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Primary Synovial Sarcoma of the Thyroid: Radiological and Pathological Correlation of a Rare Malignancy

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Abstract

Synovial sarcoma is a rare, high-grade soft tissue sarcoma that typically arises near the large joints of the extremities, and primary involvement of the thyroid gland is exceptionally uncommon. We report a 27-year-old man who presented with an anterior neck mass that had enlarged over 11 months, with dysphagia, dyspnea, cough, and hoarseness for three months. Ultrasound showed a 13×10 cm heterogeneous, vascular, solid-cystic right thyroid lobe mass with coarse calcifications and heterogeneous stiffness on shear elastography. Contrast-enhanced computed tomography (CT) showed a large, heterogeneously enhancing mass that infiltrated the right internal carotid artery, encased the external carotid artery, and displaced the trachea, together with multiple pulmonary metastases and bilateral hilar lymphadenopathy but no cervical lymphadenopathy. Biopsy showed a biphasic tumor that was positive for pan-cytokeratin, epithelial membrane antigen, and transducin-like enhancer of split 1 and negative for thyroid transcription factor-1, thyroglobulin, calcitonin, and PAX8. Fluorescence in situ hybridization confirmed the SS18-SSX fusion, establishing the diagnosis of primary synovial sarcoma of the thyroid. Because the tumor infiltrated the carotid vessels and metastases were present, upfront surgery was considered unsafe, and systemic chemotherapy was started. The patient was then lost to follow-up. Primary synovial sarcoma of the thyroid should be considered in a young adult with a rapidly enlarging, vascular, calcified solid-cystic thyroid mass, particularly when pulmonary metastases occur without cervical nodal disease. Imaging can suggest the diagnosis and define resectability, but histology, immunohistochemistry, and molecular testing are needed for confirmation.

Categories: Radiology, Pathology, Oncology
Keywords: immunohistochemistry, neck mass, pulmonary metastases, radiological-pathological correlation, soft tissue sarcoma, synovial sarcoma, thyroid neoplasms

Introduction

Synovial sarcoma (SS) is a high-grade mesenchymal tumor that accounts for about 5-10% of soft tissue sarcomas [1]. It occurs mainly in adolescents and young adults, most often near the joints of the lower extremities. In a Surveillance, Epidemiology, and End Results analysis, Patel et al. found that about 8% of SS cases arose in the head and neck [2]. Primary synovial sarcoma of the thyroid (PSST) is exceptionally rare. Ren et al. described the 16th reported case in 2023 [3], and Gupta et al. later cited only 19 cases in the English literature [4]. SS is classified histologically as monophasic, biphasic, or poorly differentiated [5] and is defined by the t(X;18) translocation that produces the SS18-SSX fusion.

Because PSST is so rare and its clinical and imaging presentation overlaps with high-grade thyroid carcinomas, it is often misdiagnosed before biopsy. Its radiological features have been described far less than its pathology. We present a case of PSST with detailed radiological-pathological correlation, discuss imaging features that may help distinguish it from more common thyroid malignancies, and review its epidemiology, prognosis, and management.

Case Presentation

A 27-year-old man presented with an anterior neck mass that had enlarged progressively over 11 months. For three months, he also had dysphagia, worsening dyspnea, cough, and hoarseness. He reported mild weight loss but denied fever, palpitations, tremor, or irritability. There was no history of neck irradiation as well as no family history of thyroid disease or malignancy, and he did not smoke.

Examination showed a large, well-defined, multilobulated, firm, mildly tender midline neck mass that moved with swallowing. The overlying skin was smooth and stretched, without ulceration (Figure *1*). There was no palpable cervical lymphadenopathy. Thyroid function tests were near normal (thyroid-stimulating hormone (TSH) 2.9 µIU/mL, free T4 1.7 ng/dL, T3 180 ng/dL), and serum calcitonin was normal.



FIGURE 1: Clinical photograph of the anterior neck

A large, multilobulated swelling is seen in the anterior neck, with smooth, stretched overlying skin and no visible ulceration.

