

Otrzymano: 2008.02.01
Zaakceptowano: 2008.02.29

Assessment and diagnosis of acute bowel ischemia with multidetector computed tomography (MDCT)

Dorota Sojka, Barbara Gieszczyk-Paraniak, Joanna Gibińska, Marek Konopka

Helimed Diagnostic Imaging, Katowice, Polska

Author's address: Dorota Sojka, Helimed Diagnostic Imaging, Katowice, Polska, e-mail: dorota.sojka@helimed.pl

Summary

Background:

Acute bowel ischemia (ABI) is a life-threatening condition which most often affects elderly patients. It requires an intensive treatment and quick diagnosis. Unfortunately, ABI is manifested not only by specific but also by various nonspecific clinical or laboratory findings. The radiological symptoms of the bowel ischemia are also differentiated and often nonspecific while the specific findings are rather uncommon. That is why the knowledge of the bowel ischemia pathogenesis and possible CT findings is so important for the correct diagnosis.

Material/Methods:

In our paper, we present the radiological findings of the acute bowel ischemia based on the analysis of the patients' examinations. The purpose of our study is to assess the MDCT in patients with acute bowel ischemia. The material of this study consists of four computer tomography examinations – three of those are angio-CT, and one abdominal-CT – in patients with acute abdomen symptoms.

Results/Conclusions:

The result revealed the mesenteric thrombosis in two cases, and mesenteric artery stenosis in one case. In one case, the thrombus was present in the abdominal aorta. In conclusion, we claim that the MDCT should be the modality of choice for the diagnosis of the acute bowel ischemia.

Key words:

acute abdomen • acute bowel ischemia • pneumatosis interstinalis

PDF file:

<http://www.polradiol.com/fulltxt.php?ICID=857108>

Background

Acute bowel ischemia is a condition in which disequilibrium between the demand for, and the supply of, oxygenated blood to an intestinal segment or to the whole intestine occurs. Ischemic incidents account for a low percentage of cases of acute abdomen in comparison with other causes and predominantly occur in elderly patients [1]. The prognosis is serious, with the extent and duration of ischemia taken into consideration as prognostic factors. 30-day survival correlates with intensity of treatment and the patient's age [2].

The most common cause of ischemia of the small intestine is thromboembolic change in the superior mesenteric artery (70%), and mesenteric vein thrombosis is the second one. Extravascular causes, such as intussusception, inflammatory processes in the intestine (diverticulitis, appendicitis) as well as extraintestinal ones (pancreatitis) or systemic conditions (circulatory failure, neoplastic processes or immunosuppression) are much less frequent.

Many pathologic processes, potentially life-threatening, can cause acute abdominal pain, therefore quick diagnosis of the cause may reduce mortality.

Acute bowel ischemia course can be manifested by a wide spectrum of clinical and radiological forms, from self-contained ones to intestinal infarction and perforation. Establishing the diagnosis in the reversible phase increases the chance of cure.

Laboratory findings are sometimes nonspecific, so diagnostic imaging plays an important role. Computed tomography (CT) is regarded as the method of choice in the diagnosis of acute abdomen [3, 4]. It allows accurate visualization of the pathology of the intestinal wall and its extend and evaluation of the coincident vascular abnormalities. Unfortunately, the early radiological signs seen on CT exam are nonspecific, which may delay the diagnosis. The introduction of conventional angiography, and now angio-CT allows to accelerate the diagnostic process. Nevertheless, acute bowel ischemia

Table 1. Classification of pathologic signs in patients with acute bowel ischemia.

Symptoms	Patient 1	Patient 2	Patient 3	Patient 4
Intestinal wall thickening	-	-	+(Slight – cecum)	-
Intestinal lumen distension	Large intestine, 53 mm	Large intestine, 72 mm		
Pneumatosis	+	+	+ Along a short segment	+
Presence of gas in blood vessels	Mesenteric blood vessels	Portal and splenic vein	-	Portal vein and mesenteric artery
Arterial/venous thrombosis	Superior mesenteric artery	Aorta, distally to renal arteries	Mesenteric artery	- (Mesenteric artery stenosis)
Infarction of parenchymatous organs			Kidneys	
Peritoneal fluid	-	-	-	+

still remains a diagnostic challenge because of variety of clinical signs and high mortality rate. It depends on the cause and extent of intestinal wall damage [5, 6, 7].

