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Mature Teratoma of the Mediastinum in an Adolescent: Clinical Camouflage as Meningioma with Hemoptysis and Pleural Effusion

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A B S T R A C T

Mediastinal mature teratomas are relatively common germ cell tumors in adolescents, typically located in the anterior mediastinum. While often benign and slow-growing, they can cause symptoms like hemoptysis through compression or local invasion. The differential diagnosis can rarely include ectopic meningioma, posing significant diagnostic challenges. The aim of this report is to describe this unusual presentation of a mediastinal mature teratoma and to emphasize the importance of a comprehensive, multidisciplinary diagnostic workup for achieving an accurate diagnosis and guiding appropriate management in such complex cases of mediastinal pathology. A 17-year-old female presented with a two-month history of blood-streaked hemoptysis and intermittent central chest pain. She had no systemic symptoms such as fever or weight loss. Physical examination was largely unremarkable, though laboratory tests revealed mild anemia (Hb 9.2 g/dL). Imaging studies, including chest X-ray and contrast-enhanced thoracic multi-slice computed tomography (MSCT), identified a large, heterogeneous anterior to middle mediastinal mass. The mass was noted to compress the right main bronchus, causing right lower lobe atelectasis, and was associated with minimal right-sided pleural effusion and mediastinal lymphadenopathy. The MSCT findings were suggestive of a teratoma. A core biopsy of the mediastinal mass indicated a mature teratoma but also raised meningioma as a differential diagnosis. Bronchoscopy revealed mucosal hyperemia and hypervascularity in the tracheobronchial tree. A brain MRI was negative for intracranial metastasis. The patient was managed conservatively pending further comprehensive evaluation and multidisciplinary team discussion. In conclusion, this case underscores an atypical presentation of a mediastinal mature teratoma in an adolescent, characterized by hemoptysis, pleural effusion, and a rare histopathological differential of meningioma. It highlights the critical role of meticulous and comprehensive diagnostic evaluation, including advanced imaging and histopathology, along with a multidisciplinary approach, in accurately diagnosing and planning the management of such complex mediastinal masses, especially when faced with unusual clinical or pathological features.

1. Introduction

The mediastinum, a central compartment within the thoracic cavity, harbors a diverse array of anatomical structures and is consequently a site where a wide spectrum of neoplastic and non-neoplastic lesions can arise. Mediastinal tumors, while relatively uncommon, accounting for approximately 3% of all tumors occurring within the thorax, represent a significant diagnostic and therapeutic challenge due to their anatomical location, proximity to vital structures, and histological heterogeneity. These masses can originate from thymic, neurogenic, lymphatic, germ cell, or mesenchymal tissues, each with distinct epidemiological, clinical, and pathological

characteristics. The distribution of these tumors often varies with age and the specific mediastinal compartment (anterior, middle, or posterior) involved. In the adolescent and young adult population, the anterior mediastinum is a frequent site for germ cell tumors (GCTs). GCTs are a group of neoplasms derived from primordial germ cells, and mediastinal GCTs are thought to arise from displaced germ cells during embryogenesis. Among mediastinal GCTs, mature teratomas are the most common histological subtype, particularly in this age group. Mature teratomas are characterized by the presence of well-differentiated tissues derived from two or more of the three embryonic germ layers: ectoderm (skin, hair, neural tissue), mesoderm (bone, cartilage, muscle, fat), and endoderm (respiratory or gastrointestinal epithelium). These tumors are typically benign, well-encapsulated, and often exhibit slow growth. Many mature teratomas are discovered incidentally on imaging studies performed for unrelated reasons. However, when they attain a significant size, they can exert compressive effects on adjacent mediastinal structures, including the tracheobronchial tree, esophagus, great vessels, and heart, leading to a variety of clinical symptoms such as chest pain, dyspnea, cough, and, less commonly, dysphagia or superior vena cava syndrome. Hemoptysis, while not a classical symptom, can occur, particularly if there is erosion into or significant irritation of the airway, or rupture into a bronchus. Pleural effusion can also accompany mediastinal masses, resulting from various mechanisms including direct pleural involvement, lymphatic obstruction, or inflammatory reactions.[1-4]

