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CASE REPORT

Diagnostic value of contrast-enhanced ultrasonography in mediastinal leiomyosarcoma mimicking aortic hematoma: A case report and review of literature

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Author contributions: Xie XJ drafted the manuscript, collected the data, and reviewed the literature; Jiang TA performed the histological examination and reviewed the manuscript; Zhao QY made intellectual contributions; All authors approved the final manuscript.

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Abstract

BACKGROUND

Primary mediastinal leiomyosarcomas are extremely rare. We report a case of leiomyosarcoma around the thoracic and abdominal aorta, mimicking an aortic hematoma, and discuss the diagnostic value of ultrasound.

CASE SUMMARY

A 63-year-old female was hospitalized for abdominal pain. Initial computed tomography angiography revealed an enhanced mass around the lower thoracic and upper abdominal aorta. Aortic hematoma was strongly suspected, and stents were placed by interventional surgery. About 1 mo postoperatively, the patient was re-hospitalized because of progressive abdominal pain. Ultrasound showed that the mass had a heterogeneous echo. In contrast-enhanced ultrasound, the hyperechoic regions were filled with contrast medium after the aortic region was, indicating that the blood supply was abundant but had no direct connection with the aorta. There was no obvious contrast medium-filling in the hypoechoic area. These findings were similar to those of malignant tumors with liquefaction and necrosis. Positron emission tomography/computed tomography confirmed that the mass had a high metabolic signal similar to that of a malignant tumor. Leiomyosarcoma was confirmed by postoperative pathology.

CONCLUSION

Symptoms of mediastinal leiomyosarcoma surrounding the aorta may mimic aortic hematoma. Contrast-enhanced ultrasound can provide valuable and unique diagnostic clues.

Key Words: Mediastinal; Leiomyosarcoma; Aortic hematoma; Contrast-enhanced ultrasonography; Case report

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Core Tip: This study not only reports a case of leiomyosarcoma around the thoracic and abdominal aorta, mimicking an aortic hematoma, but also proposes a new diagnostic strategy. Diagnosis of leiomyosarcomas of the aorta is always challenging because of its relatively low incidence as well as its similar clinical presentation and computed tomography angiography features to an aortic hematoma. Ultrasound and contrast-enhanced ultrasound can provide valuable and unique diagnostic clues. If the acoustic characteristics are abnormal, it is recommended that tumor detection be improved. We believe this strategy can minimize the risk of missed diagnosis and additional medical costs.

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INTRODUCTION

Mediastinal sarcomas are rare, accounting for only 1.4% of soft tissue sarcomas. Primary mediastinal leiomyosarcomas account for approximately 9%–11% of mediastinal sarcomas and 0.15% of mediastinal tumors[1-4]. Leiomyosarcomas reportedly originate from mesenchymal tissue[5] and usually develop from the esophagus, inferior vena cava, pulmonary artery, superior vena cava, mediastinal soft tissue, and other organs such as the heart. Leiomyosarcomas that only grow around the aorta are quite rare[1,6-10]. The clinical presentation of leiomyosarcomas is often determined by their specific anatomic location. Although masses around the aorta can easily be detected by computed tomography angiography (CTA), it is difficult to clearly distinguish whether the mass is a dissecting hematoma or a tumor, and if there are no other tumor symptoms, differential diagnostic tests for tumors are rarely used for initial differential diagnosis.

We herein report a case of a mediastinal leiomyosarcoma that only grew around the thoracic abdominal aorta, with recurrent abdominal pain as the only symptom.

CASE PRESENTATION

Chief complaints

A 63-year-old female visited our hospital for recurrent abdominal radicular pain that had lasted for approximately 2 mo. She had no other accompanying signs or symptoms.

History of present illness

On initial CTA, a thick circular mass with patchy high density enhanced signal was found around the lower thoracic aorta and upper abdominal aorta. The mass showed heterogeneous enhancement on the contrast-enhanced CT scan (Figure 1). Based on the patient's medical history and imaging test results, we initially thought that the patient had an aortic hematoma, and two stents (CUFF, 24 mm × 80 mm and 28 mm × 80 mm; Ankura™, LifeTech Scientific Co., Guangdong, China) were inserted into the aorta through endovascular interventional surgery. However, the patient's abdominal pain was not alleviated after discharge, leading to rehospitalization approximately 1 mo later.

