

CASE REPORT

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Inflammatory myofibroblastic tumor in pediatric patients: challenges in diagnosis, multidisciplinary management, and surgical strategies

Izchel Valdez García¹, Alejandro Solano Gutierrez², Sofia Brenes Guzmán^{3*}  and Brenda Aguilar Viveros⁴

Abstract

Background Inflammatory myofibroblastic tumor is a rare yet profoundly impactful condition, particularly within the pediatric population. This case report illuminates the intricate challenges of diagnosing and managing inflammatory myofibroblastic tumors in children, underscoring the importance of interdisciplinary collaboration in formulating effective treatment strategies. Notably, the choice of surgical approach holds a paramount influence on the risk of recurrence and metastasis, with wide resection with bronchotomy, lobectomy, and pneumonectomy demonstrating significantly diminished recurrence rates compared to wedge resection in bronchoscopic removal.

Case presentation We present the case of a 3-year-old girl with a progressive, nonproductive cough, occasionally accompanied by episodes of hemoptysis and pneumonia for a year, secondary to an inflammatory myofibroblastic tumor that was removed by bronchotomy with excellent results.

Conclusion Given the extraordinary rarity of this disease in pediatric patients, ongoing research endeavors and the accumulation of collective expertise are paramount.

Keywords Inflammatory myofibroblastic tumor, Case report, Endobronchial, Children

Background

Primary endobronchial tumors are uncommon in childhood. Among these disorders, the inflammatory myofibroblastic tumor (IMT) represents 20% of all primary lung tumors and more than 50% of all benign masses, making it the most common nonmalignant pulmonary neoplasm in the pediatric population [1–3].

The World Health Organization (WHO) defines IMT as “a lesion composed of a proliferation of myofibroblastic spindle and stellate cells with abundant eosinophilic cytoplasm mixed with infiltrative plasma, inflammatory cells, lymphocytes, and eosinophils” [4, 5]. Previously considered a non-neoplastic reactive inflammation, it is now classified as an intermediary lesion with clinical recurrence and malignant potential.

*Correspondence:

Sofia Brenes Guzmán
sofiabrenesg1992@gmail.com

¹ Department of Pediatric Thoracic Surgery, Pediatric Hospital, National Medical Center “Siglo XXI”, Mexican Social Security of Mexico, 605 Ignacio Morones Prieto Street, Mexico City, Mexico

² Department of Pediatric Cardiovascular Surgery, Pediatric Hospital, National Medical Center “Siglo XXI”, Mexican Social Security of Mexico, 605 Ignacio Morones Prieto Street, Mexico City, Mexico

³ Department of Pediatric Surgery, Pediatric Hospital, National Medical Center “Siglo XXI”, Mexican Social Security of Mexico, 605 Ignacio Morones Prieto Street, P.C. 06720, Cuauhtémoc, Mexico City, Mexico

⁴ Department of Pediatric Pneumology, Pediatric Hospital, National Medical Center “Siglo XXI”, Mexican Social Security of Mexico, 605 Ignacio Morones Prieto Street, Mexico City, Mexico

IMT was previously referred to by various names, including inflammatory pseudotumor, plasma cell granuloma, and postinflammatory tumor, and it was considered a reaction to an inflammatory insult [2, 6]. It most commonly affects the liver and biliary tract (31.8% of cases), head and neck (20.6%), lung (18.2%), abdomen (15.5%), and urogenital system (7.4%) [7].

Case presentation

We presented the case of a 3-year-old girl born at 36 weeks of gestational age and had a favorable neonatal adaptation. From the age of 24 months, she began experiencing a progressive, nonproductive cough, occasionally accompanied by episodes of hemoptysis, which persisted for a year. At the age of 3, she developed both lower and upper airway infections, requiring hospitalization and antibiotic therapy. Following her discharge, she continued to experience intermittent fever, loss of appetite, and a dry cough.

Her condition deteriorated, leading to respiratory distress, and a chest X-ray revealed left superior and inferior atelectasis with opacity. Consequently, she received treatment with third-generation cephalosporin and macrolide antibiotics. The left hemithorax noted reduced air entry and fine crackles on chest auscultation. Laboratory tests indicated a persistent increase in inflammatory markers, including C-reactive protein (5 mg/dL, normal range <0.08 mg/dL), leukocytes ($14.6 \times 10^6/L$, with 35%

neutrophils and 45% lymphocytes), hemoglobin (12 mg/dL), and platelets ($637 \times 10^3/\mu L$).

