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Splenic Injury in Blunt Trauma Abdomen - Study in A Tertiary Care Centre

Dr. Abhijit Medhi, Dr. Hussain Ahmed*
Department of General Surgery, Guwahati Medical College and Hospital, Guwahati, Assam, India
Corresponding Author-Dr. Hussain Ahmed (Associate Professor)
Department of General Surgery, Guwahati Medical College and Hospital, Guwahati, Assam, India

ABSTRACT
Background: *One of the most often injured solid organs in traumatic abdominal injury is the spleen, which frequently has a high mortality and morbidity rate. The management approach gradually shifted to non-invasive management with improvements in diagnosis and therapy. The goal of this study is to examine the clinical presentation of a patient with splenic trauma, the value of FAST and CT scans in such patients, and the line of care with particular emphasis on non-operative management.*
Methods: *Between June 2021 and May 2022, 50 patients with splenic injuries who were admitted to the Department of Surgery at the GMCH were included in this prospective study. Demographic information, injury mode, investigation results, management and result, hospital stay, and follow-up information were all documented and examined. The severity of the splenic damage was determined using USG (FAST) and CT scan results.*
Results: *The study involved 50 patients. All patients with Grade I and II injuries underwent conservative management. Twenty patients with Grade III injuries received non-operative care, while two individuals underwent surgery. Six patients needed surgical intervention for Grade IV injuries, whereas three patients were handled non-operatively. All patients with Grade V damage required surgical intervention. As a result, non-operative therapy of splenic damage is becoming more popular, especially in the lower Grades.*
Conclusions: *Through careful monitoring, rest, blood transfusion, and repeated imaging examinations, particularly CT scan, non-operative therapy of splenic injury can be carried out without a rise in mortality and morbidity.*

Keywords: *Splenic injury, Ultrasonography FAST, Computed Tomography (CT) scan, Angiography*

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I. Introduction

Trauma is the third most prevalent cause of death overall and the primary cause of death and disability in the first forty years of life.

The abdomen receives top importance during the examination of the injured patient due to the included organs and tissues. Blunt trauma can cause solid organs to be lacerated, which can cause bleeding and, in severe cases, hemorrhagic shock.Abdominal stiffness or hemodynamic compromise are signs that immediate investigation is necessary.

Prior to the widespread adoption of ultrasonography and FAST, Diagnostic Peritoneal Lavage (DPL) played a crucial role in the evaluation of patients who had sustained multiple traumas.The most often wounded intra-abdominal organ is the spleen, which is present in 50.7% of patients with blunt abdominal trauma and 3.2% of all injured individuals.

Motor vehicle accidents account for most of the cases of splenic injury.Splenic injury can now be accurately identified due to advancements in injury assessment with adjuncts like abdominal computed tomography (CT) and focused assessment with sonography for trauma (FAST).

Early detection and treatment of splenic injury are essential. Splenic injury treatment options range from non-operative management (NOM) to surgical management (OM), which is nonetheless difficult for surgeons to perform and is
occassionally compounded by life-threatening complications.NOM has been expanded to treat trauma patients in adults and has a >90% success rate in paediatric patients.

The following study provides the detailed understanding of different modes of presentation, different grades of splenic injury and various modalities of management of the same.

II. AIMS AND OBJECTIVES

1. To determine the various modes of splenic injury and clinical presentation of cases.
2. To determine the value of various available investigations employed.
3. To determine whether conservative or surgical management to be opted for.

III. MATERIALS AND METHODS

The clinical materials of this prospective study consist of detailed study of patients with splenic injury attending Guwahati Medical College and Hospital from 1st June, 2021 to 31st May, 2022.

METHODS OF DATA COLLECTION:

1. The patients selected for this study are diagnosed cases of splenic injury which were admitted to the hospital from 1st June, 2021 to 31st May, 2022 either preoperatively or intra operatively.
2. Initially, all patients were provided with a brief general examination and a clinical history describing the mode of splenic damage as soon as they arrived at the surgical outpatient department or casualty and also to check their vital signs and search for any external bleeding caused by a related injury. If the patient was unconscious or in shock, immediate resuscitation techniques were used. Each patient underwent a thorough examination of the abdomen and other systems and appropriate investigations were done including Hemoglobin, hematocrit, USG and CT abdomen.
3. The patients were monitored closely before a decision was made about whether to do a laparotomy or continue with conservative treatment. Laparotomies were performed on patients who did not respond to conservative treatment, who had unstable hemodynamics, who had deteriorated despite vigorous resuscitation, and who displayed signs of ongoing intra-abdominal bleeding and peritonitis.

INCLUSION CRITERIA:

Patients with blunt abdominal trauma with documented radiographic evidence of injury to spleen.