Diagnostic imaging plays a pivotal role in the evaluation of suspected mediastinal teratomas. Chest radiography may reveal a mediastinal mass, often prompting further investigation with cross-sectional imaging. Computed tomography (CT) is particularly valuable, as it can delineate the size, location, and extent of the mass, its relationship to adjacent structures, and often identify characteristic components such as fat, fluid, soft tissue, and calcifications (including tooth-like structures), which are highly suggestive of a teratoma. Magnetic resonance imaging (MRI) can provide additional soft tissue detail and is useful in specific circumstances, such as assessing vascular or neural involvement. Despite the typical imaging features, the differential diagnosis of an anterior mediastinal mass in an adolescent can be broad. It includes thymoma, lymphoma, thyroid masses, and other less common GCT subtypes. Histopathological examination via biopsy or surgical excision is crucial for definitive diagnosis and for excluding malignancy, as immature teratomas or teratomas with malignant transformation can occur, albeit less frequently.[5-8]

An exceptionally rare consideration in the differential diagnosis of mediastinal masses, particularly those with certain histological features, is ectopic meningioma. Meningiomas are tumors that arise from arachnoid cap cells, which are typically found in the coverings of the brain and spinal cord. Primary extracranial meningiomas are uncommon, and their occurrence in the mediastinum is exceedingly rare. These ectopic meningiomas can mimic other soft tissue tumors both radiologically and sometimes histologically, making their distinction challenging without specific immunohistochemical markers. The presence of meningothelial elements within a mediastinal teratoma, or a teratoma that histologically mimics a meningioma, represents a diagnostic conundrum. Theories for mediastinal meningiomas include derivation from ectopic arachnoidal cells misplaced during embryogenesis or differentiation from pluripotential mesenchymal cells. The current case report details the clinical course of a 17-year-old female who presented with hemoptysis and was found to have a large mediastinal mass. Initial imaging suggested a teratoma, but core biopsy findings introduced meningioma as a surprising differential diagnosis, adding a layer of complexity to the diagnostic process. This case is noteworthy due to the combination of an atypical presenting symptom (significant hemoptysis) for a presumed benign mature teratoma, the presence of pleural effusion, the unusual histopathological differential diagnosis

involving meningioma, and the imaging findings of suspicious lymphadenopathy and potential pulmonary metastases which contrast with the typically benign nature of mature teratomas and negative brain MRI. The novelty of this case lies in this unique constellation of clinical, radiological, and pathological features in an adolescent patient, particularly the rare consideration of meningioma in the context of a mediastinal germ cell tumor presenting with such pronounced airway symptoms.[9,10] This report aims to describe this unusual presentation of a mediastinal mature teratoma, to discuss the diagnostic challenges encountered, particularly the differentiation from or association with meningioma, and to emphasize the importance of a comprehensive, multidisciplinary diagnostic workup for achieving an accurate diagnosis and guiding appropriate management in such complex cases of mediastinal pathology. This case contributes to the literature by highlighting a rare diagnostic scenario that can inform clinical practice when faced with atypical mediastinal tumors in young patients.

2. Case Presentation

The patient, a 17-year-old Indonesian female, a third-year vocational high school student with no significant past medical history, presented to the outpatient clinic with a chief complaint of hemoptysis for two months prior to consultation. The hemoptysis was described as expectoration of fresh, red, blood-streaked sputum, occurring intermittently, typically once or twice a day, with an estimated volume of approximately one to two teaspoons per episode. The onset of symptoms was insidious, beginning approximately three months before her hospital admission. She also reported intermittent, mild, non-radiating central chest pain, described as a dull ache, unrelated to exertion or meals, for a similar duration. Crucially, the patient denied experiencing shortness of breath, wheezing, orthopnea, paroxysmal nocturnal dyspnea, fever, night sweats, unintentional weight loss, or loss of appetite. There was no history of tuberculosis infection or contact, previous pneumonia or other significant pulmonary diseases, asthma, or use of inhalers. She also denied symptoms suggestive of neurological involvement such as hoarseness, dysphagia, dizziness, blurred vision, headache, or limb weakness. Her bowel and urinary habits were normal, and she maintained full independence in her activities of daily living. The patient was a passive smoker, with regular exposure to secondhand cigarette smoke from her father, who smoked heavily at home. She had completed two doses of the COVID-19 vaccine with no adverse effects reported. There was no family history of similar conditions, malignancies, or genetic disorders. A summary of her initial clinical findings is presented in Table 1.