History of past illness

The patient had a history of hypertension for more than 10 years and was maintained on oral irbesartan and felodipine. She had undergone radiofrequency ablation for atrial fibrillation approximately 2 years prior, and took warfarin postoperatively.

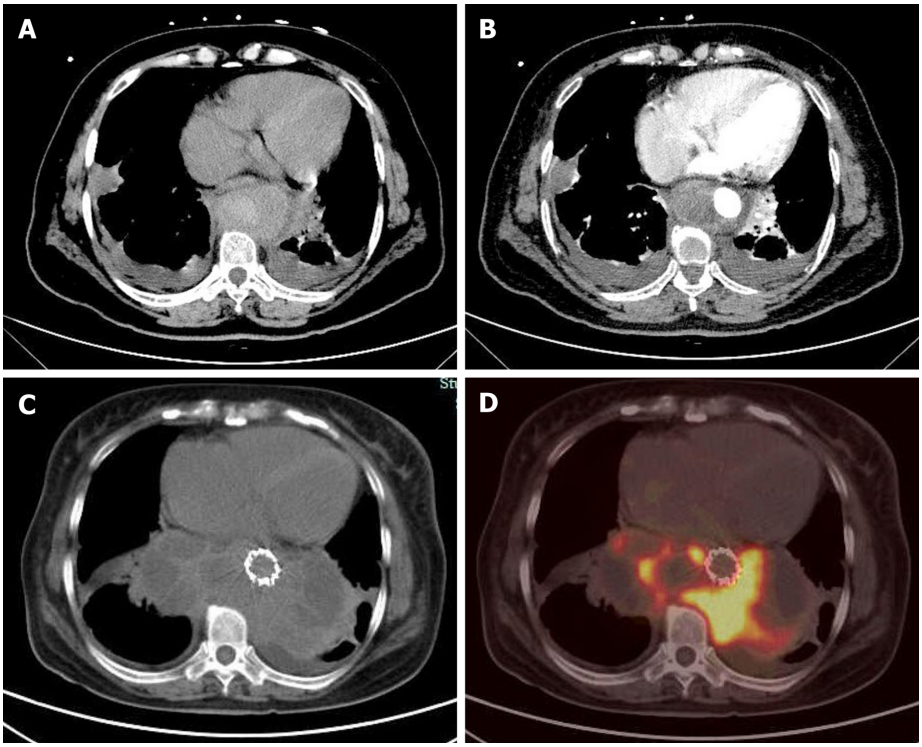

Figure 1 Computed tomography angiography and positron emission tomography/computed tomography transverse section images. A: Computed tomography (CT) scan; B: Contrast-enhanced CT scan at approximately the same anatomic level. A circular mass with a patchy high-density enhanced signal was found around the lower thoracic aorta. The mass showed heterogeneous enhancement on the contrast-enhanced CT scan; C: CT scan 1 mo later; D: Positron emission tomography scan at the same anatomic level 1 mo later. The mass had significantly increased, still surrounding the lower thoracic aorta. The high-density part of the mass had increased fluorodeoxyglucose (FDG) metabolism, whereas the low-density part had decreased FDG metabolism.

There were no other known chronic diseases.

Personal and family history

-

Physical examination

There were no positive findings on physical examination, except an irregular heart rate.

Laboratory examinations

Laboratory test results showed carbohydrate antigen 125 Level of 124.4 U/mL (normal range: 0-35 U/mL) and serum ferritin level of 806 ng/mL (normal range: 7-323 ng/mL). Serum levels of alpha-fetoprotein, carcinoembryonic antigen, carbohydrate antigen 19-9, and carbohydrate antigen 15-3 were all in normal range. D-dimer was 522 μg/L (fibrinogen equivalent units). The results of routine blood tests, liver and kidney function tests, and routine urinalysis were all in normal range.

