ORIGINAL ARTICLE

Radiological patterns of splenic injuries in blunt abdominal trauma: Experience at tertiary care center

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Introduction: Blunt abdominal trauma is one of the leading cause of death and splenic injuries are one of the common culprits. Clinical examination and laboratory data are nonspecific for diagnosing the cases of splenic injuries.lt is important to manage splenic injury in specific time interval to restore appropriate functionality, save patients life and avoid unnecessary exploratory laparotomy. Radiological imaging modalities play a very significant role in diagnosing, assessing the severity and thus guiding the course of treatment. Management of splenic injuries depends upon severity of injury i.e., high-grade injuries require surgical intervention whereas low-grade injuries can be managed conservatively. Ultrasonography is the commonly used imaging method as it is cheap and widely available. However CT scan is considered as the radiological gold standard. **Material and Methods:** This was a prospective study done in the Department of Radiodiagnosis, RMCH, Bareilly, from 1st November 2018 to 30th October 2019. All the patients with history of blunt abdominal trauma and suspected splenic injury who visited the causality Department of Rohilkhand medical college were included in the study. **Results:** The most common pattern of splenic injury was subscapular hematoma (79.92%) followed by intra-parenchymal hematoma, laceration and Pseudoaneurysm. The most common Grade of injury was grade II (46.66%) followed by grade I.

KEY WORDS: Contusion, CT Scan, laceration, splenic injury, ultrasound

INTRODUCTION

Trauma is one of the leading causes of death in Indian population. Blunt abdominal trauma in isolation represents 5% of mortality due to trauma. Hypovolemic shock due to excessive bleeding accounts 80–90% of deaths from abdominal injury. Organs commonly injured in blunt abdominal trauma are liver, spleen, pancreas, and vascular structures. Solid organs are more prone to injuries like contusion than hollow viscous organs.[1]

The radiological imaging modalities such as ultrasonography and computed tomography provide non-invasive diagnostic methods to diagnose and characterize the extent of organ injuries and help in further management.[2]

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Ultrasonography helps in assessing the cases of abdominal trauma in a very less time period. This helps in continuing the resuscitation efforts as well. Focused assessment by sonography for trauma (FAST) follows a streamlined protocol to detect hemoperitoneum.[3] Four standard abdominal views (subxiphoid, suprapubic, and bilateral upper quadrants) are taken to detect hemoperitoneum in less than 5 min.[4]

FAST scan has its own limitations due to several factors such as presence of excessive bowel gas, obese patients, and restricted mobility in patients of spinal injury. Therefore, a normal FAST scan does not rule out the presence of trauma to the spleen, and hence, CT scan can be advised depending on the clinical condition of patient. CT scan has the advantage over FAST scan as it can directly visualize viscera and vasculature, which are not evaluated by FAST scan. The management of splenic injuries

is highly aided by CT scan which helps in identification and characterization of patterns of injuries.[4]

Earlier, the diagnosis of splenic injury was based on physical examination and diagnostic peritoneal lavage. This resulted in a very high rate of laparotomy causing unnecessary agony to patients. Since the advent of newer imaging modalities like ultrasonography and CT scans, most of the cases which were taken up for surgery earlier are now managed conservatively. Splenic salvage has become an important goal in the management of splenic injury.[5] Imaging is essential to effectively identify the location, extent and grading of injury on the basis of AAST scoring system.[6]

Nowadays, conservative management of splenic injuries is becoming popular across the world. This is due to the advancement in radiological technology such as faster and accurate imaging techniques. Imaging is essential to effectively identify the location, extent, and grading of injury on the basis of the American Association for the Surgery of Trauma (AAST) scoring system.[6]

