A MULTIDISCIPLINARY APPROACH IN MANAGING THYROID ARTERIOVENOUS MALFORMATION WITH THYMOMA

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Abstract. Head and neck arteriovenous malformations (AVMs) are rare lesions. They are mostly congenital and tend to progress with age. Despite being rare, they can lead to significant morbidity and mortality. We highlight the case of a 23-year-old lady diagnosed preoperatively with thyroid AVM following unsuspecting symptoms through multidisciplinary team approach. A 23-year-old lady initially presented with hemoptysis, anterior neck swelling and obstructive symptoms. She was investigated for tuberculosis and autoimmune thyroid disorders, but all tests came back negative. Thymoma workup came back positive and she was planned for surgery under the cardiothoracic team. Clinically we noted bruits over goiter. CT Angiogram of neck showed arteriovenous malformation from left superior thyroid artery to inferior thyroid artery. Embolectomy was performed under interventional radiologist over left thyroid AVM then proceeded with total thyroidectomy. Thymectomy was performed by the cardiothoracic team recently, which was uneventful. Arteriovenous malformations (AVMs) are high-flow lesions which involve abnormal fistulous connections between arteries and veins without intervening capillary segments. They are more common in head and neck, with intracranial being most common. Schobinger clinical staging system is used to characterize AV malformations. This patient is classified as Stage 2. Despite successful angioembolization, intraoperatively we found a highly vascularized area surrounding bilateral thyroid glands, estimated blood loss amounted to 2L, requiring blood transfusion intraoperatively. This case emphasizes the importance of multidisciplinary team involvement between endocrinologist, interventional radiologist, vascular surgeon, head and neck surgeon, endocrine surgeon & pathologist in determining the diagnosis and preparing the patient for operation.
Keywords: *thyroid arteriovenous, malformation, embolization, thymoma*

Introduction

Arteriovenous malformations (AVMs) are high-flow vascular anomalies characterized by direct, abnormal communications between arterial and venous systems without an intervening capillary bed. This aberrant vascular architecture produces rapid arteriovenous shunting, altered tissue perfusion, progressive venous dilatation, and, in advanced cases, clinically significant haemodynamic consequences. Although AVMs may occur in any anatomical region, head and neck involvement is particularly important because lesions in this region can compromise airway safety, swallowing, speech, cosmesis, and operative access (Schimmel et al., 2021; Lee and Chung, 2018). The thyroid gland is an exceptionally uncommon site for AVM development. Unlike the more frequently encountered thyroid pathologies such as multinodular goitre, Graves' disease, thyroiditis, and thyroid malignancy, thyroid AVM remains poorly represented in the literature, with only a small number of published cases reported to date (Ajadi et al., 2020; Černá et al., 2015; Lee et al., 2007). This rarity makes thyroid AVM

diagnostically challenging and clinically significant, especially when it presents with non-specific symptoms or is masked by coexisting thyroid enlargement. Importantly, the vascularity of a thyroid lesion is often interpreted within the framework of inflammatory, autoimmune, or neoplastic disease; however, in rare circumstances, marked vascularity may reflect an underlying high-flow malformation with potentially severe surgical implications. Failure to recognize this diagnosis before surgery may result in unexpected haemorrhage, prolonged operative time, increased transfusion requirement, recurrent laryngeal nerve risk, and difficult intraoperative vascular control. Therefore, thyroid AVM should be considered in the differential diagnosis of a markedly hypervascular thyroid swelling, particularly when clinical examination reveals bruit, thrill, compressive symptoms, or radiological evidence of abnormal arterial feeders and venous drainage. Early suspicion is crucial because the diagnosis fundamentally changes the preoperative strategy, requiring detailed vascular mapping, interventional radiology planning, and multidisciplinary coordination before definitive surgical treatment.