Materials and methods

The material consists of CT scans performed in 4 patients admitted with acute abdomen symptoms. In case of one patient, abdominal CT was performed before and after intravenous contrast administration. And in the remaining 3 angio-CT of the abdominal blood vessels using 16- and 4-row GE units were performed. The CT results allowed to establish the diagnosis of acute bowel ischemia. The following pathologic signs were evaluated in the images: intestinal wall thickening, intestinal lumen distension, pneumatosis, presence of gas in blood vessels and free gas in the abdominal cavity, infarction of parenchymatous organs, presence of peritoneal fluid. The results are presented in table 1.

Three of four patients died because of the ischemic changes.

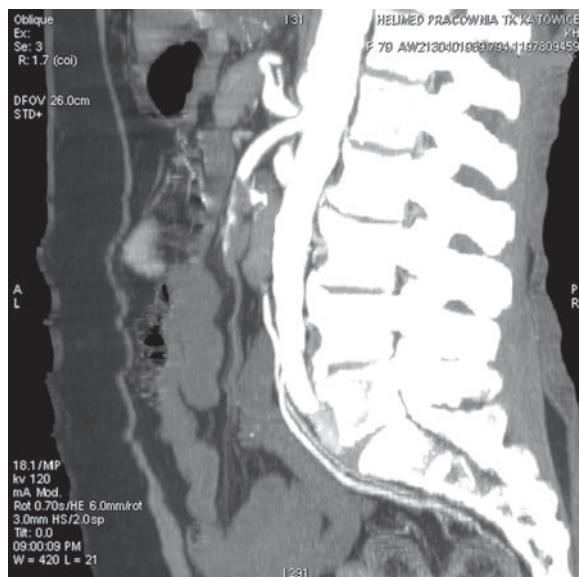


Figure 1. Sagittal projection reconstruction. Thromboembolic material in the superior mesenteric artery.

Discussion

The symptoms of acute bowel ischemia seen on CT are nonspecific, and in case of few clinical signs the diagnosis is dubious. Despite that, the sensitivity of CT is high, reaching, according to different authors 82–94% [7, 8]. The performed CT scans revealed in two patients the presence of thromboembolic changes in the mesenteric artery (fig. 1-2), which are the most frequent cause of acute bowel ischemia. In one patient, stenosis of a long segment of the mesenteric artery was found (fig. 3). In the other case in one peripheral branches of the mesenteric artery could not be visualized. Additionally, the presence of gas in the intestinal walls – pneumatosis, was found in 2 patients (fig. 4-5). In next two cases there was a gas in the portal vein (fig. 6-7), and in one case the gas was present in small mesenteric vessels.

Ischemic changes may involve the small or large intestine, may be diffuse or localized, superficial or within the intestinal walls, which can give various presentations on



Figure 2. Sagittal projection reconstruction. Thromboembolic material in the superior mesenteric artery.



Figure 3. Coronal projection reconstruction. Stenosis of a long segment of the mesenteric artery.

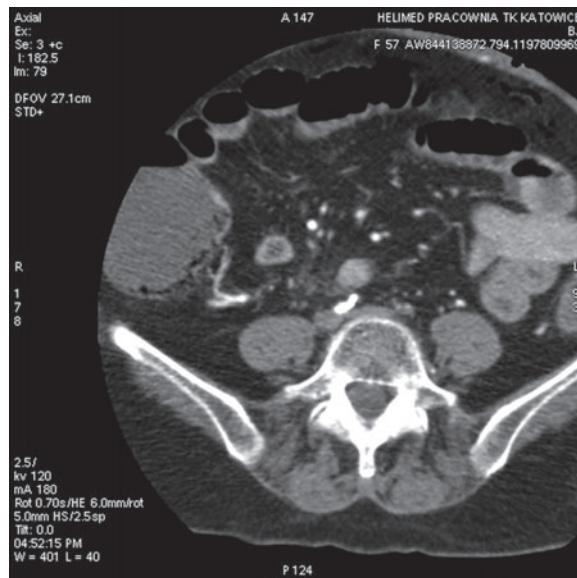


Figure 4. Transverse section. Pneumatosis intestinalis.

