CT FINDINGS IN PATIENTS WITH BLUNT ABDOMINAL TRAUMA

MARIA DANIELA PODEANU[1], ANDRADA TREABĂ[2], NINA ŞINCU[3], LIA MARIA SIMU[4], IUNIUS SIMU[5], MARIANA TILINCA[6]

[1,2,3,4,5,6]University of Medicine and Pharmacy Tîrgu-Mureş

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Abstract: *Introduction. CT scan is the gold standard in abdominal blunt trauma in stable patients because it reduces the number of laparotomies. Material and methods. We have examined 327 patients with trauma. The examinations were made with a single-slice CT AURA (Philips). Protocol for trauma has included non enhanced scan followed by CT angiography with multiphase acquisition (arterial phase, portal-venous phase and a delayed phase for renal collecting system integrity check-out). Results Of 327 patients with blunt abdominal trauma examined during 2012, 52 cases representing 15,9 % had CT detectable intraabdominal lesions. Of them, more than half (27 cases representing 51,92%) had associated injuries (cranio-cerebral, thorax, spine, pelvis and extremities). 37 were males and 15 were females. Age ranged between two and 83 years old. Regarding the cause of trauma, we found the car accidents in 79% of cases, followed by accidental falling (13%) and aggression (8%). The injured organs were spleen (26 cases), liver (18 cases), kidney (7 cases), diaphragm in one case and associated musculoskeletal injuries were noted in 33 patients. Conclusions. CT angiography represents the best option for abdominal blunt trauma showing active bleeding, contrast extravasation and also devascularisation.*

Cuvinte cheie: *traumatisme abdominale închise, hemoperitoneu, extravazare de contrast*

Rezumat: *Introducere. Examinarea CT reprezintă metoda de elecţie pentru evaluarea traumatismelor abdominale închise la pacienţii stabili pentru că reduce numărul de laparotomii. Material şi metodă. S-au examinat un număr de 327 de pacienţi traumatizaţi. Examinările s-au făcut cu un aparat monodetector spiral CT AURA (Philips). Protocolul de examinare a inclus examinarea nativă, urmată de angiografia CT cu achiziţie multifazică (faza arterială, venoasă şi tardivă pentru evaluarea integrităţii sistemului colector renal). Rezultate. Din 327 de pacienţi cu traumatisme abdominale închise examinaţi în cursul anului 2012, un număr de 52 de cazuri, reprezentând 15,9% au avut leziuni intraadominale decelabile CT. Din aceştia, mai mult de jumătate (27 cazuri, reprezentând 51,92%) au avut leziuni asociate (cranio-cerebrale, toracice, vertebrale, pelvis şi extremităţi). 37 au fost pacienţi de sex masculin, iar 15 au fost de sex feminin. Vârsta pacienţilor a fost cuprinsă între 2 şi 83 de ani. În ceea ce priveşte cauzele traumatismelor, accidentele rutiere au fost prezente în 79% din cazuri, urmate de căderile accidentale (13%) şi de agresiuni (8%). Organele lezate au fost splina (26 de cazuri), ficatul (18 cazuri), rinichii (7 cazuri), diafragmul într-un caz, iar leziuni osteo-musculare asociate s-au găsit în 33 de cazuri. Concluzii. Angiogafia CT reprezintă cea mai bună opţiune pentru traumatismele abdominale închise, evidenţiind sângerarea activă, extravazare de contrast, precum şi devascularizarea.*

INTRODUCTION

Our purpose is to emphasize the importance of CT scan in evaluating the abdominal blunt trauma. CT scan is the gold standard in abdominal blunt trauma in stable patients because it reduces the number of laparotomies. Trauma is the leading cause of death under the age of forty and of all traumatic deaths, 10% belong to abdominal injuries.(1) The role of the radiologist is to look for the following aspects that are to be expected in abdominal blunt trauma: hemoperitoneum, contrast blush consistent with active bleeding, lacerations, contusions, parenchimal hematomas, subcapsular hematomas, devascularisation of organs or part of organs, free intraperitoneal or retroperitoneal air, diaphragmatic rupture.

