Role of Computed Tomography in Traumatic Splenic Injuries

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Abstract: ***Background:*** ***Computed tomography has been used with better specificity to evaluate patients with blunt splenic trauma who are FAST (focused assessment with sonography for trauma) positive and indeterminate and clinically suspicious cases of solid organ injury. Aim & Objectives: To categorize different types of splenic injuries based on AAST splenic injury scale 2018 revision. Methods: A retrospective observational study of twenty two patients was conducted in the Department of Radiodiagnosis, PESIMSR medical college, kuppam. All patients with traumatic splenic injuries were included. Twenty-two hemodynamically stable patients with blunt splenic injury underwent multidetector CT at admission to the hospital between December 2017 and January 2021. Ultrasound abdomen screening was done with Voluson, followed by contrast MDCT on 16 Slice GE. Results: Twenty-two patients with splenic injury underwent multidetector CT. Based on the AAST score, 18 were classified as either I / II / III / IV and kept under observation (18 out of 22 [82%]). Five were managed with the splenic intervention (surgery, 4 out of 22 [18 %]). Conclusion: This study showed that multidetector CT grade is the best guide for the choice of patients for observation versus splenic intervention.***

Keywords: Abdomen, blunt injuries, computed tomography, medical imaging, spleen, trauma

1. Introduction

In blunt abdominal trauma, the most frequently injured organ is the spleen. Various methods can injure the spleen: i.e., blunt abdominal injury, stabbing injuries, iatrogenic and intraoperative incidents. Approximately splenic injuries account for 25% of all solid abdominal organ injuries. Motor vehicle accidents are the most common to produce most splenic injuries. Associated injuries of the central nervous system, liver, kidney, and hollow viscera occur in 10% to 40% of blunt splenic injuries, and these may alter therapeutic options.

There are four main ligaments of the spleen: the gastrosplenic ligament, the colicosplenic ligament, the phrenocolic ligament, and the phrenosplenic (splenorenal) ligament. The spleen is divided into four or six segments by arterial supply, whereas the venous system is highly anastomotic and does not follow predictable segmental anatomy. The arterial branch vessels enter the spleen perpendicular to the long axis, allowing segmental resection. A thin capsule derived from the peritoneum covers the spleen.

Spleen receives 5% of the cardiac output, accounts for immunological function, and hematopoiesis with red blood cell clearance. Because of its role in the immune response, it has led to substantial attempts to conserve the spleen. In hemodynamically stable patients, nonoperative management is now widely accepted.

In managing blunt splenic injuries, US and CT play a significant role in guiding clinicians for further evaluation. The primary modality for early screening of blunt abdomen is ultrasound, allowing them to display hemoperitoneum in which hemodynamically unstable patients and refer them for further evaluation. In predicting the presence of hemoperitoneum, many studies have proved that ultrasound has a sensitivity of 97% and specificity of 100%; however because the US has low sensitivity in diagnosing a solid organ injury like the spleen most common organ involved in blunt abdominal trauma.

To refer the patient to conservative treatment or surgery, CT provides an accurate diagnosis and classification of splenic injuries. CT dramatically facilitates the selection of patients who are treated nonoperatively by allowing precise identification and characterization of splenic injuries and other associated injuries..

In active splenic bleeding cases, CECT is a choice to distinguish patients showing a risk of hemorrhagic shock and requires surgery or embolization from patients with stable non-bleeding injuries, candidates for conservative management, with the valuation of vital parameters and a close follow-up, to reduce surgical morbidity and preserve the immune capacity.