EXCLUSION CRITERIA:

1.Head injury with splenic injury
2. Splenic trauma associated with other solid organ or hollow viscus injury.
3. Pre-existing liver and/or splenic diseases and other significant co morbidities.

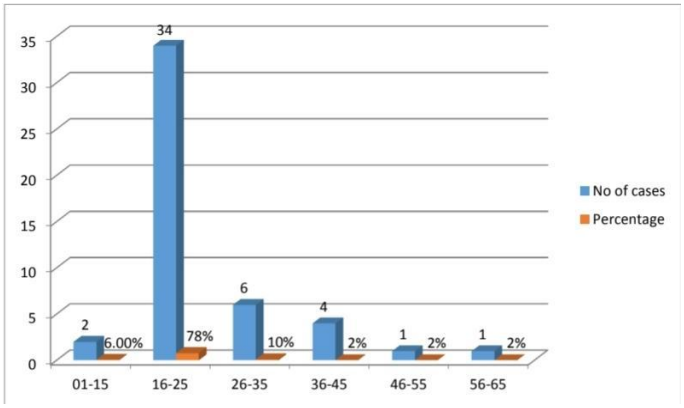
IV. RESULTS AND OBSERVATIONS

50 patients admitted in the Department of General Surgery, Gauhati Medical College during the period of study from 1st June 2021 to 31st May 2022, were taken up for this study.

1. Age distribution:

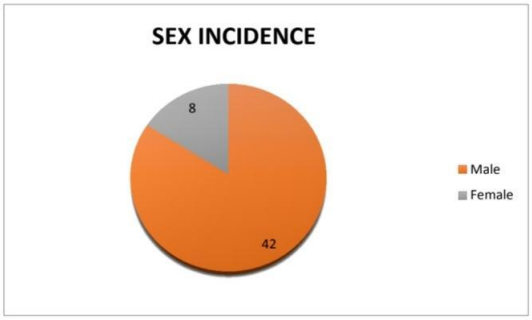
Age of the patient varied from 1 year to 65 years. Peak incidence was in the age group of 16-25 years.

CHART NO.1 AGE DISTRIBUTION IN STUDY GROUPS:



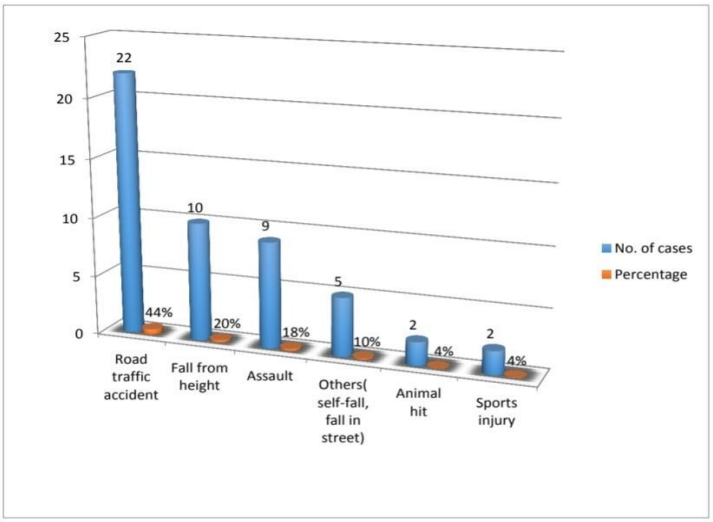
2. Distribution of Gender:

CHART NO.2 GENDER DISTRIBUTION:



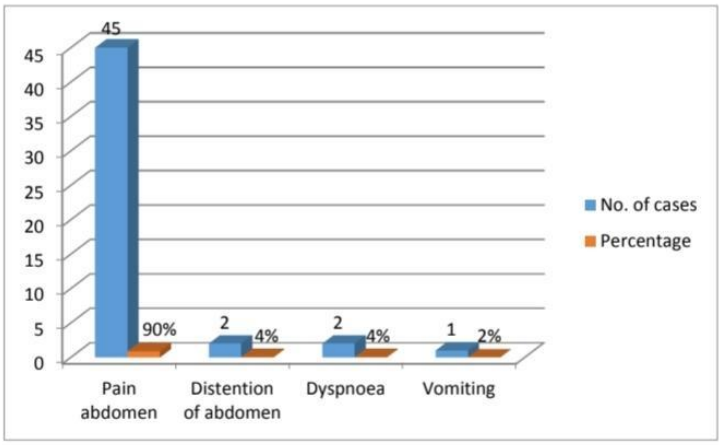
3. Causative Factors:
Road traffic accidents were the commonest cause of splenic injury accounting for 44% of the cases (22/50) followed by fall from height 20% (10/50), physical assault 18% (9/50) and street injury 10 % (5/50). These cases included isolated splenic injuries.