A posteroanterior chest radiograph showed a large, well-defined, multilobulated opacity in the superior mediastinum extending from the neck, with tracheal deviation to the left, a left hilar opacity, and a left pleural effusion (Figure *2*).

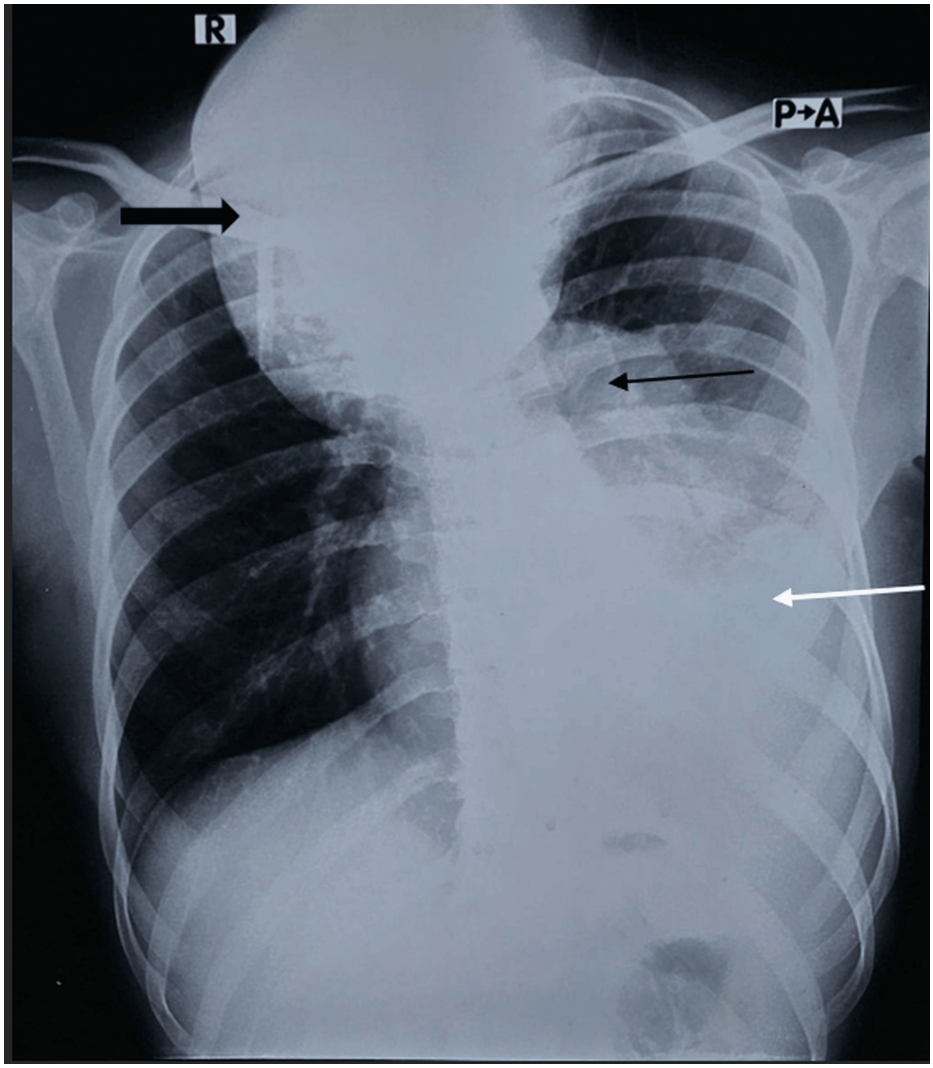


FIGURE 2: Chest radiograph (posteroanterior view)

The radiograph shows a large, well-defined, multilobulated opacity in the neck extending into the superior mediastinum (thick black arrow), with tracheal deviation to the left, an opacity in the left hilar region (thin black arrow), and a left-sided pleural effusion (white arrow).

Neck ultrasound (DC-80; Mindray, Shenzhen, China) showed a 13×10 cm heterogeneous solid-cystic mass arising from the right thyroid lobe. It had coarse internal calcifications, regular multilobulated margins, and prominent vascularity on color Doppler (Figure *3*). The left thyroid lobe was normal, and a small residual part of the right lobe was seen.



