CT Imaging Manifestations of Tubercular Aortic Aneurysm

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Research Article

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Abstract

Tubercular aortic aneurysm is a rare complication of tuberculosis but associated with very high mortality. Early diagnosis is critical, however, it is challenging due to nonspecific symptoms. This study summarized the CT features of tubercular aortic aneurysm in order to assist timely clinical diagnosis. Seventeen patients with confirmed tubercular aortic aneurysm between 2016 and 2020 were included in this study. The clinical manifestations, past medical history, laboratory and imaging examinations, treatments and other data were collected. CT angiography was routinely performed in all patients. Clinical and CT imaging data was collected and analyzed. All tuberculous aneurysms were pseudoaneurysms, which were located in the thoracic aorta, abdominal aorta, junction of thoracic and abdominal aorta or iliac aorta. The shapes of aneurysms were saccular or lobular. The diameter of aneurysm ranged from 30 to 120 mm. Thirteen patients had atherosclerosis. Mural thrombus was shown in 14 patients. Twelve patients showed enlarged lymph nodes which were found closely related to the aneurysm. Nine patients had tuberculous spondylitis including tuberculosis of thoracic lumbar and lumbosacral spine. Psoas abscess was showed in four patients and iliopsoas abscess was in one patient. Compared with other infectious aneurysms, tuberculous aneurysms typically show more cystic and lobulated shapes on CT scan, which are imaged as poured and unstressed. Another point of differential diagnosis is that the surrounding tissues and adjacent organs of tubercular aneurysms are usually infected with tuberculosis and most of them are accompanied by other sites of tuberculosis.

Introduction

Mycotic aortic aneurysm (MAA) arises from the infectious destruction of the vascular wall [1], which shows a mushroom-shaped structure on the blood vessel. MAA is an acute inflammatory response to pathogenic infection. The most common reported pathogens are Salmonella and Staphylococcus, and other pathogenic species involved are Streptococcus pneumoniae, Mycobacterium tuberculosis, human immunodeficiency virus, and Treponema pallidum [2, 3]. Tubercular aortic aneurysm (TBAA) is exceedingly rare and accounts for 0.3% of all aneurysms [4]. The first case of TBAA was reported by Kamen in 1895 [5, 6]. TBAA is associated with high mortality due to its high risk of sudden rupture. No patients of TBAA were known to have survived, until the availability of combined technologies of modern imaging, anti-TB therapy and surgical treatment [7]. Early diagnosis and prompt treatment are significant for the improvement of survival [8]. However, early diagnosis is difficult due to the non-specific symptoms and negative blood cultures. Some cases are diagnosed at an advanced stage or after developing complications, such as rupture or aortic fistula.

Current imaging modalities can detect infected aneurysms in clinically suspicious patients, and these imaging modalities include computed tomography (CT), magnetic resonance imaging (MRI), and 18F-fluorodeoxyglucose (FDG) positron emission tomography (PET)/CT [9]. CT angiography (CTA) with arterial and venous phases imaging enables assessment of the entire aorta. CTA is non-invasive, efficient, with broad coverage and isotropic voxel capabilities, thus it is increasingly used in the diagnostic assessment of aortic disease including TBAA.

The present study retrospectively reviewed 17 cases of patients with confirmed tubercular aortic aneurysm, and collected their clinical data, laboratory tests, imaging findings and treatment for analysis. The CTA imaging features of all TBAA patients were summarized and analyzed. It is expected that the results of this study will help clinicians diagnose TBAA timely and accurately.

Methods

This retrospective study included 17 patients with confirmed TBAA between 2016 and 2020. The diagnosis of TBAA was based on the history of extravascular tuberculosis, CT and CTA findings, combined with clinical manifestations and pathogenic indicators. The clinical manifestations, past medical history, laboratory and imaging examinations, therapies and other data of patients were collected. Informed consent was obtained in all cases, and protocols were approved by scientific ethical committee of the 3rd Affiliated Hospital of Shenzhen University. We confirm that all methods in our study were performed in accordance with the relevant guidelines and regulations.