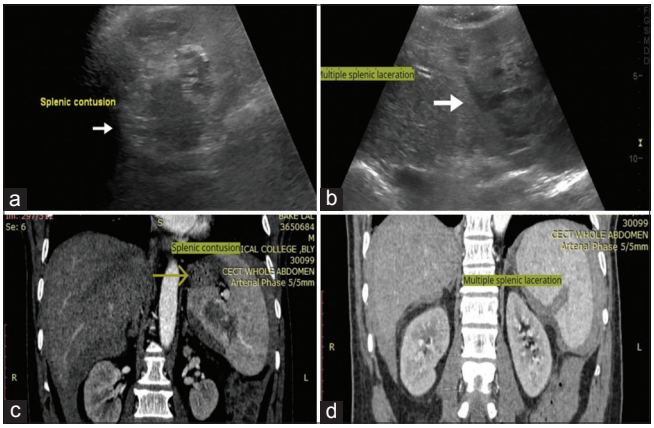

Figure 1: (a) Ultrasound image showing splenic ill-defined hyperechoic areas at the upper pole of spleen. (b) Ultrasound image showing multiple lacerations predominantly at hilar region. (c) Contrast-enhanced CT (CECT) of abdomen in coronal plane showing splenic contusion at the upper pole. (d) CECT coronal image shows a 2.5 cm long laceration reaching up to medial surface

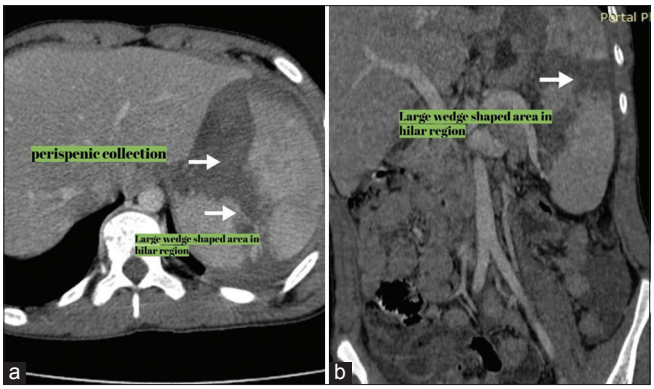

Figure 2: (a) Contrast-enhanced CT (CECT) abdomen in axial section shows a large wedge-shaped hypodense area in spleen which extended from hilum of spleen to capsular surface with perisplenic collection (b) CECT abdomen in coronal section shows a large hypodense area in hilar region with multiple branching areas of same density suggesting lacerations

Initial imaging modality for trauma assessment is ultrasonography, which is easily available and it can be performed bedside even for hemodynamically unstable patients. However, CT is considered as the gold standard for detection and characterization of splenic injuries. CT imaging findings such as location and extent of injury, presence of hemoperitoneum, evidence of ongoing hemorrhage, and presence of splenic vascular lesions predict the success of non-operative management.[1] Injuries corresponding to the AAST Grade Ill or higher and large-volume hemoperitoneum increase the risk of failure of non-operative therapy.[7]

MATERIALS AND METHODS

This was a prospective study done in the Department of Radiodiagnosis, Rohilkhand Medical College and Hospital, Bareilly, from November 1, 2018, to October 30, 2019. All the patients with a history of blunt abdominal trauma and suspected splenic injury who visited the causality department of Rohilkhand Medical College were included in the study.

The ultrasound scan was obtained with patients in supine position, with a curvilinear and sector array real time B mode with color Doppler on USG machine "GE LOGIQ V5" equipped with MHz and 7.5 MHz transducers.

CT was performed using BrightSpeed GE 16 Slice Elite CT scanner.

CT scanning protocols:
120–140 KVp and 320–350 mAs (automatic tube modulation used). Slice thickness – 2.5–5 mm.

Reconstruction of 2.5 mm.

First, non-enhanced CT followed by contrast-enhanced CT (CECT) was performed using contrast agent iohexol,

Table 1: Pattern of splenic injury

S. No.	Types of injury	Number of the patients	% of the patients
1.	Subcapsular hematoma	12	79.92
2.	Intraparenchymal hematoma	2	13.33
3.	Laceration	5	33.33
4.	Shattered spleen	1	6.66
5.	Pseudoaneurysm	1	6.66

Table 2: Percentage of splenic injury as per AAST classification

AAST grading	Number of patients	Percentage of patients
Grade I	04	26.66
Grade II	07	46.66
Grade III	02	13.33
Grade IV	01	6.66
Grade V	01	6.66

1.2–1.5 ml/kg body weight at rate of 3–4 ml/s of I/V contrast was given. Scanning was obtained in arterial, portal, and venous phases. Delayed scans were obtained whenever required.