The present case is clinically compelling because it demonstrates how thyroid AVM may emerge within a complex diagnostic pathway rather than as an obvious primary diagnosis. The patient was a young woman who initially presented with haemoptysis, anterior neck swelling, and evolving obstructive symptoms. Her early clinical workup focused appropriately on more common and clinically urgent possibilities, including tuberculosis, autoimmune thyroid disease, mediastinal pathology, and thymic neoplasm. The presence of a large anterior mediastinal mass, later diagnosed as thymoma, further complicated the diagnostic picture by shifting clinical attention toward thoracic pathology and cardiothoracic surgical planning. However, the subsequent recognition of a bruit over the goitre became a pivotal clinical finding, prompting vascular imaging and changing the management trajectory. Computed tomography angiography confirmed a left thyroid arteriovenous malformation with arterial supply from the superior thyroid artery and venous drainage through the inferior thyroid venous system. This finding illustrates the continuing importance of careful physical examination even in an era of advanced imaging. In thyroid disease, a bruit may be associated with Graves' disease; however, when thyroid function is normal and imaging demonstrates abnormal vascular channels, an AVM must be strongly considered. The diagnostic challenge is further heightened by the fact that thyroid AVM may mimic benign nodular thyroid disease, malignancy, or inflammatory hypervascularity on ultrasound, making cross-sectional angiographic evaluation essential for defining the vascular anatomy (Ajadi et al., 2020; Černá et al., 2015). In this patient, the coexistence of multinodular goitre, vocal cord palsy, compressive symptoms, and thymoma created an unusual clinical constellation that required integrated decision-making across endocrine surgery, interventional radiology, vascular surgery, otolaryngology, cardiothoracic surgery, endocrinology, anaesthesia, and pathology. Thus, this case is not merely a report of a rare thyroid vascular anomaly; it highlights the diagnostic value of correlating clinical signs, imaging findings, and multidisciplinary assessment in preventing catastrophic intraoperative complications.

The management of thyroid AVM is technically demanding because even apparently successful embolisation may not eliminate the risk of substantial intraoperative bleeding. Published case reports have emphasized that unrecognized thyroid AVMs may lead to significant operative haemorrhage, while preoperative embolisation may reduce but not fully abolish vascular risk (Ajadi et al., 2020; Borchert et al., 2015). In

the present case, near-total embolisation was performed before total thyroidectomy, yet the operation remained highly challenging, lasting approximately ten hours and involving extensive vascularity around both thyroid lobes, intraoperative vascular consultation, Doppler assessment, vessel ligation, clipping, and an estimated blood loss of approximately two litres. This underscores an important clinical lesson: thyroid AVM should be treated as a high-risk surgical pathology even after endovascular intervention. The presence of a concurrent thymoma further strengthens the significance of this case. Thymoma is itself a rare anterior mediastinal tumour, with population-based data demonstrating its low incidence and its tendency to present incidentally or with compressive, autoimmune, or paraneoplastic features (Yamada et al., 2024; Engels, 2010). Standard management depends on histological classification, staging, completeness of resection, and multidisciplinary oncological planning, with surgery remaining central for resectable disease and adjuvant radiotherapy considered in selected cases such as incomplete or close-margin resection (Conforti et al., 2021; Masaoka et al., 1981). The coexistence of thyroid AVM and thymoma in a young patient is therefore clinically unusual and academically valuable because it brings together two rare pathologies requiring staged, coordinated, and specialty-specific intervention. This report contributes to the limited literature by demonstrating the importance of preoperative vascular recognition, embolisation planning, surgical preparedness, airway and nerve assessment, and postoperative multidisciplinary follow-up. More broadly, it reinforces those rare vascular diagnoses should remain within the clinician's diagnostic horizon when thyroid enlargement presents with atypical symptoms, audible bruit, abnormal vascular imaging, or disproportionate operative risk.