CT angiography was routinely performed in all patients. CT scans were conducted on 64-slice or 128-slice scanner (the patients enrolled from several medical centers, so the scanners are different). Aortic CTA images were acquired when 75–85 ml contrast medium was administered at a rate of 5ml/s followed by intravenous injection of saline chasing of 40 ml at a rate of 5 ml/s. Images were reconstructed with a slice thickness of 0.5-0.75mm and interval of 0.25mm. Post-processing of the images was performed on a separate workstation (Vitrea FX Workstation, Vital Images, Minnetonka, USA). 1 mm thick axial, multi-planar reformations, volume-rendered and maximum intensity projection images of the aorta were produced.

All scans were assessed by two radiologists (over 5 years of experience) who were blinded to the clinical data. The two radiologists assessed the images independently and they reached agreement in all of the image interpretation. As previously reported in literature[10], the following items were regarded as being predictive for mycotic aneurysms on CT images: the site of mycotic aneurysms, the atherosclerosis around aneurysms, the aneurysm wall enhanced or not, the air bubble around the aneurysm, the bone destruction of adjacent vertebra, soft tissue involved around the aneurysm(psoas abscess, retroperitoneal abscess or peritoneal abscess), enlarged lymph nodes near lesions, and other infectious foci outside the aorta.

Results

The clinical and laboratory features and outcome of the 17 cases are described in Table 1. The mean age of the patients was 57 years (range, 6–81 years), with a marked male predominance (13 men, 4 women). The main presenting symptoms were fever (7), chest pain (6), abdominal pain (4), low back pain (2), lower limb pain (2), hemoptysis (1), chest distress and dyspnea (1). Four of them had both chest pain and fever, one of them had both abdominal pain and fever, one of them had both lower limb pain and fever, and only fever was in one case. Some of them were followed by constitutional symptoms such as weakness, fatigue, or weight loss. Some patients were accompanied with underlying diseases, such as hypertension (1), diabetes mellitus (5) and kidney atrophy (1). One patient had a history of syphilis and HIV infection. Extravascular tuberculosis (TB) was found in all patients, such as pulmonary tuberculosis in 12 patients, tuberculous spondylitis in 9, renal tuberculosis, pleural tuberculosis and prostatic tuberculosis in 1. Five of them had both pulmonary tuberculosis and tuberculous spondylitis. Sputum tuberculosis test were positive in patients with pulmonary tuberculosis. The concentration of C-reactive protein (CRP) and the erythrocyte sedimentation rate (ESR) were elevated in all patients. All patients had active tuberculosis, but the cultures of the blood were negative. All patients were treated with antituberculosis treatment. Eight patients also underwent surgery: six patients received endovascular grafting treatment and two patients received open surgical repair. Overall, 6 patients died.

