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2nd Department of Radiology, Medical University of Lublin

MAREK PASŁAWSKI, KONRAD KRZYŻANOWSKI,
KATARZYNA PIASECKA, JANUSZ ZŁOMANIEC

Splenic trauma in helical CT examination

Diagnosis and treatment of patients admitted to a trauma center with potential blunt abdominal injury has been a difficult and challenging task for the trauma surgeon and emergency radiologist. The multiple overt system injuries often seen with blunt trauma may divert attention away from the abdomen, making a complete and accurate diagnosis and triage more difficult and complex. The ability of helical 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 (4, 7). 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 centers are equipped with CT scanners (in many of them multidetector modern 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 consequence, emergency patients now benefit from faster and more accurate CT examinations (2, 5, 8, 9).

Splenic trauma may follow blunt or penetrating injuries and may be spontaneous or iatrogenic. In cases of blunt abdominal trauma, the spleen is the most commonly injured organ. Ultrasound may be used to evaluate the abdomen and may show splenic injury but CT is the modality of choice for the evaluation of splenic injury. Intravenous administration of contrast material is needed for adequate evaluation of splenic trauma, as areas of haematoma and laceration may be isodense to splenic parenchyma on noncontrast-enhanced CT (3). CT may be used to monitor healing of splenic injury, as documented by progressive diminution of perisplenic and intrasplenic haematoma or laceration. Progressive enlargement on serial CT is not an indicator of clinical deterioration. It is likely that in acutely injured patients the spleen contracts secondary to intravascular volume depletion and sympathetic drive. With time and volume replacement the spleen returns to normal size (3).

The aim of the study is to present the usefulness of Spiral CT examination in patients with splenic trauma.

MATERIAL AND METHODS

Material comprises a group of 25 patients in whom CT examination of the abdomen was performed due to blunt abdominal trauma. CT examination was performed before and after administering of contrast agent intravenously, with the helical CT scanner Somatom Emotion by Siemens. The scanning was performed from above the level of diaphragm to below of the pelvis. The collimation was 8 mm before and 5 mm after administering of contrast agent. Pitch was 1.5. The axial CT sections were assessed as well as MPR reconstruction.

RESULTS

In 17 patients splenic trauma was found on CT examination. Parenchymal hematomas were seen in 12 patients, as hipodense areas of various diameters (Fig. 1). In 3 patients multiple parenchymal hematomas were seen, with the features of laceration in one of them (Fig. 2). In one patient parenchymal hematoma was accompanied by small subcapsular one (Fig. 3). Wedge shaped area of postraumatic splenic infarct was seen in one patient (Fig. 4). Fragmentation of the spleen was seen in one patient.

Fig. 1. Parenchymal splenic hematoma (arrows)

Fig. 2. Two parenchymal splenic hematomas (arrows) with the fissure of laceration

Fig. 3. Large parenchymal splenic hematoma (arrowhead), and small subcapsular one (arrow)

Fig. 4. The cone shaped hypodense area of posttraumatic splenic infarct (arrow)

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 hemorrhage and can differentiate hemoperitoneum from water-attenuation, posttraumatic peritoneal fluid collections, such as urine with intraperitoneal bladder rupture. 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. 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 (2, 4, 5, 8, 9). Examination should be performed with i.v. and oral contrast media. Helical scanning should start from above the highest hemidiaphragm 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 may be used to opacify the bowel injury, if the state of the patients allows administering of oral contrast (5, 8).

