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Case Report

Could CT finding of gas in the sole mesenteric artery be a sign of a severe acute ischemia? Presentation of a rare fatal case and a literature review ☆

Valerio D'Agostino, MD[a,], Luigi Coppola, MD[b], Angela Barillaro, MD[c], Mariateresa Spaziano, MD[a], Nicola Bonacci, MD[a], Stefania Castaldo, MD[d], Ciro Nappa, MD[c], Giovanna Iacuessa, MD[c], Fabio Cerrone, MD[c], Antonio Salzano, MD[a]*

[a] *Department of Radiology, Sessa Aurunca Hospital, Sessa Aurunca, Caserta, Italy*
[b] *Department of Radiology, Maddaloni Hospital, Caserta, Italy*
[c] *Department of Advanced Biomedical Sciences, Federico II University of Naples, Naples, Italy*
[d] *Department of Radiology, University of Trieste, ASUGI, Cattinara Hospital, Trieste, Italy*

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ABSTRACT

Contrast-enhanced abdominal CT is the gold standard for the diagnosis of acute mesenteric ischemia (AMI). CT findings include several anomalies like bowel wall thickening, thinning, attenuation, decreased enhancement, dilated fluid-filled loops, pneumatosis, and portal venous gas. A rare case of gas found only in the superior mesenteric artery (SMA) is presented. A contrast-enhanced CT scan was performed in emergency on an 80-year-old man with vague and diffuse abdominal pain, which showed findings of occlusive AMI. Gas was found in the context of the SMA and its branches, but not in the mesenteric and portal veins. The patient underwent emergency surgery but he died the next day in the intensive care unit for complications. The rare CT finding of gas in SMA during an AMI should be considered a radiological sign of irreversible intestinal damage: surgical prompt intervention is needed, even if the mortality rate is high.

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* Corresponding author.
E-mail address: valerio.dagostino123@gmail.com (V. D'Agostino).

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Background

Acute mesenteric ischemia (AMI) is defined as the sudden reduction or cessation of blood flow to a segment of the small or large intestine leading—in the absence of early appropriate intervention—to necrosis of the bowel wall.

It is a rare entity, with an estimated incidence of 0.09%-0.2% among all acute surgical admissions, but burdened by a high mortality (60%-80%) [1]. The higher prevalence in elderly with unspecific symptoms could explain the high mortality [2]. The vague symptoms that make the diagnosis of AMI difficult are sudden, unusual, and intense abdominal pain, accompanied by nausea and vomiting, bloating, and diarrhea [3].

The main causes leading to AMI are mesenteric arterial thrombosis (MAT), mesenteric arterial embolism (MAE), mesenteric venous thrombosis (MVT), and nonocclusive mesenteric ischemia (NOMI) [4].

Computed tomography angiography (CTA) is the first-line diagnostic exam since is rapid, noninvasive, and widely available: it allows to evaluate both vascular and intestinal abnormalities and to find any alternative causes of abdominal pain, with an estimated 89% sensitivity and 99% specificity [3]. Catheter-based angiography is currently considered a second-line exam due to its invasiveness and limited availability [5], although it allows both diagnosis and treatment [6,7]. CT imaging findings include several anomalies like bowel wall thickening, more frequent in AMI by venous causes, alongside intramural hemorrhage or edema due to venous stasis [8] and bowel wall thinning, which is more frequent in AMI by arterial occlusion even though rarely it can be an early and suggestive feature in NOMI without reperfusion [9]. Other several features can result from transmural bowel infarction, including bowel wall attenuation on unenhanced images [10], decreased bowel enhancement [11], dilated fluid-filled bowel loops, pneumatosis intestinalis (PI), and portal venous gas [4].

We present an unusual case of AMI caused by MAT and MVT with simultaneous involvement of the arterial and venous mesenteric systems but with the presence of gas only in the superior mesenteric artery (SMA) without any trace of it the portal vein (PV) and in the superior mesenteric vein (SMV). The finding of gas in the sole mesenteric artery is extremely rare, with only a few cases reported in the literature.

Case presentation

An 80-year-old man, with a history of cardiovascular risk factors (hypertension, type 2 diabetes, and tabagism), presented to the emergency department (ED) with vague and diffuse abdominal pain.

On physical examination, there were no signs of peritonitis and vital signs were normal. There was no free fluid in the abdomen or others emergency ultrasound findings. The results of laboratory tests revealed leucocytosis (21,000 cells/μL), elevated PCR (15 mg/dL), and increased LDH (2245 U/I).