CHART NO.3: CAUSATIVE FACTORS



4. Mode of presentation
Pain was the most common presenting symptom (84%). Distension of abdomen was the next in frequency with 2 patients (4%), followed by vomiting (10%) and 1 patient with tenderness in left hypochondrium (2%). 3 patients (8%) were in shock.

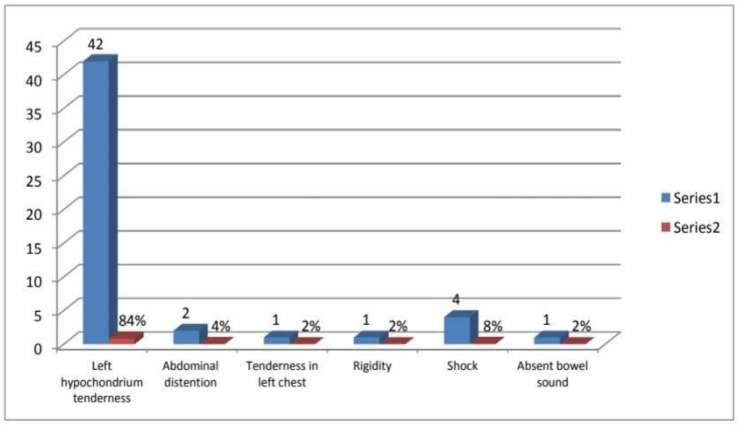
CHART NO.4: MODE OF PRESENTATION:



5. Physical findings :

Among the physical signs, abdominal tenderness was the most common physical finding being present in 42 (84%) patients followed by abdominal distention in 2 (4%) patients, tenderness over the chest in 1 (2%) patients, shock in 3 patients (6%), abdominal rigidity in 1 (2%) patients and absent bowel sound in 1 patients (2%).

CHART NO.5:PHYSICAL SIGN:

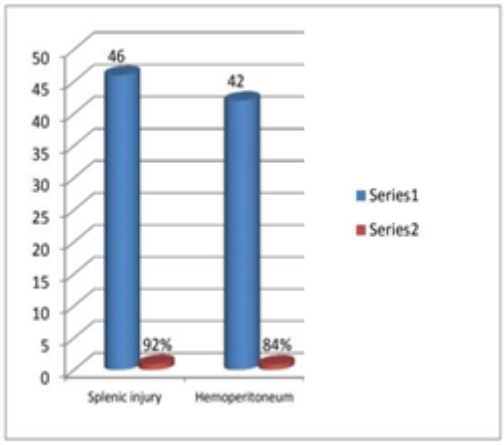


6. USG Findings:

Splenic injury was detected in 46 patients (92%), hemoperitoneum in all the 50 patients, with variability in degree (100%).

In both the cases of Grade I splenic injury and in 2 cases of Grade II injury, only mild to minimal to mild hemoperitoneum was reported without any documentation for splenic injury. 3 patients with Grade V splenic injury with shattered spleen with gross hemoperitoneum as reported in the USG (FAST) were taken directly to the operating room as vitals of these patients were also suggestive of higher grade of splenic injury.

CHART NO.6:USG FINDINGS:



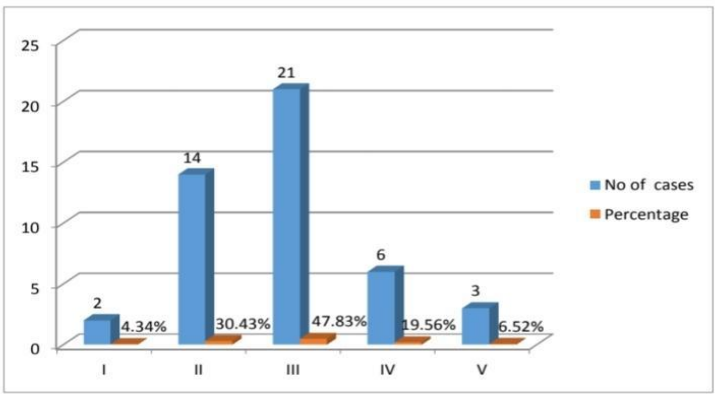
7. CT scan abdomen findings:

47 patients had undergone CT scan. All patients had splenic injury with associated hemoperitoneum of variable degrees according to the grade of splenic injury