The spleen is the most commonly injured solid abdominal organ during blunt trauma (3, 7) Only recently has the vital role played by the spleen in the immune defense system been fully appreciated, and this understanding has led to a more conservative approach in the management of splenic injury, both in adults and children. Over the past two decades, CT has had a significant impact in helping to implement a new, conservative approach to management of blunt splenic trauma (2, 7, 8). Injury to the spleen can take the form of laceration, intrasplenic haematoma, subcapsular haematoma or infarction. Splenic laceration appears as an irregular linear area of hypodensity on contrast-enhanced CT. An intrasplenic haematoma appears as a hypodense area of nonperfused spleen on the contrast-enhanced CT. A subcapsular haematoma appears as a crescentic collection of fluid that distorts the underlying spleen. A congenital splenic cleft may mimic laceration but typically these are smooth and there is no perisplenic blood. A decrease in the overall splenic enhancement to less than that of the liver has been noted in traumatized hypotensive patients and should not be misinterpreted as representing splenic vascular injury. Haemoperitoneum almost always accompanies significant splenic injury. If there is significant intraabdominal fluid, the presence of local perisplenic clot, i.e. a 'sentinel clot', suggests splenic injury at the site of bleeding. This sentinel clot has a homogeneous appearance with an attenuation coefficient greater than 60 HU. Perisplenic haematoma may have a multilayered or onion skin appearance if there are repeated episodes of bleeding. Pseudoaneurysm formation can occur after trauma and appears as a focal, well-circumscribed area of vascular enhancement within the splenic parenchyma (3).

CT is extremely sensitive in detecting even small quantities of intraperitoneal fluid or hemoperitoneum. 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. Density measurements should be obtained for all fluid collections identified by CT to help characterize its origin (7).

Many systems have been proposed to grade splenic injury following trauma. The splenic injury grades may be based on the extent of injury seen at laparotomy, CT or autopsy. In order to compare outcome, treatment protocols and standardize reporting of splenic injuries among patients in the same trauma center over a period of time, the American Association for the Surgery of Trauma (AAST) formed a committee to develop a uniform injury severity score. This injury scale is based on an anatomic depiction of splenic disruption, including the length and number of

lacerations, the surface area involved, by the subcapsular or intraparenchymal hematoma(s) seen at laparotomy (Table 1) (2, 7).

Table 1. CT-Based Splenic Injury Scale

Injury grade	Findings
I	Subcapsular hematoma <1 cm thick Laceration <1 cm parenchymal depth Parenchymal hematoma <1 cm in diameter
II	Subcapsular hematoma 1–3 cm thick Laceration 1–3 cm parenchymal depth Parenchymal hematoma 1–3 cm in diameter
III	Splenic capsular disruption Subcapsular hematoma >3 cm thick Laceration >3 cm parenchymal depth Parenchymal hematoma >3 cm in diameter
IVA	Active intraparenchymal and subcapsular splenic bleeding Splenic vascular injury (pseudoaneurysm or A-V fistula) Shattered spleen (fragmentation into three or more sections)
IVB	Active intraperitoneal splenic bleeding

Contrast-enhanced CT can accurately diagnose the four principal types of splenic injury, including hematoma(s), laceration(s), active hemorrhage, and vascular injuries such as pseudoaneurysm and post-traumatic arteriovenonous fistula. Splenic hematomas may be intraparenchymal or subcapsular. Single or multiple hematomas may be seen following blunt trauma (7, 8). On unenhanced CT, subcapsular hematomas are hyperdense relative to normal splenic parenchyma. On contrast-enhanced CT, subcapsular hematomas are typically seen as low attenuation collections of blood between the splenic capsule and the enhancing splenic parenchyma. On contrast-enhanced CT, acute hematomas appear as irregular high or low attenuation areas within the parenchyma. Acute splenic lacerations have sharp or jagged margins and appear as linear or branching, low attenuation areas on contrast-enhanced CT. On contrast-enhanced CT, active hemorrhage in the spleen is seen as an irregular or linear area of contrast extravasation. Active splenic hemorrhage may be seen within the splenic parenchyma, subcapsular space, or intraperitoneally (2, 7, 8).

The appearance of post-traumatic splenic pseudoaneurysms and arteriovenous fistulas are similar on contrast-enhanced CT and can only be differentiated using splenic angiography. Both of these lesions appear on CT as well-circumscribed, focal areas of increased CT density, higher in attenuation than the normally enhanced splenic parenchyma (measure within 10 HU of the density of an adjacent major artery) (7). On contrast-enhanced CT, post-traumatic splenic infarcts are seen as well-demarcated, segmental, wedge-shaped low attenuation areas with the base of the wedge toward the periphery of the splenic parenchyma. Infarct may be the only CT finding of blunt splenic trauma and may occur without any adjacent free fluid. Splenic infarcts may also be seen in association with splenic lacerations and segmental infarcts in the left kidney (7, 8, 9). Delayed splenic rupture (hemorrhage from splenic rupture occurring more than 48 h after trauma) has been reported in a few patients in whom the initial CT was normal. This may be secondary to a splenic fracture in which there is little initial hemorrhage, or to poor contrast opacification of the spleen rendering the haematoma isodense with splenic parenchyma on images acquired soon after trauma (3).

