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Renal trauma in helical CT examination

Since its clinical introduction in the 1970s, computed tomography revolutionized the imaging work-up of patients in the emergency department. CT now is considered to be one of the most valuable tools in the diagnostic work-up of trauma patients and patients with nontraumatic emergency conditions. Today, most emergency centres are equipped with CT scanners that are available for the evaluation of emergency patients 24 hours a day, 7 days a week. During the past 20 years, improvements in scanner hardware and software have provided increased scanning speed and faster data acquisition as well as improved spatial resolution and increased low-contrast detectability. As a consequences, emergency patients now benefit from faster and more accurate CT examinations (1, 2, 5, 8). Diagnosis and treatment of patients admitted to a trauma centre with potential blunt abdominal injury has been a difficult and challenging task for the trauma surgeon and emergency radiologist. The ability of multidetector row CT to obtain high resolution images during optimal contrast enhancement at unparalleled speed has made it the imaging modality of choice for evaluating hemodynamically stable patients with abdominal pain, tenderness, or a positive ultrasound examination for free intraperitoneal fluid (2, 4, 7).

The aim of the study is to present the usefulness of helical CT examination of abdomen in patients with renal trauma.

MATERIAL AND METHODS

Material comprises a group of 18 patients after a blunt abdominal trauma, with renal injury, in when helical CT examination of the abdomen was performed. The scanning was performed with Helical CT scanner Somatom Emotion by Siemens, before and after administering of contrast agent intravenously. The examination begins from above the level of the diaphragm to below the pelvis. The unenhanced and enhanced axial section as well as MPR reconstructions were assessed.

RESULTS

In 13 patients extravasations of the contrasted urine were seen on both urography (Fig. 1) and CT examination (Fig. 2). Subcapsular haematomas were seen in 6 patients, as hiperdense areas before administering of contrast agent (Fig. 3A) and as hipodense areas on enhanced scans (Fig. 3B). Perirenal haematoma was seen in 4 patients (Fig. 4), and in 2 of them laceration of the renal parenchyma was seen (Fig. 5). Fragmentation of renal parenchyma was seen in 3 patients (Fig. 6).

Fig. 1. Extravasation of the contrasted urine on urography (arrows)

Fig. 2. Extravasation of the contrasted urine on CT section (arrow)

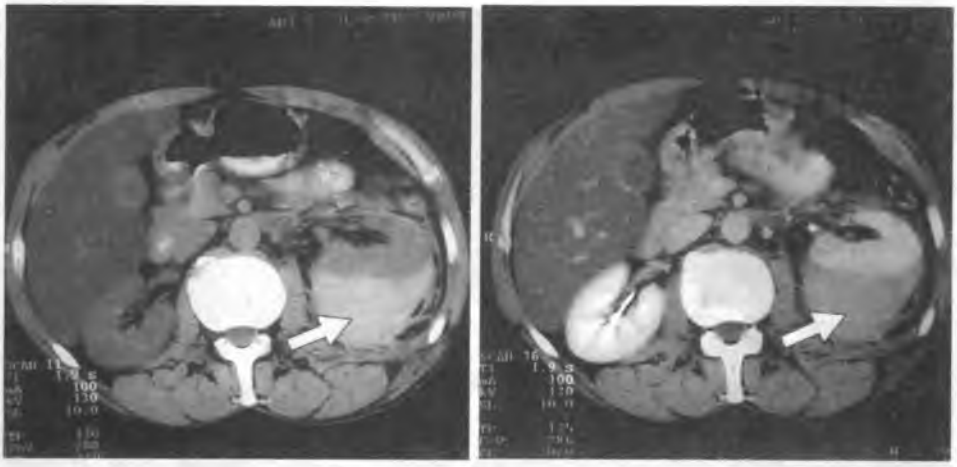

Fig. 3. Subcapsular renal haematoma (arrows) before – A and after – B administering of contrast agent

Fig. 4. Perirenal haematoma (arrow) on CT section

Fig. 5. Linear renal laceration (arrow) with perirenal haematoma

Fig. 6. Fragmentation of the renal parenchyma (arrows)

