Role of Multidetector Computed Tomography in Evaluation of Renal Trauma Cases

Medhat M. Refaat, Islam M. Elshazly, Sally M. Abd El Maksoud

Department of Radiology, Faculty of Medicine, Benha University, Egypt.

Correspondence to: Sally M. Abd El Maksoud, Department of Radiology, Faculty of Medicine Benha University, Egypt.

Email:

sallykadry1987@gmail.com

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Abstract

Background: Kidneys are the third most common solid organ injury in blunt abdominal trauma. **Objectives:** to assess the impact of different MDCT phases in diagnosis and staging of renal trauma after either blunt or penetrating trauma, or management of lesions. **Methods:** This study carried on 20 patients with renal trauma. The cases are attending to Al Ahrar education hospital & referred to the radiology department from the Urology and General Surgery Departments .The patients' ages ranged between 8 and 64 years .The patients were presenting with hematuria after blunt or penetrating trauma. Renal injuries were graded according to the last modification of AAST grading system from grade I to grade V. **Results:** This study included 20 patients, among the 20 patients included in our study, As regard to grades of trauma there were (9) Patients (45%) had grade 4 and 6 patients had grade 3 (30%) each of grade one and two present (2) patients 10%, and grade 5 were in only one patient (5%). **Conclusion:** CT become the imaging modality of choice for the evaluation of renal trauma and other associated injuries, providing the essential anatomic and functional information necessary to determine the type and extent of parenchymal, vascular, or collecting system injuries with high sensitivity (90–100%). Improvements in CT technology are advantageous for the patient selection for the best treatment and thus to prevent failure of non-operative management.

Keywords: Contrast-enhanced; multidetector CT; renal; trauma.

Introduction:

Kidneys are the third most common solid organ injury in blunt abdominal trauma. Kidney rupture is similar to splenic rupture in that it is usually caused by a direct blow to the abdomen, side, or mid-to-low back which causes damage or a tear to the organ. This is frequently seen with high-contact sports such as football, rugby, ice hockey, soccer, horseback riding, gymnastics, boxing, sledding, and skiing, though it is very rarely possible to happen spontaneously **(1).**

The kidney is the most commonly injured organ of the genitourinary system and renal injuries account for only 1%-5% of all abdominal injuries. **(2)**

Trauma is a leading cause of morbidity and mortality all over the world. Blunt abdominal trauma accounts for more abdominal injuries than the less frequent penetrating injuries. **(3)**

Severe renal injuries are usually associated with multisystem injuries, may require interventional radiology to control hemorrhage and improve the chances for renal salvage, If there is significant perinephric fluid, especially medially, or deep laceration, delayed images should be obtained to evaluate for urinary extravasation .The presence of urinary extravasation and large devitalized areas of renal parenchyma, especially with associated injuries of intraperitoneal organs, is particularly prone to complication and usually requires surgery. Active hemorrhage should be recognized because it often indicates a need for urgent surgery or embolization to prevent exsanguination. **(4)**

Of all the incurred injuries, over 95% are minor injuries and can be managed with conservative therapy with no significant complications. It is only the more grave injuries, like renal fracture or shattering, renal pedicle injury or avulsion and severe pelvicalyceal system (PCS) injury, which require active intervention or even surgery.

Ultrasonography is useful in detecting hemoperitoneum in patients with suspected intraperitoneal injury but has limited value in evaluating those with suspected extraperitoneal injury.

Contrast enhanced computed tomography (CECT) is the modality of choice for evaluation of renal injures today and can delineate the various grades of injury and associated complications. Depending upon

the imaging findings, patients may be taken for interventional procedures rather than surgery. **(5)**

With a short examination time, CT provides all the necessary information relating to the degree of parenchymal injury with or without involvement of pelvicalyceal system and renal vascular injuries and also provides information regarding the functional status of the kidneys.