On initial physical examination at the outpatient clinic, the patient appeared well-nourished and in no acute distress. Her vital signs were recorded as follows: blood pressure 104/62 mmHg, heart rate 102 beats per minute (regular rhythm), respiratory rate 24 breaths per minute (shallow but unlabored), body temperature 36.9°C, and oxygen saturation 98% while breathing room air. Her height was 162 cm, and her body weight was 53 kg, corresponding to a body mass index (BMI) of 20.2 kg/m², indicating a normal nutritional status. Clinical severity scoring assessments yielded a systemic inflammatory response syndrome (SIRS) score of 2 (based on heart rate and respiratory rate), a quick sequential organ failure assessment (qSOFA) score of 1 (based on respiratory rate), and a National Early Warning Score (NEWS) of 4.

Systemic examination was largely unremarkable. There was no pallor, jaundice, cyanosis, or clubbing. No palpable cervical, supraclavicular, axillary, or inguinal lymphadenopathy was detected. Examination of the oral cavity and pharynx was normal. Cardiovascular examination revealed a regular tachycardia but no murmurs, gallops, or rubs; peripheral pulses were normal. Respiratory examination showed symmetrical chest expansion, resonant percussion notes bilaterally, and vesicular breath sounds with no added sounds like crackles or wheezes on auscultation at that initial presentation.

The abdominal examination was unremarkable, and there was no organomegaly or tenderness. Neurological examination revealed normal cranial nerve function, motor strength, sensation, and reflexes.

Initial laboratory investigations revealed mild normocytic, normochromic anemia with a hemoglobin (Hb) level of 9.2 g/dL (reference range: 12-16 g/dL), hematocrit of 28% (reference range: 36-48%), and a normal white blood cell count of 8,500/µL with a normal differential, and a platelet count of 320,000/µL. Renal function tests (urea and creatinine), liver function tests (bilirubin, AST, ALT, alkaline phosphatase), and serum electrolytes were all within normal limits. A sputum smear for acid-fast bacilli (Ziehl-Neelsen stain) and a sputum GeneXpert MTB/RIF assay (TCM method) performed on December 17th, 2024 (prior to admission to Dr. Moewardi Regional General Hospital) were negative for *Mycobacterium tuberculosis*, effectively ruling out active pulmonary tuberculosis as the cause of hemoptysis.

Given the persistent hemoptysis and chest pain, a plain chest X-ray (posteroanterior and lateral views) was performed. The initial chest X-ray obtained at Gajah Mada Hospital on December 10th, 2024, revealed a large, well-defined opacity in the right upper and mid lung zones, suggestive of a mediastinal mass extending into the right hemithorax. Subsequent chest X-rays at Pekalongan Regional General Hospital on December 23rd, 2024, and at Dr. Moewardi Regional General Hospital (RSDM) on February 5th, 2025, confirmed the presence of a large anterior to middle mediastinal mass, with evidence of right lower lobe atelectasis.

To further characterize the mass, a contrast-enhanced thoracic Multi-Slice Computed Tomography (MSCT) scan was performed at Pekalongan Regional General Hospital on January 8th, 2025. This scan demonstrated a large, lobulated, inhomogeneously enhancing mass measuring approximately 10 x 8 x 12 cm, located in the right suprahilar and paratracheal region, extending from the anterior to the middle mediastinum. The mass exhibited heterogeneous attenuation values, with areas suggestive of soft tissue, cystic components, and subtle calcifications. It was seen to be compressing and displacing the superior vena cava and the right main bronchus.

Table 1. Summary of initial clinical findings.

Category	Finding
Anamnesis	
Age	17 years
Gender	Female
Chief complaint	Hemoptysis (blood-streaked sputum, 1-2 tsp/episode, intermittent) for 2 months; Intermittent central chest pain (dull ache) for 2 months
Associated symptoms	Denied fever, night sweats, weight loss, shortness of breath, wheezing
Past medical history	Non-significant; passive smoker
Physical examination	
Vital signs	BP 104/62 mmHg, HR 102/min, RR 24/min, Temp 36.9°C, SpO_2 98% (room air)
BMI	20.2 kg/m² (Normal nutritional status)
General	Well-nourished, no acute distress, no pallor or cyanosis
Lymph nodes	No palpable lymphadenopathy (cervical, supraclavicular, axillary, inguinal)
Respiratory system	Symmetrical expansion, resonant percussion, vesicular breath sounds, no added sounds (initial exam)
Laboratory findings	
Hemoglobin / Hematocrit	9.2 g/dL / 28% (Mild normocytic, normochromic anemia)
WBC & platelets	Normal
Sputum AFB/GeneXpert	Negative for *Mycobacterium tuberculosis*
Initial imaging	
Chest X-ray (External)	Large right upper/mid zone opacity; mediastinal mass
MSCT thorax (External)	Large (10x8x12 cm) lobulated, inhomogeneously enhancing mass (right suprahilar/paratracheal), compressing SVC & right main bronchus