DISCUSSION

Trauma is the leading cause of death in men and women under the age of 40 years. CT has proved to be an excellent technique for diagnosing abdominal injuries. The rapid diagnostic capability afforded by CT has contributed toward a decrease in morbidity and mortality from abdominal injuries. Hemoperitoneum is easily identified with CT, as are injuries of the spleen, liver, gallbladder, kidneys, pancreas, bowel, mesentery and diaphragm. CT can differentiate intraperitoneal haemorrhage and can differentiate hemoperitoneum from water-attenuation, posttraumatic peritoneal fluid collections, such as urine with intraperitoneal bladder rupture. CT can demonstrate active arterial bleeding as sites of intravenous contrast material extravasations, and bowel rupture as sites of oral contrast material extravasations. The aorta, inferior vena cava and other vascular structures can be assessed from their opacification with i.v. contrast material. And even bone injuries of the lumbar spine and pelvis may be identified on sections reviewed with bone window settings. The major advantage of helical CT in abdominal trauma imaging has been the increased speed of the CT examination, decreasing the scanning time for seriously injured patients. Respiratory and other motion artefacts are diminished with fast helical technology, and there is improved vascular and parenchymal opacification with i.v. contrast material. Reconstructions with overlapping spacing permit better evaluation of small injuries, as well as improved coronal and sagittal reformations for displaying injuries and anatomic relations in the cranicaudal direction. In patients with abdominal trauma, multiplanar reformations have been useful in demonstrating diaphragmatic rupture, traumatic avulsion of the gallbladder, and fracture of the spine. Abdominal vascular trauma such as traumatic renal artery occlusions is well shown by the excellent vascular opacification afforded by helical CT, and 3D CT angiography can provide an excellent display of these injuries (5, 9).

Examination should be performed with i.v. and oral contrast media. Helical scanning should start from above the highest hemidiaphragme to below the pelvis with the collimation of 5 mm, a pitch 1.5 and reconstructions at 5 mm of image spacing. Oral contrast material should be used to opacify the bowel injury, if the state of the patients allows administering of oral contrast (5). Renal injuries occur in about 10% of patients with blunt abdominal trauma. In most cases, hematuria is the first indication of renal injury. However, hematuria is absent in approximately 20% of patients with significant renal trauma. Overall, in a majority of cases, the renal injury is relatively minor, consisting of contusions or intrarenal and subcapsular haematoma. Major renal injury, i.e. deep lacerations, shattered kidneys, or pedicle injuries, occurs in only about 10% to 15% of trauma patients with renal injury (6). There can be intraparenchymal injuries without a perinephric haematoma, in which case the laparotomy would reveal no renal injury. Thus, CT may be the gold standard for making the diagnosis of renal injury in blunt trauma.

Most renal injuries are minor (75–98%), represented by C grades I and II, and are successfully treated without intervention. Contusions are visualized as ill-defined low attenuation areas with irregular margins. They appear as regions with a striated nephrogram pattern due to differential blood flow through the contused area, or as focal areas renal parenchymal extravasation on delayed noncontrast CT studies. These lesions usually resolve during follow-up imaging. Segmental renal infarcts are relatively common in blunt renal trauma, and result from stretching and subsequent occlusion of accessory renal artery, extrarenal or intrarenal branches of the renal artery, or the capsular artery. These infarcts appear sharply demarcated wedged-shaped areas of very low attenuate typically involving the renal pole(s). Associated ma renal injuries may or may not accompany segmental renal infraction. While renal arteriography will demonstrate the injured vessel and embolization can be performed, in general, specific angiographic confirmation and treatment is not warranted if the s mental infarct appears as an isolated renal injury. Subcapsular renal haematomas are rare (3).

Renal injury grading scale is presented in Table 1. Major renal injuries are seen in about 10% of cases of penetrating trauma to the flank and back. They occur in 15–42% of such patients with only microscopic haematuria but the absence of haematuria does not exclude injury to the kidney or collecting system (3).

CT is extremely sensitive in detecting even small quantities of intraperitoneal fluid or hemoperitoneum, often seen in patients with renal trauma. In the supine position, the most dependent region of the peritoneal cavity is the hepato-renal fossa (Morison's pouch). Other areas where free fluid or blood is often seen in trauma patients are adjacent to the bladder in the pelvis, the paracolic gutters, and the perihepatic and perisplenic spaces. Careful inspection of these areas is necessary to identify small amounts of fluid or blood that may be the only CT sign of a subtle or occult intraperitoneal visceral injury (7, 9). Density measurements should be obtained for all fluid collections identified by CT to help characterize its origin. Care should be taken to avoid volume averaging in measuring the density of free fluid. Using density measurements of intraperitoneal fluid, CT can help distinguish between simple ascites, blood, haematoma, bile, urine, chyle, and active bleeding. The highest density blood among several areas of intraperitoneal blood is adjacent to the injured organ, a concept they referred to as the "sentinel clot" sign. This sign is particularly valuable when the injury to the organ parenchyma itself is subtle (7).

