

Original Research Article

CT imaging in assessing the severity of retroperitoneal injuries in blunt abdominal trauma

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ABSTRACT

Background: Trauma is a leading cause of death in developing countries due to vehicular and railway accidents, of which abdominal trauma due to blunt injuries constitutes 13% mortality and 45% morbidity. The purpose of this study is to assess and diagnose the severity of those retroperitoneal injuries other than the common causes of abdominal trauma with multidetector computed tomography (MDCT) scanning with intravenous contrast being the gold standard diagnostic modality even in unstable patients.

Methods: A total of 204 patients of these 147 patients were males (72%) and 57 were females (28%) were included of all age groups, who had sustained abdominal trauma due to vehicular, railways accidents and also due to trivial trauma and history of fall from heights.

Results: Of the 204 patients included in our study, 110 patients (55%) had the maximum trauma affection to the kidneys, in which 48% constitutes grade I injury, which shows the high sensitivity of MDCT detecting early injuries. Nearly 12% patients had adrenal injuries, 24% had pancreatic injuries, although a small percentage also had delayed manifestation of pseudocyst formation in stable patients. Duodenal and colonic injuries constitute rest of 5% and 4% of the patients. All these patients had good correlation with the morphological MDCT grading of injuries and clinical correlation.

Conclusions: MDCT is the imaging procedure of choice for early detection or ruling out the presence of retroperitoneal injuries in trauma patients, especially now with the newer faster MDCT, scanning can be performed more quickly, minimizing patient movement, respiratory motion and vascular pulsation.

Keywords: Adrenal injuries, Computed tomography, Renal, Retroperitoneal trauma

INTRODUCTION

Trauma is a leading cause of death in developing countries due to vehicular and railway accidents, followed by fall by height, intentional trauma, injuries by fall from bicycle and handle bar and sometimes at construction sites, of which abdominal trauma due to blunt injuries constitutes 13% mortality and 45% morbidity. As the diagnosis of retroperitoneal injuries due

to blunt trauma may not manifest themselves clinically during the initial clinical assessment and also because of the presence of other injuries may divert the attention of the initial assessor for potentially life threatening retroperitoneal pathology. Early detection of significant injuries is essential, as substantial resources are used in the evaluation of the abdomen and pelvis for possible injuries, particularly in patients with multiple injuries, as any patient who is hemodynamically unstable after

blunting abdominal trauma requires immediate laparotomy. Thus, a prompt and accurate diagnosis is critical, and the radiologist plays a pivotal role in the decision-making process.¹

In our country, high speed motor vehicle and railway accidents are the commonest cause of the blunt abdominal trauma, the 2 mechanisms involve are compressive and deceleration forces leading to multiple organ injuries in the setting of acute trauma, and here MDCT provides important anatomic and physiologic information that can differentiate trivial injuries from those requiring intervention. Furthermore, multi-slice fast CT technique with multiplanar and 3D image reformation offers new diagnostic possibilities in the setting of abdominal retroperitoneal organs such as renal and adrenal trauma.²

Ultrasound (US) provides several advantages in the evaluation of abdominal trauma, including minimal preparation, low cost, wide availability, portability and non-invasiveness. Quick US can easily identify free intraabdominal fluid, such as hemoperitoneum. However, it cannot reliably differentiate blood from extravasated urine or other body fluids.³ Furthermore, with sensitivity as low as 22%. US has a limited capability in the evaluation of retroperitoneal parenchymal renal and adrenal injury when compared to a MDCT.

Since most vascular injuries can be assessed by a CT, angiography is now seldom used in the assessment of renal trauma. However, angiography with transcatheter embolization became an advantageous alternative to surgery for the control of active bleeding or secondary arterial haemorrhage, a common consequence of pseudoaneurysm or arteriovenous fistula.⁴

Magnetic imaging resonance can be used for the for the assessment of suspected renal injury when there is contraindication for the intravascular use of iodinated contrast medium or when MDCT is not available.

METHODS

A prospective study was carried on selected cases from the imaging data collected at the tertiary institute in Mumbai, during a 14-year period from 2001 to 2015. The material includes 204 cases with confirmed blunt retroperitoneal trauma. Out of 984 abdominal trauma cases, 204 patients (147 males and 57 females) were confirmed to have retroperitoneal injuries. The age range was 5-60 years (mean age 28 years). The causes of retroperitoneal trauma in our material were: motor vehicle accidents - 98, bicycle accidents - 3, falls from height - 49, contact sports - 2, domestic violence/assaults - 1.