Following referral and admission to Dr. Moewardi Regional General Hospital for further evaluation and management, a series of diagnostic procedures were undertaken, and conservative treatment was administered. These are detailed in Table 2. A repeat contrast-enhanced thoracic MSCT scan was conducted on February 21st, 2025. This scan provided more detailed anatomical information: it confirmed the presence of a large, well-circumscribed, heterogeneous anterior to middle mediastinal mass, now measured as approximately 11 x 9 x 13 cm. The imaging characteristics were highly suggestive of a teratoma, given the mixed density components including fat foci, soft tissue, and cystic changes. The mass was observed to be significantly compressing and narrowing the right main bronchus and extending into the right secondary and tertiary bronchi, leading to marked atelectasis of the right lower lobe and partial atelectasis of the right middle lobe. The mass was also noted to be adherent to the right parietal pleura, the right lateral aspect of the pericardium, the superior vena cava (though flow was still patent), and the right pulmonary vein. Significantly, multiple enlarged lymph nodes were identified in mediastinal stations 2R, 2L, 4R, 4L, 5 (aortopulmonary window), and 7 (subcarinal), with the largest nodes measuring up to 1.5 cm in short-axis diameter. Additionally, the scan reported findings suspicious for subpleural and pneumonic-type pulmonary metastases in both lungs, described as small nodules and ill-defined opacities, and noted incidental thoracic dextroscoliosis. A chest ultrasound performed on February 28th, 2025, at Dr. Moewardi Regional General Hospital confirmed the presence of minimal right-sided pleural effusion. Diagnostic thoracentesis was considered but deferred due to the minimal volume of the effusion.

To establish a definitive tissue diagnosis, an initial attempt at transthoracic needle aspiration (TTNA) was made on February 7th, 2025, but the sample obtained was inadequate for diagnosis. Subsequently, an ultrasound-guided core needle biopsy was performed from the anterior right mediastinal component of the mass on February 10th, 2025. Histopathological examination of the core biopsy specimen revealed features of a mature teratoma, characterized by the presence of derivatives from all three germ layers, including mature squamous epithelium with keratin, sebaceous glands (ectodermal), mature cartilage, adipose tissue, smooth muscle (mesodermal), and glandular structures lined by respiratory-type epithelium (endodermal). However, the pathologist also noted areas with cellular spindle cell proliferation and some meningothelial-like cells, which prompted the consideration of meningioma as a rare differential diagnosis or a possible component within the teratoma. Pulmonary function testing (spirometry) performed on February 21st, 2025, surprisingly yielded results within normal limits, with a Forced Vital Capacity (FVC) of 3.2 L (95% predicted), Forced Expiratory Volume in 1 second (FEV1) of 2.8 L (93% predicted), and an FEV1/FVC ratio of 87.5%. This was somewhat unexpected given the significant bronchial compression observed on MSCT.

A fiberoptic bronchoscopy was performed under local anesthesia and conscious sedation on March 4th, 2025, to evaluate the airways for the source of hemoptysis and to assess the extent of bronchial involvement. The vocal cords were mobile and appeared normal. The trachea was patent. However, the mucosa throughout the tracheobronchial tree, particularly in the right main bronchus, bronchus intermedius, and the orifices of the right middle and lower lobe bronchi, appeared diffusely hyperemic and hypervascularized. There was evidence of extrinsic compression of the right main and intermediate bronchi, significantly narrowing the lumen, but no endobronchial mass or active bleeding point was visualized. Bronchial washings and brushings were collected for cytological examination and microbial cultures; cytology was negative for malignant cells, and cultures showed no pathogenic organisms. Given the MSCT findings of suspicious pulmonary nodules and the unusual biopsy differential, a brain MRI with gadolinium contrast was performed on March 5th, 2025, to rule out intracranial metastases, particularly if a malignant component or an aggressive

meningioma was being considered. The brain MRI revealed no evidence of brain parenchymal or calvarial metastases. Incidental findings included left ethmoidal sinusitis, bilateral hypertrophy of the middle and inferior nasal turbinates, and mild leftward nasal septal deviation (Mladina type III).