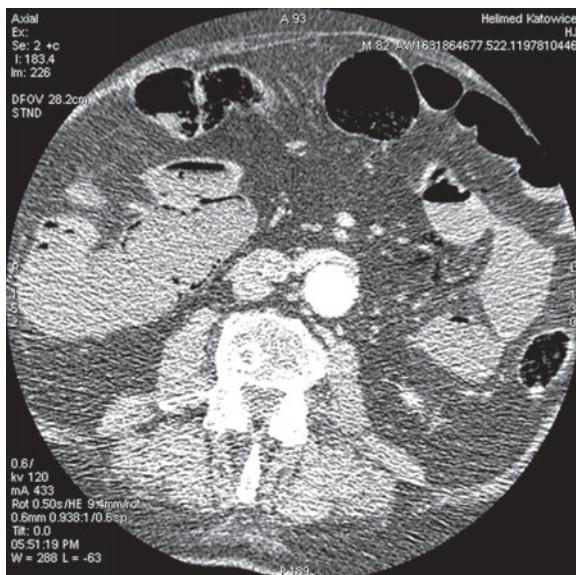


Figure 5. Transverse section. Pneumatosis intestinalis.

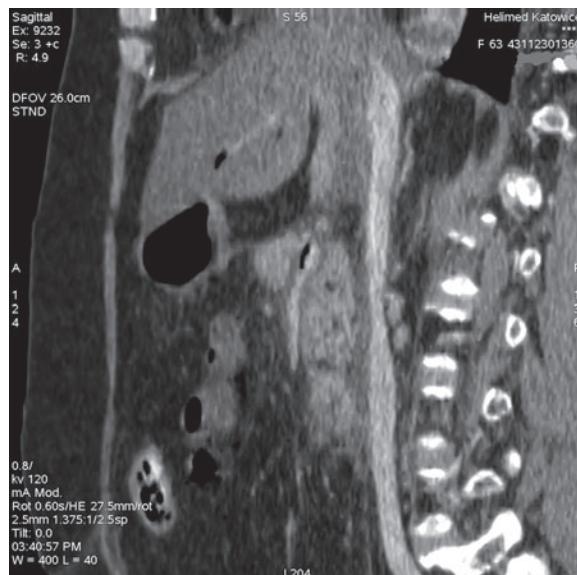


Figure 6. Sagittal projection reconstruction. Gas in the mesenteric and portal veins.

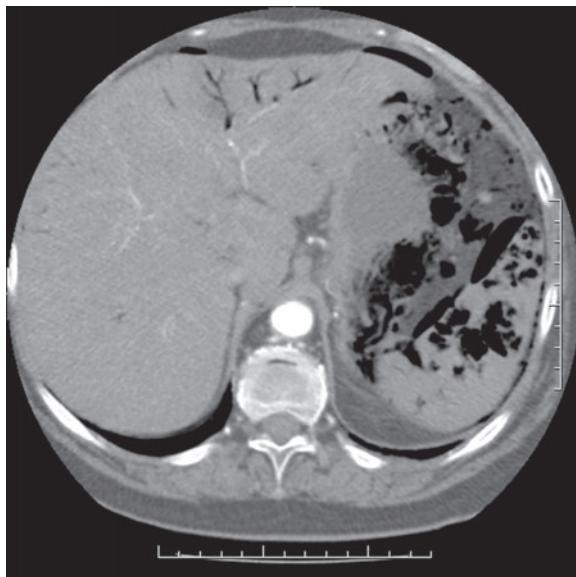
CT. The most typical location of acute bowel ischemia is the region of splenic bend of the colon, but the changes can involve any segment of the gastrointestinal tract and in such cases the diagnosis is difficult. The symptoms of acute bowel ischemia visible on CT exam can be divided into two groups – pathologies of the intestinal walls, and extraintestinal ones. The first group includes pneumatosus intestinalis, which means the presence of gas bubbles in the intestinal wall. It is a helpful sign, but not pathognomonic for acute bowel ischemia [9]. It may appear as generalized intestinal pneumatosis or it can be restricted to one segment of the gastrointestinal tract; in the wall of the stomach, it often correlates with edematous gastritis. It is rare (according to some authors 6-28% of cases) symptom of bowel ischemia [11]. Table 2. presents pathogenetic classification of pneumatosus intestinalis [9, 10].