Table 1
Summary of clinical data in 17 patients with TBAA

Patient no.	Age (y)/sex	Symptom	Underlying disease	Extravascular tuberculosis	Sputum tuberculosis test	CRP(mg/L)/ESR(mm/h)	Surgical treatment	Outcome
1	50/F	Chest pain	No	Pulmonary TB	+	83/65	Endovascular grafting	Improvement
2	55/M	Chest pain	No	Thoracic vertebra TB	-	62/45	Internal fixation of thoracic vertebra	Lost to Follow-up
3	81/M	Abdominal pain		Lumbar TB; psoas abscess	-	73/51	Endovascular grafting	Improvement
4	62/M	Low back pain	Diabetes	Lumbar TB; psoas abscess	-	78/55	Endovascular grafting	Improvement
5	76/M	Abdominal pain	Diabetes	Lumbar TB	-	82/38	No	Lost to follow-up
6	73/F	Chest pain and fever	Hypertension	Pulmonary TB; lumbar TB; psoas abscess	+	98/48	No	Death
7	20/M	Low back pain	No	Pulmonary TB; lumbar TB; psoas abscess	+	88/42	No	Death
8	6/M	Chest pain and fever	No	Pulmonary TB	+	68/33	Open surgical repair	Improvement
9	74/M	Fever, back pain and abdominal pain	Left kidney atrophy	Pulmonary TB; lumbar TB	+	66/41	No	Death
10	42/M	Left lower limb pain	No	Renal TB; pleural TB; psoas abscess	-	82/55	Endovascular grafting	Improvement
11	74/M	Abdominal pain and cough	Diabetes	Pulmonary TB; lumbosacral TB	+	83/45	No	Death
12	72/M	Fever	No	Pulmonary TB	+	74/38	Endovascular grafting	Improvement
13	47/M	Fever, left lower limb pain	HIV, syphilis	Pulmonary TB; iliopsoas abscess	+	103/65	No	Death
14	57/M	Chest distress and dyspnea	Diabetes	Pulmonary TB, prostatic TB	+	87/54	Open surgical repair	Improvement
15	84/M	Fever, chest pain, and hemoptysis	Diabetes	Pulmonary TB	+	112/50	No	Death
16	45/F	Fever and chest pain	No	Pulmonary TB	+	92/58	No	Lost to follow-up

Patient no.	Age (y)/sex	Symptom	Underlying disease	Extravascular tuberculosis	Sputum tuberculosis test	CRP(mg/L)/ESR(mm/h)	Surgical treatment	Outcome
17	58/F	Aortic aneurysm was found during thoracic spine tuberculosis surgery	No	Pulmonary TB; Thoracic vertebra TB	+	96/39	Endovascular grafting	Improvement

The imaging results of CTA are described in Table 2. Sixteen tuberculous aneurysms were solitary pseudoaneurysms which were located in the thoracic aorta (7, Fig. 2,4), abdominal aorta (7, Fig. 1), junction of thoracic and abdominal aorta (1) and iliac aorta (1, Fig. 3). Only one patient had multiple aneurysms in ascending aorta. The shapes of aneurysms were saccular (8), lobular (5), both saccular and lobular (4). One of aneurysms was found to be large saccular appearance with cyst wall separated (Fig. 1D). The diameter of aneurysm ranged from 30 to 120 mm. Thirteen patients had atherosclerosis. Mural thrombus was shown in 14 patients (Fig. 2C,D). Significant exudation around aneurysm was found in 3 patients (Fig. 1) and no gas bubbles were found. Necrosis and abscess were found around aortic (Fig. 2C,D). Twelve patients showed enlarged lymph nodes which were connected to or around the aneurysm (Fig. 1C). Nine patients had tuberculous spondylitis including tuberculosis of thoracic aorta (2), lumbar and lumbosacral (7) spine (Fig. 1,2). Psoas abscess was shown in five patients and iliopsoas abscess was showed in one patient (Fig. 3). Aortobronchial fistula was detected in one patient (Fig. 4). Multiple miliary nodules were found in bilateral lungs by pulmonary CT (Figs. 1A, 2B, 4A). Spinal CT scan showed destruction of vertebral body, soft tissue swelling or abscess around the vertebral body were also visualized (Fig. 1A, 2A).