TABLE NO.7: CT FINDINGS IN 47 PATIENTS OF SPLENIC INJURY

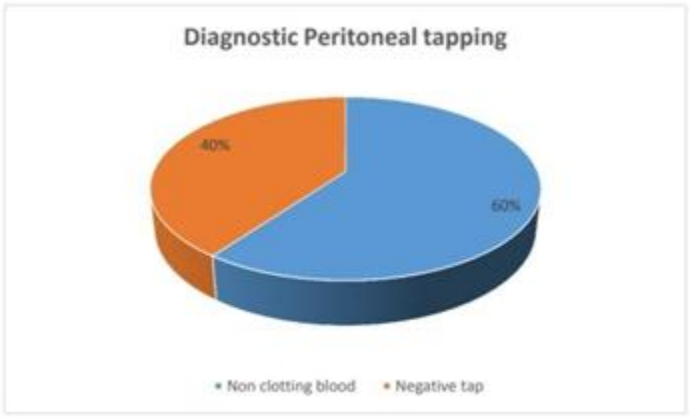
SL. No.	Grade	Findings	No. of cases	Percentage
1	I	Subcapsular hematoma <10% surface area Parenchymal laceration <1cm depth Capsular tear	2	4%
2	II	Subcapsular hematoma 10%-50% of surface area Intraparenchymal hematoma <5cm Parenchymal laceration 1-3cm	14	30%
3	III	Subcapsular hematoma >50% surface area Ruptured subcapsular or intraparenchymal hematoma >5cm Parenchymal laceration >3cm depth	22	47%
4	IV	Any injury in the presence of a splenic vascular injury or active bleeding confined within the splenic capsule Parenchymal laceration involving segmental or uhilar vessels producing >25% devascularization	9	19%
5	V	Any injury in the presence of a splenic vascular injury with active bleeding extending beyond the spleen into the peritomneum Shattered spleen	Not done as were directly operated.	
		Total	47	100%

CHART NO.7 CECT FINDINGS



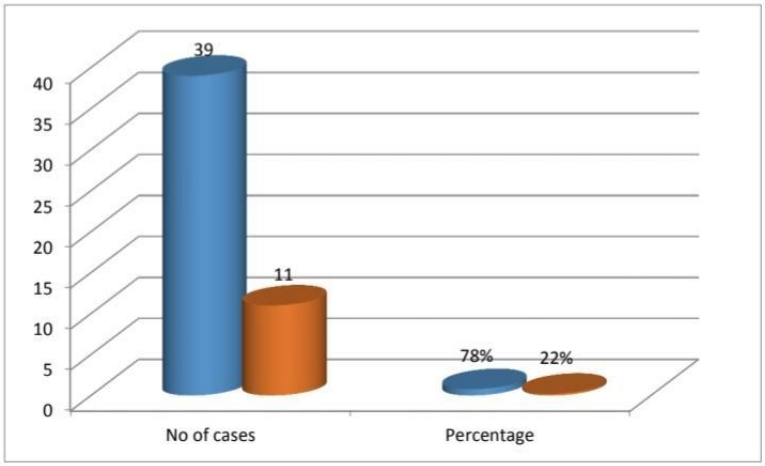
8. Diagnostic Peritoneal Tapping results:

Diagnostic peritoneal tap was performed in all patients with splenic trauma. Non clotting blood was present in 30 cases while the remaining 20 patients had a negative tap.



9. Management :
39 out of 50 patients (78%) were managedconservatively with rest, nasogastric aspiration,intravenous antibiotics, intravenous fluids, bloodtransfusion, analgesics & sedatives and splenic arteryembolization. Rest 11 patients (22%) had undergoneoperative management.

CHART NO.9: TREATMENT OPTIONS AND THEIR DISTRIBUTION:



Conservative management:
Criteria taken for conservative or non-operative management.
a) Hemodynamically stable patients
b) Absence of diffuse guarding/ rigidity/peritonitis
c) Glasgow Coma Score is 15/15
d) No other indications for surgery or no clinical deterioration.

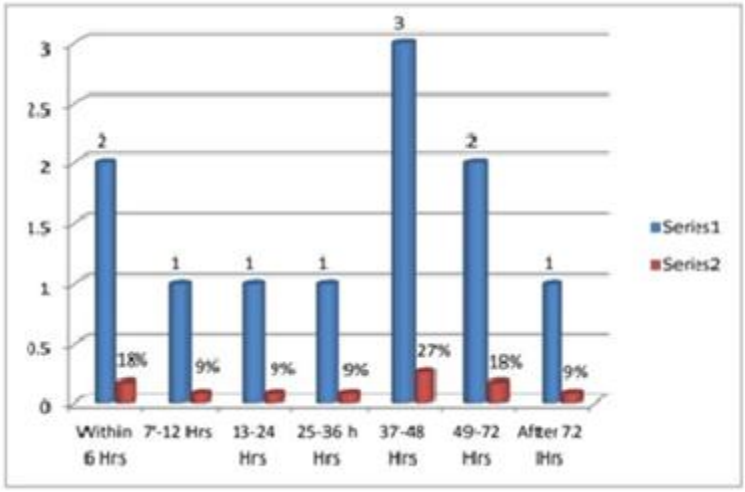
The patients meeting the above criteria were admitted. The following measures were taken :
1. **Strict bed rest with serial monitoring** of the vitals and serial abdominal examination and hematocrit monitoring.
2. **Antibiotics**
3. **Intravenous fluids**,**bloods and blood products**- were given according to need.
5. **Analgesic and sedative.** .
6. **Repeated USG Whole abdomen** after 48hrs and at 7 days from time of injury.