FIGURE 3: Color Doppler ultrasound of the neck mass

The image shows a large, multilobulated, heterogeneous mass in the anterior neck with internal vascular flow signals, cystic areas, and calcifications.

Shear elastography showed a heterogeneously stiff lesion (red and yellow areas on the color map), with a maximum elasticity of 113.85 kPa (Figure *4A*-*4B*).

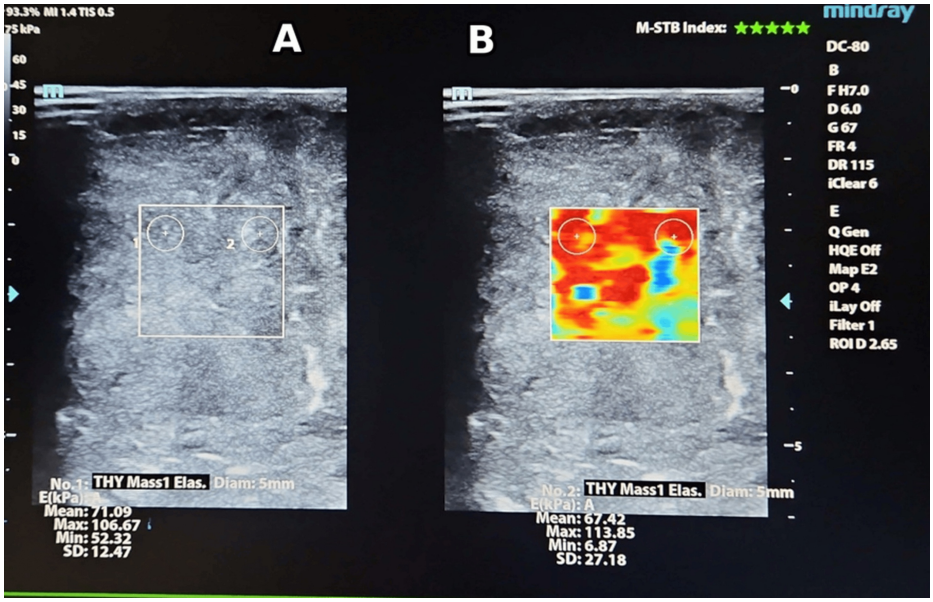


FIGURE 4: Ultrasound shear elastography of the neck mass

(A) B-mode image shows the regions of interest within the mass. (B) Shear elastography color map (scale 0-75 kPa) shows a heterogeneously stiff lesion (red and yellow), with a maximum elasticity of 113.85 kPa. The maximum elasticity value was measured within the region of interest and exceeds the upper limit of the displayed color scale.

B-mode: brightness mode; kPa: kilopascals

Contrast-enhanced computed tomography (CT) of the neck (Canon Medical Systems, Otawara, Japan) showed a large, multilobulated, heterogeneously enhancing mass arising from the right thyroid lobe, with multiple foci and streaks of internal calcification (Figure *5A*-*5C*). It extended from the level of the hyoid bone to the manubrium sterni, reaching the superior mediastinum. The mass encased the right common carotid artery by more than 180° along a segment beginning a few centimeters above its origin and encased the entire carotid bifurcation and the proximal-most parts of the right internal and external carotid arteries. The lumina of the involved vessels remained patent. The mass displaced the trachea anteriorly and to the left without tracheal wall invasion and displaced the internal jugular vein laterally. It contained a few cystic and necrotic areas, with no hemorrhage. On imaging, a claw sign with the thyroid parenchyma was seen, and no separate fat plane was identified between the mass and the thyroid gland.

