Successful resection of arteriovenous malformation from the anterior mediastinum: a case report of two presentations

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Background: Anterior mediastinal masses often pose a challenging diagnostic process. Most commonly, the differential diagnosis is between thymoma, thyroid, teratoma and lymphoma. Arteriovenous malformations (AVMs) found in the mediastinum are extremely rare with only a few cases within the mediastinum reported in the literature. The presentation of this condition could potentially cause life-threating complications, for this reason AVMs are an important differential diagnosis that should be considered when investigating anterior mediastinal masses.

Case Description: We report a series of two patients that from a tertiary centre in which computer tomography revealed an anterior mediastinal mass. Both radiology reports suggested thymic mass or teratoma as possible diagnosis. The patients underwent successful resection of the mass from the anterior mediastinum. On histopathological analysis following their operation revealed the lesions to have haphazardly arranged vessels of various types, including arteries, veins and capillaries, accompanied by fibroconnective tissue.

Conclusions: AVMs are infrequently seen in the mediastinum. Thymomas, lymphomas, thyroid lesions, and teratomas are frequently included in the differential diagnosis for these lesions. AVMs are not frequently taken into account when making a differential diagnosis, but in this report, we demonstrate that these lesions uncommonly may arise in the anterior mediastinum. Operations on such high-risk intrathoracic vascular abnormalities pose an elevated risk of bleeding.

Keywords: Arteriovenous malformations (AVMs); anterior mediastinum; histopathology; case report

Received: 31 January 2023; Accepted: 25 August 2023; Published online: 11 September 2023.

doi: 10.21037/vats-23-17

View this article at: https://dx.doi.org/10.21037/vats-23-17

Introduction

Arteriovenous malformations (AVMs) are defective connections between the artery and vein with an absent interceding capillary. AVMs are one of four types of vascular malformations classified by the International Society for the Study of Vascular anomalies, the other three are capillary malformations, lymphatic malformations and venous malformations (1). Among all vascular malformations, AVMs are relatively rare accounting for 1.5% of anomalies (2). AVMs may present as an isolated condition or as a part of a syndrome, most commonly hereditary haemorrhagic telangiectasia. The presentation may vary from asymptomatic to significant bleeding, pain, neuropathy or congestive heart failure (3). The anterior mediastinum is defined as the region below the thoracic plane, posterior to the sternum and anterior to the pericardium. It contains the thymus, fat and lymph nodes. Mediastinal masses are uncommon entities with 54% of them arising from the

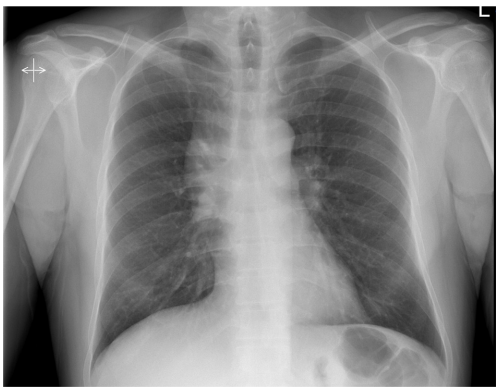

Figure 1 Chest X-ray of a 54-year-old man showing a mediastinal mass.

anterior mediastinum (4). Several studies have demonstrated that the most common anterior mediastinal masses in descending order are thymomas, lymphomas, thyroid and other endocrine tumours, teratoma, malignant germ cell and benign thymic lesions (4-6). Computed tomography (CT) is the recommended imaging modality (7). We present two cases in accordance with the CARE reporting checklist (available at https://vats.amegroups.com/article/view/10.21037/vats-23-17/rc).