Imaging examinations

Contrast-enhanced ultrasonography (US) was initially performed at the time of second hospitalization. On two-dimensional US, a heterogeneous echogenic mass was seen around the stent and was larger than it had been 1 mo prior, as measured by CTA. According to the principles of ultrasound, solids reflect ultrasound more strongly than liquids, thus presenting a higher signal. The principle of medical ultrasound imaging is also based on this theory. This implies that hyperechoic regions are mainly composed of solid tissue, whereas hypoechoic regions have more liquid components. On contrast-enhanced US (CEUS), the ultrasound contrast agent (SonoVue®; Bracco Imaging, Milan, Italy) was injected in a bolus through the peripheral vein. Delayed contrast filling was observed in the part with the lesions, and the contrast medium was dispersed rather than forming cords or clumps. No contrast medium was found in the hypoechoic area, which differs from typical endoleaks. The contrast-enhanced images closely resembled a malignant tumor (Figure 2). Positron emission tomography (PET)/CT showed a mass surrounding the descending aorta with a heterogeneous but

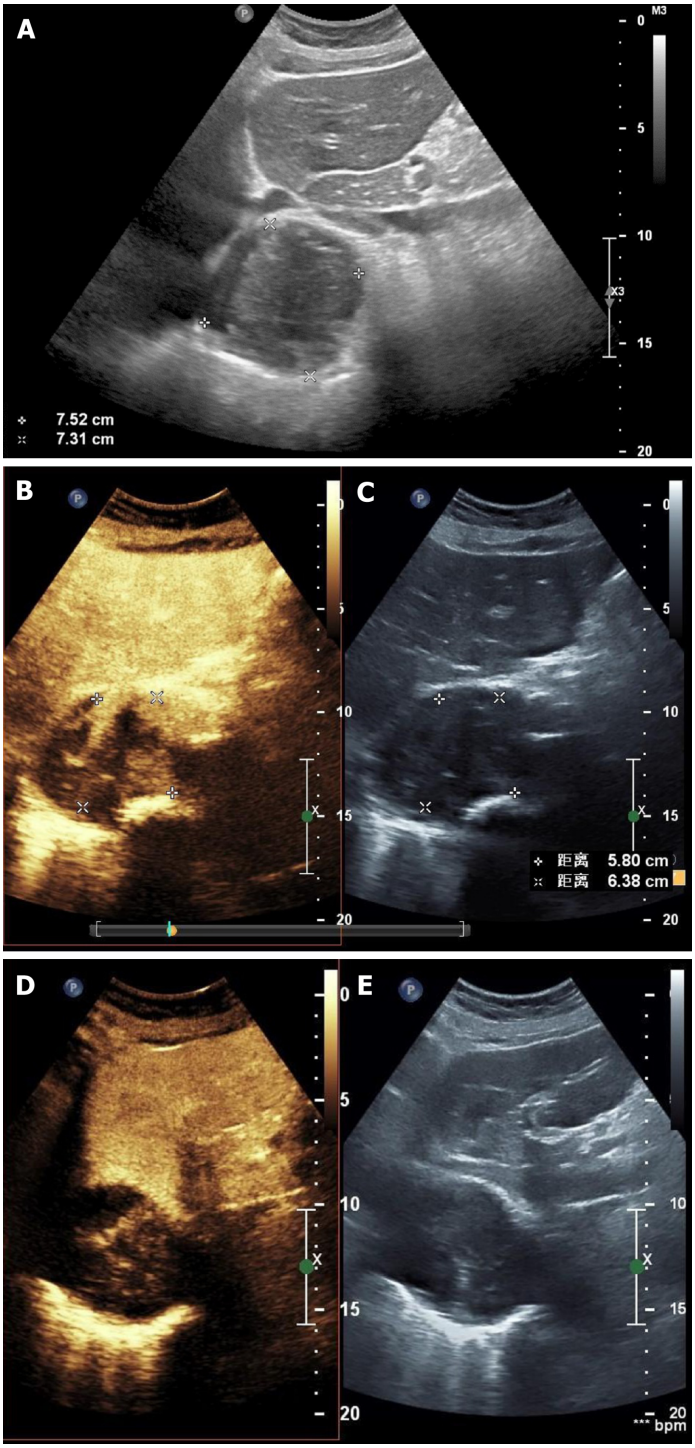

Figure 2 Ultrasound and contrast-enhanced ultrasonography images. A: Two-dimensional ultrasound image. The marked circular area is the mass; B: Synchronous contrast-enhanced ultrasonography (CEUS) pictures showing the harmonic mode; C: Synchronous CEUS pictures showing the basal mode; D: Synchronous CEUS pictures at different times and levels compared to B and C in the harmonic mode, in which the contrast signal was highlighted; E: Synchronous CEUS pictures at different times and levels compared to B and C in the basal mode, in which only the tissue signal was displayed similar to a normal ultrasound and the contrast agent signal was not highlighted. Solids have stronger properties reflecting ultrasound than liquid material, which present as a stronger signal and show more brightness in the basal mode picture. In the harmonic mode, the higher the content of contrast agent in the tissue, the stronger the signal and the higher the brightness in the image. As seen in panel A, the echo of the mass around the artery was uneven and was comprised of liquid anechoic and solid hyperechoic areas. By comparing panels B and C with panels D and E, it can be observed that the contrast medium predominantly diffusely filled the hyperechoic areas, rather than the hypoechoic areas. There was no enhancement signal of the contrast medium in the liquid anechoic area but a rich signal of contrast medium in the solid hyperechoic area was present, suggesting that the hyperechoic regions in this study were solid tissues rich in blood supply and capillaries. The lesion was similar to a malignant tumor with liquefaction and necrosis.