Materials and Methods

A 23-year-old previously healthy woman presented with persistent haemoptysis for one month, associated with progressive anterior neck swelling and occasional shortness of breath. She reported significant weight gain of approximately 25 kg over one year but denied fever, night sweats, close contact with tuberculosis patients, classical thyroid-related symptoms, or family history of malignancy. On initial examination, there was a diffuse anterior neck swelling measuring approximately 5 × 6 cm. The swelling was soft, non-tender, not warm, and without palpable thrill or audible bruit at that stage (*Figure 1*). Chest radiography demonstrated a widened mediastinum, prompting further imaging. Contrast-enhanced computed tomography of the thorax revealed a large heterogeneous enhancing left anterior mediastinal mass measuring 10.9 × 6.5 × 15.7 cm, together with multinodular goitre causing rightward tracheal deviation. Ultrasonography of the neck showed a hypervascular enlarged thyroid gland with a left TIRADS 1 thyroid cyst. Biopsy of the anterior mediastinal mass confirmed thymoma, while autoimmune and tuberculosis-related investigations were negative, and echocardiography showed no evidence of cardiac compromise.

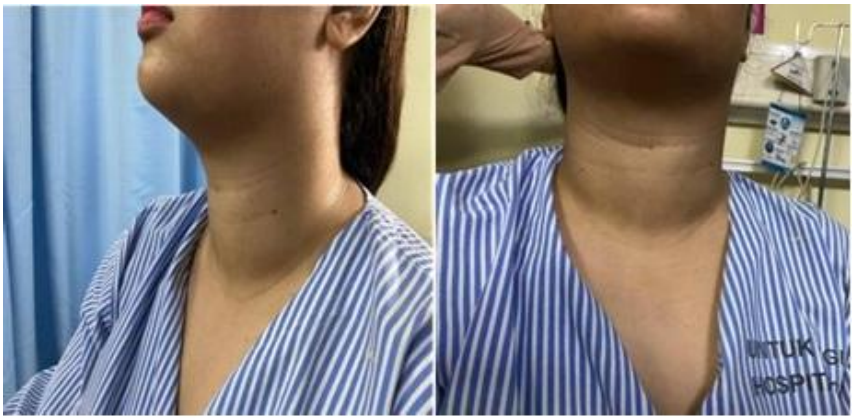

Figure 1. *Clinically palpable goitre with bruit.*

Five months later, the patient was referred to the endocrine surgery team for further assessment of multinodular goitre with associated left vocal cord palsy. By this stage, she had developed hoarseness of voice and dysphagia, although her thyroid function test remained within normal range. Repeat clinical examination revealed the presence of a bruit over the goitre, raising suspicion of an underlying vascular lesion rather than uncomplicated multinodular thyroid disease. A repeat contrast-enhanced computed tomography scan of the neck and thorax showed interval enlargement of the thymoma, now measuring 12.1 × 7.4 × 16.4 cm. The left thyroid lobe measured 3.7 × 3.5 × 10.3 cm and contained multiple isodense nodules extending inferiorly to the level of T2. Computed tomography angiography subsequently demonstrated a left thyroid arteriovenous malformation with an extrathyroidal nidus along the left carotid sheath, a major arterial feeder arising from the left superior thyroid artery, and dominant venous drainage into the right inferior thyroid vein (*Figure 2*). The scan also demonstrated a massive thymic mass with prominent capsular and intratumoural veins draining toward the right inferior thyroid vein. These findings established the diagnosis of thyroid arteriovenous malformation coexisting with thymoma and provided the anatomical basis for multidisciplinary preoperative planning.

