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Infected abdominal aortic aneurysm: early CT findings

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Abstract
We describe computed tomographic (CT) findings at the early stage of infected abdominal aortic aneurysm in three patients. Periaortic mass and increased fat density were the characteristic findings of early aortic infection on CT. Similar findings caused by other diseases may be difficult to differentiate by imaging alone, but these findings should be used to trigger close follow-up for patients with suspected infected abdominal aortic aneurysm.

Key words: Aorta, abdominal—Aneurysm, infected—Early stage—Computed tomography.

Infected (mycotic) aortic aneurysms are infrequent, with an incidence of 0.06–2.60% of all aneurysms; they usually lead to uncontrolled sepsis and catastrophic hemorrhage if not treated [1–5]. Survival and the long-term prognosis are markedly improved with early diagnosis and prompt surgical and antibiotic therapy [2, 3].

We describe computed tomographic (CT) findings at the early stage of infected abdominal aortic aneurysm prior to pseudoaneurysm formation in three patients.

Case reports

The patients were referred for the radiologic evaluation of infected aortic aneurysms. All three patients underwent CT studies, and one patient underwent a magnetic resonance (MR) study on a 1.0-T scanner (Magnex; Shimazu, Kyoto, Japan). In all cases, the mycotic nature of the aneurysm was confirmed by gross inspection at surgery and by a histologic study.

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Case 1

A 59-year-old man was admitted with rectal cancer, general fatigue, abdominal pain, and high fever. His white blood cell count (WBC) was 12,400/mL. Initial contrast-enhanced CT showed a homogeneous, dense, soft tissue mass around the infrarenal abdominal aorta, with calcification and increased fat density around the mass (Fig. 1A). Initially, the periaortic mass was considered to represent metastatic lymph nodes because the patient's rectal cancer was histologically confirmed 5 days earlier. One month later, CT showed an interval increase in size of the periaortic mass and a disruption of the aortic mural calcification (Fig. 1B). The periaortic mass showed low-signal intensity on the T1-weighted MR image and high-signal intensity on the T2-weighted MR images. Contrast-enhanced T1-weighted images revealed marked enhancement of the mass (Fig. 1C). MR angiography demonstrated a pseudoaneurysm of saccular shape arising from the posterior wall of the aorta (Fig. 1D). A diagnosis of infected aortic aneurysm was made, and repair of the pseudoaneurysm was performed. The gross specimen showed a defect in the posterior wall of the aorta, corresponding to the imaging findings (Fig. 1E). *Salmonella* was cultured from the specimen of the aortic wall. The patient did well postoperatively.

Case 2

A 61-year-old man was admitted because of recurrent low fever and abdominal pain. CT showed a slight increase of fat density adjacent to the posterior wall of the infrarenal abdominal aorta (Fig. 2A), but this important finding was not appreciated initially. The patient was treated with oral antibiotics and his symptoms improved. Five months later, he was readmitted with high fever and severe abdominal pain. His WBC was 12,400/mL. Contrast-enhanced CT demonstrated an enlargement of the aorta, and an enhancement of a small periaortic mass (Fig. 2B). An infected aortic aneurysm was suspected. At surgery, the wall of the aneurysm was found to be adherent to the retroperitoneal fat, suggestive of chronic and continuous inflammatory change. *Helicobacter pylori* was cultured from the specimen of the aortic wall.

Case 3

A 74-year-old man with tuberculous osteomyelitis had been treated with antituberculous drugs prior to referral. An aneurysmal dilatation of the infrarenal abdominal aorta had been pointed out a few years earlier. During treatment for tuberculous osteomyelitis, the patient complained of