Apart from the surgical grading by the American Association, an imaging-based grading system is now the most widely used system to describe renal injuries and carries management and prognostic implications. Renal injuries are classified into grades 1–5 based on the severity of the injury using the American Association for the Surgery of Trauma (AAST) organ injury severity scale: **(6)**

- **Grade 1:** Contusion or nonexpanding subcapsular hematoma without parenchymal laceration.
- **Grade 2:** Nonexpanding perirenal hematoma laceration < 1 cm deep without extravasation.
- **Grade 3:** Laceration > 1 cm without urinary extravasation.
- **Grade 4:** Laceration extending through renal cortex into collecting system, or segmental renal artery or vein injury with contained hemorrhage, or partial vessel laceration, or vessel thrombosis.
- **Grade 5:** Laceration: shattered kidney, or renal pedicle injury, or avulsion of renal hilum.

As most of the patients undergoing CT scan are not so co-operative in breath holding, motion artifacts can frequently compromise the study and lead to added confusion in interpreting the scan. So Faster imaging with multislice scanner and multiplanar reconstruction can help to overcome these problems and provide an accurate assessment of injury**. (7)**

Materials and Methods

This cross-sectional study was carried on 20 patients with renal trauma. The cases are attending to Al Ahrar education hospital & referred to the radiology department from the Urology and General Surgery Departments, during the period from January 2021 to September 2021. The patients' ages ranged between 8 and 64 years

Inclusion criteria: Patients with hematuria after abdominal trauma or patient with

suspected renal injury after blunt or penetrating trauma.

Exclusion criteria:

- Patients having contraindication to radiation or iodinated contrast media are excluded**.**
- Pregnant females
- Patient with high serum creatinine.

All patients will be subjected to**:**

- Clinical assessment.
- HB level with full CBC
- Blood serum creatinine.
- FAST (focused assessment with sonography in trauma)
- Multidetector computed tomography (MDCT) examination of the abdomen & pelvis including :-
    - Non- contrast CT scan.
    - Post contrast CT scan.

Informed consent will be obtained from all patients after full explanation of the benefits and risks of the procedure.

Ethical considerations

Every patient received an explanation to the purpose of the study and the benefits and risks of the procedure**.**

Any unexpected risks encountered during the course of the research were cleared to the participants as well as to the Ethical Committee on time.

After approval from institutional ethical committee, an informed consent was taken from each patient.

There were adequate provisions to maintain privacy of participants and confidentiality of data through:

- Each participant had a code number.
- All data and investigations of subjects were confidential with a private file for each patient.
- The results of the research were used only for the scientific purpose.

Statistical analysis:

All data were collected, tabulated and statistically analyzed using SPSS (Statistical package for social science) version 16. Continuous Quantitative variables e.g. age was expressed as the mean ± standard deviation (SD) & range and categorical qualitative variables were expressed as absolute frequencies (number) & relative frequencies (percentage).

Result:

This study included 20 patients; their age's ranged from (8 -64) years (mean age is 28 + 2 years). There were (15) patients were males speaking to (75%) and (5) patients were females speaking to (25%). **(tab. 1)**

In our study, their age's ranged from (8-64) years. In our study, 3 patients (15%) their age was between 8 to 24 years of age, 9

patients (45%) were between 25-34 years of age, 5 patients (25%) were between 35-44 years of age, 2 patients (10%) were between 45-54 years of age, one patients (5%) were between 46-55 years of age. **(tab. 2)**

As regard to the cause of renal trauma there were 6 Patients (30%) had Road traffic accident and 8 patients (40%) had Blunt trauma and 4 patients (20%) had fallen from height and 2 patients (10%) had Open penetrating trauma. **(tab. 3)**

As regard to clinical presentation. All patients are represented to emergency department with Flank pain. Hypovolemic shock: 6 patients only were stable (30%) and 14 patients only were shocked (35%). Hematuria: were present in 16 patients (80%) and the rest 4 patients were free (20%). Hypotension: was presented in 14 patients only (70%). Dyspnea: was presented in 7 patients only (35%). **(tab. 4)**