A contrast-enhanced CT scan of the abdomen showed extensive thrombosis affecting SMA with its major collaterals and SMV without the involvement of the portal vein. CT also highlighted marked thinning of the small bowel wall, which showed a lack of contrast-enhancement without luminal dilatation and air-fluid levels (Fig. 1). Another finding was intramural gas (pneumatosis intestinalis). These features were consistent with an occlusive AMI with signs of transmural small bowel ischemia. Additionally, multiple filling defects with low attenuation and oval morphology, indicating the presence of gas, were found in the context of the SMA and its branches, but not in the SMV and PV (Fig. 2).

The patient underwent emergency surgery with the excision of multiple necrotic bowel loops (Fig. 3) and was subsequently transferred to the intensive care unit, where he died the next day for multiple organ dysfunction syndrome (MODS), primarily correlated with ischemia-reperfusion events and the consequent significant metabolic derangements associated with systemic inflammatory response syndrome (SIRS).

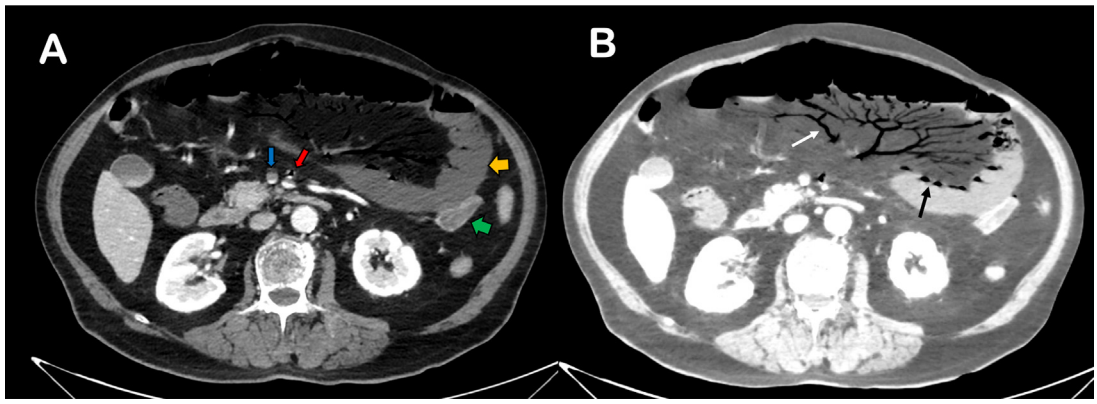

Fig. 1 – (A) CT axial image in the portal phase showing filling defect in both SMV (blue arrow) and SMA (red arrow), with the presence of gas within the latter. Moreover, the presence of small bowel loops with thinned walls and lack of enhancement (orange arrow) if compared to normal bowel (green arrow) is shown. (B) CT axial reformatted image with minimum intensity projection (minIP) highlighting the diffuse presence of intra-arterial mesenteric gas resembling the branches of a tree (white arrow), alongside the presence of gas within the bowel's wall (black arrow) consistent with pneumatosis intestinalis.