Despite the therapy, the child's symptoms of atelectasis, fever, and poor general condition persisted. Subsequently, a chest high-resolution computer tomography (HRCT) scan was performed, revealing a sizable bronchial lesion originating from the left main bronchi, completely obstructing the lumen, being the cause of pneumonia (Fig. 1). The diameter of the mass was approximately 7 mm. Suspecting an endobronchial tumor, a core needle biopsy was conducted during bronchoscopy (Fig. 2), and this procedure proceeded without complications. Pathological analysis of the biopsy specimen yielded inconclusive results of a mesenchymal tumor. A multidisciplinary panel decided that complete removal of the lesion, including the left upper bronchotomy (longitudinal opening of the left main bronchus was performed to resect the tumor, followed by repair with non-absorbable suture to preserve both the bronchus and the lung lobe. This allowed for a wide resection without the need to excise a portion of the main bronchus) via thoracotomy, which was necessary (Figs. 3 and 4).

Histological sections displayed a tumor with a fascicular pattern. The tumor components consisted of cells with oval- and spindle-shaped nuclei, exhibiting indistinct borders, a fine chromatin distribution, and inconspicuous nucleoli. No cytological atypia or mitotic figures were observed. These cells were accompanied by an inflammatory infiltrate, primarily plasma

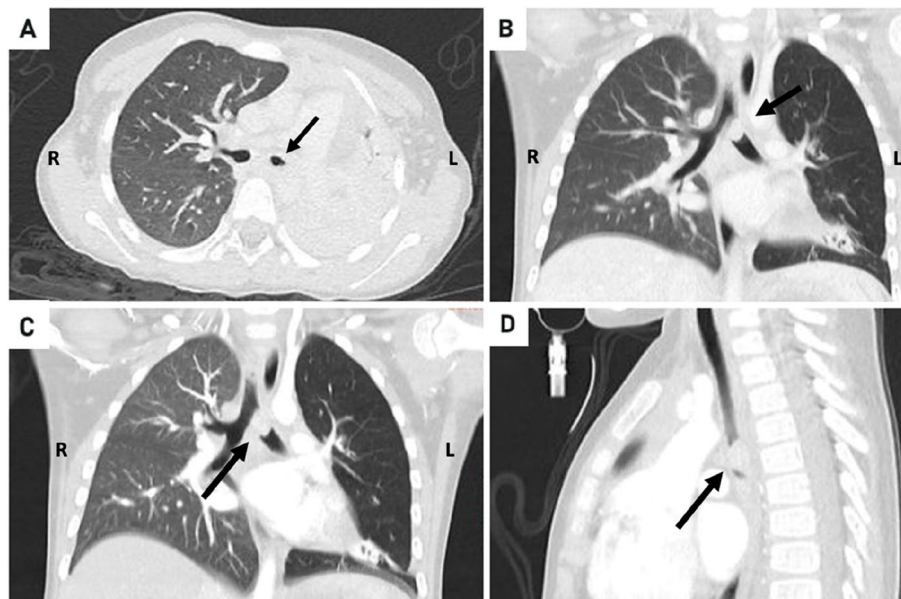


Fig. 1 Chest high-resolution computer tomography. **a** Axial view showing reduced brightness of the left main bronchus with atelectasis throughout the left. **b** and **c** Coronal view showing a hyperdense, regular, intraluminal image of the left main bronchus, corresponding to the tumor (arrow). **d** Sagittal left view showing the intraluminal tumor (arrow). (R: right) (L: left)

