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Post-traumatic abdominal fluid collections in CT

Pourazowe zbiorniki płynowe jamy brzusznej w obrazie TK

Computed tomography (CT) is a method of choice to assess the abdominal trauma, to determine its extent, localization, as well as indications to medical treatment, embolization or laparatomy, performed in order to obtain homeostasis [8]. CT shows active bleeding which reflects vessels injury and can be assessed by analyzing the morphological features of fluid collections, especially their density [14].

An actual trend to broaden indications to medical treatment in case of blunt abdominal traumas requires early diagnosis and minimal invasive treatment [5]. In such cases, CT examination with contrast is particularly valuable.

This work aims to describe morphological characteristics of posttraumatic abdominal fluid collections in CT images and to assess their usefulness in making decision of treatment type.

MATERIAL AND METHOD

The material includes 32 patients (11 women and 21 men, aged 19-38, mean age of 58) with blunt abdominal trauma.

CT examinations were performed in the years 1998-2006, in the 2nd Department of Diagnostic Radiology, Medical University of Lublin, with the use of Siemens Somatom ART CT scanner, in continuous 2, 5 and 10 mm slices, which assured an optimal spatial resolution. The scanning was performed before and after administering the contrast agent with the use of an automatic syringe. A bolus of 100 and 120 ml of Ultravist 370 (Schering-Bayer), 100 and 120 ml of Visipaque 320 (GE Healthcare), Iomeron 350 (Nycomed) was injected. In 19 cases a delay of 20-85 sec was used. When traumatic aneurysms were suspected, CT examination was performed with a dynamic protocol after administration of 100 ml Visipaque, Iodixanol 320. After axial images were analyzed, further spatial and MPR reconstructions were done with a high resolution algorithm.

RESULTS

In 27 cases, CT examination showed posttraumatic anomalies which were associated in 16 cases with injuries of other abdominal organs.

Free abdominal fluid and fluid collections were observed in 24 cases. In 8 patients fluid collections of high density suggested intraperitoneal bleeding, in 11 cases fluid collections were of lower density and in 5 patients their density resembled water density. Active bleeding was seen in the CT arterial phase, with blood collected within the peritoneum and mesentery. Four time extravasations formed a small collection which grew bigger on delayed images.

Density of every intraperitoneal fluid collection was measured to differentiate between different fluids: serous (ascites), blood contaminated, hematoma, bile, urine, chylum and active bleeding. Hematomas located near damaged organs showed the biggest density. In traumatic peritoneal hematoma, CT density measurements helped to establish its character. The most often encountered densities of the peritoneal fluid were 30-45 HU a few hours after the trauma. The clot within a hematoma presented as an area of high attenuation factor of 70 HU. Density values decreased after 48 hours due to the clot dissolution which usually formed a circular area of bleeding. Serous fluid had a density of 0-15 HU, bile density below 0 HU resulted from a high cholesterol level.

Spleen injuries were observed in 12 patients. In 5 cases fluid bands were seen around the spleen (Fig. 1), in 3 cases spleen hematomas formed later in evolution a fluid collection (Fig.2).

Spleen fracture with a subcapsular hematoma was observed in 4 patients (Fig. 3). Bands of hypodensity located within the spleen corresponded to split fissures (Fig. 4). Fluid bands around the liver with a simultaneous intraparenchymal fluid collection were diagnosed in 2 patients (Fig. 5). Fluid bands around the liver were seen in 4 patients (Fig. 3). Such a fluid band coexisted with a similar one around the spleen in 2 patients (Fig. 6).

Post-traumatic fluid collections located in the left upper abdomen and iliac fossa were observed in 2 patients (Fig. 7).

Free fluid in the peritoneum was seen in 4 patients around the liver, spleen, intestines and in the rectovesical pouch (Fig. 8).

A renal subcapsular hematoma was diagnosed in 3 patients (Fig. 9). In further 2 patients linear renal subcapsular fissures were observed.

Post-traumatic cysts within the lateral abdominal wall were seen in 2 patients (Fig. 10).

In further 2 patients fluid collections were observed within intestines (Fig. 11).