Case presentation

Case 1

A 54-year-old man presented to the emergency department with chest pain, dizziness and night sweats. He described having a 2-week history of intermittent central left squeezing chest pain that arises at any time that is worse with exercise. In addition to his chest pain, he reported a 5-day history of dizziness which included collapsing with loss of consciousness. Furthermore, he has been suffering from night sweats for the last 4 to 5 days prior to the presentation, with excessive sweating. He has also lost 5 kg unintentionally over the last month. He is usually fit and well, with no other significant past medical history and does not take any regular medication. He reported that he is a non-smoker and drinks alcohol on social occasions only. His physical examination was unremarkable with heart sounds difficult to auscultate and an electrocardiogram with normal sinus rhythm. His serial troponin was negative. His kidney function was impaired with an estimated glomerular filtration rate of 49 mL/min. His Medical Research Council (MRC) dyspnoea score was 2. He had a chest X-ray that showed a mediastinal mass (*Figure 1*). This mass was further investigated with a chest CT scan with contrast which showed a lobulated heterogeneous attenuating mass within the anterior mediastinum intimately related to the anterior aspect of the superior vena cava (*Figure 2*). This mass was described as being in close proximity along the pericardial recess between the aortic root and superior vena cava as well as the right aspect of the pericardium. It measured 4.4 cm × 5.0 cm × 7.0 cm in axial dimensions. It was also shown to have hypoattenuating areas of fat densities and focal calcification. The CT scan was initially thought to be in keeping with a teratoma or thymoma. He was further investigated with a positron emission tomography CT (PET CT) that showed standardized uptake value of 2.1 and contained small specks of calcification (*Figure 3*). He had normal levels of lactate dehydrogenase, human chorionic gonadotropin, and alpha-fetoprotein. During examination, no testicular tumours were observed, and a testicular ultrasound revealed nothing abnormal. These results did not support the teratoma diagnosis.

A CT-guided biopsy was ordered as tumour markers were normal and there was no obvious testicular mass. The CT-guided biopsy showed two cores of haphazardly arranged adipose tissue, smooth muscle bundles and blood vessels of various calibres. There was no epithelial or haematolymphoid component and no significant inflammation. There was no necrosis, atypia or evidence of invasive malignancy. The initial thinking was that this lesion could represent mesenchymal part of a teratoma, but the possibility of AVM could not be ruled out.

Highlight box

Key findings
- Two anterior mediastinal mass resections that reveal an arteriovenous malformation on histopathology analysis.

What is known and what is new?
- Differential diagnosis of anterior mediastinal masses typically includes thymomas, lymphomas, thyroid lesions, and teratomas.
- Arteriovenous malformations infrequently arise in the anterior mediastinum. They are high risk intrathoracic vascular abnormalities pose that an elevated risk of intraoperative bleeding.

What is the implication, and what should change now?
- AVMs despite being a rare finding in the anterior mediastinum can have devastating results if mistreated. They should be considered in the differential diagnosis of an anterior mediastinal mass.

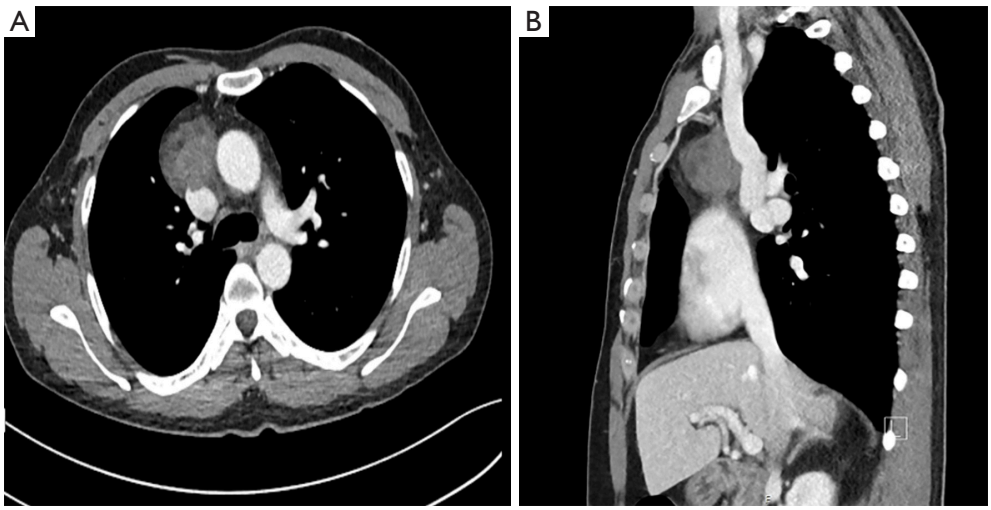

Figure 2 CT showing an attenuating mass within the anterior mediastinum intimately related to the anterior aspect of the superior vena cava. (A) Axial view; (B) sagittal view. CT, computed tomography.