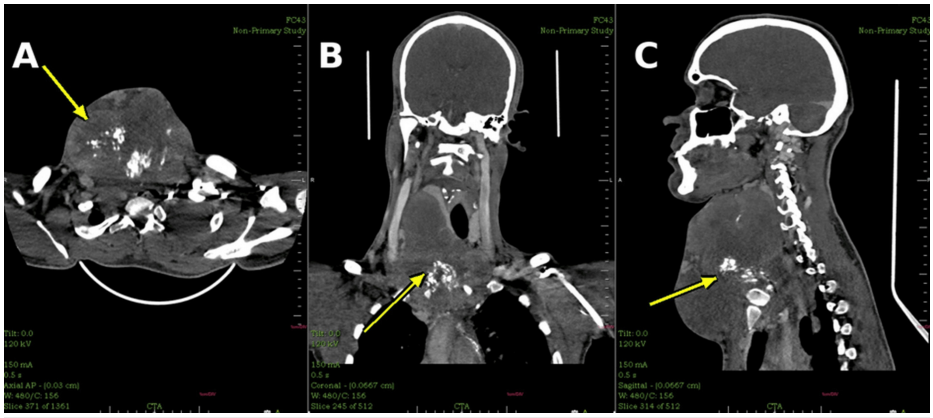


FIGURE 5: Contrast-enhanced CT of the neck in axial, coronal, and sagittal planes

Contrast-enhanced CT of the neck in the (A) axial, (B) coronal, and (C) sagittal planes shows a large, heterogeneously enhancing mass originating from the right thyroid lobe, with multiple foci and streaks of internal calcification. The lesion extends from the hyoid bone superiorly to the manubrium sterni inferiorly, with involvement of the adjacent cervical vessels and lateral displacement of the internal jugular vein. Arrows indicate foci of internal calcification within the mass.

CT: computed tomography

No cervical lymphadenopathy was seen on CT. An esophagogram showed extrinsic compression of the esophagus without direct invasion.

Contrast-enhanced CT of the chest showed multiple variable-sized pulmonary metastatic nodules, none of which showed cavitation. The largest, an 8.2 cm multilobulated lesion in the left hilar region, is shown in Figure *6*. Heterogeneously enhancing bilateral hilar lymphadenopathy was also present. A left pleural effusion was also seen on CT. Ultrasound-guided diagnostic thoracentesis of the left pleural effusion yielded approximately 20 mL of serosanguinous, hemorrhagic fluid. Cytological examination showed highly cellular clusters of spindle cells that were positive for malignant cells, confirming a malignant pleural effusion. Cell block preparation and immunocytochemistry were not performed. The pulmonary lesions were not biopsied.

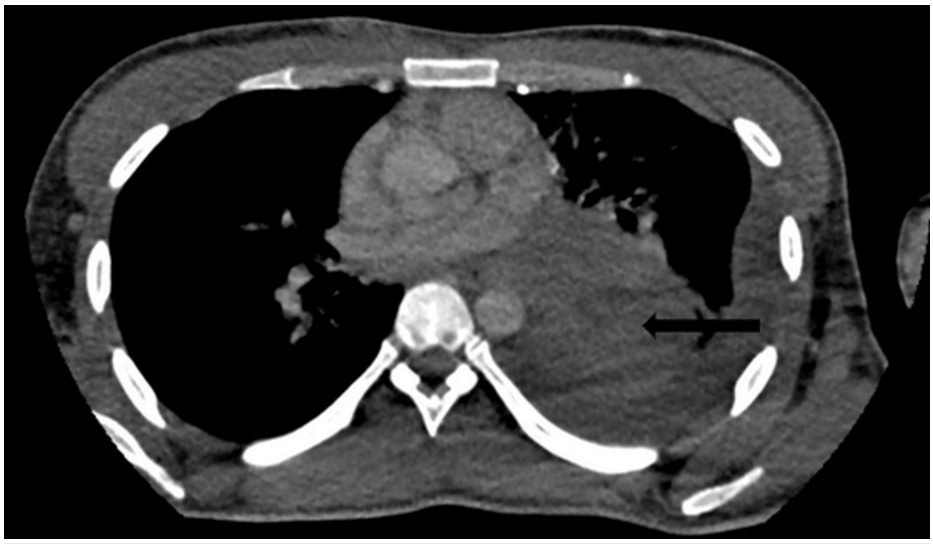


FIGURE 6: Contrast-enhanced CT of the chest (axial section)

An axial section demonstrates a heterogeneously enhancing, multilobulated lesion in the left hilar region (thick black arrow), consistent with a metastatic deposit.