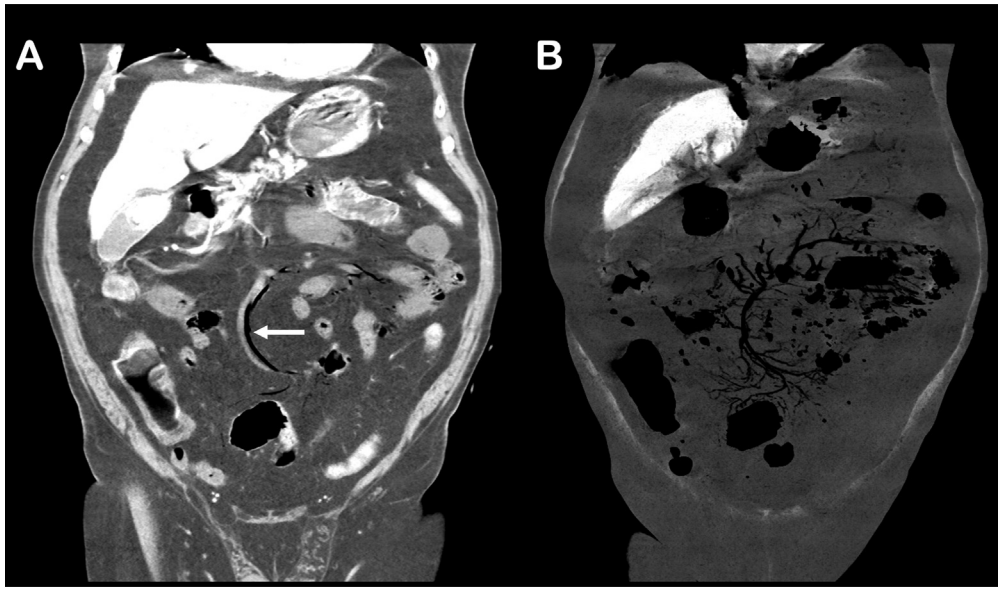

Fig. 2 – (A) CT coronal image in the portal phase showing an extensive filling defect in SMA (white arrow), with the presence of endoluminal gas. (B) CT coronal reformatted image with minimum intensity projection (minIP) which depicts nicely the tree-like distribution of gas in SMA and its collaterals.

Fig. 3 – Operative photography prior of the multiple bowel loops resection, which looked severely and extensively pale, atonic, and enlarged.

Discussion

AMI is defined as an insufficient blood irroration to the gastrointestinal tract causing, if not promptly recognized and treated, the necrosis of the bowel wall. Due to the lack of specific signs and symptoms, any sudden, unusual, and intense abdominal pain should be suspicious of AMI. The other associated signs (vomiting, diarrhea, hyperleukocytosis, and lactic acidosis) are delayed and have, at any rate, a low diagnostic value [12]. Late diagnosis results in bowel wall necrosis, perforation, and peritonitis, thus requiring surgical resection [13]. Mortality rate without treatment amounts to about 95% versus 70%, when emergency surgery is performed or not, respectively [14]. AMI could be caused by MAE, MAT, MVT, or NOMI. Arterial occlusion is the most common subtype, representing 50%-75% of all cases of AMI [15]. An embolic or thrombotic cause is possible, with embolic AMI accounting for 40%-50%, while thrombosis is responsible for 20%-35% of all occlusive AMI [15]. In 20%-30% of cases, AMI is the result of mesenteric hypoperfusion caused by reduced cardiac output without evidence of vascular occlusion (NOMI) [16]. AMI of venous origin is the less common, accounting for 5%-20% of cases [15].

CTA, a first-line imaging technique, with good sensitivity and specificity [3], should be performed as quickly as possible, after the onset of symptoms.

Table 1 – Cases reporting AMI with CT finding of gas in the SMA.

Author, year	Age, gender	Symptoms	Laboratory	CT findings	Treatment	Outcome
Numata et al. [20]	51, F	acute abdominal pain	-	Acute type A aortic dissection with multiple malperfusions of the vessels and gas in the superior mesenteric artery	Emergency aortic replacement	Death soon for massive bowel necrosis
Lambert et al. [21]	50, M	-	↑ Lactate ↑ Creatinine	CT performed twice on the first postoperative day—replacement of the ascending aorta for aortic dissection type A—showed abundant air in the superior mesenteric artery and its branches (but not in the portal-venous system) indicating air embolism with no signs of bowel necrosis.	Extensive bowel resection the day after	Death the day after on MODS/ SIRS
Fujiwara et al. [22]	83, F	Abdominal pain for two days	Findings of sepsis	Lack of enhancement in the intestinal and cecal wall, with intramural gas, portal venous gas and gas in the superior mesenteric artery	Extensive bowel resection	Death 27 days after for progression of the mediastinal tumor
Giulio et al. [23]	89	Abdominal pain and vomiting	Leucocytosis ↑ Troponin ↑ Lactate	Paralytic ileus; marked parietal thinning of the small bowel; absence of parietal enhancement and PI	-	Death
This case	80	Abdominal pain	Leucocytosis ↑ PCR ↑LDH	SMA - SMV thrombosis; marked thinning of the small bowel wall, lack of contrast-enhancement without luminal dilatation and air-fluid levels.	Surgery	Death after 1 day in Intensive Care Unit

However, the gold standard is contrast-enhanced abdominal CT: diagnosis of AMI is based on the finding of changes in mesenteric vessels, the bowel walls, and the surrounding mesentery. Thickening of the intestinal wall, secondary to edema or mural hemorrhage, has a high sensibility but a lower specificity, being also common in infection and inflammatory states [11]. Thinning of the bowel wall, often associated with lumen dilation with hydro-aerial levels, is common in arterial AMI [4] and is secondary to the disruption of normal peristalsis and hypotonia, caused by damage of the bowel's muscle-nervous structures following ischemia [4,11]: in these cases, parietal hypo-enhancement is an early and specific sign of AMI [15].