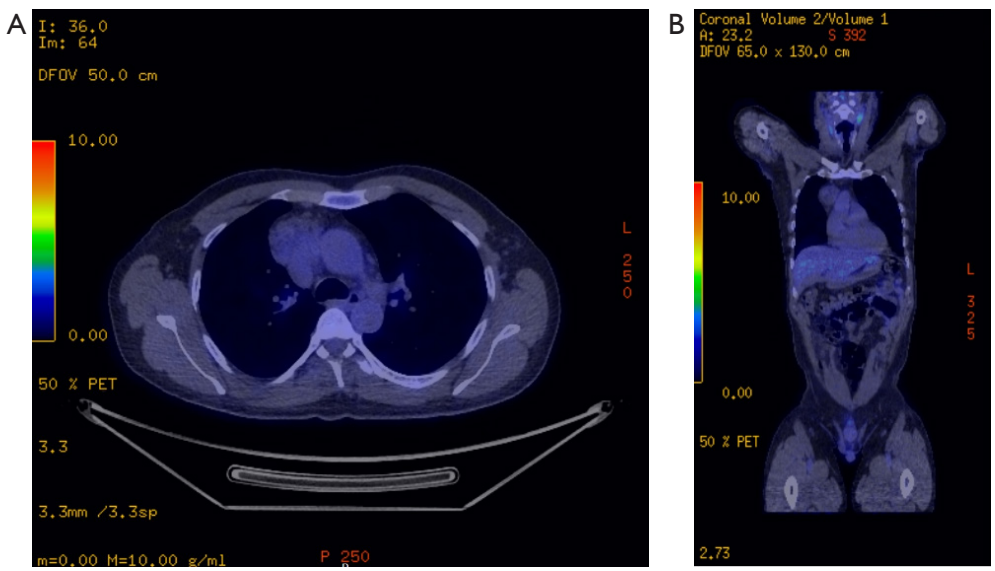

Figure 3 PET CT scan: (A) axial view, (B) coronal view. PET CT, positron emission tomography computed tomography.

After a multidisciplinary meeting discussion, the patient was referred to thoracic surgery and underwent a median sternotomy and resection of the anterior mediastinal mass with repair of superior vena cava (SVC) tear and right hemidiaphragmatic plication. The solid mass was found in the anterosuperior mediastinum overlying the SVC. The mass was attached to the confluence of the right and left brachiocephalic vein where it becomes the SVC. The right phrenic nerve was also involved in the tumour with no prospect of preserving it and was therefore divided. A small portion of the right upper lung was wedge resected out to free it from the mass. A portion of the pericardium overlying the right atrium was resected *en bloc* with the tumour. Upon mobilisation, it became clear that the mass was directly connected to the vasculature. A Satinsky clamp was placed across the base of the tumour as it was cut free from the SVC, necessarily taking a portion of the vasculature. A 2 cm defect in the SVC was closed with 4/0 running prolene with good effect. After resection of the mass, the right hemidiaphragm was plicated. The patient

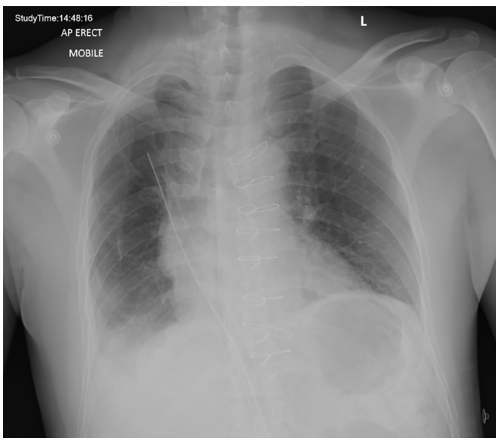

Figure 4 Chest X-ray of patient following mediastinal mass resection.

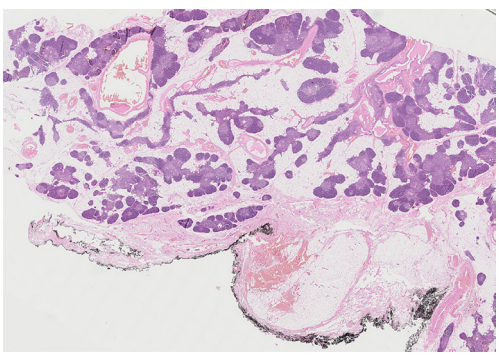

Figure 5 Admixture of malformed, various sized vessels haphazardly distributed in the fatty thymic tissue. Haematoxylin and eosin stain at ×40 magnification.

was transfused 4 units of blood intraoperatively with an estimated blood loss of 1,400 mL.