Detailed clinical examination and history was documented as per our institute trauma protocol. USG was done in all patients. MDCT is done in patients

having haemoperitoneum with normal appearance of solid organs and positive history of trauma suspecting pancreas, vascular and bowel injury. No gender and age predilection was considered.

The most representative cases of renal trauma were reviewed according to the spectrum of CT findings and categorized according to the AAST grading system 5. Patients were examined using a 4-slice CT (Volume zoom, Siemens Germany) and most currently 64-multislice (Brilliance 64-slice Philips Netherland). A spiral acquisition volume covered the abdomen and pelvis with an 8-mm collimation, followed by a 1 mm reconstruction and multiplanar reformatting. In adults, scanning usually started with a delay of 55–70 seconds from the time of intravenous (IV) administration of 90–120 ml of non-ionic contrast medium at an injection rate of 2–3 ml/sec) in arterial phase (bolus tracking) and venous phase(70-80 seconds delay) with delayed full bladder scan was performed when required. CT angiography was done for suspected vascular injury. Penetrating injuries were excluded in this study. Additionally, abdominal scanning was repeated 7–10 minutes from the beginning of IV contrast administration to register renal excretory phase.

RESULTS

The importance of trauma patient accessing to MDCT imaging for further definitive management and early planning in the golden of trauma after which morbidity and mortality increases significantly has been emphasized in many management protocols in the past.

Table 1: No. of patients and gender distribution.

Gender	Numbers	Percentage
Male	147	72%
Female	57	28%
Total	204	100%

In this study 204 patients MDCT findings were compared with operative results; and follow up CT scan/USG. Specificity and sensitivity of the MDCT findings were obtained as given below.

Table 2: Age distribution of patients studied.

Age in years	Number	Percent
0-10	2	01
11-20	8	04
21-30	60	30
31-40	71	35
41-50	37	18
51-60	22	10
61-70	04	02
Total	204	100

Out of 204 patients who underwent the study, 72% were males and 28% were females. This shows high susceptibility of blunt abdominal trauma for males as compared to females, although the incidence of traumatic injuries in female was more due to fall from height or non-vehicular blunt trauma.

As observed from the study, the maximum incidence of trauma occurred in the younger working age group of 21-30 years and 31-40 years, particularly with road traffic accidents and railway accidents, while assault and accidental injuries are of lesser percentage.

Table 3: Mode of blunt injury abdomen.

Mode of injury	Males	Females	Total
RTA	98	22	120
Accidental fall	11	03	14
Assault	6	2	8
Railway accident	48	14	62

The commonest cause of blunt abdominal trauma was found to be road traffic accident followed by railway accidents. The youngest of the patient aged 6 years, had injury due to bicycle fall with handle impaction causing blunt injury.

Table 4: Distribution of retroperitoneal organ injuries.

Retroperitoneal visceral organ	Number
Renal	149
Pancreas	34
Duodenum	01
Adrenal	18
Aorta and IVC	02

Of the 204 patients included in our study, 190 patients (almost 90%) had hemoretroperitoneum with no false positive or false negative diagnosis during reporting.

Traumatic renal injuries form the bulk of injuries and were categorized according to the AAST grading system. The grade I-II upper renal pole injuries were the commonest (60%) and approximately 30% of them associated with adrenal hematomas. Although, these patients had a stable hospital stay initially, however showed signs of instability intermittently due to blood pressure variations. Those patients with grade III- V renal injuries had unstable periods during admission and some of them even referred for image guided endovascular embolization. Perinephric hematomas were observed in most of renal injuries, but grade I-II injuries with stable thickness as observed on USG were usually managed conservatively, wherein grade III-IV injuries with hypotension underwent laparotomies and some of them endovascular embolization.

Pancreas was the second most commonly injured organ, wherein the imaging reveals laceration and transections

in the neck and body region (Figure 4). Initial CT findings may be normal, even with pancreatic transections, because the elastic pancreatic parenchyma A repeated CT abdominal scan at 24 to 48 hours can help reveal evolving injuries.

However, it was interesting to note that the patients with subtle pancreatic injuries, although with initial imaging showed only peripancreatic fat stranding, had on follow-up imaging presented with pseudocyst and abscess formation.

The case with duodenal injury showed a focus of air in the retroperitoneum due to small perforation in the second part.

The vascular injuries were less common in blunt trauma although one patient had a short segment dissection in the posterior wall of the suprarenal aorta. One patient developed IVC thrombosis with grade 5 renal injury extending from the renal vein.