Post-traumatic fluid collections in the region of pancreas were seen in 2 cases (Fig. 12).

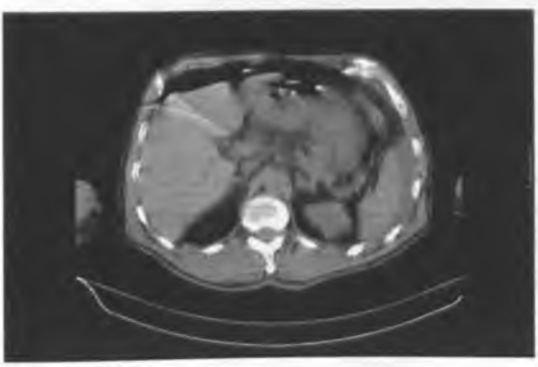

Fig. 1 Fluid band around the spleen.

Fig. 2 Splenic hematoma forms an area of fluid density as a result of blood liquefaction.

Fig. 3 Spleen fracture with a subcapsular hematoma. Evolution of the subcapsular spleen hematoma. Fluid band around the liver.

Fig. 4 Hypodense bands within the spleen show fracture fissures.

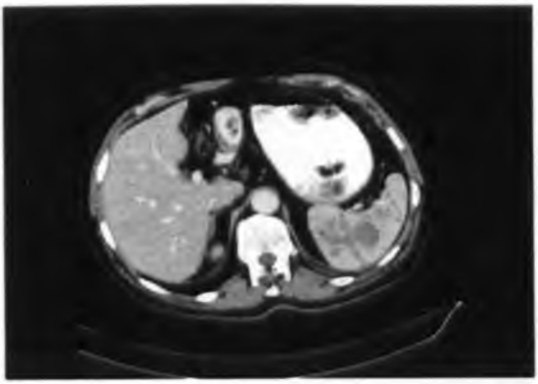

Fig. 5 Intraparenchymal area of fluid in the spleen.

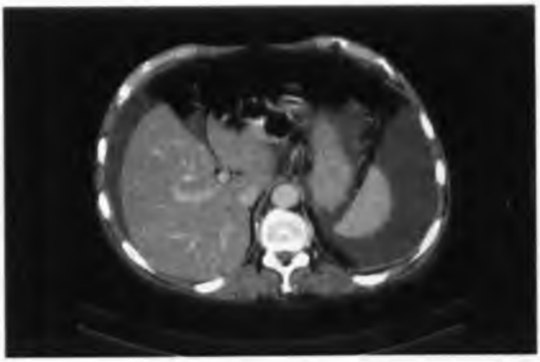

Fig. 6 Fluid band around the liver co-exist with a similar one around the spleen.

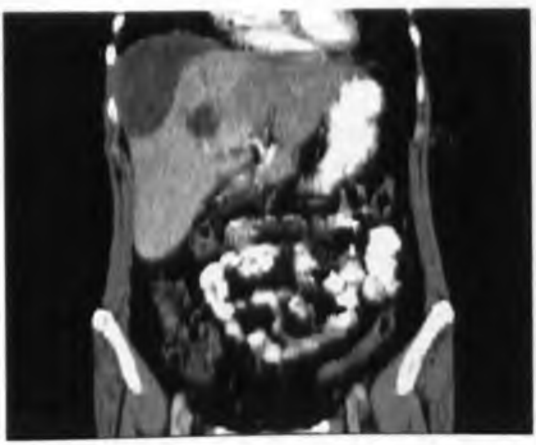

Fig. 7 Post-traumatic fluid collections located in the right upper abdomen and iliac fossa.

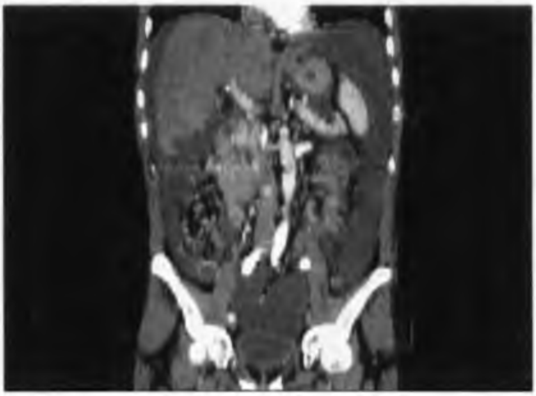

Fig. 8 Free fluid intraperitoneally, around the liver, spleen, intestines and in the recto-vesical fossa.