clear boundary. The high-density part of the mass had increased fluorodeoxyglucose (FDG) metabolism, whereas the low-density part had decreased FDG metabolism. Malignant tumors were initially considered. A nodule with high FDG metabolism was

observed in the left upper lobe, and was considered as metastatic foci. No abnormal increase in FDG metabolism was observed in the rest of the body, including the brain (Figure 1 and 3).

FINAL DIAGNOSIS

Primary mediastinal leiomyosarcoma.

Rapid freezing pathology showed pleomorphic soft tissue tumors rich in sinusoids.

Routine pathology showed that the size of the resected tumor tissue was about 12 cm × 7 cm × 4.5 cm, with hemorrhage and necrosis. Under microscopy (hematoxylin and eosin staining), atypical, short fusiform or epithelioid cells, and multinucleated, pleomorphic giant tumor cells were seen. Mitosis was also present, which indicated rapid cell growth. Immunohistochemistry revealed that the tumor was positive for smooth muscle actin, desmin, and caldesmon, which suggested that the tumor originated from the smooth muscle. The tumor was negative for cytokeratin, epithelial membrane antigen, synaptophysin, S-100, chromogranin A, and cluster of differentiation 56, which indicated that it was not epithelial, neurogenic, neuroendocrine, or neuroectodermal in origin. Overall, these findings suggested that the tumor was a highly malignant soft tissue sarcoma, specifically a pleomorphic leiomyosarcoma (Figure 4). We determined that the primary leiomyosarcoma was located in the mediastinum because it did not adhere to the aorta and the mediastinal volume was larger than the retroperitoneum volume.

TREATMENT

During surgery, an incision was made from the sixth intercostal space to the outer edge of the left rectus abdominis. The costal arch and diaphragm were severed after, into the thoracic cavity and retroperitoneum. The tumor grew in the mediastinum and retroperitoneum, surrounded the thoracic aorta, and invaded the left lung. The tumor and lung metastasis were all completely removed. No treatment was performed for the aorta, as it was not invaded by the tumor. No signs of aortic dilatation or endoleak were observed during the operation.