Table 1. Renal injury grading scale

Injury grade	Description or CT finding
I	Superficial laceration(s) involving cortex Renal contusion(s) <1 cm subcapsular haematoma Perinephric haematoma not filling Gerota's space and no active bleeding Segmental renal infarction
II	Deeper renal laceration extending to medulla, with intact collecting system >1 cm subcapsular haematoma with intact renal function Perinephric haematoma limited to and not distending the perinephric space; no active bleeding
III	Laceration extending into collecting system with urine extravasation limited to retroperitoneum Perinephric haematoma distending perinephric space or extending into pararenal spaces; no active bleeding
IV	Fragmentation (3 or more segments) of the kidney (usually partially devitalized with large perinephric haematoma Devascularization >50% of parenchyma Main renal pedicle injury Active bleeding by CT Extravasation of urine into peritoneal cavity or extensive extravasation Subcapsular haematoma compromising renal perfusion

CONCLUSIONS

CT is the imaging modality of choice in evaluation of patients with renal trauma. Rapid acquisition of helical CT is additional advantage. There can be intraparenchymal injuries without a perirenal haematoma, in which case the laparotomy would reveal no renal injury. Thus, CT may be the gold standard for making the diagnosis of renal injury in blunt trauma. CT enables precise evaluation as well as grading the renal injury severity.

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SUMMARY

The aim of the study is to present the usefulness of helical CT examination of abdomen in patients with renal trauma. Material comprises group of 18 patients after a blunt abdominal trauma, with renal injury, in whom helical CT examination of the abdomen was performed. The scanning was performed with Helical CT scanner Somatom Emotion by Siemens, before and after administering of contrast agent intravenously. The examination begins from above the level of the diaphragm to below the pelvis. The unenhanced and enhanced axial section as well as MPR reconstructions was assessed. In 13 patients extravasation of the contrasted urine was seen on both Urography and CT examination. Subcapsular haematomas were seen in 6 patients, as hiperedense areas before administering of contrast agent and as hipodense areas on enhanced scans. Perirenal haematoma was seen in 4 patients, and in 2 of them laceration of the renal parenchyma was seen. Fragmentation of renal parenchyma was seen in 3 patients. CT is the imaging modality of choice in evaluation of patients with renal trauma. Rapid acquisition of helical CT is additional advantage. There can be intraparenchymal injuries without a perirenal haematoma, in which case the laparotomy would reveal no renal injury. Thus, CT may be the gold standard for making the diagnosis of renal injury in blunt trauma. CT enables precise evaluation as well as grading of the renal injury severity.

Urazy nerek w spiralnej tomografii komputerowej

Celem pracy jest przedstawienie zastosowania spiralnej tomografii komputerowej jamy brzusznej w ocenie pacjentów z urazami nerek. Materiał stanowi grupa 18 pacjentów po tępych urazach jamy brzusznej z uszkodzeniami nerek, u których wykonano badanie TK jamy brzusznej. Skanowanie przeprowadzono od poziomu powyżej kopuł przepony do poziomu spojenia łonowego, spiralnym tomografem komputerowym Somatom Emotion firmy Siemens, przed i po podaniu iv bolusa środka kontrastowego. Oceniano skany przed podaniem kontrastu, po jego podaniu oraz rekonstrukcje MPR. U 13 pacjentów wynaczynienie zakontrastowanego moczu było widoczne na urografii i w badaniu TK. Podtorebkowy krwiak był widoczny u sześciu pacjentów jako hiperdensyjny obszar przed podaniem kontrastu oraz jako obszar hipodensyjny po jego podaniu. Krwiak okołonerkowy był widoczny u czterech pacjentów, a u dwóch z nich widoczne były szczeliny pęknięcia miąższu nerki. U trzech pacjentów stwierdzono fragmentację miąższu nerki. TK jest metodą obrazowania z wyboru w ocenie pacjentów z urazami nerek. Krótki czas badania tomografów spiralnych ma dodatkowe znaczenie. Tomografia komputerowa moze być uznana za złoty standard w ocenie uszkodzeń nerek po tępych urazach jamy brzusznej, umożliwiając precyzyjną ocenę jak też klasyfikację stopnia uszkodzenia.