As regard to CT findings in the patients included in our study, Contusion was found in 2 patients (10%). Perinephric hematoma: Was found in 16 patients (80%). Superficial laceration < 1cm: was found in 3 patients (15 %). Deep laceration > 1cm: was found in 5 patients (25 %). Collecting system affection: 10 patients were affected (50%) and the rest 6 patients were free (30%). Vascular injury: only 3 patients had vascular injury (15%) and the other 17 patients were free (85%). **(tab. 5)**

Other organs affection**:** spleen was affected in 4 patients (20%), liver injured in 3 patients (15%), 2 patient (10%) had fracture spine, lung was affected in only 1 patients (5%) and there were 12 Patients (60%) had no affection to other organs. **(tab. 6)**

As regard to grades of trauma there were (9) patients (45%) had grade 4 and 6 patients had grade 3 (30%) each of grade one and two present (2) patients 10% ,and grade 5 were in only one patient (5%) as shown in table (13), **(tab. 7)**

Cases :

Case 1: A 28 years male patient was involved in motor bicycle accident, represented by haematuria and worsening pain. **(Fig. 1)**

The left kidney shows a superficial contusion (non-enlarging non enhancing hypodense sub capsular hematoma) seen at the lower pole, no extension to the collecting system & no extravasation of the contrast material in the perinephric space in addition to an intact left renal artery and vein with no evidence of pedicle avulsion.

Multiple hypodense full thickness lacerations are seen reaching the splenic capsule in addition to an intact splenic pedicle. Moderate amount of hypodense perisplenic collection is seen surrounding the spleen and extending inferiorly. Moderate amount of free intraperitoneal fluid \ hemorrhage is noted.

Final diagnosis According to ASST classification this is considered grade I renal injury.

Case 2: A 50 years old female patient was fallen on a hard object in bathroom, represented by hematuria and fractured ribs. **(Fig. 2)**

The right kidney shows multiple hyper-dense sup-capsular hematomas, largest measuring 15 x 10 mm and parenchymatous non enhanced area (laceration) measuring 15mm not reaching the collecting system

Final diagnosis According to ASST classification this is considered grade II renal injury.

Case 3: A 42 years old male patient was traumatized in high speed road traffic accident, represented by hematuria and severe left sided flank pain. **(Fig. 3)**

The left kidney shows a single deep laceration involving the cortex and medulla of the mid renal zone and also extending to the collecting system with no extravasation of the contrast material in the perinephric space, in addition of an intact left renal artery and vein with no evidence of pedicle avulsion. Moderate amount of hypodense perinephric collection is seen surrounding the left kidney (mostly perinephric hematoma). A single hypodense laceration seen at the parietal surface of the spleen with intact splenic pedicle is noted.

Final diagnosis According to ASST classification this is considered grade III renal injury.

Case 4: A 27 years old male patient with history of sever open trauma in the right flank, presented clinically with severe right sided flank pain and gross hematuria. **(Fig. 4)**

The right kidney shows a single deep laceration involving the cortex and medulla of the mid renal zone and also extending to the collecting system with subsequent extravasation of the contrast material in the middle compartment of the perinephric space, in addition to an intact right renal artery and vein with no evidence of pedicle avulsion. Moderate amount of hypodense perinephric collection is seen surrounding

the right kidney (mostly perinephric hematoma).

Final diagnosis According to ASST classification this is considered grade IV renal injury

Case 5: A 35years old female patient presented clinically with fever and severe left flank pain following history of blunt trauma. **(Fig. 5)**

The Left kidney shows totally non perfused renal parenchyma with no opacification of the left renal artery (cut off sign) picture impressive of complete renal pedicle avulsion, no extravasation of the contrast material in the perinephric space. Moderate amount of hypodense perinephric collection is seen surrounding the left kidney (mostly perinephric hematoma). Left lung contusion.

Final diagnosis According to ASST classification this is considered grade V renal injury

Table (1): Gender distribution among 20 patients in our study (n= 20).