OUTCOME AND FOLLOW-UP

The patient did not receive chemotherapy or radiotherapy, and was discharged 10 d after the operation. There were no complications during the perioperative period. When discharged, the patient had no discomfort and could walk with assistance. The first postoperative follow-up was scheduled 1 mo later, and the follow-up treatment plan was supposed to be determined according to the test results. However, the patient did not return to the hospital for follow-up, and since hospital discharge, we have not been able to contact the patient.

DISCUSSION

Leiomyosarcoma has been reported in all mediastinal anatomic regions, including the anterior, middle and posterior mediastinum, but the most common location is the posterior mediastinum[1,10,11]. The histologic origin of primary mediastinal leiomyosarcomas is unclear. Some studies have suggested that sarcomas originate from the smooth muscle cells of small vessels in the soft mediastinal tissue, smooth muscle cells that shed from the esophageal wall during development, or heterotrophic smooth muscle cells displaced during embryonal development[12-14]. Research on retroperitoneal leiomyosarcomas has shown that leiomyosarcomas may originate from the smooth muscle remaining in the retroperitoneum, veins, or embryonic Wolffian remnants[15].

Retroperitoneal leiomyosarcomas can be divided into three categories according to the major growth patterns when diagnosed. Completely extravascular retroperitoneal leiomyosarcomas are the most common (62%), followed by extravascular and intravascular (33%) retroperitoneal leiomyosarcomas. Completely intravascular

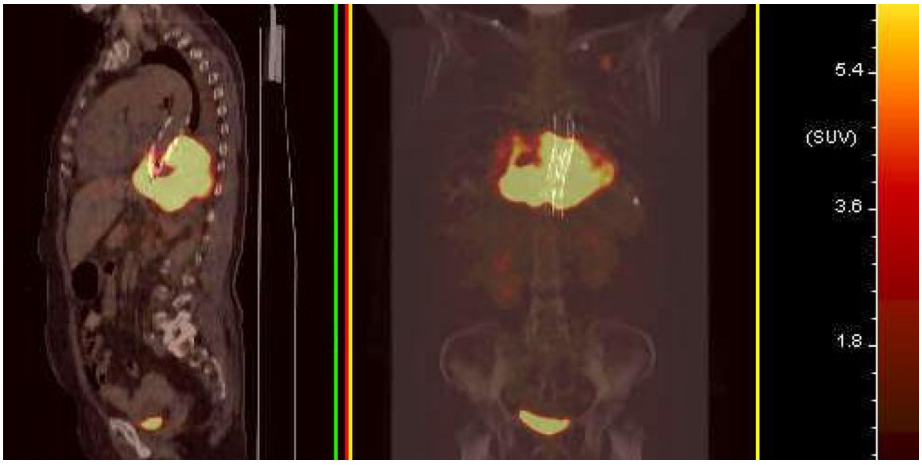

Figure 3 Median sagittal and coronal section images of positron emission tomography/computed tomography. Positron emission tomography/computed tomography showed that the mass with high fluorodeoxyglucose (FDG) metabolism surrounded the descending aorta. The maximum standardized uptake value (SUV) was 28.8. A nodule with a high FDG metabolism was observed in the left upper lobe, with a maximum SUV of 9.5. The high metabolic signal in the bladder should represent the excreted drugs. No abnormal increase in FDG metabolism was observed in the rest of the body.

retroperitoneal leiomyosarcomas are the least common (5%)[15,16]. The lungs and liver are common distant metastatic organs[1,5,17]. It has been reported that foreign bodies such as bullets, laparotomy sponges, and bone wax may be associated with sarcoma causes, but the exact mechanisms are unclear[18,19]. Initial primary mediastinal leiomyosarcoma symptoms lack specificity and depend on the tumor location[1,2,10,20,21]. Posterior mediastinal tumors often do not cause obvious clinical symptoms and discomfort in the early stage[9].