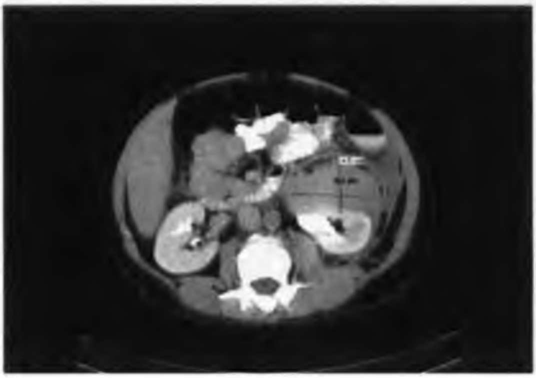

Fig. 9 Subcapsular renal hematoma.

Fig. 10 Post-traumatic cysts of the lateral abdominal wall.

Fig. 11 Fluid collections around the intestines located in the lower and central abdomen.

Fig. 12 Post-traumatic fluid collections around the pancreas.

Urine leakage together with a free fluid within the pelvis and bone fractures was observed in 9 patients. CT examination revealed bladder trauma and hematoma within the pelvis. In pelvis fractures CT examination was performed with intrabladder contrast administration. A presence of contrast located around the bladder indicated intraperitoneal trauma. Urine displayed a similar density to serum fluid (0-15 HU).

Important density differences between extravasated contrast and hematomas helped to differentiate between hemorrhage and a presence of blood clots. Active bleeding during intravenous contrast administration had mostly a density of 70-80 HU and in 5 cases the density was higher. Clotted blood or hematoma displayed a density of 50-70 HU; partially clotted blood had a density of 50-60 HU. Extravasated contrast which indicates active bleeding from an injured organ was responsible for the high density and usually formed irregular areas of high density (60 HU), which in 3 cases coexisted with the so-called "guarding clot".

In the group of 7 patients who presented with intraintestinal free fluid, 3 patients demonstrated features of active blood extravasation.

In 2 cases free fluid in the lower abdomen coexisted with bladder injury and pelvis fractures.

Intravenous contrast administration was helpful in diagnosing aorta injuries and isodense hematomas of parenchymal organs. In 4 cases examination with contrast administration in the delayed phase helped to differentiate between the blood extravasation and traumatic pseudoaneurysm and in 2 cases it enabled to diagnose urine extravasation. Leakage of contrast beyond the renal capsula into the extraperitoneal space was observed in injuries of urinary system.

The presence of more than 75 ml of free intraperitoneal fluid suggested further hidden injuries. The presence of free fluid is a non-specific but very sensible feature of bowel injuries.

Triangular fluid collection located between adhering bowel loops in 4 patients turned out to mean bowel injuries. Fluid density, similar to water density suggested bowel perforation; the density over 45 HU suggested the presence of blood addition.

DISCUSSION

Suspicion of abdominal hemorrhage requires a multi-phase CT examination with contrast injection. Blood loss and hemodynamic instability in spleen and liver injuries are indications to perform an operation. Diagnosis of intraintestinal hemorrhage in parenchymal organ injuries qualifies patients for laparatomy.

CT examination has a sensitivity of over 90% in showing important liver and spleen traumas (2, 6).

CT examination has a similar sensitivity to ultrasound examination in diagnosing small quantities of abdominal free fluid. Its sensitivity increases however in cases of parenchymal trauma, especially in hemodynamically unstable patients.

Abdominal hemorrhage is a cause of 80-90% deaths in patients with abdominal trauma. Over 75% of such cases require operation (7, 3).