Nowadays, more than 50% of spleen injuries, almost 80% of liver injuries and virtually all renal injuries are managed non-operatively because the long-term outcome of patient is better related to visceral conservative management.(1) Video assisted diagnostic laparoscopy has helped reducing the number of laparotomies for evaluating abdominal trauma. Laparotomy is indicated in active bleeding, significant hemoperitoneum, free air (hollow viscus perforation), tear of diaphragm and severe injuries of parenchymal organs. CT scan has 100% sensibility for hemoperitoneum and contrast enhanced sequence allows the detection of active bleeding followed by embolization or surgery.(2,3) Free intraperitoneal blood has between 30 and 45 HU, clotted blood from 45 to 70 HU. Active bleeding (extravasation) is suggested by the presence of hyperdensities whose values are within 10 HU compared to the nearby vascular structures or aorta. Differentiation from posttraumatic aneurysm or AV fistula is possible on the delayed sequences where if contrast persists is suggestive for extravasation (in posttraumatic aneurysm or AV fistula contrast will wash away with the blood stream). Another important image that is present is the "sentinel clot" sign. The most commonly injured solid abdominal organ in

[1]Corresponding author: Iunius Simu, Str. Ghe. Marinescu, Nr. 30, Tîrgu-Mureş, România, E-mail: inuniuspaul.simu@umftgm.ro, Tel: +40265 215551
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blunt trauma is the spleen (25% of cases). Statistically, the majority of blunt abdominal trauma is caused by car accidents (more than 75% of cases) followed by aggressions (15% of cases), accidental falls (6 to 9%) and child abuse. The latter represents the second cause of child's death.(4)

Abdominal trauma is seldom isolated, being associated with extraabdominal injuries. The gravity of lesions is classified by the AAST – American Association for Surgery of Trauma. The most common injured organ in blunt abdominal trauma is the spleen. In 50% of cases, it is the only intraperitoneal injured organ.(1,5,6) CT scan shows the presence of active bleeding followed by embolization or surgery.

The liver is the second most frequent intraperitoneal solid organ in adults and the first one in children.(4) In 45% of cases it associates splenic lesions. CT scan may demonstrate subcapsular or intraparenchymal hematoma, laceration or active bleeding. In 80% of cases the treatment is conservative.(7) Even the hematoma, subcapsular or parenchymal is over 10 cm if the capsule is intact, there is a non-operatively management. Surgical treatment is needed when active bleeding with hemoperitoneum is present. The complications appear in 10 to 25% of cases and are usually represented by hemorrhage (6%), abscess (1-4%) and biloma (< 1%).

Kidneys are frequently injured in abdominal trauma (up to 80-90% of cases) but the majority of them are managed non-operatively (95%).(1,8) CT findings are represented by: acute subcapsular hematoma with cortical compression and ischemia, superficial cortical laceration without collecting system injury which may associate perirenal hematoma, capsule rupture with perirenal hematoma, renal fracture crossing cortex to hilum, shattered kidney with traumatic renal artery occlusion (lack of nephrogram and excretion).

Pancreatic injury is rarely isolated, usually it is associated with other lesions caused by car accidents in adults, in children it may appear isolated in bicycle accidents (handle bar impact). CT findings are represented by: normal aspect followed by posttraumatic pancreatitis, hypodensity at cephalo-corporeal junction (contusion, laceration), active bleeding, peripancreatic fluid, posttraumatic pancreatitis with pseudocyst formation, Wirsung duct rupture requiring surgery in the first 24 hours.

Hollow viscus`s injury appears very rarely isolated, being associated with multiple posttraumatic injuries of solid organs. Sometimes the CT signs are very subtle. They are represented by: free intraperitoneal air, interileal fluid, intramural or intramesenteric hematoma, parietal thickness with submucosa edema and mucosal enhancement.(9) The rupture of diaphragm is not common but it is important not to be missed because of the further surgical procedure.(10)

PURPOSE

Our purpose is to emphasize the importance of CT scan in evaluating the abdominal blunt trauma.

METHODS

The study has included the patients with abdominal blunt trauma sent to our department by the Emergency Unit in the last year. The examinations were made with a single-slice CT AURA (Philips). The position of the patients was supine, with arms elevated and the scan ranged from diaphragm domes to the pubic symphysis.