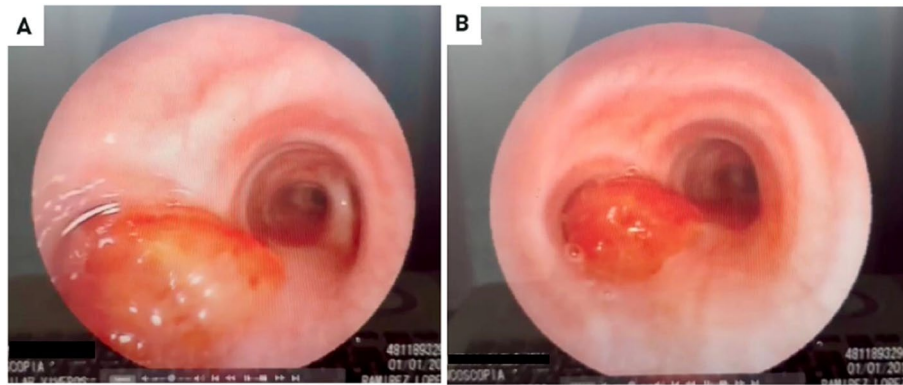


Fig. 2 IMT during bronchoscopy. **a** IMT with a diameter of approximately 7 mm. **b** A core needle biopsy was conducted during the study

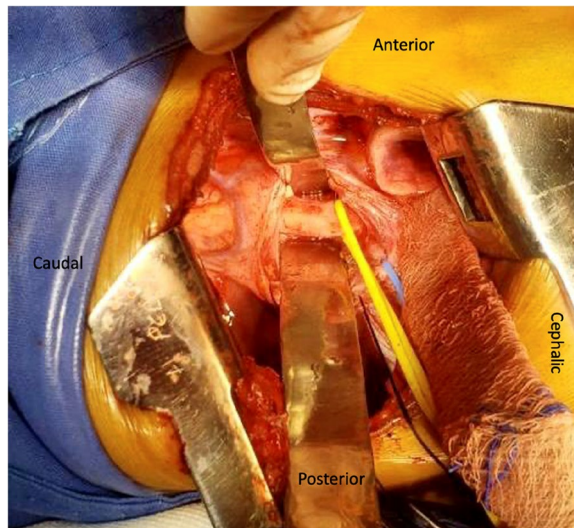


Fig. 3 IMT during surgery. During thoracotomy, the right main bronchus was identified with a yellow vessel loop, and the bronchial vein with blue vessel loop. The patient is positioned in the lateral decubitus, exposing the left side of the chest. The image shows the lateral portion of the left chest, identifying both the upper or cephalic portion and the lower or caudal portion of the patient, as well as the posterior and anterior aspects of the chest

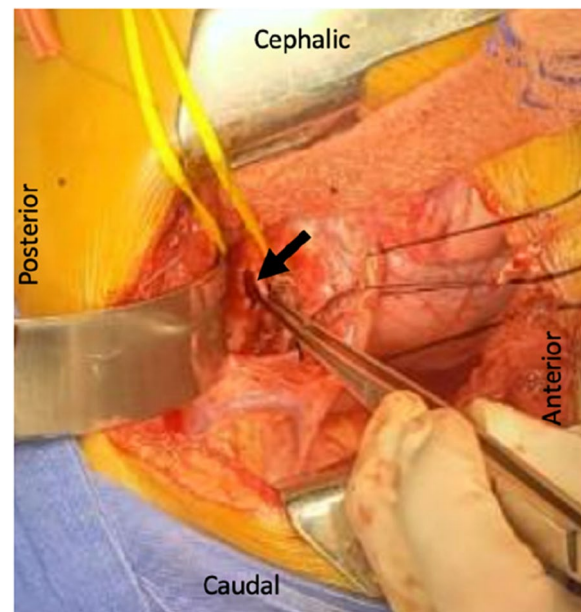


Fig. 4 IMT during surgery. Bronchotomy of the left principal bronchi (yellow. Vessel loop) and identifying the IMT inside the previous resection (arrow). Bronchial vessels were identified on black stitches

cells and lymphocytes. Immunohistochemical studies confirmed diffuse expression of smooth muscle actin in spindle cells. Subsequent histological evaluation confirmed the presence of an IMT that tested positive for actin, anaplastic lymphoma kinase 1 (ALK1), and desmin. The final pathological diagnosis was IMT.

The postoperative recovery period was uneventful, and after six months of follow-up, there was no radiological evidence of persistent or recurrent disease.