During the period of investigation, the patient was managed conservatively. This included oxygen therapy via nasal cannula (3 L/min) as needed for any desaturation, though her baseline saturation remained adequate. She received two units of packed red cells to correct her mild anemia, which improved her hemoglobin to 10.8 g/dL. Nutritional support was provided with a high-calorie, high-protein diet (approximately 1500 kcal/day). Intravenous fluids (0.9% NaCl) were administered for hydration. Symptomatic relief was provided with oral paracetamol for chest pain, and folic acid supplementation was given. Her symptoms of hemoptysis decreased in frequency and volume during this period. Her clinical condition remained stable throughout the extensive diagnostic workup. The case was discussed extensively in a multidisciplinary team meeting involving thoracic surgeons, oncologists, radiologists, and pathologists to determine the optimal subsequent management strategy, which was leaning towards surgical excision given the size, symptoms, and diagnostic uncertainty, but further specific immunohistochemical results from the biopsy and a detailed discussion with the patient and family regarding surgical risks and benefits were pending.

Table 2. Diagnostic procedures, treatment, and follow-up at Dr. Moewardi Regional General Hospital.

Category	Details
Diagnostic procedures (RSDM)	
Chest X-ray	Confirmed large anterior to middle mediastinal mass, right lower lobe atelectasis
MSCT thorax (Contrast)	Large (11x9x13 cm) heterogeneous mass (fat, soft tissue, cystic changes) suggestive of teratoma; Compressing right bronchi causing RLL atelectasis; Adherent to pleura, pericardium, SVC, R pulmonary vein; Mediastinal lymphadenopathy (stations 2RL, 4RL, 5, 7); Suspicious subpleural/pneumonic pulmonary nodules
Chest ultrasound	Minimal right-sided pleural effusion
Transthoracic needle aspiration (TTNA)	Sample inadequate for diagnosis
Core needle biopsy	Ultrasound-guided, anterior right mediastinum
Pulmonary function tests (PFTs)	Within normal limits (FVC 95% pred, FEV1 93% pred, FEV1/FVC 87.5%)
Fiberoptic bronchoscopy	Diffuse mucosal hyperemia & hypervascularity (esp. right side); Extrinsic compression of right bronchi; No endobronchial mass/active bleeding; Washings negative for malignancy/pathogens
Brain MRI (Contrast)	No brain or calvarial metastasis; Incidental sinusitis, turbinate hypertrophy, septal deviation
Histopathological findings	
Core biopsy result	Mature teratoma (squamous epithelium, keratin, sebaceous glands, cartilage, adipose tissue, smooth muscle, respiratory epithelium); Differential diagnosis: Meningioma (areas with cellular spindle cell proliferation, meningothelial-like cells)
Conservative management	
Interventions	Oxygen therapy (3 L/min prn), 2 units Packed Red Cells, High-calorie high-protein diet (1500 kcal), IV fluids (NaCl 0.9%), Folic acid, Oral paracetamol, Symptom monitoring
Response	Hemoptysis decreased in frequency/volume; Hemoglobin improved; Clinically stable
Follow-up status	
Current status	Patient clinically stable; undergoing further evaluation; multidisciplinary team discussion concluded; Surgical excision considered pending further histopathological clarification and family consent

3. Discussion

The case of this 17-year-old female presents a fascinating intersection of common pathology with uncommon manifestations and diagnostic intricacies. The diagnosis of a mediastinal mature teratoma, while frequent in her age group, was accompanied by significant hemoptysis, pleural effusion, and a confounding histopathological differential of meningioma, all set against a backdrop of concerning radiological findings like extensive lymphadenopathy and suspected pulmonary nodules. This constellation of findings necessitates a deep dive into the underlying pathophysiology, a comparative review of similar occurrences, and a thorough understanding of the diagnostic theories involved. Mature teratomas are germ cell tumors composed of well-differentiated tissues from at least two, and often all three, embryonic germ layers: ectoderm, mesoderm, and endoderm. Their presence in the mediastinum is attributed to the aberrant migration of primordial germ cells during early embryogenesis. These cells, originating in the yolk sac endoderm, normally migrate along the dorsal mesentery to the gonadal ridges. If some cells arrest or stray during this migration, they can deposit in extragonadal sites, with the anterior mediastinum being the most common extragonadal location. Once settled, these pluripotent cells can differentiate along somatic lines, forming a benign mature teratoma. These tumors are typically slow-growing and encapsulated. In adolescents and young adults, they represent a significant proportion of anterior mediastinal masses.[11,12]