Protocol for trauma has included non enhanced scan followed by intravenous contrast media administration with multiphase acquisition: time of delay for arterial phase - 25 seconds, time of delay for portal-venous phase - 60-70 seconds and a delayed phase after 3-5 minutes for renal collecting system integrity check-out. It has been used 100 ml Optiray with a flow rate of 3 ml per second. The spiral protocol we used had the following parameters: 5 mm slice thickness, 7,5 mm table feed and reconstruction increment of 5 mm, 1,5 pitch factor. We have examined 327 patients with trauma.

RESULTS

Of the 327 patients examined during 2011, a number of 52 cases representing 15,9 % had CT detectable intraabdominal lesions. Of them, more than half (27 cases representing 51,92%) had associated injuries (cranio-cerebral, thorax, spine, pelvis and extremities). 37 were males and 15 were females. Age ranged between two and 83 years old. The majority of patients belonged to the third decade and the least were patients within their first decade. Regarding the cause of trauma, we found the car accident in 79% of cases, followed by accidental falling (13%) and aggression (8%). The injured organs were spleen (26 cases), liver (18 cases), kidney (7 cases), diaphragm in one case (grade III, figure no. 5) and associated musculoskeletal injuries were noted in 33 patients.

Figure no. 1. Patients' age

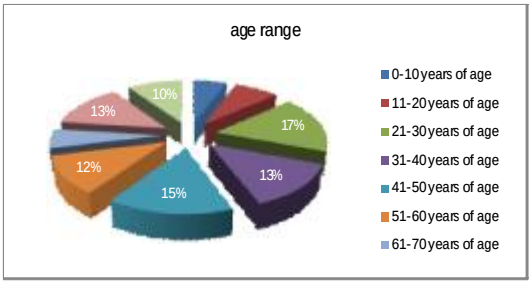


Table no. 1. Injured organs grading results

Grade	Number of cases
I	11 spleen, 2 liver, 2 kidney
II	6 spleen, 6 liver, 2 kidney
III	5 spleen, 4 liver
IV	4 spleen, 3 liver, 1 kidney
V	2 liver, 2 kidney

DISCUSSIONS

Ultrasound in patients with abdominal blunt trauma is used as first method at admission because it can be done quickly and can show posttraumatic intraperitoneal, pleural or pericardial fluid (FAST - Focused Assessment with Sonography for Trauma).(11) Sometimes, the presence of free air or meteorism can make very difficult or impossible to see the lesions. CT exam brings additional information regarding fluid density, laceration's extension, active bleeding or especially pancreatic trauma.(12) The presence of pelvic fractures implies to perform delayed scan sequences for the excretory phase which can show extravazation (rupture of bladder).(1,13) In the presence of hemoperitoneum without solid organ injuries the most likely source of blood is the bowel or mesentery.

Usually, the blood from solid organ injuries tends to flow along paracolic gutters as against the blood from a mesenteric tear which appears as triangular shape densities. Another important thing is that retroperitoneal blood tends to be localized to the site of injury (periduodenal hematoma in duodenal laceration). This is in contrast with intraperitoneal blood which flows freely and accumulates in the lowest regions of peritoneal cavity (recto-uterine or recto-vesical pouch).(3)

The most important answer for the surgeon is that it is or it is not active blood extravazation. Multiphase contrast enhanced protocols allow the detection of bleeding.(14,15) Also,

within this protocol, it is possible to differentiate arterial from venous bleeding. Sometimes, extravazation is subtle and it is not visible in arterial and portal-venous phase, but it can be depicted by measuring hemoperitoneum atenuation values that are higher than the clotted blood, ranging from 85 to 370 HU.(3) Another important fact is that not the grade of injury decides surgery but the presence of active bleeding and the presence of hemoperitoneum.(1) In our case of a 10 year-old male patient with splenic laceration, we found multiple laceration but without involving the hilum, without active bleeding and without hemoperitoneum (figure no. 2).

The outcome was favourable with nonoperative management. The right grading of injury is conditioned by the manner of contrast administration because CT angiography allows to observe devascularization. In a 34 year-old male patient with car accident nonenhanced CT showed a massive intraparenchymal hepatic hematoma with hypodense right lobe consistent with devascularization but contrast enhanced sequences showed right portal vein branches so the hypodensity was interpreted as postcontusional edema (figure no. 3). The presence of devascularization in renal trauma needs surgery, in our case of he 20 year-old male, there was a ruptured right kidney with lumbar vertebrae fracture with spinal cord compression (figure no. 4).