Multiplanar reformations were done and organ injuries were graded using AAST classification.

All images were viewed in soft tissue as well as lung window settings besides bone window settings.

Inclusion Criteria

All patients who visited causality department with clinical suspicion of splenic injury and who underwent radiological evaluation were included in the study.

Exclusion Criteria

The following criteria were excluded from the study:

- Hemodynamically unstable patients
- Patients unwilling to participate in study.

Methods of Collection of Data

After patient referral, the splenic injuries were characterized by both USG and CT scan. The cases selected for this study were subjected to detailed radiological assessment and relevant clinical examination.

RESULTS

Fifteen patients were included in study. The most common pattern of splenic injury was subscapular hematoma (79.92%), followed by intraparenchymal hematoma, laceration [Figure 1], and pseudoaneurysm. The most common grade of injury was Grade II (46.66%) followed by Grade I [Table 1].

The most common age group affected was 20–40 years. It is probably due to fact that this age group was involved in high-risk activities which lead to increased incidence of accidents.

The most common organ affected was liver (32%), followed by spleen (28%), kidney (18%), pancreas (4%), urinary bladder (2%), and bowel (2%). All the 15 cases of splenic injuries were classified

Table 3: USG, CT, and other findings in individual patients

Patient No.	USG findings	CT findings	Other findings
1	Hypoechoic area in subcapsular region	Subcapsular hematoma (Grade I)	Liver laceration with subcutaneous emphysema
2	Hypoechoic area in subcapsular region at upper pole of spleen	Subcapsular breech and hematoma at upper pole (Grade I)	Nothing significant
3	Hypoechoic area in subcapsular region at lower pole and linear hypoechoic area involving 3.2 cm thickness of spleen	Subcapsular hematoma and splenic laceration (Grade III) [Figure 2]	Subcutaneous emphysema
4	A liner hypoechoic area at interpolar region measuring ~2.7 cm	Splenic hematoma and laceration (Grade II)	Nothing significant
5	Hypoechoic area in subcapsular region at lower pole and perihilar region	Subcapsular hematoma and splenic laceration measuring 1 cm at upper pole (Grade I)	Subcutaneous emphysema
6	Hypoechoic area at mid and lower pole of spleen representing hematoma	Subcapsular hematoma (Grade I)	Nothing significant
7	Hypoechoic area in subcapsular region and a linear hypoechoic area measuring ~2.3 cm is seen in the hilar region. Intraparenchymal oval shape hypoechoic area measuring ~5.5 mm. On color Doppler this area shows arterial flow characteristic s/o splenic pseudoaneurysm. Hemoperitoneum	Splenic laceration. Intraparenchymal splenic pseudoaneurysm measuring ~5.5 mm is seen likely from terminal branch of the splenic artery just distal to the splenic hilum with perisplenic hematoma (Grade IV)	Left renal contusion and multiple small laceration
8	Hypoechoic area in upper pole intraparenchymal region of spleen	Intraparenchymal hematoma (Grade I)	Nothing significant
9	Hypoechoic area in subcapsular region in upper pole with hemoperitoneum.	Subcapsular hematoma and hemoperitoneum (Grade II)	Nothing significant
10	Liner hypoechoic area in splenic hilar region which is extending from hila to cortical capsular surface of spleen hemoperitoneum	Shattered spleen with hemoperitoneum (Grade V)	Left renal contusion, multiple rib fractures
11	Hypoechoic area in upper pole and subcapsular region	Subcapsular hematoma (Grade II)	Nothing significant
12	Hypoechoic area in subcapsular region at mid pole and linear hypoechoic area adjacent to it involving~ 5, cm area of spleen with hemoperitoneum.	Subcapsular hematoma and splenic laceration with hemoperitoneum (Grade III)	VII and VIII rib fracture subcutaneous emphysema and left renal laceration
13	Multiple hypoechoic areas at lower pole	Subcapsular hematoma (Grade II) with hemoperitoneum	Nothing significant
14	Hypoechoic areas at upper pole	Intraparenchymal hematoma (Grade II)	Nothing significant
15	Multiple hypoechoic areas at upper pole, midpole region. Hemoperitoneum	Subcapsular hematoma (Grade II) with hemoperitoneum	Nothing significant