Gender	N	%
Male	15	75%
Female	5	25%
Total	20	100%

Table (2): The age of the studied patients (n = 20)

Age	N	%
8-24	3	15%
25-34	9	45%
35-44	5	25%
45-54	2	10%
55-64	1	5%
Total	20	100%

Table (3): Causes of renal trauma among 20 patients included in our study:

Causes of renal trauma	N	%
Road traffic accident	6	30%
blunt trauma	8	40%
fallen from height	4	20%
open trauma	2	10%

Table (4): clinical presentation among 20 patients included in our study:

Clinical presentation	N		%
Flank pain	Yes	20	100%
	No	0	0%
Hematuria	Yes	16	80%
	No	4	20%
Hypovolemic shoke	Yes	6	30%
	No	14	70%
Dyspnea	Yes	7	35%
	No	13	65%
Hypotension	Yes	14	70%
	No	6	30%

Table (5): CT findings of renal injuries in our 20 patients included in the study

Renal injuries	N	%
Contusion	2	10%
Perinephric hematoma	16	80%
superficial laceration < 1cm	3	15%
deep laceration > 1cm	5	25%
Collecting system affection	10	50%
Vascular injury	3	15%
Shattered kidney	2	10%

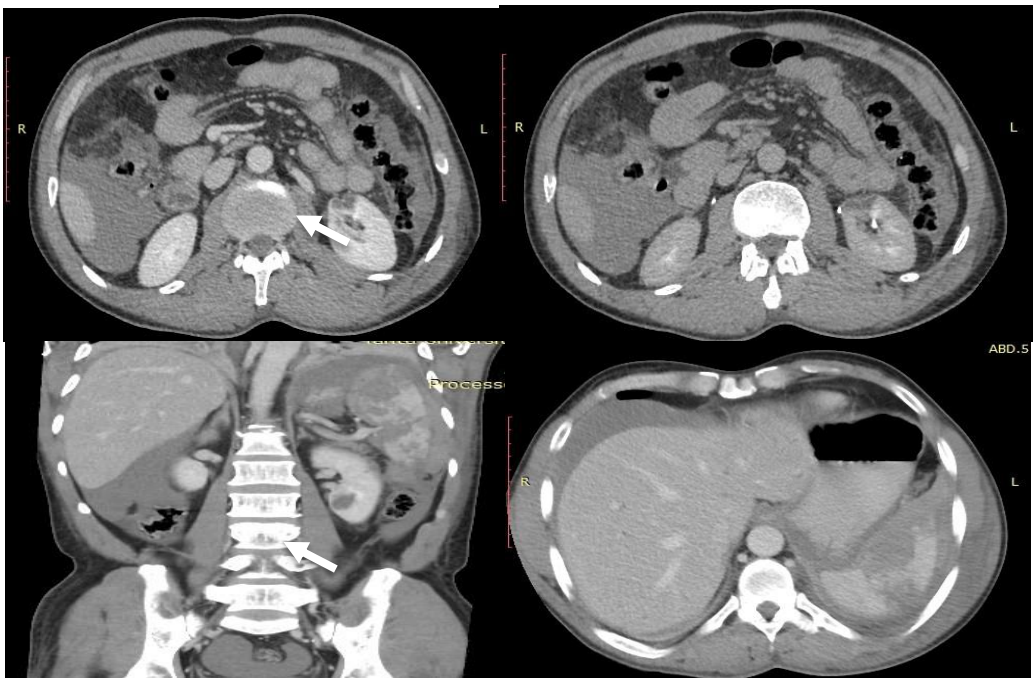
Table (6): CT findings of other organs affected in our 20 patients included in the study

Other Ogans Affected	N	%
Spleen laceration	4	20 %
Fracture spine	2	10 %
Lung injury	1	5 %
Liver injury	3	15 %
No associated organs injury	12	60 %

Table (7): grades of trauma among 20 patients included in our study:

Grades of Trauma	N	%
Grade I	2	10%
Grade II	3	15%
Grade III	5	25%
Grade IV	7	35%
Grade V	3	15%
Total	20	100%

Fig. (1):