While often asymptomatic and discovered incidentally, symptoms arise when the growing teratoma compresses or irritates adjacent structures. The nature of these symptoms is dictated by the structures involved. In this patient, the anterior to middle mediastinal location of the mass, measuring up to 11x9x13 cm, led to significant interaction with vital thoracic organs. Chest pain, as reported by the patient, is a common symptom, likely arising from stretching of the mediastinal pleura, compression of intercostal nerves, or direct pressure on the pericardium or chest wall structures. The intermittent, dull ache is characteristic of such slow-growing compressive lesions. Hemoptysis, the expectoration of blood from the lower respiratory tract, was a prominent and alarming symptom in this patient, persisting for two months. While more commonly associated with malignant tumors or infections like tuberculosis, hemoptysis in the context of a benign mature teratoma, though less frequent, is well-documented and can occur through several pathophysiological mechanisms: The MSCT scans vividly demonstrated the mass compressing and narrowing the right main, secondary, and tertiary bronchi. Chronic compression can lead to mucosal inflammation, edema, and increased friability. The bronchoscopy findings of diffuse mucosal hyperemia and hypervascularity throughout the tracheobronchial tree, especially on the right side, directly support this mechanism. This hyperemic mucosa is prone to bleeding with coughing or minor irritation. Prolonged and severe compression can, in some instances, lead to pressure necrosis of the bronchial wall, resulting in erosion or ulceration and subsequent bleeding. While no frank endobronchial lesion or overt erosion was seen on bronchoscopy in this case, microscopic breaches in mucosal integrity due to sustained pressure cannot be entirely excluded. The compression led to right lower lobe atelectasis. Atelectatic lung segments can become secondarily infected or inflamed (post-obstructive pneumonitis), even without systemic signs of infection. Inflamed lung parenchyma or airways distal to an obstruction can be a source of bleeding. Rarely, a teratoma, particularly if it contains pancreatic or gastric tissue producing enzymes, can erode into an adjacent bronchus, forming a fistula. This patient's biopsy did not specify such components, but it remains a theoretical possibility with large teratomas. The blood-streaked nature of the sputum, rather than massive hemoptysis, suggests oozing from an irritated mucosal surface rather than a major vessel erosion or large fistulous connection. Extrinsic compression of pulmonary veins or bronchial arteries by the large

mass could lead to venous hypertension or altered arterial flow in the bronchial circulation, predisposing to mucosal bleeding. The adherence of the mass to the right pulmonary vein was noted. Comparing this case to others, reported a case of a ruptured mediastinal mature teratoma presenting with hemoptysis, highlighting that acute events can also precipitate this symptom. In our patient, the chronic nature of the hemoptysis points more towards sustained irritation and compression. The bronchoscopic finding of generalized hyperemia and hypervascularity is a key piece of evidence linking the mass effect to the hemoptysis.[13,14]

The finding of a minimal right-sided pleural effusion on ultrasound and MSCT is another clinically relevant aspect. Pleural effusions accompanying mediastinal masses can be transudative or exudative and arise via several pathways. The mediastinum is rich in lymphatic channels. A large mass can compress these channels, impairing the drainage of pleural fluid and leading to its accumulation. The extensive mediastinal lymphadenopathy noted, whether reactive or otherwise, could also contribute to altered lymphatic flow. Compression of systemic veins (like the superior vena cava, though it remained patent) or pulmonary veins can increase hydrostatic pressure in the pleural capillaries. The presence of a large foreign body (the teratoma) or inflammatory processes associated with the tumor or its compressive effects (like atelectasis and potential subclinical pneumonitis) can lead to an exudative effusion due to increased capillary permeability. The MSCT noted adherence of the mass to the right parietal pleura. Direct irritation or microscopic involvement of the pleura by the tumor could provoke an effusion. Given the minimal volume and the absence of signs of infection or heart failure, an effusion related to local compressive effects, lymphatic interference, or reactive inflammation seems most plausible.[15,16]