Two 24-French chest drains were inserted in the mediastinum and in the right pleura (*Figure 4*). Both drains were removed 2 days post-operation. After the chest drain removal the patient developed moderated right-sided pleural effusion which was resolved with an image-guided pigtail chest drain insertion which was removed 2 days later successfully. Post operatively he was commenced on a 3-month course of antiplatelet therapy to reduce the risk of thrombosis and treated for a chest infection with oral antibiotics. The patient was discharged on day ten after his admission.

The anterior mediastinal mass resected intraoperatively was sent for histopathological analysis along with tissue from SVC and pericardium. The mass was divided into 12 slices showing features of AVM with involved adipose tissue adjacent to the fatty thymic gland. The lesion showed haphazardly arranged vessels of various types, including arteries, veins and capillaries, accompanied by fibroconnective tissue. No evidence of malignancy was found, and the attached lung was not involved. The final diagnosis was AVM in the anterior mediastinum (*Figure 5*).

On his follow up appointment 13 months post operation, he developed symptoms consistent with narrowing of SVC. He underwent a balloon dilatation under our interventional radiology colleagues (*Figure 6*).

Case 2

A 38-year-old woman presented with a 6-month history of nausea and vomiting associated with night sweats and diarrhoea. She has a past medical history of irritable bowel syndrome, depression and anxiety. She is a smoker with an 8-pack-year history and drinks 9 units of alcohol a day and a known history of illicit substance abuse. She has stopped working 3 years ago for mental health reasons and is currently unemployed. Physical examination was unremarkable, but she was found to have generalised fatigue atypical for myasthenia gravis. Her lung function test showed good results with forced expiratory volume in 1 second (FEV1) 104.3%, an forced vital capacity (FVC) 100% and transfer factor for carbon monoxide (TLCO) 77% of predicted. A CT was performed which showed a 1.9 cm prominence of thymic tissue with a small soft tissue nodule in the superior aspect of the thymus (*Figure 7*). It was radiologically described to be either hyperplasia or a thymoma. This prominence was further investigated with a PET CT which suggested features more in keeping with a benign lesion, such as a thymic remnant or thymic reactivation rather than a malignant process with a standardized uptake value of 3 (*Figure 8*).

After a multidisciplinary meeting discussion, the patient was referred to thoracic surgery for resection of the mass. She underwent a robot-assisted thoracoscopic anterior mass resection where the thymic tissue and peri-thymic fat was removed *en bloc* from the internal mammary vessels to the phrenic nerve and from the superior horn of the thymus to the diaphragm. Extra pericardial margin was obtained. Her operation was uneventful. Post-operatively the patient suffered from generalised chest pain around the port sites and she was discharged on day 10 once analgesia was adequately optimised.