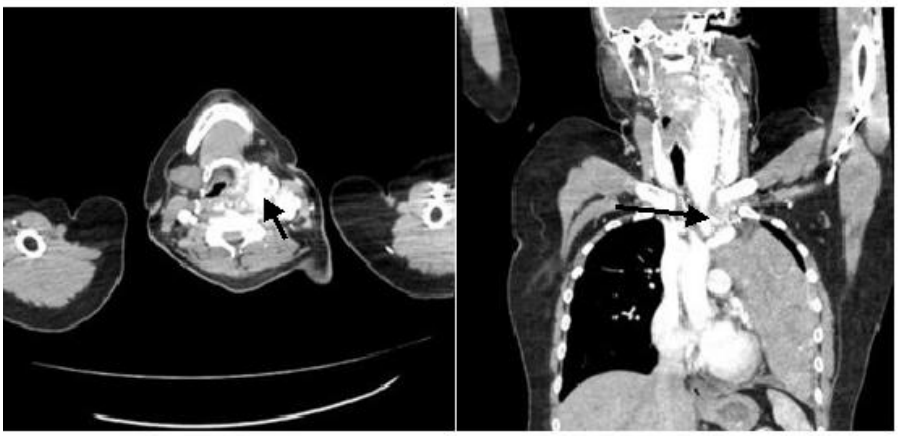

Figure 2. *CTA showed left thyroid artetiovenous malfunction with extrathyroidal nidus along the left carotid extending to the superior mediastinum. Massive thymic mass is visualized.*

Results and Discussion

The diagnostic outcome of this case demonstrates the clinical complexity of identifying thyroid arteriovenous malformation (AVM) in a young patient whose initial presentation was dominated by haemoptysis, anterior neck swelling, compressive symptoms, and a large anterior mediastinal mass. At first presentation, the clinical picture was not immediately suggestive of a thyroid AVM because the patient had no classical hyperthyroid symptoms, no family history of malignancy, and no initial palpable thrill or audible bruit. Initial imaging instead revealed a large heterogeneous anterior mediastinal mass and multinodular goitre with rightward tracheal deviation, leading to an appropriate workup for tuberculosis, autoimmune disease, thyroid pathology, and thymic neoplasm. The eventual diagnosis of thymoma further complicated the clinical pathway by introducing a second major pathology requiring cardiothoracic planning. However, the later development of hoarseness, dysphagia, and the presence of a bruit over the goitre became decisive clinical indicators that the thyroid lesion was not a conventional multinodular goitre alone. Computed tomography angiography confirmed a left thyroid AVM with an extrathyroidal nidus along the left carotid sheath, major arterial supply from the left superior thyroid artery, and venous drainage into the right inferior thyroid vein. This finding was clinically important because AVMs are high-flow vascular malformations composed of direct artery-to-vein communications without an intervening capillary bed, which can cause progressive venous dilatation, tissue distortion, haemodynamic strain, and severe operative bleeding if unrecognized (Lee and Chung, 2018). Although head and neck AVMs are recognized vascular anomalies, thyroid involvement remains extremely rare, with only a limited number of cases described in the literature (Ajadi et al., 2020; Borchert et al., 2015; Černá et al., 2015; Lee et al., 2007). This case therefore reinforces the importance of maintaining diagnostic suspicion when thyroid enlargement is associated with atypical vascular signs, compressive symptoms, or radiological hypervascularity.

Following radiological confirmation, the patient underwent near-total endovascular embolisation of the left thyroid AVM and thymic arterial supply by the interventional radiology team prior to definitive thyroid surgery. *Figure 3* demonstrates the pre-embolisation angiographic findings, showing the abnormal vascular supply to the left thyroid AVM. This angiographic assessment was essential because it confirmed the high-flow nature of the lesion and allowed the interventional radiology team to identify the dominant feeding vessels and abnormal venous drainage pattern before surgery. *Figure 4* shows the post-embolisation angiographic result, demonstrating near-total embolisation of the left thyroid AVM with reduction of vascular flow. The embolisation result was a critical component of preoperative risk reduction because thyroid AVM surgery carries substantial bleeding risk due to high-flow shunting, abnormal arterial feeders, enlarged draining veins, and possible collateral vascular channels. The use of embolisation was consistent with prior reports showing that preoperative vascular control can improve surgical preparedness in high-flow thyroid AVMs, although complete elimination of haemorrhagic risk is not guaranteed (Ajadi et al., 2020; Borchert et al., 2015). This is particularly important because thyroid AVMs may not be confined to the thyroid parenchyma; they may involve extrathyroidal vascular networks, carotid sheath structures, mediastinal venous drainage, or surrounding soft tissues. In this patient, the AVM was anatomically complex because the nidus was extrathyroidal and the venous drainage communicated with the inferior thyroid venous system, while the thymic mass also demonstrated prominent capsular and intratumoural veins.