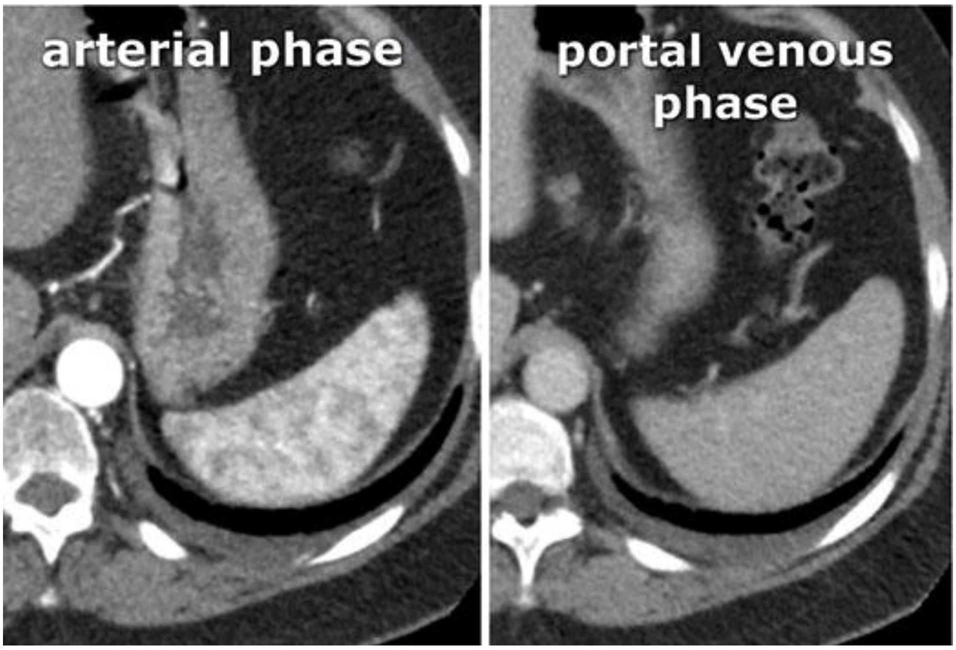
2. Materials and Methods

Twenty-two patients with blunt splenic trauma were admitted to our institution from December 2017 to January 2021. A total of 22 hemodynamically stable patients (19 male (87 %), three female (12%); age range, 12–65years) fulfilled the study group. This study's criteria were blunt splenic trauma and primary CECT examination, including both arterial and portal venous phase imaging of the abdomen performed.

Out of the distribution of age group most commonly involved age groups are between 30 to 40 (37 %), followed by 20-30 (20%), 10-20 (16 %), 40-50 (16 %), 50-60 (4%) and 60-70 (4 %) respectively.

MDCT is always conducting in dual-phase, and images are acquiring in the arterial and portal venous phases. It is essential that the amount of contrast is adequate and customized to the patient's weight. The flow must be high because those parameters significantly influence the quality of the examination. Multislice CT scanning with the bolus technique is preferred to optimize injury detection and to minimize delay within the department..

In the arterial phase, splenic parenchyma shows a different filling of red and white pulps leads to inhomogeneous enhancement of the spleen (Zebra / psychedelic spleen). So, the spleen assessment should be in portal venous or delayed phase study will show homogeneous attenuation throughout the spleen. The arterial phase is useful in detecting vascular injuries such as pseudoaneurysm and AV fistula.



Assessment of splenic injury should include evaluation for
a) Hematoma,
b) Extent of laceration
c) Active extravasation of contrast material and
d) Associated vascular injuries.

Splenic hematomas are frequently hypodense on contrast-enhanced CT and hyperdense relative to the splenic parenchyma on unenhanced CT.

Splenic hematomas may be intraparenchymal, subcapsular, or perisplenic.

Intrasplenic hematomas also appear as hypodense within the splenic parenchyma after administration of contrast medium. Subcapsular hematomas are due to the accumulation of low-attenuation blood seen between the splenic capsule and enhanced splenic parenchyma that causes the underlying spleen's indentation. In the perisplenic space, free intraperitoneal blood does not produce this effect on the underlying spleen parenchyma.

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A splenic contusion is seen as a small hypodense area with blurred margins caused by perilesional interstitial edema and local blood.

A laceration is seen as a linear line of nonopacification of splenic parenchyma that may extend to the capsule . The laceration site can be superficial if it presents only the capsule or in-depth, involving vascular structures of splenic hilum.

Shattered" spleen is due to severe disruption of splenic parenchyma. Vascular hilum injuries usually result in significant bleeding and cardiovascular instability.

According to AAST splenic criteria, active splenic bleeding and nonbleeding vascular injury (pseudoaneurysms or arteriovenous fistula) were diagnosed.

