Acute Abdomen: Imaging spectrum of CT findings.

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Learning objectives

To show a variety of diagnostic findings in patients with clinical manifestations of acute abdomen. To emphasise a role of CT in detection of vascular causes of acute abdomen syndrome.
Main clinical signs of acute abdomen symptom complex are: pain which can vary from mild up to unbearable, shock, nausea and vomiting, dysuria, hematuria, fever, impaired gastrointestinal tract function, chills [2,3]. Laboratory parameters are very variable and not always specific.

In our work, we will discuss in more detail the vascular causes of acute abdominal pain, and the difficulties with finding the causes of the acute abdomen in patients in the early postoperative period, and some rare illustrations.
Findings and procedure details

We have carried out retrospective analysis of 296 patients who have been admitted to the emergency department (ED) with acute abdominal pain from September 2016 till September 2017. We started with a native phase of the abdomen and pelvis. If possible, the multiphase contrast protocol was performed, adapted to special needs.

Case 1.

64 year old male was admitted to the ED, he was complaining of acute abdominal pain, without any clear localization. In the anamnesis there was a permanent form of atrial fibrillation. He takes anticoagulants. INR at admission was 1.15. Duration from the onset of the pain attack was 4 hours. He had stool with blood two times. Laboratory data showed no significant abnormalities.

Preliminary diagnosis: aortic rupture/dissection?, acute mesenteric ischemia?, perforation of a hollow organ?

Emergent CT angiography showed complete occlusion of the mid-portion of the main stem and origin of the ileocolic and right colic branches of SMA due to thromboembolism (Fig. 1). Laparoscopy in 5 hours after the onset of the pain syndrome showed no signs of ischemia of intestines. Conservative tactic was chosen in the form of long-time heparin infusion and vasodilatation. In order to stop the pain, we have carried out epidural administration of fentanyl. In a day control laparoscopy showed ischemic spots on the intestinal wall and fibrin accumulation. Digital subtraction angiography (DSA) showed no signs of thrombi in the lumen of the SMA. The surgical interventions were accompanied by intense haemorrhage from the tissues due to heparin therapy. Abdominal compartment syndrome was diagnosed. 35 days after the onset of the disease the patient died as a result of cardiac decompensation, multiple organ failure and sepsis.

Because acute mesenteric ischemia is a condition with an unclear initial presentation, a substantial morbidity, and a high mortality if not properly treated, a high index of clinical suspicion should be maintained [2-4].

Case 2.

57 years old male was admitted to the ED with acute pain in abdomen and back without a clear localisation, mainly in the periumbilical zone. Anamnesis - alcohol abuse, generalised atherosclerosis.

Preliminary diagnosis: acute pancreatitis?, perforation of hollow organ? , aortic rupture/dissection?, neuralgia?
Case 3.

64 year old male was admitted to the ED 72 hours after the onset of the disease. The onset of the disease: acute great pain in back and abdomen, lower paraparesis.

**Preliminary diagnosis:** aortic dissection?, acute spinal cord ischemia?

During CT examination the patient was restless, tachycardia, cold sweat, anxiety.

**CT showed** (Fig.3): diffuse thickening of the aortic along the entire length. Thickness of the aortic wall was 12 mm (the level of the ascending thoracic aorta). There were CT signs of systemic vasculitis, aortitis. Aortitis is a general term that refers to a broad category of infectious or noninfectious conditions in which there is abnormal inflammation of the aortic wall [5]. Adamkiewicz artery was supposedly thrombosed or compresses, the artery is not visible. Diagnosis of acute myeloischemia was confirmed by MRI. The patient received multicomponent conservative therapy with corticosteroids. Examination in 6 months - subtotal regression of manifestations of aortitis. There are still aneurysms of the SMA arteries, which imitate dissection on the axial images.

The acute abdomen in postoperative patients is different. The patient may not complain due to severity of his/her condition. Depending on the intervention, the patient is receiving some sort of anesthesia, anti-inflammatory and antimicrobial therapy, which smooths over the clinical manifestations. Monitoring of vital functions, laboratory data and interpretation of images are of primary importance for this category of patients. The patients with abdominal trauma can also be attributed to this category, because these patients receive medical anesthesia during the transportation period [1]. In order to illustrate acute abdomen in postoperative patients and patients with polytrauma, we have provided the cases 4, 5.

Case 4.

78-year-old patient was transferred to our center from a small suburban hospital 6 days after the onset of the disease. The disease began with right-sided renal colic. The patient underwent stenting of the right kidney cavity and the right ureter. The patient with long-time history of warfarin administration (more than 7 years) due to initial cardiological problems and episode of PE in the past. The stenting was complicated by damage to the
perirenal soft tissues with formation of retroperitoneal hematoma. The complication was established, surgical revision was performed, retroperitoneal hematoma was removed, drainage of retroperitoneal space was carried out. CT scan was not performed.