Another pathology is thickening of the intestinal wall (fig. 8). It is a sign of different bowel pathologies, additionally highly dependent on the degree of distension of the intestinal loops. Proper bowel wall thickness in the distended loop does not exceed 3 mm in the small intestine and 5 mm in the large one. The presence and grade of thickening does not correlate with the severity of acute bowel ischemia. Moreover, thromboembolism of the superior mesenteric artery may lead to intestinal wall necrosis and thinning of the wall, resulting in so-called paper-thin wall. It is an unfavorable diagnostic sign, evidencing necrosis of the intestinal wall, which may lead to perforation [7].

Another relatively common symptom of acute bowel ischemia is a distension of the bowel loops: >3 cm in small

Table 2. Pathogenetic classification of pneumatosis intestinalis.

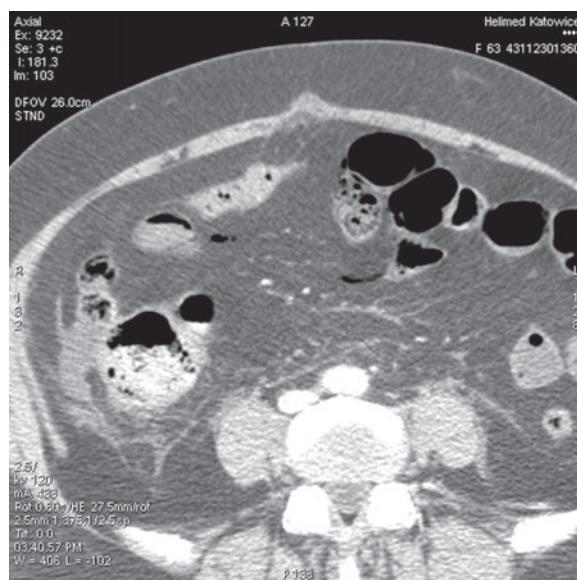
Intestinal loop necrosis	Epithelial damage	Increased epithelial permeability	Pulmonary disease
Necrotizing enteritis	Peptic ulceration	Immunotherapy	Asthma
Ischemia or infarction	Critical pyloric stenosis	AIDS-related enteritis	Chronic obstructive lung disease
Sepsis	Ileus	Steroid therapy	Mucoviscidosis
Edematous gastritis	Diverticulitis	Chemotherapy	Thoracic trauma
	Postoperative	Collagenoses	
	Bile duct drain perforation		
	Abdominal trauma		
	Crohn disease		
	Ulcerative enteritis		
	Amyloidosis		

**Figure 7.** Transverse section. Gas in portal and splenic vessels, free gas in the abdominal cavity.**Figure 8.** Transverse section. Nonspecific thickening of the cecal wall.

bowel and >8 cm in a large one. Often with presence of the fluid or gas in the intestinal lumen.

Non-contrast-enhanced CT scan can visualize the change of X rays attenuation in the ischemic intestinal tissue. The intestinal walls may show decreased attenuation, which most often indicates its edema. Increased attenuation may be due to bleeding inside the intestinal wall. The enhancement of the intestinal wall is evaluated after contrast injection. Segmental mucosa enhancement indicates venostasis and hyperemia of bowel segment. Non-enhanced segments are poor prognostic sign, most frequently associated with necrosis of the intestinal wall. It is also a very specific sign for acute bowel ischemia with 62% sensitivity and 96% specificity values [7].