Operative management

For any patient who had the following circumstances as enumerated below, a decision for laparotomy was taken.

1. Signs of clinical deterioration requiring the need of an ICU.
2. Otherwise unexplained sustained hypotension (Systolic BP < 90 mmHg with further fall in erect posture) since admission, not responding to fluid challenge.
3. Progressively dropping Hb% levels by > 1.5 gm% or systolic BP < 90 mmHg or progressively falling haematocrit.
4. Signs of increasing abdominal tenderness, generalized guarding, distension and absence of bowel sounds.
5. On repeat abdominal USG, increase in size of the splenic hematoma seen.
6. CECT (Whole abdomen) with angiography showing active blush.

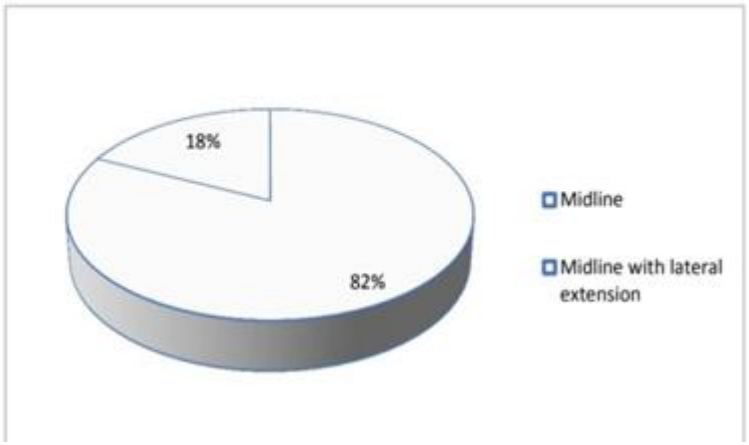
10. Time interval between injury and operation



Anaesthesia - General Anaesthesiain all the operated cases.

11. Incisions

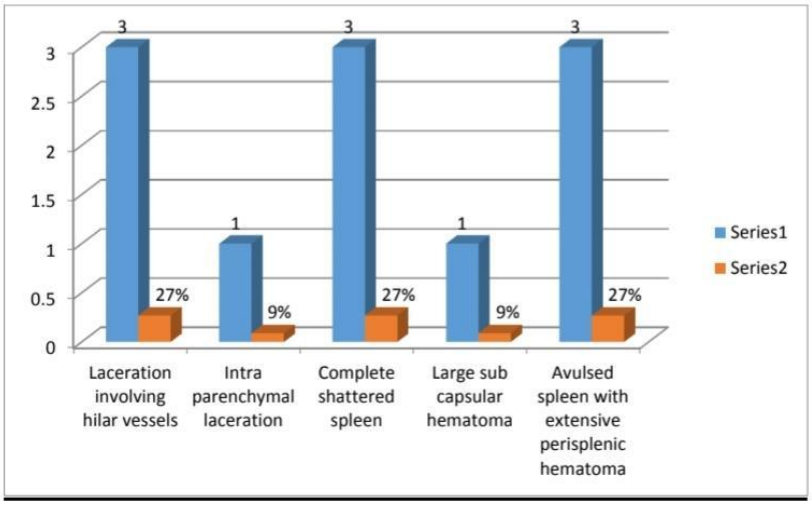
CHART NO.11:TYPES OF INCISION:



12. Operative findings:

The splenic injuries varied from large sucapsular hematoma, intraparenchymal laceration, laceration involving hilar vessels to completely shattered spleen and splenectomy was done in all those cases. Blood in peritoneal cavity was found in all such cases.

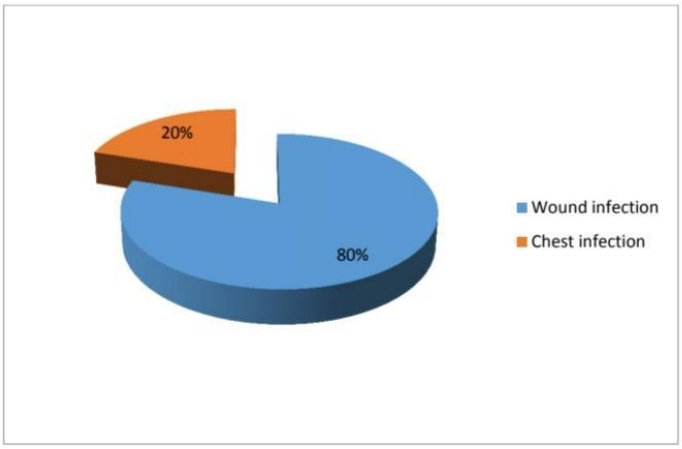
CHART NO.12:OPERATIVE FINDINGS:



13. Complications :

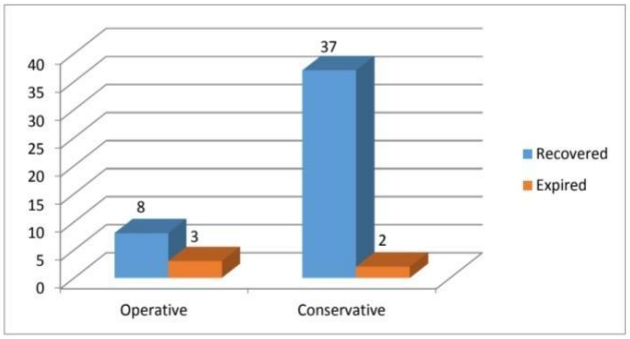
Post-operative complications with surgical site wound infection in 4 and chest infection in 1 were found.

CHART NO.13: INCIDENCE OF POSTOPERATIVE COMPLICATION:



14. Mortality

CHART NO.14: MANAGEMENT AND OUTCOME:



15. Follow up

All patients could be followed up to the first and second visit. During the follow up period patients were examined for evidence of thrombocytosis, overwhelming post splenectomy infection or infection with capsulated.

V. DISCUSSION

In the current study, individuals between the ages of 16 and 25 made up the majority of the population, accounting for 78% of all cases (34 out of 78 patients).

The patient's age ranged from 1 to 65. These findings agree with those of Elmo et al. (1970)[(1)], who discovered patients with ages ranging from 7 to 71 with a mean of 43. Between 4 and 82 years old, the mean patient age was found by Peter et al. in 1986[(2)], and between 55 and 98 years old, the mean patient age was found by Siriratsivawong et al. in 2007[(3)].

According to Tugnoli et al. (2014)[(4)], the average age of the patients ranged from 4 to 98 years old. Patients between the ages of 16 and 85 were found by Chastang et al. (2015)[(5)], with a mean age of 39.

Male participation in this study was significantly higher than female participation, with a relative percentage of 84% for men and 16% for women. Analyses of other series reveal comparable outcomes. This is consistent with the study done by Elmo et al. in 1970[(1)], which demonstrated the incidence of male and female as 84.98 and 15.01%.

According to Peter et alstudy's from 1986[(2)], there were 69.69% men and 30.0% women. In a retrospective analysis, Harbrecht, Brian, et al. (2004)[(6)] discovered a male to female incidence of 66.60% and 33.40%. Male to female incidence was reported to be 51.88% and 48.12%, respectively, by Siriratsivawong et al. in 2007[(3)]. According to Tugnoli et al. (2014)[(4)], male-female incidence is 98% and 2%, respectively. Males are more likely to sustain splenic trauma than females because of their outside jobs, which expose them to more trauma.

In the current investigation, it was discovered that motor vehicle accidents accounted for 44% of cases where blunt splenic damage occurred. This number is consistent with research by W. E. Longo et al. (1989)[(7)], which found that out of 60 cases involving motor vehicle accidents, 20% involved blunt splenic trauma. In a 1990 study by MA Malangoni et al,[(8)] out of a total of 37 patients, there were 7 adults and 12 children who had cases related to motor vehicle accidents.

According to studies by Satish D. and T. T. Changlani et al. (1994)[(9)], Bryan G. Garber et al. (1996)[(10)], and Powell and colleagues[(11)] (1997), motor vehicle accidents accounted for 54%, 69%, and 67% of all deaths, respectively. According to R. Khanna et al. (151) (1999)[(12)], road traffic accidents caused 52% (17 patients) of blunt abdominal trauma, while blunt object blows to the abdomen caused 33% (11 patients), and falls from height caused 15%. (patients of injuries). (27) According to a study by Dheer S. Kalwaniya et al. (2019)[(13)] at Safdurjung Hospital, splenic injury in blunt trauma abdomen is caused by road traffic accidents 60% of the time, falls from heights 18% of the time, assaults and other reasons 12% of the time.

Three (6%) of the patients in the current series displayed shock.Hypovolemia was the cause of shock, and it could also have been a reaction to intense pain or fear. According to a study by Sanjay Sisodiya et al.[(14)] done in July 2020 at Gandhi Medical College in Bhopal, shock with sepsis and cardiopulmonary arrest were the two most frequent causes of mortality after traumatic abdominal injuries. In 2015, Ahmed et al.[(15)] published in the International Surgery Journal that the shock rate was 13.33%. According to Storck[(16)], shock following abdominal injury may be caused by hypovolemia, psychogenic factors, or neurogenic factors.