Nowadays, over 50% of splenic trauma and approximately 80% of liver trauma are treated conservatively.(1) In fact, in our cases, surgery was conditioned by significant hemoperitoneum in the presence of parenchymal lacerations with ruptured capsule even with lack of obvious active bleeding.

Figure no. 2. Contrast Enhanced Computed Tomography (CECT) in a ten year-old male patient with car accident: perisplenic minimal hemoperitoneum multiple spleen lacerations without active bleeding, grade III AAST

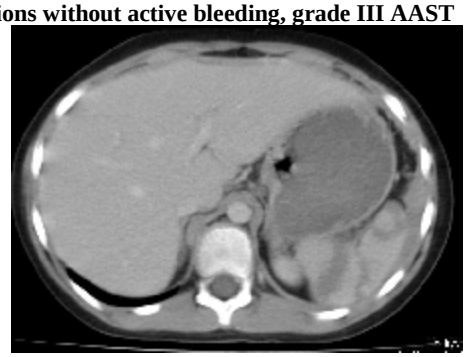


Figure no. 3. CECT in a 34 year-old patient with car accident: hepatic laceration with large intraparenchymal hematoma, hepatic contusion of the right lobe associated with perihepatic and perisplenic hemoperitoneum; there is no evidence of active bleeding and the vascularisation of right lobe is preserved, grade IV AAST

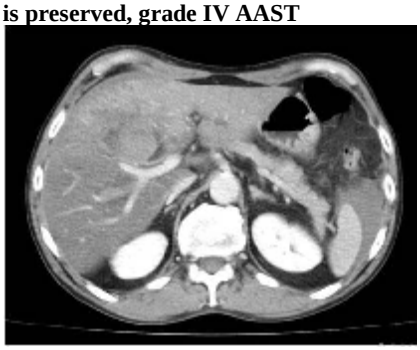


Figure no. 4. CECT in a 20 year-old male with car accident: right perirenal hematoma, minimal subcapsular left renal hematoma associated with spine fracture with spinal cord compression and rib fracture with left psoas injury and also ruptured right kidney in which anterior half is nonenhaced – grade V AAST

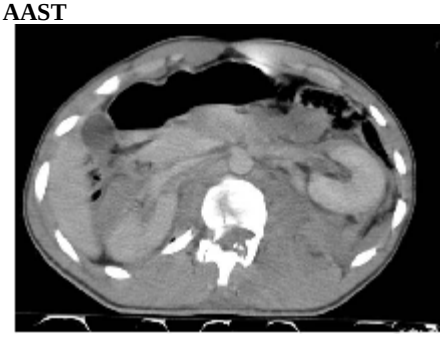
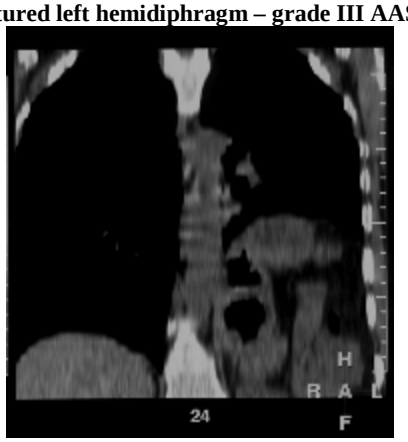


Figure no. 5. NECT Coronal MPR thick reconstruction in a 49 year-old male patient with an accidental fall with left intrathoracic presence of spleen and splenic flexure of colon due to ruptured left hemidiphragm – grade III AAST



CONCLUSIONS

CT angiography represents the best option for abdominal blunt trauma. It allows depicting active bleeding, contrast extravasation and also devascularisation. The differentiation between active extravasation, arteriovenous fistula or posttraumatic pseudoaneurysm is important in therapy options (surgery or interventional procedures).

It is necessary to make multiphase acquisition, only arterial and portal venous phases alone cannot show the integrity of ureters, bladder or urethra, therefore delayed phases are performed. CT scan is also used for recovery surveillance in patients with nonoperative management. In the presence of new symptoms (pain, fever, leukocytosis), new scans are performed for further surgical procedures (surinfected hematoma, biloma or urinoma).

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