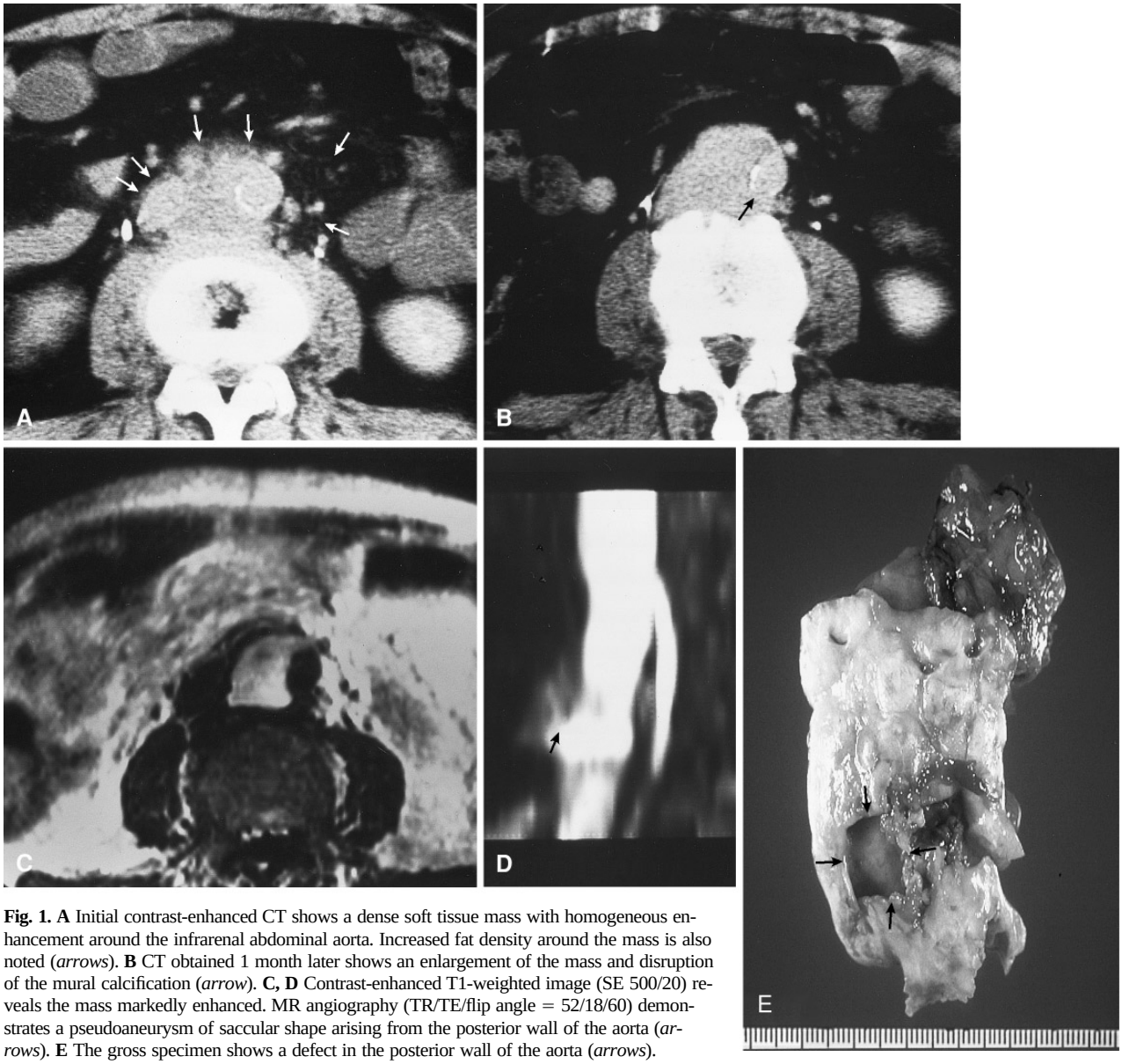

Fig. 1. A Initial contrast-enhanced CT shows a dense soft tissue mass with homogeneous enhancement around the infrarenal abdominal aorta. Increased fat density around the mass is also noted (*arrows*). **B** CT obtained 1 month later shows an enlargement of the mass and disruption of the mural calcification (*arrow*). **C, D** Contrast-enhanced T1-weighted image (SE 500/20) reveals the mass markedly enhanced. MR angiography (TR/TE/flip angle = 52/18/60) demonstrates a pseudoaneurysm of saccular shape arising from the posterior wall of the aorta (*arrows*). **E** The gross specimen shows a defect in the posterior wall of the aorta (*arrows*).

severe abdominal pain and lumbago with high-grade fever. The WBC count at the time of admission was 10,500/mL. Contrast-enhanced CT revealed a dense, soft tissue mass with a rim enhancement and increase of fat density around the dilated aorta (Fig. 3A). The diagnosis of infectious aortitis caused by an extension of the contiguous tuberculous osteomyelitis was considered. An increased dose of antituberculous drugs was administered. Two weeks later, contrast-enhanced CT showed a fusiform-shaped dilatation of the aorta (Fig. 3B). Repair of the aneurysm was performed. The gross specimen revealed a large defect in the posterior wall of the aorta. *Candida* was cultured from the specimen of the aortic wall, suggesting that the infected aneurysm of the patient was caused by hematogenous seeding.