DISCUSSION

Traumatic retroperitoneal injuries in blunt abdominal trauma are common life-threatening complication of abdomen and pelvic injuries, hence early diagnosis for conservative or urgent radiological interventions and surgical management are necessary.⁶

In this study, we selected 204 patients MDCT at our institution for determining, further management strategy of the patients with fatal abdominal trauma. Approximately 28% of the patients required radiological and surgical interventions, thereby concluding that MDCT imaging in trauma patients can enhance the help us determining the further management.⁷

With the advent of MDCT with intravenous contrast, shorter scanning time and increased resolution due to thin collimation and reduced partial volume or motion artefacts, appropriate classification of the injuries can be determining for categorizing the patient's status.

The most widely used injury grading system is the American association for the surgery of trauma (AAST) scale.⁵ Ultrasonography is a portable, easily available, and fast and a bed side procedure, although it gives lot of valuable information in trauma patients regarding free fluid and solid organ injury, it has its own limitation for retroperitoneal organs, vascular and bony injuries. In blunt abdominal trauma patients, early management is very important and with MDCT we get complete evaluation regarding number of organs injured and grading of injuries, in terms of conservative, radiological interventions like embolization or surgical management⁸. In cases where radiological targeted embolization or surgical management is required, it aids in planning the procedure and surgical backup for preparations.

Polytrauma patients with hemodynamically normal status showing positive USG findings may require a CT scan for determining the exact status of injuries, thus many a times reducing the possibility of negative laparotomy rate.

Renal trauma

In blunt abdominal trauma, after liver and spleen, retroperitoneal renal, pancreatic and adrenal injuries are commonly encountered.⁹



Figure 1: Grade I renal injury; Contrast-enhanced portal venous CT scan shows Grade I renal injury of the right kidney showing a low attenuation area in the mid region cortex.

Renal injury accounts for 75-80% of cases. CT has become the primary diagnostic tool for the rapid and accurate assessment of acute traumatic genitourinary injuries, as well as for the diagnosis of related complications, as the protocol involves multiple phases with faster MDCT such as plain scan from the dome of diaphragm to the pubic symphysis. Arterial phase study is performed at 15-25 seconds after the start of intravenous (IV) contrast medium injection. The corticomedullary phase starts at about 30-40 seconds of IV contrast injection. The nephrogenic phase begins at 80-120 seconds after the start of IV contrast injection and Excretory or delayed phase at 180-210 seconds after the IV injection for opacification of the calyces, renal pelvis and ureters to observe any leak or extravasation outside the urinary system. Blunt trauma includes minor contusion 60% and mostly treated with conservative management and major includes deep corticomedullary lacerations with extravasation, large perinephric hematoma, and renal pedicle injury.¹⁰

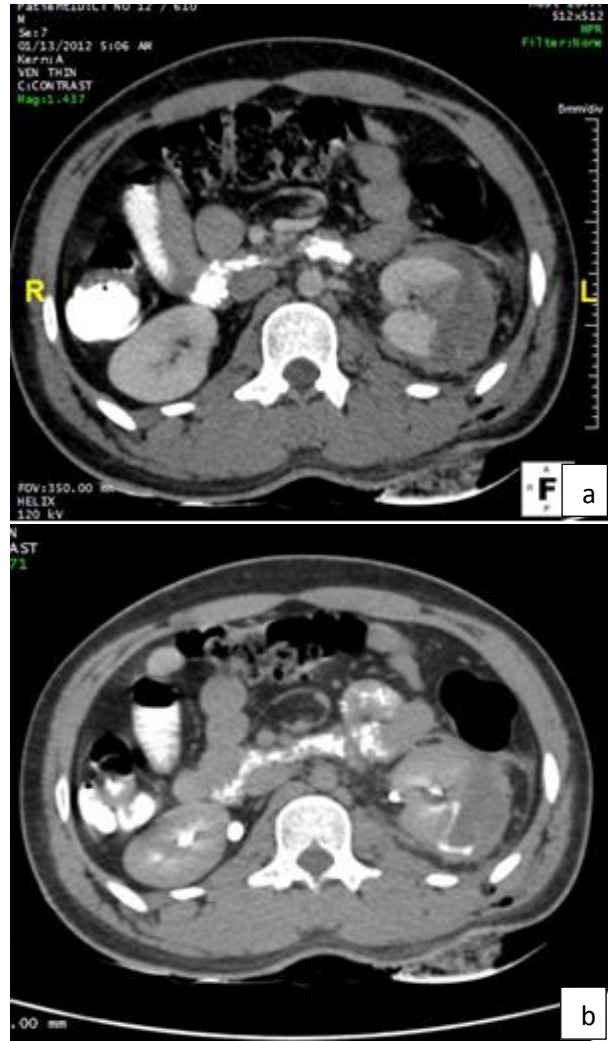


Figure 2: (a and b) Grade III renal injury; Contrast-enhanced portal venous CT scan shows Grade III renal injury of the left kidney a deep laceration reaching upto the pelvi-calyceal system.