The diagnosis of such malignancies is often delayed[21-24], because of their extremely low incidence rate, vague symptoms, similarities between periarterial leiomyosarcoma imaging and aortic hematoma imaging, endoleak after endovascular aortic aneurysm repair (EVAR), or graft infection[22,25]. CT and magnetic resonance imaging (MRI) can demonstrate anatomical relationships between masses and surrounding tissues but are not sufficient for judging histiocyte types[26,27]. Leiomyosarcomas usually present on CT as lobulated noncalcified masses, with or without internal low-density areas that appear similar to necrosis or cystic nodules. The mass does not contain any fat density, distinguishing it from liposarcomas[8]. On MRI, leiomyosarcomas often show a homogeneous intermediate signal intensity on T1-weighted imaging and obvious enhancement. These characteristics help differentiate leiomyosarcomas from thrombi, because thrombi usually have a high signal intensity on both T1 and T2 sequences, and have no enhancement after gadolinium administration[2,28]. PET/CT can provide very reliable diagnostic information[14,22,29,30]. Moreover, ultrasound- or CT-guided aortic punctures can be used for tissue biopsies. However, for reasons such as avoiding unnecessary radiation risks, economy, and safety, PET/CT or biopsy is not performed on each aortic mass as a primary test. The diagnosis is not difficult but is very challenging using safe and economical methods [22].

Additionally, CEUS can be used for the differential diagnosis of malignant tumors and has lower radiation and contrast agent risks than other diagnostic methods[29,31]. On our CEUS, the echo of the mass around the artery was heterogeneous and was comprised of liquid anechoic and solid hyperechoic areas. There was no enhancement signal of the contrast medium in the liquid anechoic area, but a high signal of the contrast medium in the solid hyperechoic area was present, opposite to that for endoleaks. In this study, the contrast medium in the solid hyperechoic region was dispersed, and the rising tides and fades were slower than those for the aorta. It was thought that the hyperechoic regions in this study were solid tissues rich in blood supply and capillaries. Accordingly, the mass was more likely a malignant tumor with liquefaction and necrosis than endoleaks.

Endoleaks are the main EVAR complications and are defined as blood in arteries flowing inside the aneurysm sac and outside the stent, leading to expansion and rupture of the aneurysm. Under ultrasound, endoleaks are composed of liquid anechoic and solid hyperechoic regions. In typical endoleak case, the anechoic regions contained flowing arterial blood, which showed enhancement upon the administration of contrast agent. In contrast, the solid tissue was either coagulated or an organized