Another sign often seen in AMI is the finding of gas in the intestinal wall (intestinal pneumatosis, IP), which may extend into the mesenteric venous system and portal vein [15]. PI and porto-mesenteric gas present in isolation is not specific for AMI [16], but when associated with other signs, such as parietal hypo-enhancement, it is highly specific for AMI [17].

As far as bowel ischemia is concerned, point-of-care ultrasonography (POCUS) has shown relatively high accuracy—both sensitivity and specificity of 85%-90%—in diagnosing AMI, particularly when the upper mesenteric artery is involved by a thrombosis or an embolus [18]. Unfortunately, it requires expert sonographers and its accuracy decrease in distal vessels' ischemia or in NOMI. Some case reported the detection of porto-mesenteric venous gas with POCUS thanks to the clear artifacts from airt within the intrahepatic portal veins [19]. Unfortunately, to the best of our knowledge, in literature, there were no cases described of gas in the SMA detected by POCUS, so we do not recommend basing the diagnosis solely on this exam.

We presented a case of AMI in an elderly patient, in which thinning and parietal hypo-enhancement suggested a transmural form of ischemia; small bowel loops appeared collapsed, indicating an advanced state of parietal necrosis. Surprisingly, in addition to PI, gas in the SMA and its branches, without the involvement of the mesenteric and portal venous systems, was found.

Gas in the SMA is a very rare occurrence in the setting of bowel ischemia. Few cases in the literature reported the finding of gas in the SMA (Table 1).

Two cases reported AMI as a complication of surgery for type A aorta dissection. Visceral vessel stenosis [20] or iatrogenic embolism [21] was described; in both cases, gas in the SMA was found, while evidence of bowel wall necrosis occurred only in the following days [20,21].

Another case reported necrosis of the small bowel and ascending cecum as a complication of a disseminated intravascular coagulation where lack of parietal enhancement, intramural gas in the portal venous system and in the SMA were found, but without evidence of paralytic ileus or wall thrombosis, indicating an AMI of embolic origin [22].

Finally, a recent paper reported a case of AMI resulting from acute thrombotic occlusion of SMA with evidence of paralytic ileus, marked parietal thinning of the small bowel, absence of parietal enhancement, and PI. As in our case, the peculiar finding of gas in the mesenteric arterial system but without evidence of involvement of the portal-mesenteric venous system was described [23].

Conclusions

AMI is a rare clinical condition that is difficult to diagnose and has a high mortality rate. Prompt recognition and intervention can reduce mortality. Therefore, the rare presence of gas in SMA, with or without the involvement of the portal/mesenteric venous system, should be considered a radiological sign of impending irreversible intestinal damage and should guide to a timely and appropriate surgical therapy.

Patient consent

Informed consent was obtained by the patient for publication of this case.

REFERENCES

[1] Kundan M, Chebrolu H, Muniswamppa C, Kumar N, Chintamani VV. Outcomes of management of patients with acute mesenteric ischemia: a prospective study. Niger J Surg 2021;27(1):16–21. doi:10.4103/njs.NJS_54_20.

[2] Ginsburg M, Obara P, Lambert DL, Hanley M, Steigner ML, et al., Expert Panels on Vascular Imaging and Gastrointestinal Imaging ACR Appropriateness Criteria® imaging of mesenteric ischemia. J Am Coll Radiol 2018;15(11S):S332–40. doi:10.1016/j.jacr.2018.09.018.

[3] Olson MC, Fletcher JG, Nagpal P, Froemming AT, Khandelwal A. Mesenteric ischemia: what the radiologist needs to know. Cardiovasc Diagn Ther 2019;9(Suppl 1):S74–87. doi:10.21037/cdt.2018.09.06.

[4] Garzelli L, Nuzzo A, Copin P, Calame P, Corcos O, Vilgrain V, et al. Contrast-enhanced CT for the diagnosis of acute mesenteric ischemia. AJR Am J Roentgenol 2020;215(1):29–38. doi:10.2214/AJR.19.22625.

[5] Costa AF, Chidambaram V, Lee JJ, Asquith J, Skaff ER, Thipphavong S. Multidetector computed tomography of mesenteric ischaemia. Insights Imaging 2014;5(6):657–66. doi:10.1007/s13244-014-0361-1.

