality during the first four decades of life and is the third commonest reported cause of death overall.Of the 36 patients, 27(75%) were males and 9 (25%) were females. The majority of patients were between the ages 21- 30, 27.78% of the total, followed by those between the ages of 31 – 40 (22.22%). Similar findings were reported by Matthew C. Hernandez et al.[7] 2020. in a study that involved 127 individuals who had splenic injury. In their study 42 (33%) were women and 85 (67%) were males.

In our study road traffic accidents causing blunt splenic injury trauma accounted for 52.8% of patients (19/36). 19.4% of patients (7/36) presented with injury due to industrial accidents and 16.7% of patients (6/36) presented with injury due to fall from a height (such as tree and building roof). Assault as a cause of injury was seen in 11.1% of patients (4/36).These figure correlate with the study of MuddasarShahzadet al[2] (2019). Road traffic accidents (52.8%) were the single most important cause for splenic injury in our study that these injuries occur in people in their most active and productive phase of life assumes special significance.

In our series, 83% of patients (31/36) presented with abdominal pain. Most of them had additional abdominal tenderness.80% of patients (29/36) on examination had abdominal tenderness, guarding and rigidity. Bowel sounds were present in only 61.1% of patients (22/36). Tripathi et al. also reported abdominal pain as the commonest symptom in 91.4% of their cases of splenic trauma. Ahmed et al.[8] documented that the rigidity was observed only in 10%of their cases mainly to the left side of the upper abdomen. Jervis et al[9] observed that rigidity was a reliable finding in a patient with blunt abdominal trauma. In his study the most common symptoms and signs were abdominal pain with associated guarding and rigidity.

63.2% of patients had associated injuries. 27.8% of patients (10/36) presented with thoracic injuries and 22.2% of patients (8/36) with head injury. 5% of the mortality (2/36) was due to associated injuries. This included one patient of hemorrhagic shock from a pelvic fracture and one patient with subdural hematomain grade V splenic trauma. This figure correlates with a study done by Kaiying Yang et al[9] who concluded that the most common associated injury with splenic trauma was lung injury (26.7%), followed by brain (21.8%) and liver injury (21.8%). Kundavaram Paul et al[1]observed injuries to the chest (23.5%), long bones (17.6%), other abdominal injuries (37.2%), pelvis (5.9%), head (13.7%) and spine (9.8%) as common associations to splenic injuries. Gaby Jabbour at el[10] concluded that (35.1%) splenic injury patientsalso had other solid organ injuries such as that of the liver (19.9%), kidneys (17.8%), and pancreas (4.2%).

In our series, 100% of patients underwent an ultrasound scan of the abdomen and pelvis preoperatively. The sensitivity of ultrasound scans for detecting haemoperitoneum in our series was 84.81% similar to 82% reported by Bode et al[11] and 81.8% by Golleti et al.[11] Rozycki et al.[12] found aspecificity of 99.7% and sensitivity of 81.5% for their ultrasound scans.

In our study a CT scan was performed in 35 patients who did not merit an immediate laparotomy on clinical grounds. It was found to be accurate in distinguishing a subcapsular hematoma from a splenic laceration with free intraperitoneal blood and helped diagnose accurately associated injuries to other intraperitoneal and retroperitoneal structures. We found a 93.6 % sensitivity for CT scans in our study. Similar results were found in a study conducted by Kranthi Kumar Marathuet al[13]. All their patients underwent an Ultrasound and CT scan of the abdomen. The patients with haemoperitoneum or abdominal visceral injury or both were considered as positive for intra abdominal injury. The detection of organ injuries and haemoperitoneum on USG were correlated with CT findings. The overall sensitivity of USG in the detection of solid organ injuries was 83.3% and specificity was 87.5%. The PPV was 93.7%, NPV was 70% and accuracy was 84%. The overall sensitivity and specificity in this study with respect to detection of solid organ injuries by CT was 94.7% and 100% respectively.

54.78% patients of grade I and II (19/36) were managed non-operatively 44.4% (17/36) were managed operatively. 11.1% of patients (5/36) were initially managed non operatively. one patient of grade III and two patents of grade IV underwent exploratory laparotomy within 6 - 12 hours and the remaining two patients of grade III and IV

underwent surgery between 12 – 18hours. 75 % of the operatedpatient were taken up for laparotomy within 6 hours.

Of the 36 patients, 11.1%(4 patients) of grade III & IV initially managed non-operatively were converted to operative management. Splenorrhaphy was done in3 patients (two patients of grade III &one patient of gradeIV were of 17.6% patients). Splenectomyweas done in 14 patients (one patient of grade III , five patients of grade IV &eight patients of grade V).

Early complications of splenic injury in our study were pleural effusion (19.4%) and surgical site infections (5.5%) in the operative group. Late complications, subphrenic abscess (11.1%) and pneumonia (5.5%) were considerably greater in the surgical group as compared to the non-operative group. Similar results were found in a study by Sarah Corn et al.[14] in which the incidence of wound infections (11.5% vs 1.3% vs 0%, $p < 0.001$), pneumonia (12.3% vs 7.9% vs 1.3%, $p = 0.033$), and other complications, such as urinary tract infection, deep vein thrombosis, and pressure sores (46.6% vs 17.6% vs 5.3%, $p < 0.001$) were significantly higher in the operative group than in the nonoperative and embolization groups.

Conclusion

Road traffic accident is the commonest cause for blunt splenic injury. In our study,the most common age group involved was 21-30 years predominantly males. Blunt splenic injury usually presented with abdominal pain and tenderness in grade I &II injuriesand with shock, guarding and rigidity in grade IV and V injuries.Improvements in assessment of injuries with adjuncts such as the FAST and higher resolution CT scanners have allowed reliable identification of grade of injury and associated injuries that can guide the surgeon either to immediate laparotomy, angiography, or a non-operative course. All grade I and II splenic injuries were managed conservatively. Injuries of grades III, IV, and V required surgical intervention. 7 out of 10 Grade III splenic injuries could be managed conservatively. Three were underwent surgical intervention. Out of these 3 patients splenectomy was done in one and splenorhraphy was done in the other two patients. In Grade IV splenic injury, 6 out of 7 patients were managed operatively, splenectomies were performed in 5 patients, and splenorrhaphy was performed in 1 patient. All patients(8 out of 8 patients) of grade V splenic injury underwent splenectomy. Surgical site infection, pleural effusion, pneumonia were the common complications in the operative group and subphrenic abscess was common in thenon operative group.Overall mortality due to splenic injury abdomen was 8.33 %(3 out of 36). 1 out of 3 patient died due to pulmonary thromboembolismwhich occured due to pelvic fracture and associated head injury in 2 out of 3 were the major causes of death.

In our study, patients with Grade I and Grade II splenic trauma and the majority of Grade III trauma a total of 52.5% of patients could be managed conservatively. Conservative management with its obvious immunological advantages is an extremely viable option for splenic injuries.

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