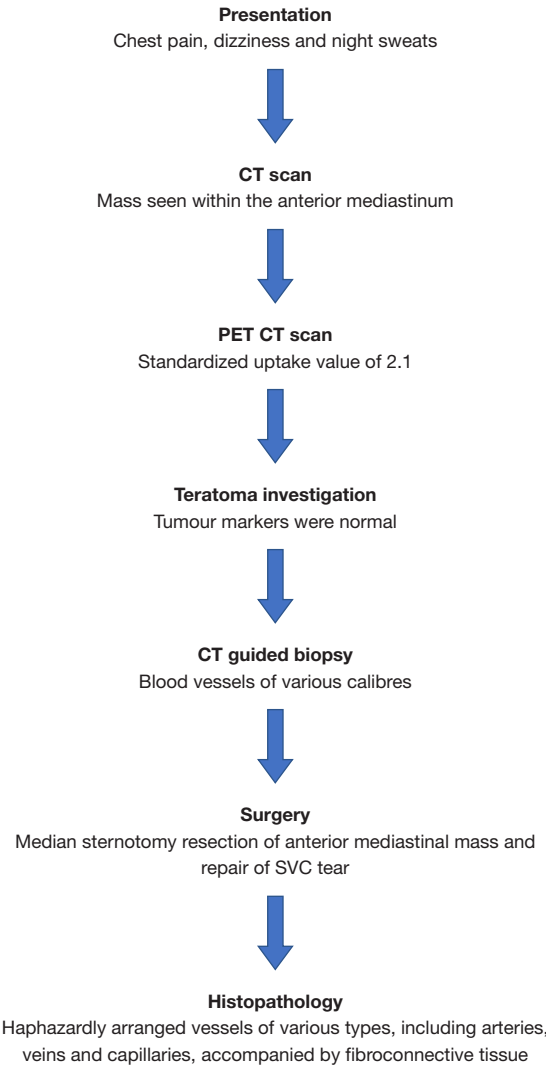

Figure 6 Timeline of events for Case 1. PET CT, positron emission tomography computed tomography; SVC, superior vena cava.

The histopathology report of the anterior mass showed sections of patchy fatty thymic gland bearing haphazardly arranged various-sized vessels with variable wall thickness concluding that the features were consistent with an AVM. There was no evidence of malignancy and the thymus showed focal cystic changes.

On her follow-up appointment 8 weeks post operation, she reported improved neuropathic pain and respiratory symptoms (*Figure 9*).

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee(s) and with the Helsinki

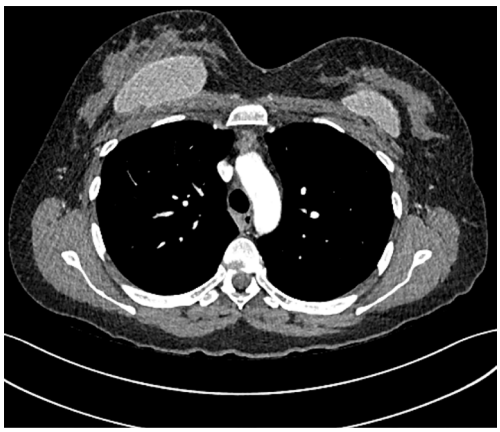

Figure 7 CT of a 38-year-old lady showing a 1.9 cm prominence of thymic tissue. CT, computed tomography.

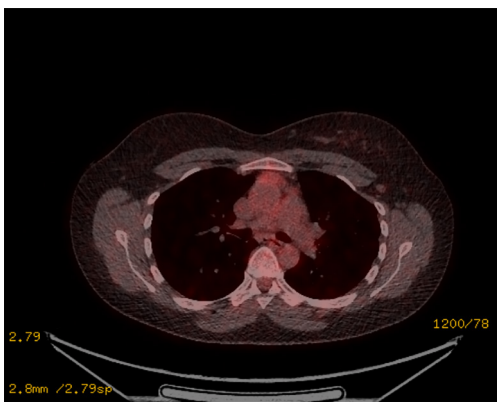

Figure 8 PET CT which suggested features of benign lesion. PET CT, positron emission tomography computed tomography.

Declaration (as revised in 2013). Written informed consent was obtained from the patients for publication of this case report and accompanying images. A copy of the written consent is available for review by the editorial office of this journal.

Discussion

Our case series describes two cases of very rare AVMs in the anterior mediastinum which were successfully treated surgically after extensive pre-operative investigations and multi-disciplinary team (MDT) discussions. First of which presented with atypical chest pain, the mass was found to be invading the superior vena cava. In the second case, the presentation was asymptomatic. In both cases, a CT

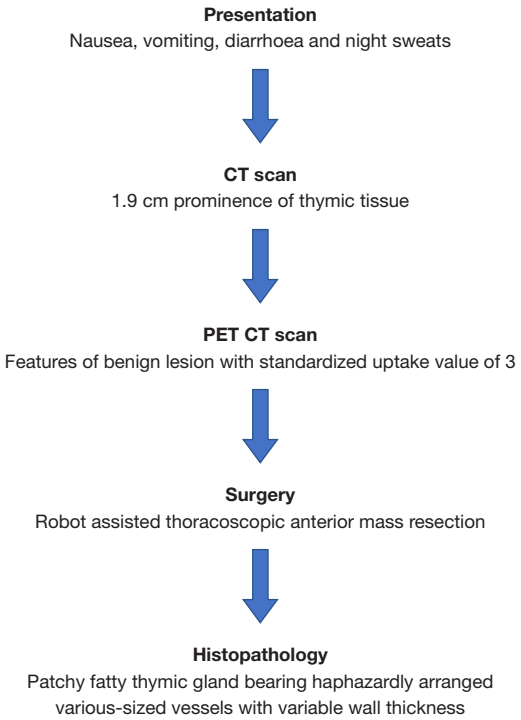

Figure 9 Timeline of events for Case 2. PET CT, positron emission tomography computed tomography.