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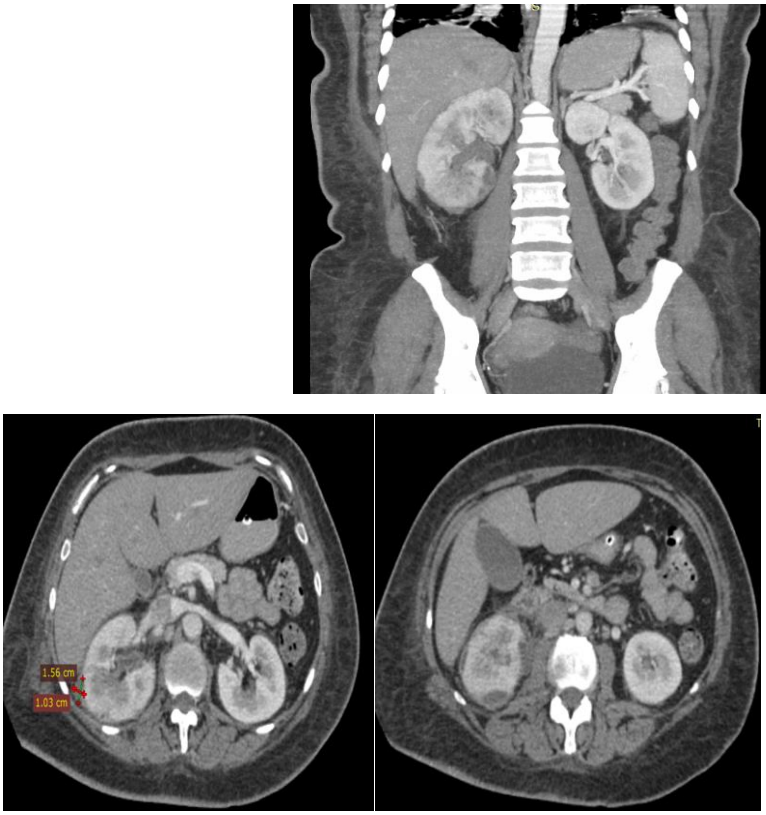