Among the extraintestinal signs of acute bowel ischemia, gas presence in the hepatic blood vessels may be visualized. The most common cause of gas presence in the mesenteric and portal veins is ischemia of the mesentery [12]. Several mechanisms of this sign have been proposed: intestinal wall pathologies, intestinal distension and intraintestinal inflammatory process. In CT scans this sign is visualized as tubular, branching hypodense spaces in the peripheral parts

**Figure 9.** Transverse section. Small mesenteric blood vessels containing gas bubbles.

of the liver. Most frequently it extends subcapsular to 2 cm depth. Such symptoms are usually predominant in the left lobe. Coexistence of this sign with pneumatosis intestinalis is in almost 100% specific for acute bowel ischemia. This sign should be differentiated from pneumobilia, also more frequent in the left lobe but localized in the central parts of the liver and not extending to the capsula [13].

At less advanced stages, small gas bubbles can be seen only in small mesenteric veins surrounding the intestine and are visualized using window width change (fig. 9).

In the cases presented above, CT exam allowed to establish the diagnosis and start a proper treatment.

Conclusions

The aim of modern diagnostic imaging is to provide fast and reliable results. It is very important for optimal treatment

in patients with acute bowel ischemia. However, because of a wide spectrum of symptoms, both clinical and radiological, this condition still remains a diagnostic problem. It is a rare disease, with different etiologies and most frequently poor prognosis. Besides USG, CT is the most important method in the diagnostics of abdominal abnormalities. In acute bowel ischemia, the sensitivity of CT is 82%, and is slightly lower than the angiography (87.5%)[7]. Unlike conventional angiography, CT visualizes not only vascular abnormalities, but also intestinal or extraintestinal pathologies. It also allows to exclude the presence of other causes of acute abdomen symptoms. Computed tomography is quick, commonly available and noninvasive technique. It should be the method of choice in the assessment of acute bowel ischemia. In case of acute abdominal pain of unclear etiology – a method which could be considered as early as possible.

References:

1. Multi-detector computed tomography of acute abdomen, Leschka S., Eur Radiol (2005) 15: 2435–2447 [Acute intestinal ischaemia. A review of 214 cases. Jrvinen O., Ann Chir Gynaecol. 1994; 83(1): 22–5].
2. Acute intestinal ischaemia. A review of 214 cases. Jrvinen O., Ann Chir Gynaecol. 1994; 83(1): 22–5] [Survival after operations for ischaemic bowel disease. Wadman M, Eur J Surg. 2000 Nov; 166(11): 872–7].
3. Marincek B (2002) Nontraumatic abdominal emergencies. Acute abdominal pain: diagnostic strategies. Eur Radiol 12: 2136–2150.
4. Rosen MP, Siewert B, Sands DZ, Bromberg R, Edlow J, Raptopoulos V (2003) Value of abdominal CT in the emergency department for patients with abdominal pain. Eur Radiol 13: 418–424.
5. Acute mesenteric ischemia. Inderbitzi R. Eur J Surg 1992; 158: 123–126.
6. Acute intestinal ischemia, a review of 214 cases. Jrvén O. Ann Chir Gynaecol 1994; 83: 22–25.
7. CT of acute bowel Ischemia; Walter Weisener, Bharti Khurana, Hoom Ji, Pablo R. Ross 226: 635 Radiology 2003.
8. Acute mesenteric venous thrombosis: management controversies; Saleh M. Al. Salamah, Shaukat Mahmood Mirza; vol. 11 no. 4, Oct. 2004.
9. Pneumatosis intestinalis in the adult: benign to life threatening causes; Lisa M. Ho, Erik K.Paulson, William M. Tompson, AJR 2007; 188: 1604–1613.
10. Pneumatosis Intestinalis: A review. Pear BL. Radiology 1998; 207: 13–19.
11. CT of acute bowel Ischemia; Walter Weisener, Bharti Khurana, Hoom Ji, Pablo R. Ross 226: 635 Radiology 2003.
12. Portomesenteric vein gas: Pathologic Mechanism, CT findings, Prognosis. Sebastia C. Radiographics 2000; 20: 1213–1224.
13. Hepatic-portal venous gas in adults: etiology, pathophysiology, and clinical significance. Liebman PR. Ann Surg 1978; 187: 281.