Therefore, the findings shown in *Figure 3* and *Figure 4* directly influenced surgical planning, anaesthetic preparedness, transfusion readiness, and the decision to proceed with multidisciplinary operative support.

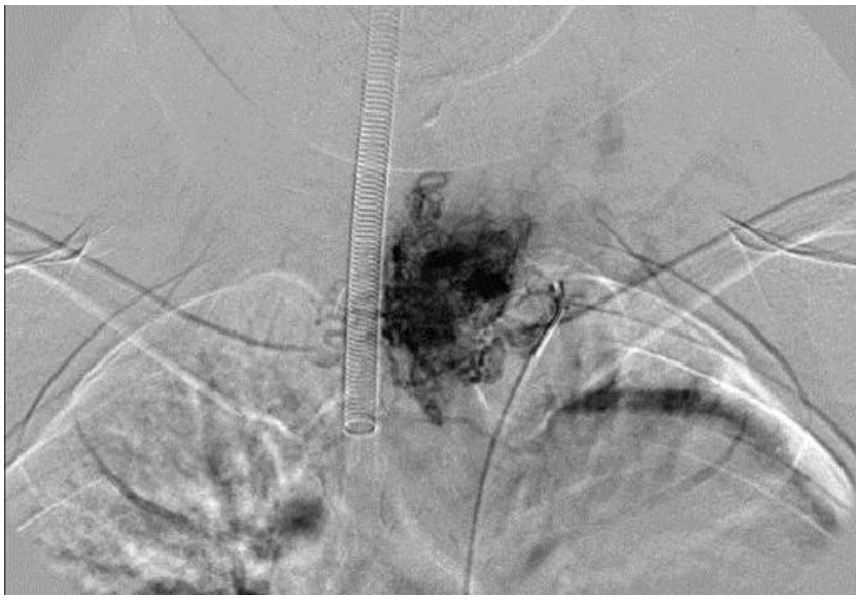

Figure 3. *Large network of dilated & tortuous vessels at left anterior cervical region forming the nidus of left thyroid AVM. Feeding arteries from bilateral superior thyroid arteries, left inferior thyroid artery & right internal thoracic artery.*

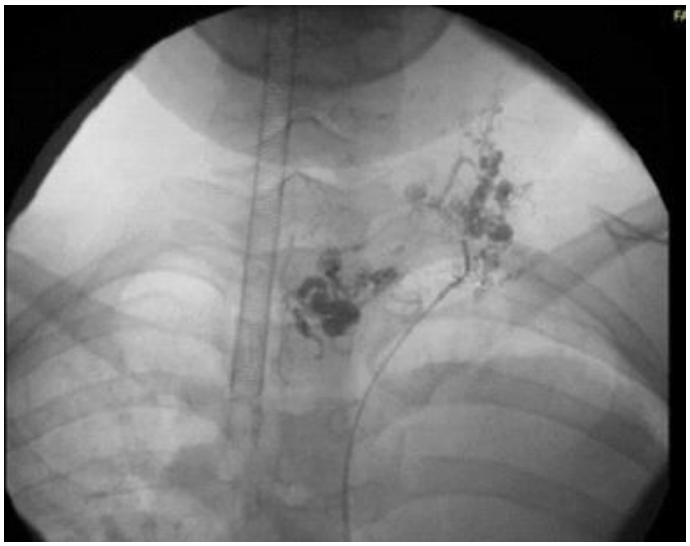

Figure 4. *Successful near total occlusion of nidus using 13ml of histoacryl 20%. Bilateral drainingveins are patent.*

Despite technically successful preoperative embolisation, the intraoperative result demonstrated that thyroid AVM remains a high-risk surgical condition. The patient underwent total thyroidectomy three days after embolisation under intraoperative nerve monitoring by an experienced high-volume endocrine surgeon. Intraoperatively, the thyroid gland appeared grossly normal, but extensive abnormal vascularity was found surrounding both thyroid lobes. This finding is clinically important because it shows that surface appearance alone may underestimate the vascular risk of thyroid AVM.