Table 2
Summary of CT imaging appearances in 17 patients with TBAA

Patient no	Site	Shape	Outside diameter (mm)	Effusion/ gas bubble/ separation	Mural thrombus	Enlarged lymph nodes	Atherosclerosis	Surrounding tissue
1	Thoracic aorta	Saccular	39	+/-/-	-	+	-	Multiple tuberculosis nodules in bilateral lung
2	Thoracic aorta	Saccular	36	-/-/-	+	+	+	Destruction of thoracic vertebral body; postoperative thoracic vertebra internal fixation
3	Abdominal aorta	Saccular	110	-/-/-	+	+	+	Destruction of vertebral body from L3 to L5; psoas abscess
4	Abdominal aorta	Lobular	105	-/-/-	+	+	+	Destruction of lumbar vertebral body; psoas abscess
5	Abdominal aorta	Lobular	120	-/-/-	+	+	+	Destruction of vertebral body from L3 to L4
6	The junction of thoracic aorta and abdominal aorta	Lobular	73	-/-/-	-	+	+	Multiple tuberculosis nodules in bilateral lung; destruction of lumbar vertebral body; psoas abscess
7	Upper abdominal aorta	Lobular	83	+/-/+	+	+	-	Multiple tuberculosis nodules in bilateral lung; obvious destruction of lumbar vertebral body; psoas abscess
8	Thoracic descending aorta	Saccular and lobular	30	-/-/-	-	+	-	Multiple tuberculosis nodules in bilateral lung
9	Upper abdominal aorta	Large saccular, cyst wall separation	45	+/-/+	+	+	+	Multiple tuberculosis nodules in bilateral lung; erosion of the vertebral body and endplate at T9 and T10; perivascular abscess

Patient no	Site	Shape	Outside diameter (mm)	Effusion/ gas bubble/ separation	Mural thrombus	Enlarged lymph nodes	Atherosclerosis	Surrounding tissue
10	Abdominal aorta	Lobular	111	-/-/+	+	+	-	Psoas abscess; kidney and pleura involvement
11	Upper abdominal aorta	Saccular and lobular	100	-/-/-	+	-	+	Multiple tuberculosis nodules in bilateral lung; destruction of lumbosacral vertebral body
12	Thoracic aorta	Saccular	32	-/-/-	+	-	+	Multiple tuberculosis nodules in bilateral lung
13	Iliac artery	Saccular and lobular	94	-/-/+	+	+	+	Multiple tuberculosis nodules in bilateral lung; iliopsoas abscess
14	Ascending aorta	Saccular	59	-/-/-	+	+	+	Multiple tuberculosis nodules in bilateral lung
15	Thoracic descending aorta	Saccular and lobular	72	-/-/-	+	-	+	Multiple tuberculosis nodules in bilateral lung; aortobronchial fistula
16	Thoracic descending aorta	Saccular	33	-/-/-	+	-	-	Multiple tuberculosis nodules in bilateral lung
17	Descending aortic arch	Saccular	58	-/-/-	+	-	+	Multiple tuberculosis nodules in bilateral lung; destruction of vertebral body from T2 to T7

Discussion

This study shows our experience of reporting clinical and CT imaging features in patients with confirmed tubercular aortic aneurysm. Main CT findings include: TBAA is mostly single saccular and lobulated pseudoaneurysm and often occurs in the thoracic aorta and abdominal aorta. Extravascular tuberculosis usually can be found such as miliary pulmonary tuberculosis, lymph node tuberculosis, tuberculous spondylitis, iliopsoas abscess and psoas abscess.

Mycotic aortic aneurysm of tuberculous is a rare complication of TB but with very high mortality. The incidence may increase in the future because of the greater number of immunodeficient patients and the emergence of drug resistant tuberculosis [1]. When mycotic aneurysms are present in the context of TB and, particularly, disseminated TB, TBAA should be suspected [6]. Active tuberculosis of any type was diagnosed on presentation in all of our cases. Sputum tuberculosis test was positive in patients with pulmonary tuberculosis. The concentration of CRP and ESR were high in all patients of this group, although cultures of the blood were negative. A few patients

had an underlying condition that was known to increase the risk of TB such as HIV infection, rheumatic diseases, or oral immunosuppressants [11]. In addition, diabetes is a risk factor for tuberculosis [11]. In this group one patient had HIV infection and 5 cases had diabetes history. Most of the reported cases of TBAA are symptomatic, but the symptoms are nonspecific and depend on the size, position, and rapid growth of the aneurysm. Patients may describe thoracic, abdominal or dorsal pain. Some patients may be accompanied by fever. It has been reported that fever occurs in 35% of patients [6]. In this group the proportion of fever is relatively high, with 7 patients having fever (41.2%). They may also present as palpable or radiographically visible periarterial mass, especially if expanding or pulsatile. Haemorrhage or hypovolemic shock may occur if the aneurysm ruptures or perforates. If a fistula is formed between the aneurysm and the nearby organs such as the trachea (Fig. 4) or intestines, massive haemoptysis [12] or gastrointestinal bleeding [13] may be caused. The poor prognosis of these patients emphasizes the importance of early diagnosis.