In 63.33% of patients, tenderness was noted, more frequently in the left hypochondrium and epigastrium. According to Whiteshell et al,[(17)] the patient's splenic laceration was consistently dominated by soreness. In 1991, Tripathi et al.[(17)] observed that 91.4% of cases had discomfort. In 2015, Ahmed et al.[(15)] reported in the International Surgery Journal that the left hypochondrium and epigastrium were sore in 63.33% of patients and more.

Clinical Traits

Symptoms: In 90% of cases, abdominal pain was the only symptom recorded (45 patients). Mild to moderate pain was present. However, Storck[(16)] noted that pain is frequently insignificant or nonexistent. It was listed as one of the most prevalent signs of abdominal trauma by Loris (1948)[(18)].Whiteshell[(17)] noted that symptoms of a splenic laceration were predominately pain-related.In 91.4% of cases, Tripathi et al.[(17)] reported pain.

One patient (2%), who vomited, was identified. According to Griswold and Collier,[(19)] vertigo, nausea, and vomiting are almost always symptoms of splenic damage.Arlet et al.[(20)] discovered a 28% splenic laceration in patients who were continuously dominated. Tripathi et al.[(17)] noted that 91.4% of cases involved tenderness.

Signs: Rigidity was noted in one case (2%) in the current investigation, and it mostly affected the left side of the upper abdomen. In patients with blunt abdominal injuries, stiffness was observed by Jarvis et al.[21] to be a trustworthy observation. Two instances had fixed splenic dullness (the Ballance sign).

According to Cope, a demonstration of fluctuating dullness in the side is adequate to show that solid visceral bleeding is occurring.However, in many cases of splenic damage, the dullness on the left side cannot be changed (Ballance sign).

All 50 cases of splenic trauma were diagnosed by ultrasonography (FAST) of the abdomen as soon as the patients arrived at the surgery department (within 15-20 minutes). According to Johns et al, abdominal trauma can be treated with USG in 10-15 minutes, and the procedure can be repeated to monitor the healing process.

Ultrasonography (FAST) is a common study for blunt abdominal trauma and is proven to be safe, accurate, completely non-invasive, and time-efficient. It also successfully detects splenic injury in 46 out of 50 patients (92%) prior to surgery.

According to Karen J. Brasel et al.[22], skilled hands could use ultrasound with a 95.6% accuracy rate. Specificity of 99.7% and sensitivity of 81.5% were reported by Rozycki et al.[23] According to Mathew J. Kuehnert,[15] in 25 out of 25 cases, ultrasonography was able to identify anomalous fluid, including hemoperitoneum and isolated splenic parenchymal injuries in 22 of 25 patients .

Diagnosis

Early diagnosis of clinically significant abdominal injury is aided by Focused Assessment with Sonography for Trauma (FAST) evaluation of the perihepatic, peri-splenic, and pelvic areas. FAST examination is a fantastic auxiliary to physical examination that may be carried out frequently.

Diagnostic peritoneal tap (aspiration): In all 50 cases, a bilateral flank tap or a four quadrant tap was done, with positive results in 30 cases andnegative results in 20. Aspiration of any liquid was regarded as a positive tap. Negative taps were those thatshowed no aspirate. The full positive tap was consistent with the results of surgery.

A CT scan was done on 47 different patients. Cases that didn't require an initial laparotomy due to clinical considerations or other investigative results were then given a CT scan of the entire abdomen for additional assessment.

It was carried out on 47 patients and was found to be reliable for differentiating between a subcapsular hematoma and a splenic laceration with free intraperitoneal blood. It also aids in accurately diagnosing any associated injury to other intraperitoneal and retroperitoneal structures, which is crucial for the conservative management of splenic rupture.

In 1982, Federale and Co-workers[15] reported that 200 patients with acute abdominal injuries had CT scans that were 99% accurate. The majority of individuals with grade 1 and grade II splenic injury don't require surgery to be treated. Sutyak and coworkers[24] in 1994 stated CT in 49 patients had 43 splenic injuries that were surgically connected to the CT results.

According to a 2012 study by Stassen and colleagues[25], an intravenous contrast-enhanced computed tomography scan is the best diagnostic tool for assessing blunt splenic injuries.

Treatment

Conservative treatment: We included 50 cases of splenic trauma in this investigation. 39 cases were managed cautiously out of the total. The 39 instances that were chosen for non-operative management received the following CECT grades:

Grades	**No. of cases**
I	**2**
II	**14**
III	**22**
IV	**9**
V	**Not done as were directly operated**

In the current study, 2 patients in this group are reported to have died, and the success rate is 95%. In 1990, Pachter et al.[26] reported the following success rates for grade 2 injuries: NOM-53%, grade 3 injuries: 29%, grade 4 injuries: 4%, and grade 5 injuries: 2%. In a 1994 study by J. A. Haller et al.[27], NOM had a 90% success rate.