chest was performed that ruled out pulmonary AVMs. Neither patient had a past medical history of hereditary haemorrhagic telangiectasia The major shortcoming of our report is the small sample size from a single centre as two cases cannot lead to a generalisation of management. The association with AVMs and the anterior mediastinal space does not imply a cause-effect relationship and further studies are required to consolidate the clinical presentation of mediastinal AVMs. However, we believe that this case report is of significance as it will add to the very limited literature regarding mediastinal AVMs.

AVMs are extremely rare and complex entities of unknown aetiology. An AVM in the mediastinum was first reported by Lunde *et al.* in 1984 (8). In more recent literature there has been one report of an anterior mediastinal AVM being resected (9). There have been AVMs described in the posterior mediastinum found in the right lower posterior mediastinum and in contact with the descending aorta with para-aortic supplying branches. In both reports the AVM was found incidentally with no symptoms (10,11). The presentation of this condition may vary from asymptomatic to high output heart failure depending on the location and size of the mass (12).

The exact pathophysiology of AVMs is still being investigated. Mutations in the RAS pathway have been discovered, including KRAS, MAP2K1, and BRAF (13-15). RAS activation causes morphological changes in the vessel, such as enlargement, an increase in sprouting behaviour, and an abnormal connection between arteries and veins (16). Although AVMs can be isolated, many of them are associated with a number of syndromes, most commonly hereditary haemorrhagic telangiectasia.

Traditionally, computer tomography with intravenous contrast has been the imaging modality of choice when approaching mediastinal masses (7). On non-contrast CT, diagnosis of AVMs may be difficult however following contrast administration the feeding arteries and draining veins are typically present. The intervening nidus can be demonstrated with a "bag of worms" appearance. In our cases, despite undergoing CT Thorax with contrast the differential diagnosis did not include AVMs. Both radiology reports suggested thymic mass or teratoma as possible diagnosis.

To obtain tissue, a variety of techniques have been described, including CT-guided transthoracic needle biopsy, video-assisted thoracoscopic surgery, mediastinoscopy, and open surgical biopsy (5). CT-guided biopsy of AVMs carry a risk of bleeding complications (17). In both of the reported cases, the potential neoplastic diagnosis was the emphasis rather than a vascular anomaly and therefore a CT-guided biopsy was performed in Case 1. However, we highlight the importance of careful collaboration with interventional radiologists to reduce potential bleeding risk in managing high risk intrathoracic vascular anomalies. In addition to surgical resection, management options of AVMs also include coil or Onyx embolization. This method may be used as a primary treatment option or as a preoperative procedure to minimise risk of haemorrhage (9).

Conclusions

AVMs are rarely found in the mediastinum, there are only few cases in the anterior mediastinum described in the literature. The differential diagnosis in these lesions is typically among thymomas, lymphomas, thyroid lesions and teratomas and this should be considered during the therapeutic management of these patients. AVMs are rarely considered in the differential diagnosis, however in this report we demonstrate that uncommonly this condition can arise in the anterior mediastinum.

Acknowledgments

Funding: None.

Footnote

Reporting Checklist: The authors have completed the CARE reporting checklist. Available at https://vats.amegroups.com/article/view/10.21037/vats-23-17/rc

Peer Review File: Available at https://vats.amegroups.com/article/view/10.21037/vats-23-17/prf

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at https://vats.amegroups.com/article/view/10.21037/vats-23-17/coif). A.B. has personal contract with Intuitive Surgical, Inc. She proctors surgeons in Europe when they start doing robotic surgery and supports them. The other authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee(s) and with the Helsinki Declaration (as revised in 2013). Written informed consent was obtained from the patients for publication of this case report and accompanying images. A copy of the written consent is available for review by the editorial office of this journal.

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doi: 10.21037/vats-23-17
Cite this article as: Hurley PD, Nizami M, Billè A, Okiror L, Nonaka D. Successful resection of arteriovenous malformation from the anterior mediastinum: a case report of two presentations. Video-assist Thorac Surg 2023;8:42.