It is reported that the vast majority of tuberculous aneurysms are pseudoaneurysms (87%), although true (9%) or dissecting (4%) aneurysms have been described [14]. All tuberculous aneurysms of our patients were pseudoaneurysms (Fig. 1–4). About 75% of TBAA present as a contiguous lesion on the surrounding tissue, such as tuberculous lymphadenitis, pericarditis, empyema, spondylitis, or paravertebral abscess [6]. Caseous necrosis invading the entire arterial wall results in perforation, some with massive hemorrhage or perivascular hematoma formation. Fibrosis gradually forms in the periphery of hematoma, and the hematoma is encapsulated and communicated with the lumen. Thus the pseudoaneurysm is formed [15]. Of 17 cases in this group, extravascular tuberculosis was found in all patients. Tuberculosis adjacent to aneurysm includes miliary pulmonary tuberculosis, tuberculous spondylitis, pleural tuberculosis, renal tuberculosis, iliopsoas abscess or psoas abscess. Some patients have multiple tuberculosis sites. Twelve of them had enlarged lymph nodes. Other mechanisms of tubercular aneurysm formation may include the following: mycobacterium tuberculosis reaching the vessel wall through vasa vasorum; spread of bacteria through lymphatic vessels around the artery; direct implantation of bacteria on the internal surface of the vessel wall after vasculature trauma. Normal arterial intima is very resistant to infection. In this study, thirteen patients (76.5%) had atherosclerosis, their average age was 62.5 years. The atherosclerosis can alter the arterial lining and lower the resistance to infection [16]. At present, the incidence of tuberculosis is increasing in the elderly population who have most of the atherosclerosis, it could be anticipated that seeding of the aorta would be a common finding.

The contrast-enhanced CT can provide valuable information about the morphology of aortic aneurysm, aortic wall enhancement, and the relationship between the aneurysm and adjacent tissue because of the higher quality spatial resolution. TBAA typically appears on CT as a focal, contrast-enhancing, saccular lumen, lobulated, with an indistinct, irregular aortic wall [10]. Tuberculous aneurysms may occur anywhere along the arterial system [17] and usually occur as a solitary lesion [18]. In this study tubercular aneurysms were mostly solitary and only one patient with multiple aneurysms. It is reported that the thoracic aorta is the most common location [19], because it is adjacent to the lungs and mediastinum where TB most commonly occurs. In this group tuberculous pseudoaneurysms were located in the thoracic aorta, abdominal aorta, junction of thoracic and abdominal aorta and iliac aorta in 8, 7, 1 and 1 cases, respectively. Thus, TB pseudoaneurysm often occurs in the thoracic and abdominal aorta [6]. Less frequently, femoral [20], iliac [21] and subclavian [14] arteries can also be affected. Most of the aneurysms were saccular (98%) [6]. The shapes of TBAA in this study were saccular, lobular, both saccular and lobular in 8, 5 and 4 cases respectively. One of aneurysms was large saccular which cystic wall was separated (Fig. 1). A lobulated aneurysm indicates more instability and higher risk of rupture. The diameter of aneurysm ranged from 39 to 120 mm. The size of the aneurysm is neither a risk factor of rupture, nor of the necessity for influencing treatment [22]. However, rapidly progressive growth of aneurysms (> 5 mm in 2 weeks) is suggestive of an infectious etiology [10]. CT is very sensitive to detect calcification and gas bubbles. Calcification is very uncommon in TBAA [6]. In this group of patients, only one patient had calcification in the arterial wall suggesting atherosclerosis (Fig. 1B). No patients showed gas bubbles which may appear in and around MAAs which could be indicative of high diagnostic reliability of bacterial infection [10]. Although gas bubble is an important sign of arterial infection, it is too rare to make the differential diagnosis. In this study, all cases of aneurysm ruptured at different locations of arterial wall, which was a process of forming pseudoaneurysms. In fact, three-tier structure of the aneurysm wall was incomplete, especially the sparse elastic fiber fracture of middle smooth muscle had broken. CT showed that the wall of some aneurysms was thin and there was no obvious soft tissue around it. Those lobulated, tension-free aneurysms are more likely to rupture, some of which look like a mess of mud and may have ruptured. CT can well display soft tissue and adjacent organ damage around tubercular aneurysm.