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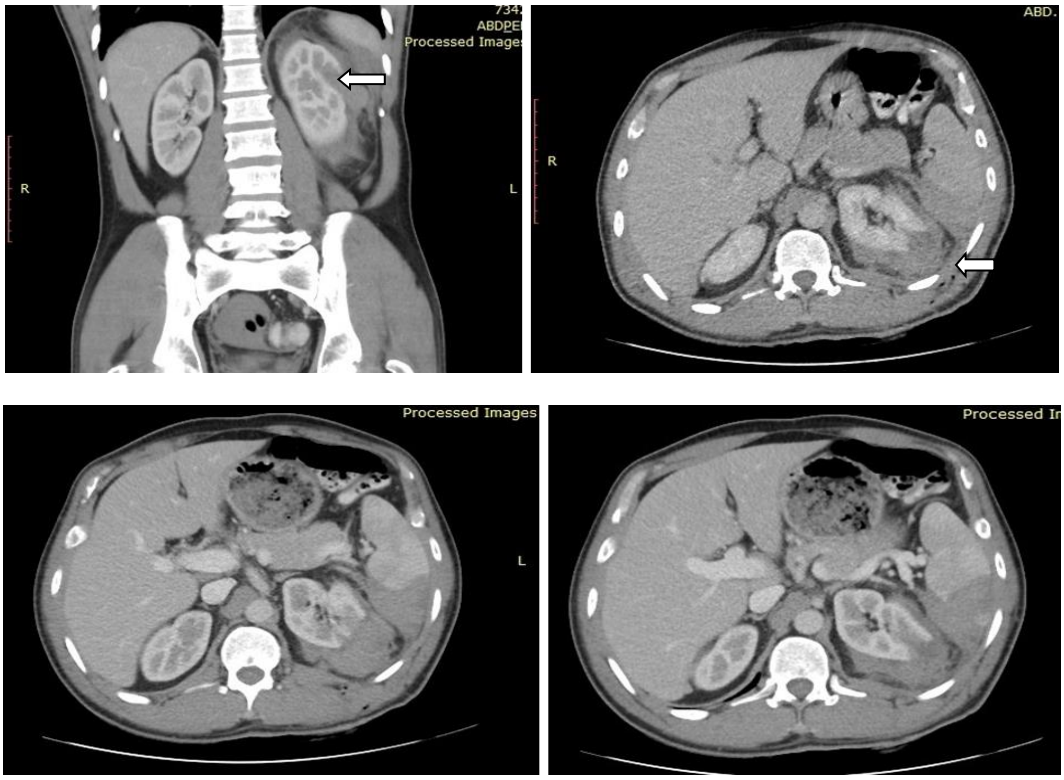
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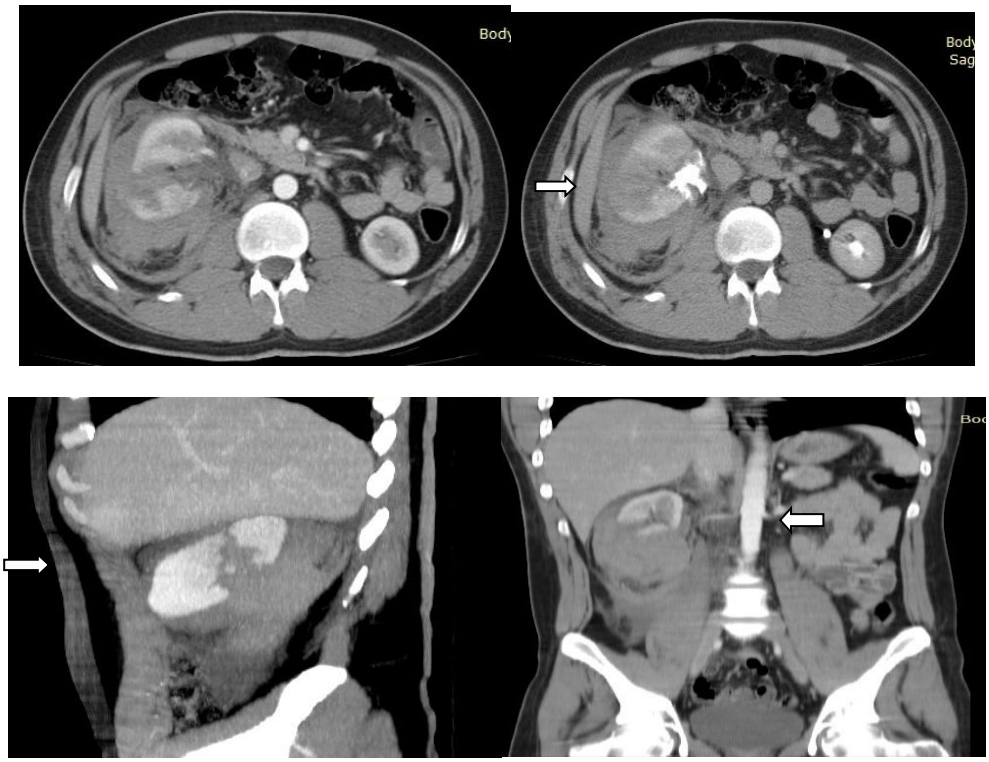
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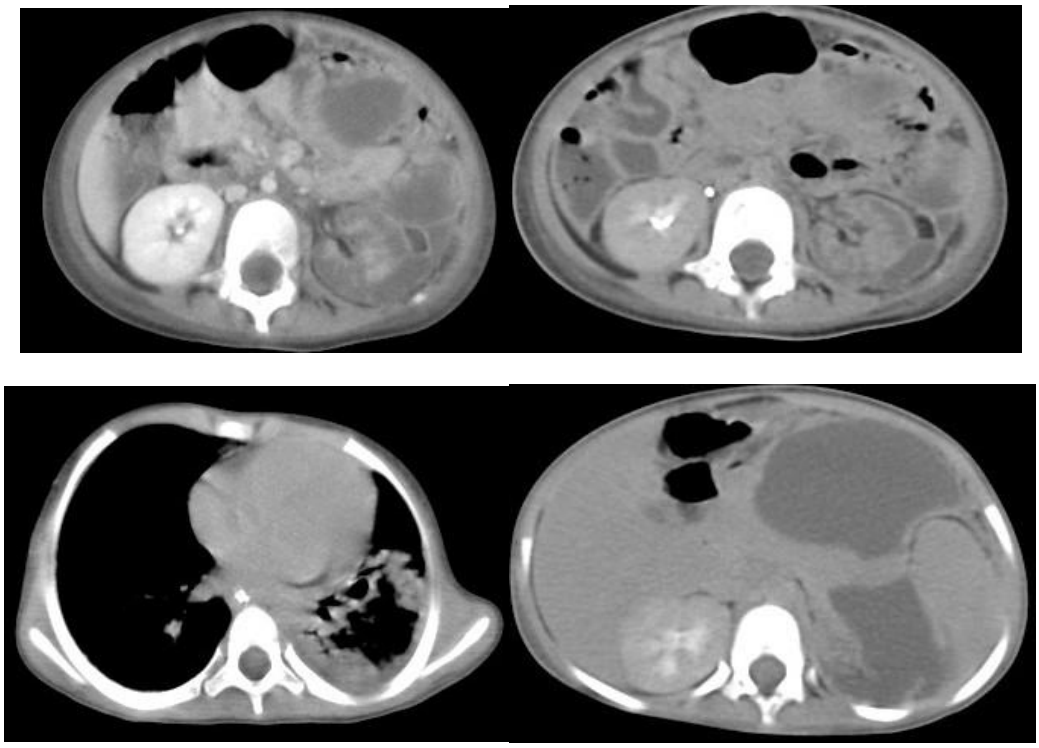