CT: computed tomography

Ultrasound-guided core needle biopsy of the neck mass showed a biphasic tumor with spindle and epithelial

components. The spindle cells formed fascicles of atypical fibroblast-like cells, and the epithelial cells formed pleomorphic nests (Figure 7A-7C).

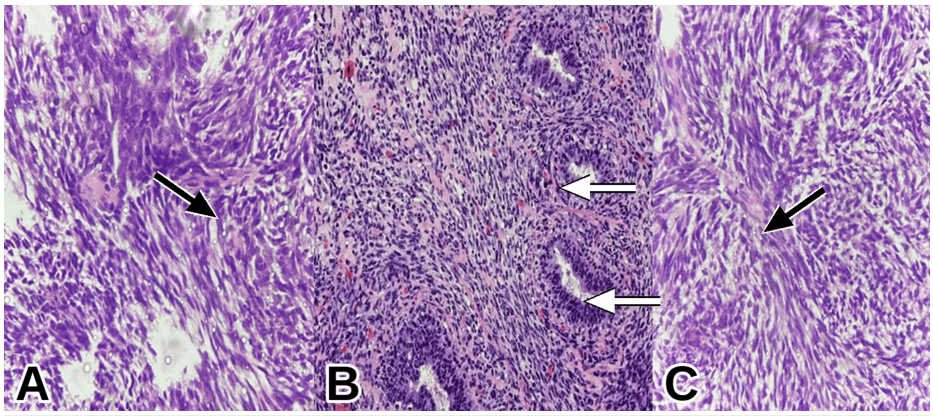


FIGURE 7: Histopathology of the tumor (H&E stain)

H&E stain at 400× magnification shows a biphasic tumor composed of spindle and epithelial cell components: (A, C) spindle cell component forming fascicles of atypical fibroblast-like cells (black arrows) and (B) epithelial component forming nests of pleomorphic cells (white arrows).

H&E: hematoxylin and eosin

Immunohistochemistry (IHC) showed focal, patchy staining for pan-cytokeratin (Pan-CK) and diffuse nuclear expression of transducin-like enhancer of split 1 (TLE-1) (Figure 8A-8B). The tumor was also positive for epithelial membrane antigen (EMA), mainly in the epithelial-like component, and for CD99, and it showed diffuse positivity for vimentin and B-cell lymphoma 2 (Bcl-2). Thyroid transcription factor-1 (TTF-1), thyroglobulin, calcitonin, and PAX8 were negative, which argued against a primary thyroid carcinoma.

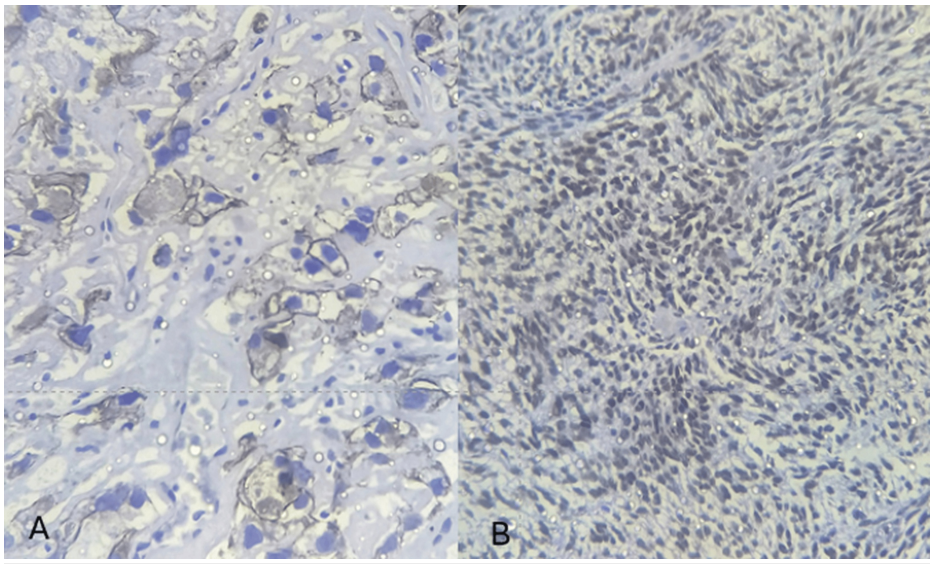


FIGURE 8: Immunohistochemistry of the tumor

(A) Focal, patchy staining for pan-cytokeratin (Pan-CK). (B) Diffuse nuclear expression of transducin-like enhancer of split 1 (TLE-1).