AAST Spleen Injury Scale 2018 revision

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 splenic capsule parenchymal laceration involving segmental or hilar vessels producing >25% devascularisation

Grade V
Shattered spleen
Any injury in the presence of splenic vascular injury with active bleeding extending beyond the spleen into the peritoneum

3. Results

Grading of visceral injury by AAST:
In this study, out of 22 patients with splenic injury, 2 (9%) patients had grade I injury, 4 (18%) patients had grade II injury, 10 (45 %) patients had grade III injury, 5 (22 %) patients had grade IV injury, and 1 (4 %) patient had grade V injury based on American Association for the surgery of trauma (AAST).

More cases belonging to grade III injuries due to the most common mode of trauma are road traffic accidents.

100% of grade V injuries were needed surgical intervention. The most common splenic injury is grade III (45 %), followed by grade IV and grade II .

Table 1: Age distribution of splenic injuries

Grades	10 -20 yrs	20 -30 yrs	30 – 40 yrs	40 -50 yrs	50 -60 yrs	60 -70 yrs	Total (22)
I	1	-	1	-	-		2
II	-	2	2	-	-		4
III	3	1	4	1	-	1	10
IV	-	1	2	1	1	-	5
V	-	-	-	1	-	-	1

The most common type of splenic injury in all age groups is GRADE III

Table 2: Sex distribution of splenic injuries

	10 -20 yrs	20-30 yrs	30-40 yrs	40-50 yrs	50-60 yrs	60-70 yrs
Males	3	4	8	4	1	1
Females	0	1	1	1	0	0

Most common age group involving splenic injuries is 30 – 40 yrs followed by 40 – 50 yrs and 20 – 30 yrs.

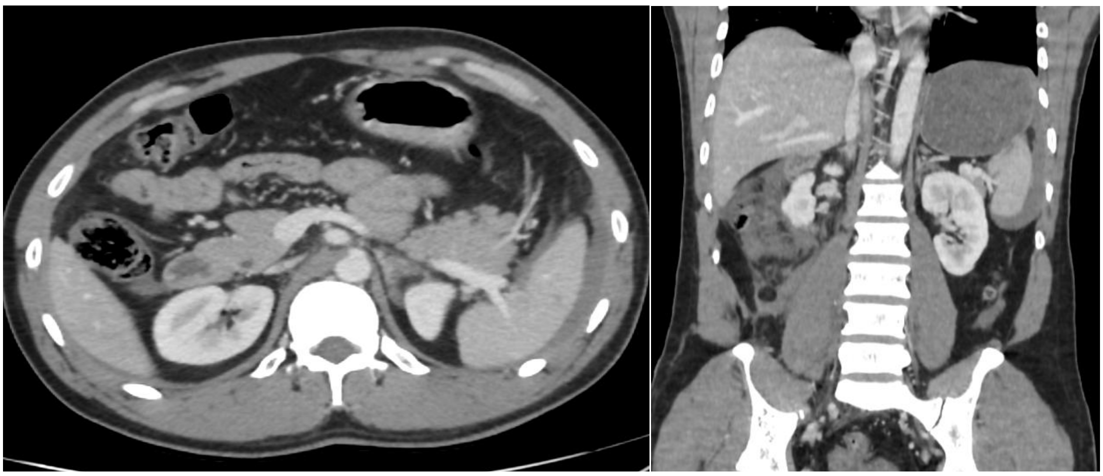
Those patients with stable blood pressure, adequate urine output, maintained abdominal circumference, and insignificant changes in laboratory investigations were managed conservatively. Conservative management is an established and accepted management protocol for most blunt splenic injuries. Conservative management has a significant decrease in hospital stay length and morbidity than patients who undergo surgery.
One Grade V case shattered spleen with unstable clinical condition needs operative management .Three cases with grade IV, III and II needs operative management. The indication in these cases are different based on associated renal injury, bowel injury, presence of hemoperitoneum and decreasing blood pressure. In grade II splenic injury the surgical intervention is needed because of associated renal injuries and hemoperitoneum, when they became unstable clinically.

The sensitivity of MDCT is assessed on depending on accurate CECT findings helps in guiding patient management (Operative versus Conservative).

Table: Grades of splenic laceration with respective hematoma and lacerations

Grades	Hematoma (Parenchymal / Subcapsular)	Laceration (Parenchymal / Subcapsular)	Vascular Injury	Active Bleeding	No. of cases	% (100)
I	<10%	<1 cm	No	No	2	9%
II	10 %– 50%	1 – 3 cm	No	No	4	18%
III	>50%	> 3 cm	No	No	10	45%
IV	>50%	> 3 cm	yes	No	5	22%
V	10 – 50 %	1 – 3 cm	Yes	Yes	1	4%

Grade I type:
In this study (9%) two cases were categorized into Grade I. These cases show splenic laceration less than 1 cm, one case shows less than 10 % subcapsular hematoma. All are treated under nonoperative management.