The core biopsy result suggesting mature teratoma with meningioma as a differential diagnosis is perhaps the most academically intriguing part of this case. Teratomas, by definition, contain tissues from multiple germ layers. Neural elements, including glial tissue and even rudimentary brain-like structures, are common ectodermal derivatives. It is conceivable that within these neural elements, there could be differentiation towards meningothelial cells or structures that closely resemble them, particularly given that arachnoid cap cells (from which meningiomas arise) are themselves of neuroectodermal origin. This would imply that the meningothelial-like cells are an integral, albeit rare, component of the teratoma itself. Though extremely rare, one could theorize a scenario where a true primary mediastinal meningioma coexists and collides with a separate mature teratoma. Alternatively, a composite tumor with distinct teratomatous and meningiomatous components could exist. This is highly speculative without more extensive tissue. Certain spindle cell components or reactive mesenchymal elements within a teratoma, or even specific arrangements of epithelial cells, might superficially mimic the whorls or syncytial patterns of a meningioma on a small core biopsy. The pathologist noted "cellular spindle cell proliferation and some meningothelial-like cells". This is less likely given that the biopsy also clearly identified components of all three germ layers characteristic of a mature teratoma. Primary mediastinal meningiomas are exceptionally uncommon. Other studies reported such cases, emphasizing their rarity. These tumors are thought to arise from ectopic arachnoidal cells that were misplaced during embryogenesis, possibly migrating with neural crest derivatives or along nerve roots into the mediastinum. Another theory involves the metaplastic transformation of pluripotential mesenchymal cells already present in the mediastinum into meningothelial cells. Other studied a series of primary ectopic meningiomas, highlighting their diverse locations and the importance of molecular studies in some cases. Other studies also contributed case reports and imaging findings of these rare entities, noting their often non-specific radiological appearances that can mimic other soft tissue tumors.[17,18]

To definitively distinguish between these possibilities, especially on a small core biopsy, is challenging. Immunohistochemistry plays a critical role. Meningiomas characteristically express vimentin and epithelial membrane antigen (EMA), the latter often showing a characteristic cell membrane staining pattern. Somatostatin receptor 2A (SSTR2A) is another highly sensitive and relatively specific marker for meningiomas. They are typically negative for S100 protein (though some variants can be positive) and glial fibrillary acidic protein (GFAP), which would be expected in glial components of a teratoma. Cytokeratins can be variably expressed in some meningioma subtypes but would be strongly positive in epithelial components (squamous, glandular) of a teratoma. The diverse tissue types within a teratoma would show a mosaic of staining: cytokeratins in epithelial parts, S100 in neural and adipose tissue, desmin/actin in muscle. The pathologists' plan for further immunohistochemical stains would be crucial to elucidate the nature of these "meningothelial-like cells."

The MSCT findings of extensive mediastinal lymphadenopathy (stations 2RL, 4RL, 5, and 7) and suspicious subpleural/pneumonic-type pulmonary nodules presented a significant diagnostic challenge, suggesting potential malignancy or aggressive behavior. This is in stark contrast to the core biopsy diagnosis of a *mature* teratoma, which is inherently benign, and the negative brain MRI. Large benign masses, especially those causing chronic inflammation or irritation (as evidenced by hemoptysis and bronchial hyperemia), can induce significant reactive hyperplasia in regional lymph nodes. The size of these nodes (up to 1.5 cm) is within the range that can be seen with reactive changes, although it also overlaps with malignant involvement. Teratomas can sometimes incite a granulomatous foreign body reaction in surrounding tissues or lymph nodes, especially if there has been minor leakage of contents. A core biopsy samples only a minuscule fraction of a large, heterogeneous tumor. It is theoretically possible that the 11x9x13 cm mass could harbor an unsampled focus of immature teratoma, malignant transformation (carcinoma, sarcoma, or yolk sac tumor arising within a teratoma), or even a separate synchronous malignancy, with the biopsy fortuitously hitting only a mature component. Malignant germ cell tumors frequently metastasize to regional lymph nodes and lungs. Wang et al. (2020) discussed the incidence and survival in mediastinal malignant teratoma populations. Kalua & Soewondo (2024) reported a massive mature mediastinal teratoma with malignant transformation, underscoring this risk. The "subpleural and pneumonic-type pulmonary metastases" are not definitively characterized as metastases without biopsy. They could represent: Related to chronic airway irritation, aspiration from hemoptysis, or post-obstructive changes; Unrelated incidental findings; If an unsampled malignant component exists; Extremely rare for purely mature teratomas without prior rupture or surgery, but theoretically possible. Growing Teratoma Syndrome involves growth of mature teratoma components during or after chemotherapy for a malignant GCT, which is not the scenario here. The negative brain MRI makes widespread, aggressive metastatic disease less likely but does not exclude regional metastasis from certain tumor types. The normal pulmonary function tests, despite significant bronchial compression and atelectasis seen on MSCT, are somewhat perplexing. This could indicate that the atelectasis was segmental and compensated by other lung regions, or that the compression was more significant for smaller airways rather than large central airways critical for overall PFT values, or that the patient had significant respiratory reserve.[19,20]