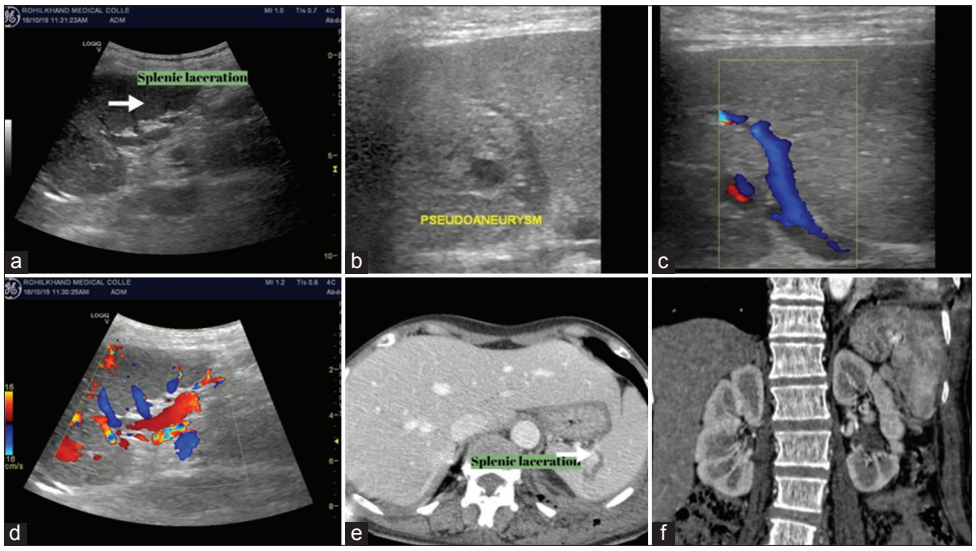

Figure 3: (a) Ultrasound image shows linear hypoechoic area near to the hilar region. (b and c) An oval hypodense area at upper pole of spleen depicting arterial flow characteristics on color Doppler (d and e) on color Doppler, the oval area shows Yin-Yang sign. (e) Contrast-enhanced CT (CECT) abdomen axial section shows a curvilinear hypodense area near hilar region. (f) CECT abdomen in coronal sections showing a small intraparenchymal contrast filled structure at the upper pole representing an intraparenchymal pseudoaneurysm

according to the AAST grading scales and characterization of injuries was done on the basis of pattern of injury. Twelve of them underwent non-operative management. Only three patients required spleen-related surgical intervention (laparotomy). The most common pattern of splenic injury found in our study belonged to Grade II [Table 2].

DISCUSSION

In this study, 15 patients with radiologically documented splenic injuries were included in the study. The injuries were classified according to the AAST grading scales for organ injury. Grade II AAST injuries accounted for most of our cases (46.66%) followed by Grade I (26.66%). Subcapsular hematoma was the most common lesion [Table 3].

We found 1 case of shattered spleen which was surgically resected. Intrasplenic pseudoaneurysm was the only vascular injury we found. No case of frank arterial extravasation was seen [Figure 3]. Twelve of the patients underwent non-operative management and three underwent operative management. One Grade V and two Grade IV splenic injury patients were treated by operative management.

In our study, surgical management was done only in patients with injuries of Grade III and higher. This was in contrary to the study of Demetriades *et al*. where emergency laparotomy was done even in 33 percent of cases of grade I injury.[8] Our study corresponds with the study of Beuran et al, where conservative management is the most common therapeutic method followed by splenectomy.[9]

In our study, CT was found to be more sensitive and specific than ultrasonography in detecting the splenic injuries. In one case, USG suggested features of subcapsular hematoma only, whereas on CT, the same patient demonstrated splenic lacerations along with subcapsular hematoma. The sensitivity of both USG and CT in detecting hemoperitoneum was found to be equal.

CONCLUSION

For blunt splenic injuries, MDCT is considered as the gold standard which provides accurate diagnosis and characterization of patterns of splenic injury and thus aiding in planning the proper management protocol for successful patient-related outcomes. CT must be included in all cases of suspected splenic trauma imaging irrespective of a positive or negative FAST scan.

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