Figure 3: Grade IV renal injury: Contrast-enhanced portal venous CT scan shows Grade IV renal injury of the right kidney with large perirenal hematoma.

Pancreatic trauma

Although pancreatic injuries were not so commonly observed in our study, however an interesting observation was seen that it was more common in younger age group and due to history of more trivial trauma due to bicycle accidents caused by handle in hemodynamically stable patients, who later presented with pseudocyst and abscess formation. However, in acute condition the imaging reveals laceration and transections (Figure 4). Initial CT findings may be normal, even with pancreatic transection, because the elastic pancreatic parenchyma. A repeated CT abdominal scan at 24 to 48 hours can help reveal evolving injuries.¹¹

MDCT findings of peripancreatic fluid in the absence of other abdominal visceral injury should suspect pancreatic injury.

Over all, the MDCT has sensitivity of 88% and specificity of 99% for pancreatic injuries. MDCT of the patients with suspected injuries were performed in plain, arterial and venous phases having a delay of 60-70 seconds after IV contrast injections.¹²

Injury to the main pancreatic duct is a primary sign in the development of significant complications after pancreatic injury. As a result, major ductal laceration is recognised as an indicator for prompt surgical intervention, the presence of peripancreatic collections may be a useful marker for major ductal injury.¹³

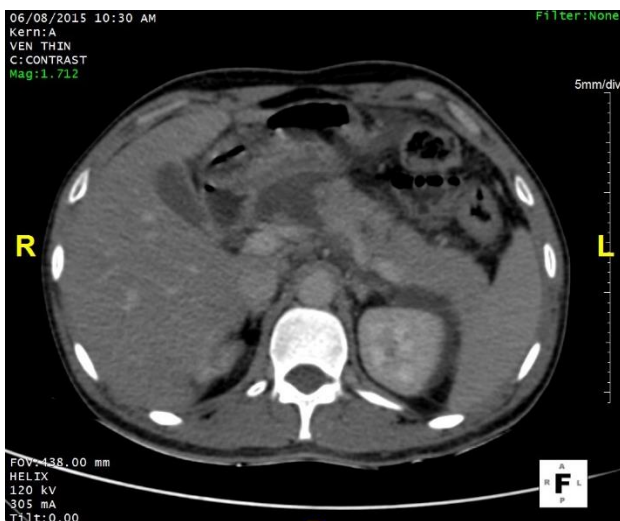


Figure 4: Pancreatic neck fracture- MDCT venous phase of a 42-year-old male in a motor vehicle accident showing a large area of transection of neck region with fluid collection.

Adrenal gland trauma

The current trend now has started increasingly focus on baseline MDCT imaging for adrenal gland injuries who

are hemodynamically stable, as the prevalence rate of adrenal traumatic haemorrhage is increasing.

The MDCT of adrenal traumatic injury usually shows a bulky gland which appears isodense to hyperdense gland with round to oval margins, associated with surrounding fat stranding and thickening of the diaphragmatic crus (Figure 5). A specific sign of injury is active contrast extravasation as may be seen in other organ injuries.¹⁴