Discussion

Infected (mycotic) aortic aneurysms, although rare, have potentially fatal complications such as uncontrolled sepsis and aortic rupture [1–5]. Therefore, a high index of suspicion of this disease is required for timely diagnosis. The most common location for an infected aneurysm is the femoral artery, followed by the abdominal aorta [2].

Infectious aortitis, which initially weakens and destroys the aortic wall, may subsequently progress to a rupture and form a pseudoaneurysm. The process of the aortic wall destruction is relatively slow, allowing for the formation of an inflammatory response in the periaortic region. This response is thought to prevent immediate aortic rupture [3].

The findings of previous studies have suggested three potential sources of infection: (1) septic arterial emboli usually originating from bacterial endocarditis, (2) hema-

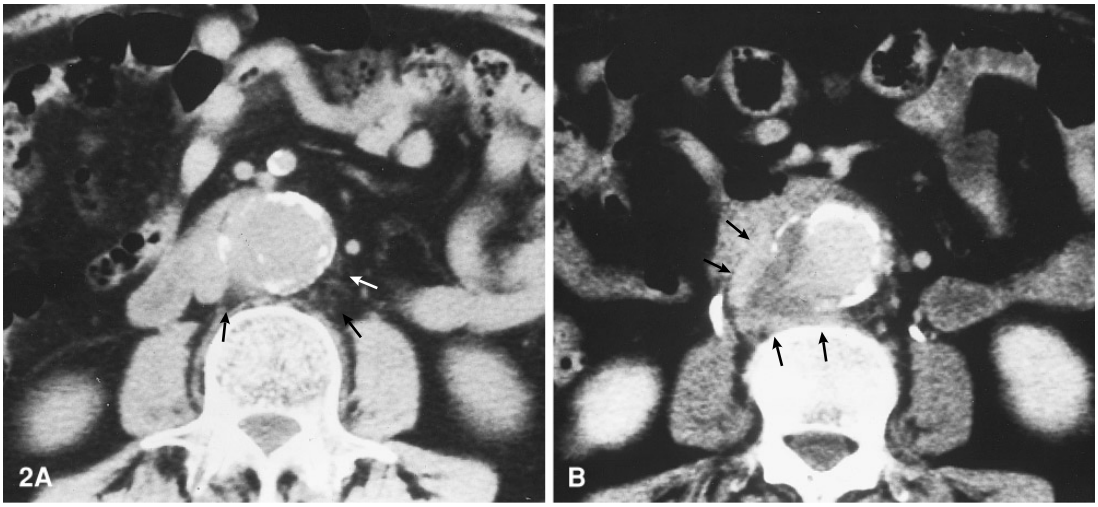

Fig. 2. A The initial CT shows a slight increase of fat density adjacent to the posterior infrarenal aortic wall (*arrows*). **B** Contrast-enhanced CT demonstrates an enlargement of the aorta with an enhancement of a small periaortic mass (*arrows*).