Diagnosis of direct vascular damage in CT examination such as intrasplenic "blush" indicates the fact that medical treatment will not be effective and thus, endovascular embolisation or operative treatment is required (9). Mesentery trauma is seen by the presence of active extravasation of contrast media (10).

Multi-slice computed tomography (MSCT) with high resolution and optimal contrast enhancement is a method of choice in showing intraperitoneal free fluid, even in small quantities, as well as peritoneal hematoma and active bleeding (14).

The presence of retroperitoneal fluid located in the region of duodenum suggests duodenum injury (1). If the posterior part of the parietal peritoneum becomes perforated, a retroperitoneal hematoma can develop further into an intraperitoneal hematoma.

In a supine position, an abdominal hematoma is most often located in the hepato-renal recess (the so-called Morisson's pouch). It can often be located near the bladder in the pelvis minor, near the colon or in the space around the liver and spleen. Precise assessment of these locations is necessary in identifying small quantities of fluid or blood, being often unique symptom of a subtle or hidden parenchymal trauma (6).

CT examination is necessary when the ultrasound examination shows abdominal free fluid, organ injuries with retroperitoneal hemorrhage, when symptoms are unclear or exists incompatibility between increasing symptoms and a normal ultrasound examination (12).

Fluid collections around the pancreas located near the superior mesenteric artery, transverse mesocolon, in the minor omental bursa or between the pancreas and splenic vein are indirect symptoms of pancreatic injuries (5).

Active bleeding from the injured spleen forms an irregular area of extravasated contrast in the subcapsular space or intraperitoneally.

Bleeding in multi-row CT examination can be assessed by a quantity of extravasated contrast, measured in identical anatomical areas in the arterial and late parenchymal phase. Assessment of the peak contrast bleeding in the early arterial and venous portal phase helps to differentiate active bleeding and splenic post-traumatic pseudoaneurysm or arteriovenous fistula (12). Vascular damage shows an enhanced density in the arterial phase (4).

Subcapsular spleen hematomas forms blood collections of a low density, located between the splenic capsula and enhanced parenchyma (2, 11).

Intraperitoneal hemorrhage often forms collections of fresh blood located in the hepato-renal recess and extending along the right kidney further into the pelvis. The fresh blood density is around 70 HU but may be lower, around 20-30 HU. The „guarding clot" having the density of 70-80 HU may indicate the bleeding location (11, 13).

CONCLUSIONS

In serious cases of abdominal multi-trauma CT examination should be preformed as the first diagnostic examination, thus eliminating other imaging methods and shortening the diagnostic process.

Spiral CT with intravenous contrast administration is a method of choice in patients with serious, blunt abdominal traumas who are unstable hemodynamically.

Evaluation of morphological features of injuries, especially pathological free fluid collection is important in determining further medical treatment.

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ABSTRACT

In the group of 32 patients with blunt abdominal trauma, 27 patients were diagnosed with organ trauma and 24 patients with fluid collections.

CT examination shows small quantities of free fluid and blood which could be a unique symptom of hidden abdominal organs injuries.

In multi-organ trauma, CT examination should be a method of choice, especially when bleeding is suspected in high-risk patients who are unstable hemodynamically.

Furthermore, CT examination makes elimination of other imaging methods and shortening of the diagnostic process possible. Measurements of fluid collections density allow for establishing their character, especially the possibility of active bleeding.

STRESZCZENIE

W grupie 32 chorych z tępymi urazami jamy brzusznej stwierdzono u 27 zmiany pourazowe narządów, w 24 przypadkach obecność zbiorników płynowych.

TK ujawnia małe ilości płynu lub krwi mogące być jedynym objawem ukrytego uszkodzenia narządów miąższowych jamy brzusznej.

W urazach wielonarządowych TK powinna być pierwszym badaniem zwłaszcza w podejrzeniu krwawień u chorych niestabilnych hemodynamicznie dużego ryzyka.

TK umożliwia wyeliminowanie innych technik obrazowych i skrócenie procesu diagnostycznego. Pomiary gęstości zbiorników płynowych pozwalają określić ich charakter zwłaszcza możliwość aktywnego krwawienia.

Key words: CT, fluid collections, abdominal, trauma