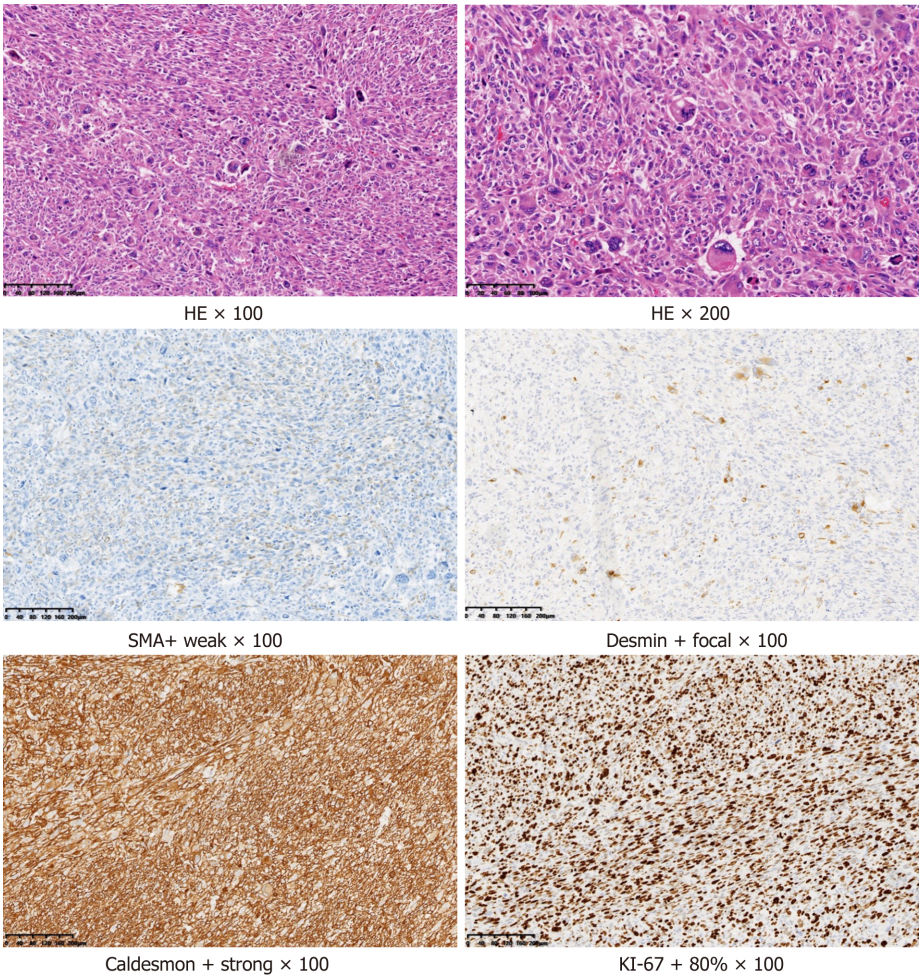

Figure 4 Postoperative pathological picture. The size of the resected tumor tissue was about 12 cm × 7 cm × 4.5 cm, with hemorrhage and necrosis. Under the microscope (hematoxylin and eosin staining), the tumor cells were short fusiform or epithelioid with obvious atypia. Multinucleated and pleomorphic giant cells were also present. Mitosis indicating active growth was present. Immunohistochemistry revealed that the tumor was positive for smooth muscle actin, desmin, and caldesmon, suggesting a smooth muscle origin, and was negative for cytokeratin, epithelial membrane antigen, synaptophysin, S-100, chromogranin A, and cluster of differentiation 56 (CD56), suggesting that the tumor was not epithelial, neurogenic, neuroendocrine, or neuroectodermal. Ki-67, an antigen index of cell proliferation, had a value of 60%. The higher the index, the higher the risk of malignancy. Cytokeratin, epithelial membrane antigen, synaptophysin, S-100, chromogranin A, and CD56 were all negative in this case (data not shown), suggesting that the tumor was not epithelial, neurogenic, neuroendocrine, or neuroectodermal. HE: Hematoxylin and eosin.

thrombus with less blood supply; thus, there was no obvious contrast agent signal in the enhancement phase (Figure 5). For Type 1, 3, and 4 endoleaks, contrast enhancement usually reaches the aneurysm and the stent simultaneously due to a direct connection to the aorta. In Type 2 endoleaks, there is usually a delay of more than 5 s from when the contrast enhancement usually reaches the aneurysm and the stent. Feeding vessels can often be found by expanding the scanning range. Blood flow and contrast are distributed in bundles or masses rather than diffusely in aneurysms[32].

However, it is difficult to clearly detect all mediastinal masses using ultrasound. The mediastinal area that can be detected by ultrasound is affected by the heart, lung, sternum, ribs, and spine. There may be a blind spot in the posterior mediastinum and thoracic segment of descending aorta. The European Federation of Societies for Ultrasound in Medicine and Biology guidelines and recommendations on the clinical practice of CEUS suggest CEUS as a prior choice for detecting and characterizing endoleaks after abdominal aortic aneurysm repair and endoleak follow-up (recommendation level of A; 1A)[33]. Sonographers should pay more attention to periarterial sarcomas and to whether acoustic characteristics tend to indicate tumors during follow-up, regardless of the initial diagnosis.