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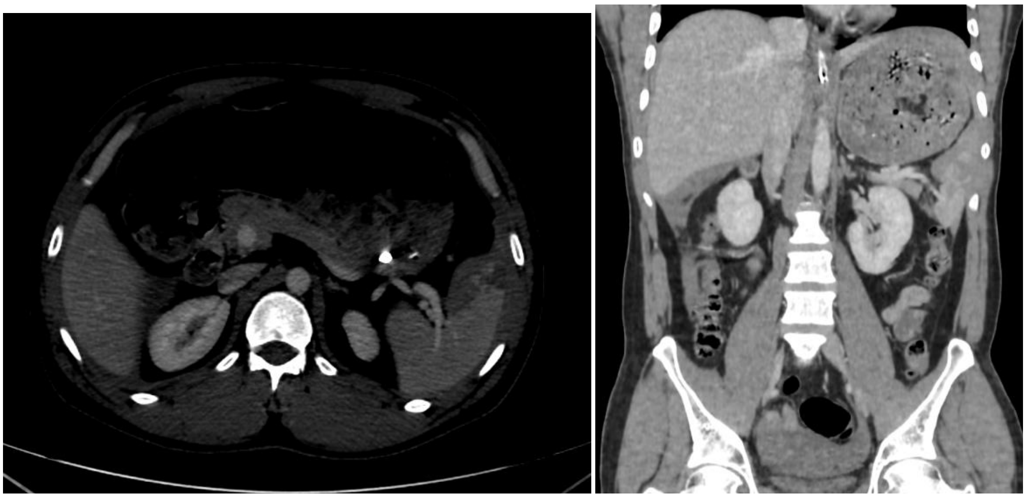
Grade II:

In this study, 4 cases (18 %) shows grade II features like irregular non enhancing areas noted involving anterior portion of spleen with intraparenchymal hematoma < 5cm in size, laceration < 3 cm in depth and subcapsular hematoma< 50% of surface area. No obvious extravasation of contrast seen. Splenic vein and splenic hilum are normal. Splenic artery and splenic vein shows normal enhancement. Only one case shows abnormal clinical conditions due to associated with other injuries leads to surgical intervention.

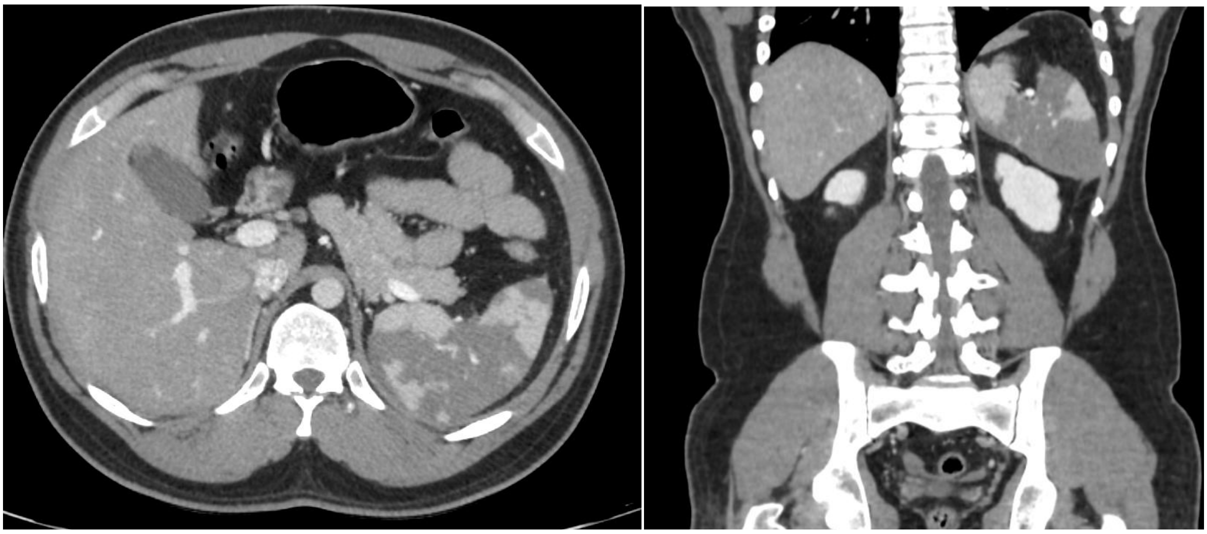


Grade III:

Majority of the cases show grade III splenic injuries i.e, 10 (45 %) like large irregular non enhancing area [60-70%] noted involving body and superior pole. Areas of capsular breech noted. Moderate perisplenic collection noted. No active contrast leakage noted. Splenic vein and splenic hilum are normal. Majority of the cases (9) are treated with non surgical management. Only one patient treated with operative management.

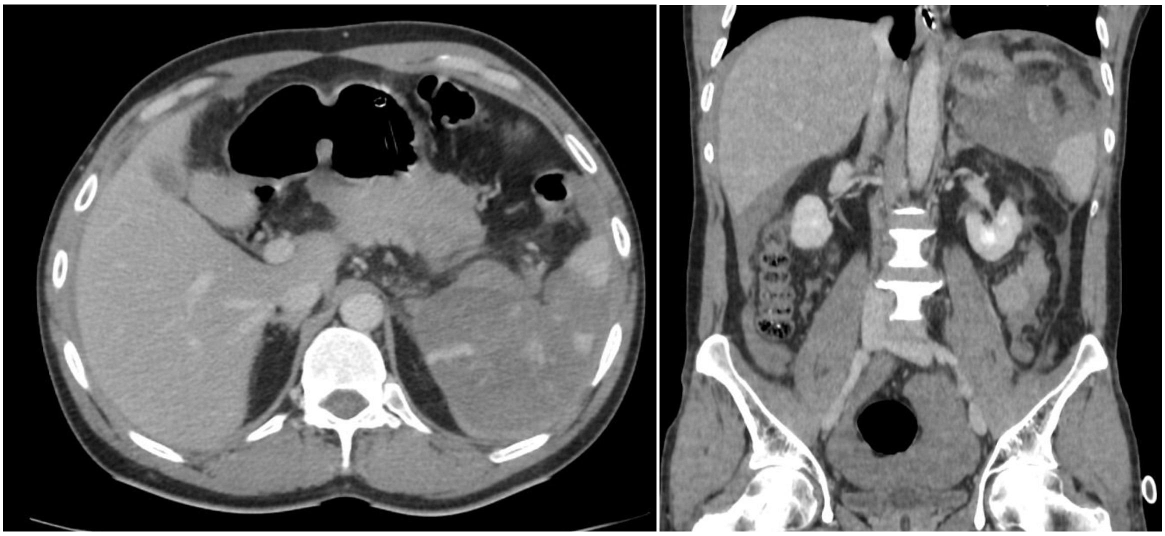
Grade IV

Four cases show grade IV criteria like parenchymal disruption and multiple nonenhancing areas in the portal phase, predominantly in mid and lower portions and along the subcapsular location, some of the nonenhancing areas being wedge/ linear in orientation extending till the capsular surface, suggests 50% devascularisation. No actiive extravasation/ pooling of contrast seen in arterial and delayed phases. Splenic artery and vein upto hilum show normal contrast opacification. Out of four, three managed with nonoperative management and one needs surgical intervention due to associated renal and bowel injuries.



Grade V

One of twenty two cases show completely shattered spleen seen, except small portion in the anteroinferior aspect of about 5 cm and small superomedial portion of about 4 cm. Heterogenous collection of about 8.5 x 6.3 x 8.5 cm seen at the site of injury- suggestive of hematoma. Linear enhancing areas seen in the venous phase- suggestive of active bleed.



4. Conclusion

CECT is an important imaging modality in diagnosing splenic injuries in patients with abdominal trauma. CECT helps in grading the severity of splenic injury in patients with abdominal trauma, which further helps in deciding the further course of management of the patient. Grade III splenic injuries are most common than other grades of organ injuries, and majority of the patients (18) with splenic injuries were managed conservatively (Non operative management) and four are managed with surgery. The overall CT analysis of splenic injuries directed the appropriate management protocols in most patients except for those with associated injuries.

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