Intraoperative vascular surgical consultation was required, and Doppler assessment demonstrated audible vascular signals from the right thyroid gland and left thyroid bed, confirming persistent vascular flow despite prior embolisation. Dilated vessels around the thyroid gland were carefully ligated and clipped, and both recurrent laryngeal nerves were identified and preserved. Nevertheless, the procedure lasted approximately ten hours, with an estimated blood loss of approximately two litres and a requirement for two pints of packed cell transfusion. *Figure 5* shows the thyroidectomy specimen following total thyroidectomy and provides visual evidence of the definitive surgical management of the thyroid pathology. This operative course closely parallels the warnings in previous literature, where unrecognized or incompletely controlled thyroid AVMs have resulted in unexpected and significant intraoperative blood loss (Ajadi et al., 2020). The experience also supports the broader surgical principle that embolisation should be viewed as an adjunct rather than a substitute for meticulous operative planning. Residual vascularity may persist through collateral circulation, incomplete occlusion, recanalization, or vascular recruitment from adjacent arterial territories. Therefore, surgeons managing such cases must prepare for prolonged dissection, distorted tissue planes, difficult haemostasis, transfusion requirements, and possible involvement of vascular or head and neck specialists.

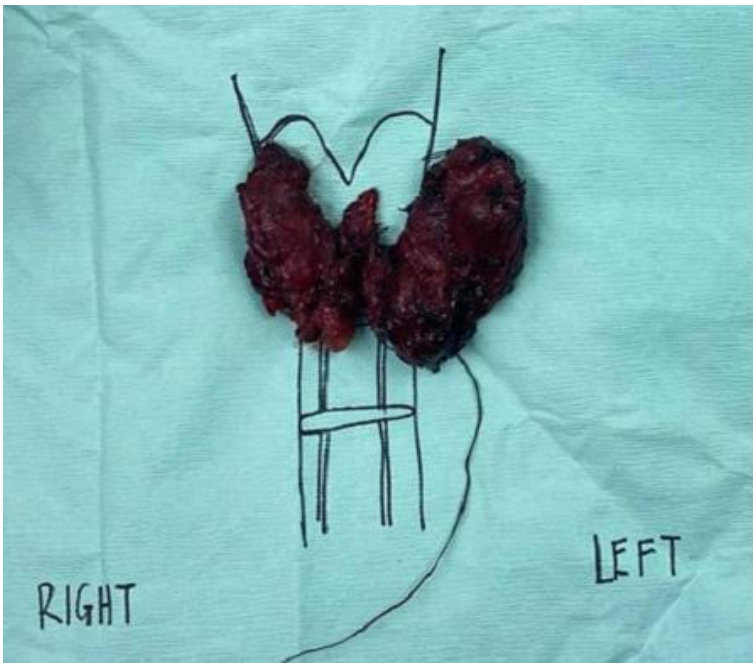

Figure 5. *Intraoperatively left thyroid lobe meaures 6x5cm, right lobe measures 4x5cm. Both lobes were highly vascularised. Histology shows right adenomatoid hyperplasia & left thyroid AVM.*