Eccentric periaortic surrounding soft tissue can show as rim or septum enhancement by the administration of contrast material (venous phase) on contrast-enhanced CT. Significant exudation around aneurysm was in 3 patients in this study. Exudation and edema around aneurysm suggested acute infection, and also suggests that the aneurysm was unstable and may have ruptured with extravasation. The exudation and edema around the aneurysm cannot be identified by CT examination, which needs to be identified in combination with clinical symptoms. Lymph nodes adjacent to TBAA might also appear swollen and enhanced. Twelve patients of this group showed enlarged lymph nodes connected to or around the aneurysm. These enlarged lymph nodes showed ring enhancement and

necrosis in the center (Fig. 1C). Tuberculosis can cause progressive enlargement of the surrounding lymph nodes, and the rupture of lymph nodes can spread to the adjacent aorta to form an aneurysm. Tuberculous aneurysm can also cause lymph node hyperplasia. It couldn't be identified that the causal relationship between aneurysm and enlarged lymph nodes especially in late stage of disease. Iliopsoas abscess (IPA) or psoas abscess are common complications in the abdominal TBAA presenting as a direct invasive infection with purulent materials occurring within the iliopsoas or psoas muscles. The typical features on CT are enlarged and swollen muscles with single or multiple relatively low-density area and contrast-enhanced rim of the abscess wall (Fig. 3B). In tuberculous spondylitis patients, TBAA can involve secondary spread from spine lesions. Sometimes it is difficult to identify the causal relationship between spinal infection and infectious aneurysms. Primary and secondary pyogenic spondylitis manifests erosion of the vertebral body and/or intervertebral disc on CT (Fig. 1A). Soft tissue swelling or abscess may be detected around the vertebral body (Fig. 1A). Pseudoaneurysm may develop adjacent to the eroded vertebral body, which greatly increases the risk of rupture during surgery. It was reported that an abdominal aortic aneurysm was iatrogenically ruptured during surgery for lumbar tuberculous spondylitis with psoas abscess [23]. In one case of this study, the patient's aortic aneurysm was found during thoracic spine tuberculosis surgery. It is very important to evaluate the presence of aneurysm before operation in patients with tuberculous spondylitis. Tuberculosis in other parts usually can be found in patients of TBAA by CT scan, such as pulmonary tuberculosis (Figs. 1,2,4), renal tuberculosis, tuberculosis of reproductive system, etc.

Treatment of TBAA include antituberculosis chemotherapy treatment, open surgery (in situ reconstruction or extra-anatomic bypass), and endovascular treatment (embolization, stent grafting) [24]. Mortality rate of tubercular aneurysm is 35% in this group, which is still high. Early diagnosis and timely treatment are critical in reducing the mortality of TBAA. CT plays an important role in the diagnosis of TBAA. Compared with other infectious aneurysms, tuberculous aneurysms show more cysts and lobulated shapes on CT scan, which are imaged as poured and unstressed. Another point of differential diagnosis is that the surrounding tissues and adjacent organs of tubercular aneurysms are usually infected with tuberculosis and most of them are accompanied by other sites of tuberculosis. Regular CT follow-up is also important for diagnosis.