**At admission:** the patient is on mechanical ventilation, the consciousness is depressed.

**Preliminary diagnosis:** retroperitoneal hematoma? /abscess?/ peritonitis?

**MSCT showed** infiltration of perirenal space at the right with affection of the psoas major muscle and paraaortic tissues (Fig.4). The inflammation of paraaortal tissue with penetrating ulcer and local rupture of the aortic wall were diagnosed. A limited paraaortal hematoma, paraaortic infiltrate, diffuse thickening of the wall of the abdominal aorta were visualized.

Infection of the aorta is rare but potentially very dangerous [5]. An attempt was made prosthetics of the affected segment of the abdominal aorta.

**Surgical revision:** paraaortic retroperitoneal hematoma with changed paraaortal tissues and with the signs of inflammation was identified. Aortic wall is edematous, easily traumatized. Numerous attempts have been made to fix the vascular prosthesis at various levels, including the thoracic aorta. The operation was continued in conditions of deep hypothermia, using the heart and lung machine (HLM). All attempts to fix the vascular prosthesis were unsuccessful, due to the functional inconsistency of the wall of the aorta.

**Case 5.**

The patient is 22 years old, she was taken to the emergency department 1.5 hours after falling from the height of 10th floor. CT examination was carried out according to polytrauma program with IV bolus contrasting (Fig.5).

**At admission:** conscious, no complaints, anaesthetised with narcotic analgesics. The abdomen is dense, tachycardia 120 beats per minute, blood pressure 100/70 mm Hg.

**CT showed:** spleen rupture and subcapsular hematoma of the spleen; CT signs of liver ruptures; acute infarction of the parenchyma of the left kidney due to impaired renal blood supply [6]. Bone injuries.

During surgical revision blood leaking from a ruptured spleen was identified.

Splenectomy, sanation and drainage of the abdominal cavity were performed. Minor intrahepatic bile leaks following trauma were managed conservatively. Few days later correction of bone injuries was performed. The patient was discharged in 20 days.
Case 6.

75 years old female patient with dementia was admitted to the ED with pain in the left lower quadrant, irradiating to the inguinal and periumbilical area. Laboratory leukocytosis up to $25 \times 10^9$ cells/L. Duration of the disease is about two weeks.

**Preliminary diagnosis:** abdominal abscess?, tumor with paracolic abscess?

MSCT showed inflammatory infiltrate in the lower parts of the descending colon (Fig.6). Intestinal wall is circularly thickened, which made it possible to suspect lymphoma, tumor. In the paracolic inflamed tissues there is a linear foreign body, which origin is unclear. At the surgical intervention we have found a piece of toothpick which resulted in perforation of the intestinal wall, with formation of the inflammatory infiltrate and the abscess. The intestine was resected, which was followed by a recovery.
Fig. 1: CT angiography shows a subtotal thrombotic occlusion of the mid-portion of the main stem of SMA and the origin of ileocolic (yellow arrow), jejunal and ileal branches of SMA (white arrows) due to a large amount of thromboembolism (a, b). Axial and sagittal views: Enhanced CT shows a filling defect of the SMA main trunk (c, d).

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**Case 2**

**Penetrating atherosclerotic ulcers of the abdominal aorta**

Fig. 2: Penetrating atherosclerotic ulceration in the abdominal aorta with false aneurysm: a, b - axial view of CECT, c - MIP reconstruction.

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Fig. 3: Contrast-enhanced CT images show the case of acute non-infectious aortitis. CT images show diffuse abnormal thickening of the thoracic and abdominal aorta (a, b). Aneurysms of the superior mesenteric artery as a manifestation of systemic vasculitis (#). Axial scan imitate dissection of the SMA. There are areas of ulceration of the aortic wall at various levels also as manifestation of systemic vasculitis (e).

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Fig. 4: Axial CT scans (a, b) show inflammatory changes of perirenal and periaortal tissues (yellow arrows), drainage in the right perirenal space (white arrow). CECT (MIP) shows penetrating atherosclerotic ulceration with rupture of lateral wall of abdominal aorta, with formation of extraaortic hematoma (c). A right ureteric stent in proper position. (d).

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Case 5

Injury to the visceral organs in a patient with polytrauma. The patient is conscious, no complaints. Clinically - traumatic shock.

**Fig. 5:** CECT scan showed a injury of liver, spleen and left kidney in a 22-year-old woman with polytrauma. Intrahepatic leakage of bile from a hepatic laceration (a). CECT scan showed no damage to the blood vessels of the liver (a). Subcapsular haematoma appears as a region of low attenuation that compress the normal splenic parenchyma. Note also multiple laceration of the spleen (b). Well-demarcated non-enhanced parenchyma (green arrows) of the left kidney, which indicated left renal infarction (c).

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Case 6

Paracolic abscess, due to injury of the large intestine

Fig. 6: MSCT showed inflammatory infiltrate in the lower parts of the descending colon (a). Foreign body toothpick perforates the descending colon, with formation of paracolic abscess (b,c,d).

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Conclusion

MSCT data are highly accurate and specific, which in some cases results in an essential revision of the perception of the causes of the disease. The vascular causes of acute abdominal pain are not rare, so it is necessary to carry out studies with intravenous contrasting (if possible) in order not to miss the acute vascular pathology and start treatment in time.
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