The management of such a complex case hinges on a robust multidisciplinary team (MDT) approach. The convergence of thoracic surgery, radiology (interpreting complex imaging), pathology (deciphering ambiguous biopsies), pulmonology (managing hemoptysis and airway issues), and oncology (considering potential malignancy) is essential. The decision for conservative management initially, with blood transfusions and symptomatic support, was

appropriate to stabilize the patient and allow for this thorough diagnostic workup. Surgical excision is the mainstay of treatment for mature mediastinal teratomas, especially when symptomatic or large. Surgery provides definitive histological diagnosis of the entire lesion (addressing sampling bias concerns), relieves compressive symptoms (like hemoptysis and chest pain), prevents further growth and complications (such as rupture, infection, or malignant change), and allows for pathological assessment of the lymph nodes and any resectable pulmonary nodules. The adherence to the right parietal pleura, pericardium, superior vena cava, and right pulmonary vein noted on MSCT suggests that the surgery could be technically challenging, potentially requiring careful dissection and possibly reconstruction if major vascular involvement was confirmed intraoperatively. Other studies provide overviews on the surgical management of anterior mediastinal tumors, highlighting the importance of complete resection.

The unique elements of this case—the prominent hemoptysis from a benign tumor, the rare meningioma differential, and the discordant imaging findings—contribute valuable insights. It underscores that clinical presentations can deviate from classical descriptions and that diagnostic pathways must be flexible and thorough. The final pathology of the excised specimen and lymph nodes will be crucial in unraveling the complete picture and guiding any further adjuvant therapy, should an unexpected malignant component be identified. The patient's young age and otherwise good general health are favorable factors for undergoing major thoracic surgery.

4. Conclusion

This case report presented a 17-year-old female with an anterior to middle mediastinal mature teratoma that exhibited an atypical clinical course characterized by significant hemoptysis and pleural effusion. The diagnostic process was further complicated by a rare histopathological differential diagnosis of meningioma arising from the core biopsy findings, and by imaging features suggestive of regional lymphadenopathy and distant pulmonary nodules that initially raised concerns for a more aggressive pathology. Despite the benign nature typically associated with mature teratomas, their anatomical location within the crowded mediastinum can lead to substantial clinical symptoms due to compression or irritation of adjacent vital structures, as evidenced by the hemoptysis and airway irritation in this patient. The comprehensive diagnostic workup, encompassing detailed imaging modalities (MSCT, ultrasound, brain MRI), bronchoscopy, and histopathological analysis of biopsy specimens, proved essential in delineating the nature of the mass, understanding the cause of the symptoms, and ruling out alternative diagnoses such as active tuberculosis or primary intracranial pathology with metastasis. The unusual consideration of meningioma in the differential diagnosis underscores the histological diversity that can be encountered within germ cell tumors or as separate exceedingly rare primary mediastinal entities, demanding careful pathological interpretation and often requiring ancillary studies like immunohistochemistry for clarification. The presence of suspicious lymphadenopathy and pulmonary nodules on imaging, contrasting with the biopsy of a mature teratoma and a negative brain MRI, highlights the importance of a multidisciplinary team approach to reconcile such discordant findings and to formulate an appropriate management plan. Ultimately, this case emphasizes that early recognition of symptoms, even if atypical for a suspected diagnosis, coupled with a meticulous and systematic diagnostic evaluation, is critical for achieving timely and accurate diagnosis and for guiding the subsequent management of complex mediastinal masses, particularly in young patients presenting with challenging clinical and pathological features. Surgical intervention remains the cornerstone for symptomatic and large mediastinal teratomas to provide definitive diagnosis, alleviate symptoms, and prevent future complications.

5. References

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