Discussion:

Renal injury occurs in approximately 8–10% of blunt or penetrating abdominal trauma **(8)**. The overwhelming majority (80–90%) of renal trauma involves blunt rather than penetrating injury. 75–80% of major renal injuries are associated with penetrating or blunt trauma to other abdominal organs.

Renal trauma is a disease of young. It divides into two basic categories blunt trauma and penetrating trauma as well as iatrogenic. **(9)**

Generally accepted indications for kidney trauma imaging are: penetrating injury and hematuria, blunt trauma and gross hematuria, microscopic hematuria and hypotension, microscopic hematuria and significant associated injuries, direct contusion or hematoma of flank soft tissue, fractures of the lower ribs, transverse processes or dorso-lumbar spine .**(10)**

CT has replaced intravenous urography and became the diagnostic tool of choice for the assessment of renal trauma and other associated injuries **(11)** .In the setting of acute trauma, CT provides essential anatomic and physiologic information that

can differentiate insignificant injuries from those requiring intervention. **(10)**

Furthermore, multislice fast CT technique with multiplanar and 3D image reformation offers new diagnostic possibilities in the setting of abdominal and renal trauma. **(12)**

CT provides all the necessary information relating to the degree of parenchymal injury with or without involvement of pelvi calcyeal system and renal vascular injuries and also provides information regarding the functional status of the kidneys. Doing a phasic scan also helps in differentiating active hemorrhage from urine extravasation **(13).** With the wider availability of newer CT machines and helical multislice scanners, much faster scanning, increased volume coverage and improved multiplanar reconstruction ability now can provide high quality images with shorter time on the table for the patient .**(14)**

As most of the patients undergoing CT scan are not so co-operative in breath holding, motion artifacts can frequently compromise the study and lead to added confusion in interpreting the scan. Faster imaging with multislice scanner and multiplanar reconstruction can help to overcome these problems and provide an accurate assessment of injury. **(15)**

MDCT scanning is the only imaging modality that can provide information required to grade renal injuries as part of the AAST renal injury grading system. **(16)**

Conclusion: CT become the imaging modality of choice for the evaluation of renal trauma and other associated injuries, providing the essential anatomic and functional information necessary to determine the type and extent of parenchymal, vascular, or collecting system injuries with high sensitivity (90–100%). Improvements in CT technology are advantageous for the patient selection for the best treatment and thus to prevent failure of non-operative management.

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