[6] Gore RM, Yaghmai V, Thakrar KH, Berlin JW, Mehta UK, Newmark GM, et al. Imaging in intestinal ischemic disorders. Radiol Clin North Am 2008;46(5):845–75. doi:10.1016/j.rcl.2008.05.004.

[7] Oliva IB, Davarpanah AH, Rybicki FJ, Desjardins B, Flamm SD, Francois CJ, et al. ACR Appropriateness Criteria ® imaging of mesenteric ischemia. Abdom Imaging 2013;38(4):714–19 Erratum in: Abdom Imaging. 2014 Aug;39(4):937-9. doi:10.1007/s00261-012-9975-2.

[8] Horton KM, Fishman EK. Multidetector CT angiography in the diagnosis of mesenteric ischemia. Radiol Clin North Am 2007;45(2):275–88. doi:10.1016/j.rcl.2007.03.010.

[9] Versyck G, de Gheldere C, Vanclooster P. Non-occlusive mesenteric ischemia: two case reports and a short review of the literature. Acta Chir Belg 2018;118(6):392–7. doi:10.1080/00015458.2017.1408280.

[10] Schieda N, Fasih N, Shabana W. Triphasic CT in the diagnosis of acute mesenteric ischaemia. Eur Radiol 2013;23(7):1891–900. doi:10.1007/s00330-013-2797-y.

[11] Wiesner W, Khurana B, Ji H, Ros PR. CT of acute bowel ischemia. Radiology 2003;226(3):635–50. doi:10.1148/radiol.2263011540.

[12] Corcos O, Nuzzo A. Gastro-intestinal vascular emergencies. Best Pract Res Clin Gastroenterol 2013;27(5):709–25. doi:10.1016/j.bpg.2013.08.006.

[13] Nuzzo A, Corcos O. Reversible acute mesenteric ischemia. N Engl J Med 2016;375(15):e31. doi:10.1056/NEJMicm1509318.

[14] Schoots IG, Koffeman GI, Legemate DA, Levi M, van Gulik TM. Systematic review of survival after acute mesenteric ischaemia according to disease aetiology. Br J Surg 2004;91(1):17–27. doi:10.1002/bjs.4459.

[15] Yu H, Kirkpatrick IDC. An update on acute mesenteric ischemia. Can Assoc Radiol J 2023;74(1):160–71. doi:10.1177/08465371221094280.

[16] Pérez-García C, de Miguel Campos E, Fernández Gonzalo A, Malfaz C, Martín Pinacho JJ, Fernández Álvarez C, et al. Non-occlusive mesenteric ischaemia: CT findings, clinical outcomes and assessment of the diameter of the superior mesenteric artery. Br J Radiol 2018;91(1081):20170492. doi:10.1259/bjr.20170492.

[17] Ho LM, Paulson EK, Thompson WM. Pneumatosis intestinalis in the adult: benign to life-threatening causes. AJR Am J Roentgenol 2007;188(6):1604–13. doi:10.2214/AJR.06.1309.

[18] Moneta GL. Screening for mesenteric vascular insufficiency and follow-up of mesenteric artery bypass procedures. Semin Vasc Surg 2001;14(3):186–92.

[19] Di Capua M, Tonani M, Paglia S. Ultrasound detection of portomesenteric venous gas is an early sign of bowel ischaemia in non-traumatic abdominal pain: old dogs, new tricks-four cases report. Case Rep Crit Care 2022;2022:1734612. doi:10.1155/2022/1734612.

[20] Numata S, Tsutsumi Y, Ohashi H. Gas in the superior mesenteric artery: severe malperfusion and bowel necrosis caused by acute aortic dissection. Eur J Cardiothorac Surg 2013;43(6):1267–8. doi:10.1093/ejcts/ezs606.

[21] Lambert L, Grus T, Spunda R, Balik M, Trca S. Air embolism into superior mesenteric artery following replacement of ascending aorta for aortic dissection—a rare and fatal case. J Belg Soc Radiol 2018;102(1):68. doi:10.5334/jbsr.822.

[22] Fujiwara S, Sekine Y. Gas in the superior mesenteric artery. BMJ Case Rep 2017;2017:bcr2017219470. doi:10.1136/bcr-2017-219470.

[23] Giulio F, Ruggiero S, Vicini S, Bellini D, Rengo M, Carbone I. Unusual computed tomography findings of gas in the superior mesenteric artery system with no signs of porto-mesenteric venous gas in a case of acute mesenteric ischemia. Radiol Case Rep 2022;17(7):2568–72. doi:10.1016/j.radcr.2022.04.037.