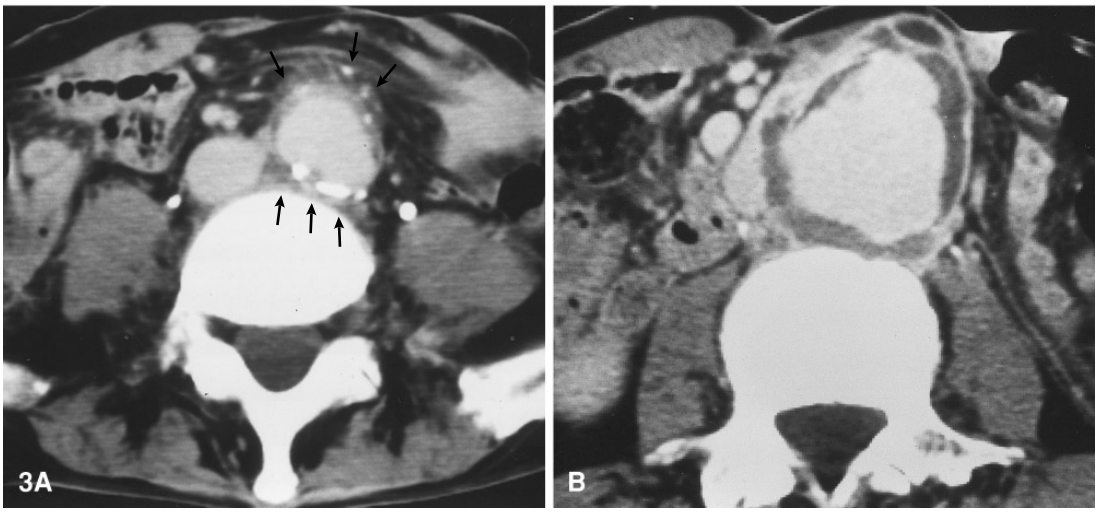

Fig. 3. A Contrast-enhanced CT reveals the dense soft tissue mass with a rim enhancement and increase of fat density around the aorta (*arrows*). **B** Contrast-enhanced CT obtained two weeks later shows a fusiform-shaped dilatation of the aorta.

togenous seeding of the arterial wall during bacteremia from a distant focus other than the heart, and (3) direct extension from an adjacent infectious process or via the lymphatics from the surrounding infectious process [1, 2, 6]. The hematogenous spread of infections into the vasa vasorum of the aortic wall is thought to be the most common pathogenesis of infected aneurysms, and the most common organisms causing infected aortic aneurysms are *Staphylococcus aureus* and *Salmonella* [2, 3, 7]. In our case 2, *Helicobacter pylori*, an organism causing gastrointestinal diseases such as inflammation, ulcer, and cancer, was cultured from the aortic wall [8, 9]. To our knowledge, this is the first report to recognize *Helicobacter pylori* as an organism causing an infected aortic aneurysm.

The clinical diagnosis of infected abdominal aortic aneurysms is based on the presence of inflammatory signs and symptoms (fever, leukocytosis, abdominal or back pain) combined with a pulsatile abdominal mass, which is a late manifestation of the disease [2, 3].

The radiologic diagnosis of advanced aortic infection is often straightforward, regardless of the cause. On CT, a rapidly enlarging noncalcified eccentric saccular or irregular aneurysm often in an atypical location is usually identified. Disruption of the aortic wall calcification, paraaortic gas, enlarged lymph nodes, and retroperitoneal hematoma of various stages may be present [1, 4, 5]. Previous studies have demonstrated that CT is also useful in the diagnosis of early aortic infection. The features described represent an early stage of infectious aortitis, reflecting hyperemia and resulting in a homogeneous enhancement of the periaortic mass, which may undergo centrifugal necrosis that may lead to the ap-

parent peripheral rim enhancement [2, 3]. All three patients demonstrated an increase of fat density around the affected aorta on CT, which was the only finding suggestive of infectious aortitis in one patient. We hypothesize that the CT finding of an increase of fat density, representing a retroperitoneal inflammatory response, is characteristic of a very early aortic infection.

Case 1 had a soft tissue mass with homogeneous enhancement around the affected aorta on the initial contrast-enhanced CT. However, this finding could be mistaken on CT for primary retroperitoneal pathology, such as retroperitoneal fibrosis, lymphoma, neoplastic or infectious lymphadenopathy, or hematoma [2, 3, 5]. In case 1, the periaortic mass appeared as low intensity on the T1-weighted MR images and as high intensity on the T2-weighted images. Contrast-enhanced T1-weighted MR images revealed a marked enhancement of the mass. MR imaging may be useful to differentiate some of these diseases because nonmalignant retroperitoneal fibrosis may show low intensity on a T2-weighted MR image [10], and hematoma may usually not be enhanced. However, other periaortic masses may be difficult or impossible to differentiate by imaging alone; further study is needed to investigate this problem.

In conclusion, our findings of a periaortic mass and increased fat density indicate that an early diagnosis of infected aortic aneurysm can be made in patients with inflammatory signs and symptoms.

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