CONCLUSIONS

The spleen is the most commonly injured solid abdominal organ during blunt trauma. CT has become the imaging modality of choice in evaluation of the trauma patients. The spleen trauma may be precisely evaluated on helical CT examination, enabling the proper grading of the severity of the splenic injury. The CT examination may be used to detect delayed splenic rupture as well as to monitor the patients with splenic trauma that were not qualified for the surgery intervention.

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SUMMARY

The aim of the study is to present the usefulness of Spiral CT examination in patients with splenic trauma. Material comprises a group of 25 patients in whom CT examination of the abdomen was performed due to blunt abdominal trauma. CT examination was performed before and after administering of contrast agent intravenously, with the helical CT scanner Somatom Emotion by Siemens. The scanning was performed from above the level of diaphragm to below of the pelvis. The collimation was 8 mm before and 5 mm after administering of contrast agent. Pitch was 1.5. The axial CT section were assessed as well as MPR reconstruction. In 17 patients splenic trauma was found on CT examination. Parenchymal hematomas were seen in 12 patients, as hipodense areas of various diameters. In 3 patients multiple parenchymal hematomas were seen, with the features of laceration in one of them. In one patient parenchymal hematoma was accompanied by small subcapsular one. Wedge shaped area of posttraumatic splenic infract was seen in one patient. Fragmentation of the spleen was seen in one patient, as nonspecific heterogenous areas. The spleen is the most commonly injured solid abdominal organ during blunt trauma. CT has become the imaging modality of choice in evaluation of the trauma patients. The spleen trauma may be precisely evaluated on helical CT examination, enabling the proper grading of the severity of the splenic injury. The CT examination may be used to detect delayed splenic rupture as well as to monitor the patients with splenic trauma that were not qualified for the surgery intervention.

Urazy śledziony w spiralnej tomografii komputerowej

Celem pracy jest przedstawienie zastosowania spiralnej tomografii komputerowej u pacjentów z urazami śledziony. Materiał stanowi grupa 25 pacjentów po tępych urazach brzucha, u których wykonano badanie TK jamy brzusznej. Badanie wykonano przed i po podaniu iv bolusa środka kontrastowego, od poziomu przepony do poziomu spojenia łonowego, spiralnym tomografem komputerowym Somatom Emotion firmy Siemens. Kolimacja skanów wynosiła 8 mm przed i 5 mm po podaniu środka kontrastowego. U 17 pacjentów stwierdzono pourazowe uszkodzenie śledziony. Krwiaki śródmiąższowe stwierdzono u 12 pacjentów, jako hipodensyjne obszary o różnych wymiarach. U trzech pacjentów były to krwiaki mnogie, u jednego z nich z wyraźną szczeliną pęknięcia miąższu. U jednego pacjenta krwiakowi śródmiąższowemu towarzyszył mały krwiak podtorebkowy. Stożkowaty obszar hipodensyjny pourazowego zawału śledziony stwierdzono u jednego pacjenta. W jednym przypadku stwierdzono znaczną fragmentację miąższu śledziony z licznymi krwiakami. Śledziona jest narządem często ulegającym uszkodzeniu w wyniku tępych urazów jamy brzusznej. TK jest metodą obrazowania z wyboru u pacjentów z urazami. Spiralna tomografia komputerowa umożliwia precyzyjną ocenę śledziony, oraz dokładną klasyfikację stopnia tego uszkodzenia. Krótki czas badania i powtarzalność wyników umożliwia zastosowanie spiralnej tomografii komputerowej w ocenie wtórnego pęknięcia śledziony oraz do monitorowania pacjentów.

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WYDAWNICTWO
UNIWERSYTETU MARII CURIE-SKŁODOWSKIEJ
Pl. Marii Curie Skłodowskiej 5, 20-031 Lublin
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