Fluorescence in situ hybridization (FISH), using an SS18-SSX fusion probe, demonstrated the SS18-SSX fusion, confirming the diagnosis of PSST. The tumor involved the carotid vessels, and metastases were present, including a malignant left pleural effusion. The multidisciplinary team therefore considered upfront resection unsafe and started systemic chemotherapy with doxorubicin-ifosfamide, with surgery to be considered after response assessment. The patient received four cycles and was then lost to follow-up, and the treatment response, surgical outcome, and subsequent course are unknown.

Discussion

Epidemiology and prognosis

SS accounts for 5-10% of soft tissue sarcomas and occurs mainly in adolescents and young adults [1,6]. Head and neck involvement is uncommon (about 8% of cases [2]), and thyroid origin is among the rarest presentations [3,4,7]. The hypopharynx, parapharyngeal space, and neck soft tissues are more frequent sites. PSST usually affects young to middle-aged adults and presents as a rapidly enlarging neck mass with compressive symptoms such as dysphagia, dyspnea, and hoarseness [3,7]. In head and neck SS, a male predominance is reported, with a median age at diagnosis of 28 years in one large series [8]. The prognosis of PSST is generally poor because of local aggressiveness, high recurrence rates, and hematogenous spread, most often to the lungs. Published five-year overall survival for head and neck SS ranges from about 66% to 81%, largely in patients with localized disease [8], whereas about 60% has been cited for PSST [3]. Tumor size, location, extension, and metastatic status at presentation are the main adverse factors [9]. Our patient had a very large tumor, vascular encasement, and lung metastases at diagnosis, all of which predict a poor outcome.

Radiological features and diagnostic clues

Individually, the imaging findings of SS in the thyroid are nonspecific, but a combination of features can raise suspicion before biopsy. The first is a large mass with rapid growth in a young adult. Our patient's mass reached 13 cm in less than a year at 27 years of age, which is unusual for differentiated thyroid carcinoma and less typical of anaplastic carcinoma, which mainly affects older patients. As the patient had no prior imaging, this growth rate is based on the clinical history alone. The second feature is a heterogeneous solid-cystic architecture with calcification. SS commonly shows cystic, necrotic, and hemorrhagic areas alongside solid components, and calcification, often fine or stippled, is a recognized feature [6,10]. In our patient, ultrasound showed a solid-cystic mass with coarse internal calcifications, and CT showed a few cystic and necrotic areas without hemorrhage. Third, Doppler ultrasound and CT showed a vascular, heterogeneously enhancing mass, a nonspecific finding that nevertheless favors an aggressive neoplasm over a benign nodule. Fourth, the margins were deceptively well defined. Although the mass had regular, well-defined margins and displaced rather than invaded the airway, it encased the right common carotid artery, the entire carotid bifurcation, and the proximal-most parts of the internal and external carotid arteries. It displaced the trachea without wall invasion and compressed the esophagus without direct invasion, which may reflect the expansile growth pattern of SS, with vascular involvement rather than early aerodigestive invasion. Defining which carotid segments are involved, and the degree of circumferential encasement, is the key determinant of resectability. In our patient, the common carotid artery was encased by more than 180° along a segment beginning a few centimeters above its origin, and the entire bifurcation and the proximal-most parts of the internal and external carotid arteries were also encased, although all lumina remained patent. Fifth, the pattern of spread was distinctive. Pulmonary metastases and hilar adenopathy were present without cervical nodal disease, whereas differentiated thyroid carcinomas typically spread first to cervical lymph nodes. This pattern suggested a sarcoma before pathology was available. Sixth, magnetic resonance imaging (MRI) was not performed in our patient, which is a limitation. In SS elsewhere, MRI classically shows the triple sign (areas of high, intermediate, and low signal intensity on T2-weighted images), fluid-fluid levels, and a bowl of grapes appearance resulting from hemorrhage, cystic change, and septation [6,10]. MRI should be considered in future cases to define local extent and vascular involvement. Finally, shear elastography showed marked, heterogeneous stiffness (maximum 113.85 kPa). This supports a malignant, cellular tumor but is not specific, since stiffness is also seen in thyroid carcinomas.