Postoperatively, the patient remained haemodynamically stable and recovered from the obstructive symptoms that had contributed to her presentation. She continued to experience baseline hoarseness of voice, which was consistent with her preoperative left vocal cord palsy, and postoperative laryngoscopy showed oedematous true and false vocal cords following intubation. She was subsequently managed with voice therapy under a speech therapist and demonstrated gradual progress. Histopathological examination of the thyroid specimen confirmed arteriovenous malformation involving the left thyroid lobe and adenomatoid hyperplasia of the right thyroid lobe. This

histological result was essential because it provided definitive confirmation that the vascular lesion was a true AVM rather than vascular congestion, Graves' disease-related hypervascularity, thyroiditis, or neoplastic vascular invasion. After recovery from thyroid surgery, the patient underwent midline sternotomy and thymectomy six months later under the cardiothoracic team. *Figure 6* demonstrates the thymectomy phase of management, representing the staged surgical treatment of the anterior mediastinal thymoma after the thyroid AVM had been addressed. The thymectomy was uneventful, and histopathological examination confirmed thymoma, type B3, Masaoka stage IIa, with a margin of less than 1 mm from the superficial margin. These findings are clinically significant because thymoma management depends on histological subtype, clinical stage, resection status, and multidisciplinary evaluation (Detterbeck, 2006; Masaoka et al., 1981). The close margin justified referral for oncological assessment and adjuvant radiotherapy consideration, consistent with recommendations that postoperative radiotherapy may be appropriate in selected patients with incomplete resection or high-risk pathological features (Conforti et al., 2021).

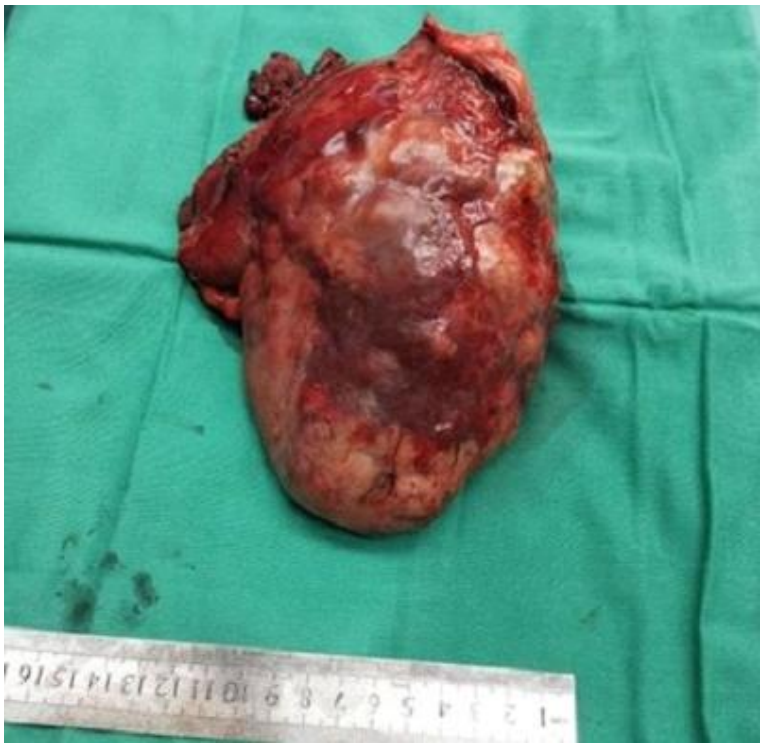

Figure 6. *Thymic mass removed by cardiothoracic team.*

The broader significance of this case lies in its contribution to the limited literature on thyroid AVM and its demonstration of how rare vascular pathology can intersect with endocrine, thoracic, airway, and oncological decision-making. Several important clinical lessons emerge. First, thyroid AVM should be considered when a patient with thyroid enlargement has bruit, thrill, unexplained hypervascularity, compressive symptoms, or atypical venous drainage on imaging. Second, computed tomography angiography should be used early when vascular malformation is suspected because it provides critical information on arterial feeders, venous drainage, nidus location, and relationship to vital neck structures. Third, preoperative embolisation is valuable but should not create false reassurance; substantial bleeding may still occur, and high-risk