The prognosis of patients with leiomyosarcoma depends on complete surgical resection of the tumor[9]. The practical treatment plan is mainly based on sarcoma invasion sites. Currently, there are no widely recognized chemotherapy and targeted treatment options. In this study, initial CTA results were not typical, and the presence of aortic calcification, hypertension, and warfarin history made the diagnosis more

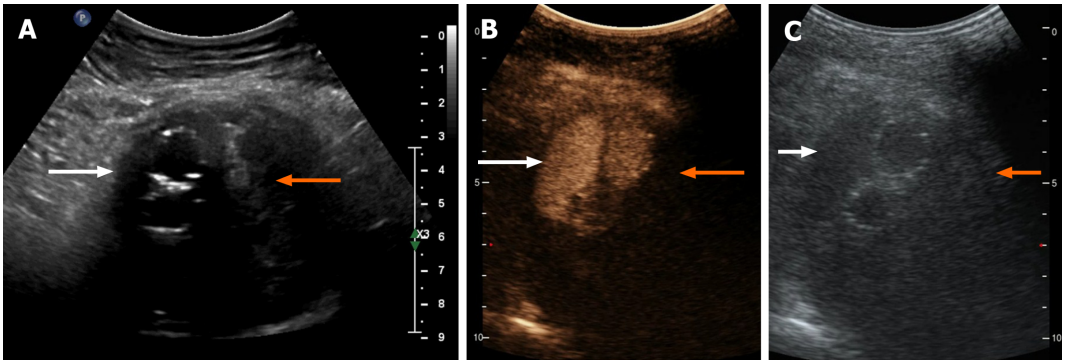

Figure 5 Typical Type 2 endoleak contrast-enhanced ultrasonography findings. A-C: The areas referred to by the white arrows are approximately the same anatomical location, as are the areas referred to by the orange arrows. A: Two-dimensional ultrasound image. The region pointed to by the white arrows are hypoechoic areas presumed to be flowing blood, and the areas pointed to by the orange arrows indicate patchy hyperechoic areas presumed to be clotted thrombi; B: Synchronous contrast-enhanced ultrasonography (CEUS) pictures indicating the harmonic mode, in which the contrast signal was highlighted. The areas pointed to by the white arrows indicate the fascicular contrast signal presumed to be flowing blood with rich contrast medium. The areas pointed to by the orange arrows have no contrast signal and are presumed to have very little blood supply; C: Synchronous CEUS pictures indicating the basal mode, in which only the tissue signal was displayed similar to a normal ultrasound and the contrast agent signal was not highlighted. The areas pointed to by the white arrow are hypoechoic areas, and the area indicated by the orange arrow has a patchy hyperechoic area. Comparing B and C, it could be seen that the contrast medium filled the hypoechoic area in bundles.

confusing. Aortic hematoma was considered to be the most likely diagnosis. However, the inability to directly visualize the lesion and obtain a biopsy led to a 1-mo delay in diagnosis. EVAR with stenting is currently the primary treatment standard for aortic hematoma[34]. So, the initial purpose of aortic stenting in this patient was not to treat the leiomyosarcoma. Considering the relatively higher aortic syndrome incidence and treatment urgency, stenting surgery has plausible benefits despite data that suggest difficulty in evaluating its protective effects on patients with leiomyosarcoma.

In conclusion, the incidence of mediastinal leiomyosarcomas is relatively low and clinical presentations are often associated with specific anatomic locations. When the tumor only grows around the aorta, it may have similar clinical symptoms and CTA features as an aortic hematoma, making the diagnosis challenging. Although aortic hematoma or dissection has a high incidence rate and needs immediate treatment, the possibility of the existence of malignant tumors around or in the aorta should be considered. Ultrasound and CEUS can provide valuable and unique diagnostic clues. If acoustic characteristics are abnormal, it is recommended that tumor detection be improved. We believe that this strategy can minimize the risk of missed diagnosis and medical costs.

CONCLUSION

In conclusion, the incidence of mediastinal leiomyosarcomas is relatively low, and clinical presentations are often associated with specific anatomic locations. When the tumor only grows around the aorta, it may have similar clinical symptoms and CTA features to an aortic hematoma, making the diagnosis challenging. Although aortic hematoma or dissection has a high incidence rate and more urgent treatment needs, the possibility of the existence of malignant tumors around or in the aorta should be considered. Ultrasound and CEUS can provide valuable and unique diagnostic clues. If acoustic characteristics are abnormal, it is recommended that tumor detection be improved. We believe that this strategy can minimize the risk of missed diagnosis and medical costs.

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