There are some limitations in this study which should be acknowledged. This study analyzed the CT features of TBAA in order to assist its clinical diagnosis based on a single centre experience, however, the number of cases was relatively small. We will continue to collect cases of TBAA in our work and analyze their imaging characteristics in order to obtain more CT imaging characteristics of TBAA and help diagnosis. Further, we did not follow-up these patients who survived in terms of treatment outcomes. This will be addressed in further studies when more cases are included.

In conclusion. This study shows that TBAA typically appears on CT as a single saccular and lobulated pseudoaneurysm, usually occurring in the thoracic aorta or abdominal aorta. Surrounding tissues and adjacent organs of pseudoaneurysm are infected with tuberculosis and other sites of tuberculosis may be found.

Declarations

Contributions:

X.X.and Y.L. were part of the design of the manuscript. W.X. and Z.Z. performed the analysis. X.X.and Y.L. drafted the manuscript. Z.S.and L.C.substantively revised the work. All authors read and approved the submitted version.

Competing interests:

The authors declare that they have no competing interests

Ethics approval and consent to participate:

Informed consent was obtained in all cases, and protocols were approved by scientific ethical committee of the 3rd Affiliated Hospital of Shenzhen University.

Consent for publicationL:

Written informed consent to publish the clinical details and images of the patient was obtained.

Availability of data and materials:

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

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Figures

Figure 1

Tuberculous spondylitis involving the aorta. A 74-year-old man presented with repeated fever combined with back pain 8 months ago and abdominal pain for 1 month. A and B: Computed tomography (CT) of lung scan images in September 2018. Multiple miliary nodules were found in bilateral lungs, erosion of the vertebral body and endplate at T9 and T10, soft tissue swelling or abscess around the vertebral body was also visualized (A, arrow). The aorta outline at the level of T11 was normal, calcification of the wall of aorta was shown (B). C, D: abdominal pain, 8 months post operation of tuberculous spondylitis at T9 and T10 without standard antitubercular

drugs treatment. Coronal and transverse views of contrast-enhanced CT images in May 2019 demonstrated a large pseudoaneurysm at the level of T11 and enlarged lymph nodes with hypodense center which indicate necrosis (arrow).

Figure 2

Tuberculous MAA with abscess. A 74-year-old man who underwent surgical treatment of lumbosacral tuberculosis 1 year ago complained of cough and abdominal pain for 3 months. Lumbar and sacrum spinal CT scan showed destruction of vertebral body from L5 to S1 and internal fixation from L4 to S1 (A). Coronal view of lung CT demonstrated multiple miliary nodules in bilateral lungs. The outline of distal segment of thoracic aorta was enlarged obviously (B, arrow). Transverse view of abdominal CTA (artery phase and venous phase) showed the left wall was intact and mural thrombus formed in the lumen, lower density in the periaortic soft tissue with septum, which indicated necrosis and abscess (C, D).

Figure 3

Iliopsoas abscess associated with MAA. A 47-year-old man with history of HIV, syphilis and tuberculosis, presented with fever and left lower quadrant abdominal pain for 1 month. Multiplanar reconstruction CTA of left iliac artery showed giant lobular MAA (A). Left iliopsoas muscle is swelling and enlarged with a relatively low-density area, with contrast enhanced rim of the abscess wall (B arrow).

Figure 4

Aortobronchial fistula. An 84-year-old male with a history of diabetes mellitus and tuberculosis presented with fever, chest pain, and hemoptysis. A: Maximum-intensity projection image shows multiple small nodules with sharp edges and upper lobe distribution, saccular pseudoaneurysm of the thoracic aorta with surrounding soft tissue (arrow). B: Transverse view demonstrates patchy shadow in the right lower lobe consistent with alveolar hemorrhage. C: Minimum-intensity projection image shows the lumen of right basal segmental bronchus (adjacent to the aneurysm wall) obstruction filled with high density material.