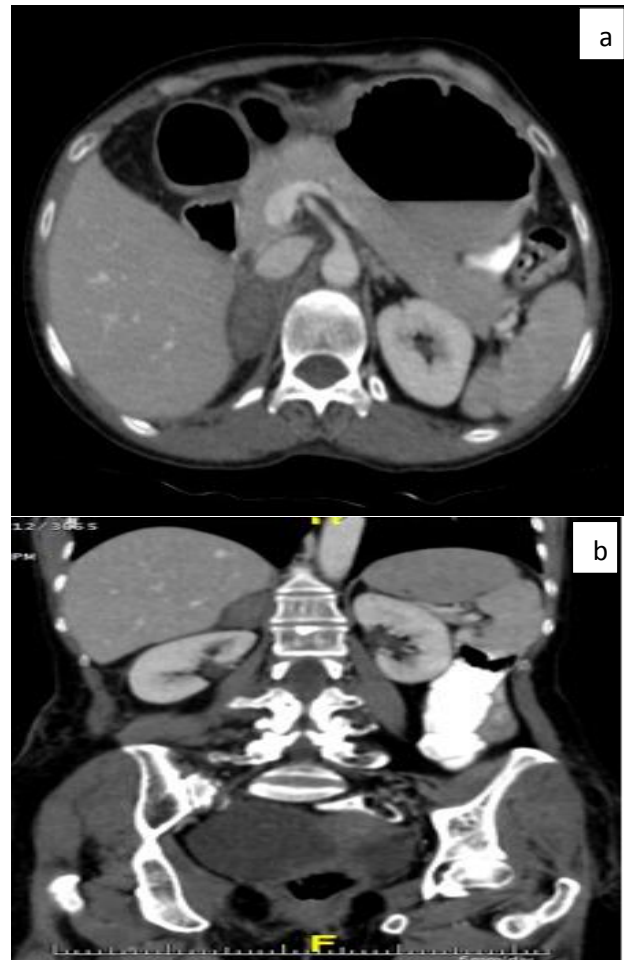


Figure 5: (a and b) Typical adrenal hematoma: an ovoid or round with relatively well-defined margins with surrounding fat stranding and thickening of the diaphragmatic crus goes in favour of adrenal hematoma on the right side.

The presence of small pocket of retroperitoneal air should raise suspicion of bowel injury, particularly in assault related trauma, for a perforated retroperitoneal viscus as focal pneumoretroperitoneum in the anterior pararenal space adjacent to the duodenum is suggestive of a duodenal perforation.¹⁵

CONCLUSION

MDCT is the imaging procedure of choice for detecting retroperitoneal injuries with blunt abdominal trauma, as the sensitivity of detecting even smaller lesions with

newer and faster scanners even in unstable patients with reduced motion artefacts specifically in renal, pancreas and adrenal injuries which helps in further management and categorising the patients, reducing hospital stay and negative laparotomies.

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Ethical approval: The study was approved by the institutional ethics committee

REFERENCES

1. Fang JF, Wong YC, Lin BC. Usefulness of multidetector computed tomography for the initial assessment of blunt abdominal trauma patients. *World J Surg.* 2006;30:176-82.
2. Berry M, Mukhopadhyay S, Chaudhry V. *Diagnostic radiology, gastrointestinal imaging.* 3rd edition: Jaypee Brothers Medical Publishers (P) Ltd; 2009:37-50.
3. Friese RS, Malekzadeh S, Shafi S, Gentilello LM, Starr A. Abdominal ultrasound is an unreliable modality for the detection of hemoperitoneum in patients with pelvic fracture. *J Trauma.* 2007;63(1):97-102.
4. Genovese EA, Fonio P, Floridi C. Abdominal vascular emergencies: US and CT assessment. *Critical Ultrasound J.* 2013;5(Suppl 1):S10.
5. Croce MA, Fabian TC, Menke PG. Nonoperative management of blunt trauma is the treatment of choice for hemodynamically stable patients. Results of a prospective trial. *Ann Surg.* 1995;221:744-55.
6. Robert A, Novelline M, James T. Helical CT in Emergency Radiology. *Radiology.* 1999;213:321-39.
7. Porter JM, Singh Y. Value of computed tomography in the evaluation of retroperitoneal organ injury in blunt abdominal trauma. *Am J Emerg Med.* 1998;16(3): 225-7.
8. Fang JF, Wong YC, Lin BC, Hsu YP, Chen MF. Usefulness of multidetector computed tomography for the initial assessment of blunt abdominal trauma patients. *World J Surg.* 2006;30(2):176-82.
9. Mullinix AJ, Foley WD. Multidetector computed tomography and blunt thoracoabdominal trauma. *J Comput Assist Tomogr.* 2004;28(suppl 1):S20-27.
10. Alonso RC, Nacenta SB, Martinez PD. CT findings of blunt and penetrating renal trauma. *Radio Graphics.* 2009;21:2033-53.
11. Szmigielski W, Darweesh A, Kassem H. Imaging of blunt pancreatic trauma: the value of initial and sequential CT examinations. *Pol J Radiol.* 2008;73(3):37-45.
12. Ilahi O, Bochicchio GV, Scalea TM. Efficacy of computed tomography in the diagnosis of pancreatic injury in adult blunt trauma patients: a single-institutional study. *Am Surg.* 2002;68(8):704-7.
13. Teh SH, Sheppard BC, Mullins RJ, Schreiber MA, Mayberry JC. Diagnosis and management of blunt pancreatic ductal injury in the era of high-resolution computed axial tomography. *Am J Surg.* 2007;193(5):641-3.
14. Rana AI, Kenny PJ, Lockhart ME. Adrenal gland hematomas in trauma patients. *Radiol.* 2004;230:669-75.
15. Stuhlfaut JW, Anderson SW, Soto JA. Blunt abdominal trauma: current imaging techniques and CT findings in patients with solid organ, bowel, and mesenteric injury. *Semin Ultrasound CT MR.* 2007;28(2):115-29.

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