Features supporting thyroid origin: PSST

Because the title emphasizes a primary thyroid origin, it is important to consider whether the tumor could instead be a neck soft tissue sarcoma secondarily involving the thyroid. Several features favored a thyroid origin in our patient. Ultrasound and CT showed the mass arising from the right thyroid lobe, a claw sign was seen with the thyroid parenchyma wrapping around the edge of the mass, no separate fat plane was identified between the mass and the thyroid gland, the mass moved with swallowing on examination, and the left lobe was normal. Negative TTF-1, thyroglobulin, and PAX8 staining excluded a thyroid carcinoma but does not by itself prove thyroid origin. Because of the size of the mass (13 cm) and the absence of a surgical specimen, secondary thyroid involvement from an adjacent neck sarcoma cannot be completely excluded.

Differential diagnosis, pathology, and management

The main differential is high-grade thyroid carcinoma, and several other entities are also considered (Table *1*). The final distinction needs histology, IHC, and molecular testing. In our patient, negative TTF-1, thyroglobulin, calcitonin, and PAX8 staining excluded thyroid carcinoma.

Entity	Typical features	Points of differentiation from this case
Anaplastic thyroid carcinoma	Older patients (usually >60 years), rapid growth, infiltrative mass, necrosis, coarse calcification, extrathyroidal extension, nodal and lung metastases	Age 27 years; well-defined margins with airway displacement without wall invasion, despite vascular infiltration; absent cervical nodes; coarse calcification overlaps and does not separate the two; final diagnosis by TLE-1 positivity and SS18-SSX fusion, which are absent in anaplastic carcinoma
Poorly differentiated thyroid carcinoma	Solid, lobulated mass, necrosis, invasion, cervical nodal metastases	Predominantly solid and nodal, whereas this case was solid-cystic without cervical nodes
Papillary carcinoma (aggressive variants)	Cystic nodal metastases, microcalcifications, thyroid parenchymal disease	Cervical nodal metastases are typical and were absent; calcification was coarse rather than micro; large size with rapid growth is unusual
Medullary carcinoma	Calcifications, nodal disease, raised calcitonin	Serum calcitonin was normal, which argues against medullary carcinoma
Thyroid lymphoma	Older women, Hashimoto thyroiditis, homogeneous hypoechoic mass, little calcification, vessels often encased but patent	Young male; heterogeneous, calcified, cystic lesion; not typical of lymphoma
Other sarcomas and malignant teratoma	Heterogeneous mass with variable calcification; teratoma may contain fat or bone	Imaging overlaps, so IHC and molecular tests are needed
Large multinodular goiter or degenerated adenoma	Well-defined, benign features, no vascular encasement, no metastases	Vascular encasement and pulmonary metastases exclude a benign process

TABLE 1: Imaging and clinical differential diagnosis of a large, aggressive thyroid mass

IHC: immunohistochemistry; SS18-SSX: synovial sarcoma translocation, chromosome 18-synovial sarcoma X fusion; TLE-1: transducin-like enhancer of split 1

Sources: anaplastic carcinoma, Ahmed et al. [11]; papillary carcinoma and benign nodular disease, Haugen et al. [12]; medullary carcinoma, Wells et al. [13]; thyroid lymphoma, Li et al. [14]

SS is divided into biphasic, monophasic, and poorly differentiated subtypes [5]. Biphasic SS has spindle and epithelial components, as in our patient, whereas monophasic SS is mainly spindle cell and harder to diagnose. IHC typically shows EMA, cytokeratins, vimentin, CD99, Bcl-2, and TLE-1 [15]. Definitive diagnosis rests on the detection of the SS18-SSX fusion from t(X;18)(p11.2;q11.2) by reverse transcription polymerase chain reaction (RT-PCR) or FISH [5,7]. Fine-needle aspiration can mimic other carcinomas and sarcomas [7], so core biopsy with IHC and molecular testing is preferred, as was done in our patient.