operative planning remains essential. Fourth, cases involving complex thyroid vascularity should ideally be managed in centres with access to endocrine surgery, interventional radiology, vascular surgery, otolaryngology, anaesthesia, blood bank support, intensive monitoring, pathology, and oncological expertise. Finally, the coexistence of thymoma in this patient adds a further layer of rarity and complexity, requiring staged multidisciplinary management and long-term surveillance. The sequence represented by *Figure 3* to *Figure 6* reflects the full clinical pathway of this case: vascular diagnosis and embolisation, definitive thyroid surgery, and subsequent thymoma resection. In an era increasingly dominated by laboratory and radiological investigations, this case reinforces the enduring value of careful clinical examination, particularly the detection of a bruit over the goitre, which became the key turning point leading to vascular imaging and definitive diagnosis.

Conclusion

This case highlights the diagnostic and surgical significance of thyroid arteriovenous malformation as an exceptionally rare but potentially life-threatening vascular anomaly that may masquerade as more common thyroid pathology. In this patient, the clinical course was particularly complex because the initial presentation included haemoptysis, anterior neck swelling, obstructive symptoms, multinodular goitre, vocal cord palsy, and a concurrent anterior mediastinal thymoma. The diagnosis of thyroid arteriovenous malformation was not immediately apparent at first presentation, but the later detection of a bruit over the goitre became the decisive clinical clue that prompted computed tomography angiography and enabled accurate preoperative vascular mapping. This reinforces an important clinical lesson: even in the presence of advanced imaging and extensive biochemical testing, careful physical examination remains indispensable, especially when thyroid swelling presents with atypical features. Thyroid arteriovenous malformation should be considered when a thyroid lesion demonstrates disproportionate vascularity, bruit, thrill, compressive symptoms, abnormal venous drainage, or unexpected anatomical extension. Early recognition is essential because delayed or missed diagnosis may expose the patient to catastrophic intraoperative haemorrhage, prolonged operative duration, transfusion requirement, airway risk, and recurrent laryngeal nerve injury. In this case, preoperative embolisation was appropriately performed and contributed to surgical planning; however, persistent intraoperative vascularity and significant blood loss demonstrated that embolisation reduces but does not completely abolish operative risk. Therefore, thyroid arteriovenous malformation should be approached not as a routine hypervascular goitre, but as a high-risk vascular lesion requiring detailed anatomical assessment, haemostatic preparedness, and contingency planning before surgery.

The broader value of this case lies in its demonstration of multidisciplinary care as the central determinant of safe and effective management. The successful treatment pathway required coordinated input from endocrinology, endocrine surgery, interventional radiology, vascular surgery, otolaryngology, cardiothoracic surgery, anaesthesia, pathology, speech therapy, and oncology. Each specialty contributed a critical element: diagnosis, vascular risk reduction, airway and vocal cord assessment, operative control, histological confirmation, staged thymoma resection, voice rehabilitation, and postoperative oncological planning. The coexistence of thyroid arteriovenous malformation and thymoma in a young patient adds further clinical rarity

and highlights the importance of individualized sequencing of treatment. Addressing the thyroid vascular lesion first allowed control of the neck pathology and reduction of immediate surgical risk before subsequent thymectomy was undertaken. Histopathological confirmation of thyroid arteriovenous malformation and type B3 Masaoka stage IIa thymoma further emphasized the importance of tissue diagnosis in guiding postoperative management and long-term surveillance. This case contributes to the limited published experience on thyroid arteriovenous malformation by showing that even preoperatively diagnosed and embolised lesions may remain surgically challenging. It also provides a practical message for clinicians: when a thyroid mass behaves atypically, vascular pathology must remain within the differential diagnosis. Early computed tomography angiography, timely interventional radiology involvement, experienced endocrine surgical management, blood product readiness, nerve monitoring, and access to vascular support are crucial to improving patient safety. Ultimately, this case underscores that rare endocrine vascular anomalies demand not only technical expertise but also integrated clinical judgment, meticulous preparation, and multidisciplinary collaboration.

Acknowledgement

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Conflict of interest

The authors confirm that there is no conflict of interest involve with any parties in this research study.

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