A retrospective research by MC Coburn et al.[28] found that 94% of splenic injuries with multiple injuries could be successfully managed non-operatively in 1995. A 90% success rate for NOM was reported by Satish D and TT Changlani[9] in 1995.

While Davis et al. (1998)[29] reported a 94% success rate for NOM. According to Pietzman and Richardson [30] (2010), non-operative care is the preferred course of treatment in 61.5% of splenic injuries. Morell et al.[31] (1995) reported a 52% success rate. Non-operational management had a success percentage of 52.2%, according to a 2016 study by Scarborough et al.[32] In another retrospective study conducted by Hannes Ruhnke et al [33] in 2021, non operavtive management was successful in 94% patients (119/126).

Operative management: Of the 50 patients in the current study, 14 (28%) had surgery. Out of 14 patients, 2 instances were initially chosen for conservative management but ultimately underwent laparotomy due to a decline in clinical status.

Incisions

Paramedian incisions, either rectus splitting or rectus retracting, were most frequently employed. A midline incision was used in 9 of the 11 patients who had surgery, and a midline incision with lateral extension (T or L Shaped) was used in 2 patients. In every instance, large incisions were made to provide sufficient exposure. Vertical incisions (paramedian or midline) were beneficial for extending upwards, downwards, or laterally, according to Jarvis et al. [21](1946).

Out of 11 patients who underwent surgery in a studyby Ahmed et al[15] from 2015, 4 patients had a midline incision, 5 patients had a midline incision with lateral extension (T or L-shaped), 1 patient had a left paramedian incision with lateral extension, and 1 patient had a left subcostal incision with hockey stick extension. In every instance, large incisions were made to provide sufficient exposure.

Operative results

Blood was always discovered in the peritoneal cavity during laparotomies. Large subcapsularhaemorrhage,subcapsular hematoma, intraparenchymal laceration, a laceration involving hilar arteries, a completely shattered spleen was found intraoperatively and splenectomy was performed in all.

11 patients (22% of 50 splenic trauma cases) required procedures, leading to splenectomy. In a 2019 study by Dheer S. Kalwaniya et al,[13] 38 (42.2%) patients had surgery. Abhilash et al.[34] treated 41% of the patients, while Ahmed et al.(15) managed 36.67% (11/30). According to Kasula et al.[35] (159), only 13% of patients received conservative treatment while 87% underwent surgery.

As soon as feasible after surgery, injections of meningococcal, pneumococcal, and Hib vaccines were given to all of the patients.

VI. Results

In our study, all patients with grade 5 underwent splenectomy, 6 of the 9 patients with grade 4 underwent splenectomy, and 2 of the patients with grade 3 underwent conservative splenectomy after first receiving conservative management for more than 48 hours.

In our study, all grade III, IV, and grade V (all patients) splenic injuries exhibited hemodynamic instability, necessitating splenectomy. Grade I, II, III, and IV splenic injuries were successfully managed conservatively. At the fourth postoperative day, a grade V patient who had undergone a splenectomy passed away.

In 6 patients with satisfactory non-operative treatment, Karen J. Brasal[22] reportedfive patients had grade IV splenic injuries, ranging in severity from I to III. The spleens of all grade V patients were completely removed. 40% of patients had grade I and grade II splenic injuries, 50% had grade III and grade IV splenic injuries, and 10% had grade V splenic injuries, according to Satish D et.al.[9] (out of total 150 cases).As experience has accumulated, most feel comfortable with observing stablegrade III injuries and many have begun observing grade IV and V injuries.

Complications

In the current study, 7 individuals (14%) had post surgical problems. The majority of problems were wound-related. We were only able to follow up for longer than six months with 30 patients. One of these 30 patients experienced recurrent chest infections, the rest did not.

VII. CONCLUSION

Road traffic accidents were shown to be the most frequent cause of splenic damage. The majority of splenic injuries occurred in young guys between the ages of 20 and 30. Early diagnosis depends on a thorough physical examination. Physical discoveries are complemented by investigation reports.

Early hospitalisation, improved diagnostic tools, appropriate and prompt surgical intervention, and blood transfusion availability,closed clinical observation and nursing care provide a significant role in lowering mortality following blunt splenic damage. With the help of adjuncts like the FAST and higher resolution CT scanners, injuries may now be assessed more accurately, allowing the surgeon to decide whether to do an immediate laparotomy, perform angiography, or pursue non-operative treatment.

Most individuals with blunt splenic injury can be handled without surgery. The decision of which patients should receive surgical or nonsurgical treatment is still difficult. The successful therapy of patients with splenic injury depends heavily on the careful observation of patients receiving conservative care and the availability of rapid surgical surgery, should it be necessary.

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