Management should be multidisciplinary. Wide surgical excision with negative margins is the mainstay for resectable disease, but in the head and neck, it is often limited by proximity to vital structures [9,16]. Perioperative radiotherapy is generally recommended and has been associated with lower recurrence and better survival in some series [9,17], although the evidence is limited and not uniform [18]. Systemic chemotherapy, commonly anthracycline- and ifosfamide-based, is used for large, high-risk, unresectable, or metastatic disease [1,8]. Its role in resectable disease is still debated, but ifosfamide-based regimens have been associated with improved survival in selected high-risk patients [1,19], and a thyroid-specific report described a response to doxorubicin-ifosfamide [7]. For our patient, upfront surgery was considered unsafe because of vascular involvement and pulmonary metastases, so systemic chemotherapy with doxorubicin-ifosfamide was started (four cycles), with surgery to follow if a response allowed. A suggested approach is core biopsy with IHC and FISH, staging with CT of the chest and neck and MRI for local extent [1,20], multidisciplinary discussion of resectability, surgery plus radiotherapy for resectable disease or systemic therapy first for unresectable or metastatic disease, and long-term surveillance for local recurrence and lung metastases. Early diagnosis matters because PSST grows fast and spreads early to the lungs and the chance

of complete surgical resection falls as the tumor grows and involves the cervical vessels. Our patient presented at 13 cm with vascular involvement and metastases, which ruled out upfront curative resection. Recognizing the imaging pattern described above should prompt early core biopsy with IHC and FISH rather than reliance on fine-needle aspiration alone and earlier referral to a sarcoma team.

This report has few limitations. The patient had no prior imaging, so interval growth could not be assessed radiologically, and the 11-month progression rests on the clinical history. The pulmonary lesions were not biopsied and were considered metastatic on imaging grounds, supported by the malignant pleural effusion. MRI was not performed. Thyroid origin was supported by imaging and clinical features but could not be confirmed on a surgical specimen. Finally, the patient was lost to follow-up after four cycles of chemotherapy, so the treatment response and long-term outcome are unknown.

Conclusions

PSST should be considered in a young adult with a rapidly enlarging, vascular, calcified solid-cystic thyroid mass, particularly when pulmonary metastases are present without cervical lymphadenopathy. In our patient, the diagnosis was made at an advanced stage, with involvement of the carotid vessels, pulmonary metastases, and a malignant pleural effusion that made upfront surgery unsafe, and systemic chemotherapy with doxorubicin-ifosfamide was started. The patient was then lost to follow-up after four cycles, so the treatment response and long-term outcome are unknown, which highlights the need for early recognition and close follow-up. Imaging can raise suspicion and help define resectability, but diagnosis requires histopathology, IHC, and molecular confirmation. Early recognition and multidisciplinary management are essential.

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

Concept and design: Simmi Kumari, Nikunj Bhimani

Acquisition, analysis, or interpretation of data: Simmi Kumari, Ayush Mittal, Nikunj Bhimani

Drafting of the manuscript: Simmi Kumari, Ayush Mittal, Nikunj Bhimani

Critical review of the manuscript for important intellectual content: Simmi Kumari, Nikunj Bhimani

Supervision: Simmi Kumari, Ayush Mittal, Nikunj Bhimani

Disclosures

Human subjects: Informed consent for treatment and open access publication was obtained or waived by all participants in this study. **Conflicts of interest:** In compliance with the ICMJE uniform disclosure form, all authors declare the following: **Payment/services info:** All authors have declared that no financial support was received from any organization for the submitted work. **Financial relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. **Other relationships:** All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

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