Discussion

IMT exhibits a relatively high incidence in children and young individuals, accounting for 50% of primary benign lung tumors in infancy. IMT typically presents as a parenchymal nodule and, less frequently, as a slow-growing endobronchial lesion [2, 3]. The age range affected by IMT spans 3 to 13 years, although the incidence is presumed to be higher.

The clinical presentation of IMT is primarily influenced by its location. Some cases remain asymptomatic and are only incidentally discovered during imaging studies [8]. Children with endobronchial IMT often experience symptoms of bronchial irritation, including cough and

occasional hemoptysis, which may be accompanied by chest pain [4, 9]. In some instances, patients may present with symptoms related to the local effects of the mass, such as stridor or a history of wheezing [5]. They may also exhibit signs of chronic inflammation, such as low-grade fever, weight loss, anemia, thrombocytosis, polyclonal hypergammaglobulinemia, elevated sedimentation rate, and C-reactive protein [10, 11].

In our case, the patient's clinical history and intermittent fever initially suggested an infectious disease. However, the lack of response to broad-spectrum antibiotics and the persistence of atelectasis prompted us to investigate the possibility of a non-infectious lesion, with chest high-resolution computer tomography (HRCT) proving to be a crucial diagnostic tool.

Central and endobronchial tumors account for only 10% of IMT cases, leading to bronchial obstruction and atelectasis. Central IMTs are typically identified earlier, possibly due to the resulting symptoms of acute obstruction. Conversely, peripheral parenchymal tumors present with more misleading and nonspecific symptoms, leading to delayed diagnosis [12].

The differential diagnosis of IMT should include foreign body aspiration, infectious diseases (e.g., *Aspergillus* and *Mycobacterium*), necrotizing pneumonia, and spindle cell neoplasms [1]. Chest X-rays usually reveal a peripheral lesion or nodule of varying sizes (1.2 to 15 cm in diameter). On HRCT, IMTs often appear as solid single masses with homogeneous or heterogeneous enhancement, well-defined borders, a lobulated appearance, and occasional punctate calcifications, mimicking malignant tumors. Additionally, associated findings may include pneumothorax, pleural effusion, atelectasis, cavitations, and lymphadenopathies [13, 14].

Bronchoscopy is indicated when there is suspicion of an endoluminal lesion. It serves as both a diagnostic and therapeutic tool, allowing for the removal of tumoral obstructions and the collection of biopsy samples [15–18].

The anatomopathological differential diagnosis is broad and relies on the clinical presentation, morphological alterations, and the immune phenotype of spindle cells. Histological assessment is crucial to rule out malignant mesenchymal tumors such as sarcomas and gastrointestinal stromal tumors [8, 19, 20].

Molecular rearrangements on chromosome 2p23 have been detected in several IMT cases (34–56% of both pulmonary and extrapulmonary IMTs). This locus harbors the human ALK gene, which codes for a tyrosine kinase receptor known as ALK. ALK rearrangements can be identified through immunohistochemical analysis using the monoclonal ALK-1 antibody and appear to be highly specific for these lesions. However,

they may not be a sensitive marker in children [12, 21]. ALK-positivity does not seem to correlate with recurrence [6, 22, 23]. Other genetic abnormalities have also been implicated, such as aneuploidy, RET gene rearrangement, EML4-ALK inversion, and fusions of other kinase genes. Cytologic atypia and positive ALK status are more frequent in aggressive tumors, whereas metastatic tumors tend to be harmful for ALK. Additionally, positive immunohistochemical staining has been reported for vimentin, alpha-smooth muscle actin (alpha-SMA), ALK, and other markers such as desmin, cytokeratin (AE 1–3), CD34, protein S-100, and HHV8 [12, 24].

The primary treatment for IMT involves complete, yet conservative, surgical excision. This approach is essential to prevent recurrence. Adequate histologic assessment should precede surgery, typically achieved through needle biopsy during bronchoscopy, to avoid unnecessary procedures. The choice of surgical approach (e.g., wedge resection by bronchotomy with lobectomy or pneumonectomy) depends on factors such as the tumor's size and location, its relationship with surrounding structures, and the surgeon's experience with the available equipment. In cases where complete removal is not feasible due to invasion of vital structures, partial resection may be necessary [2, 4, 17, 20, 25].

Chemotherapy may be considered an alternative option for patients with microscopic or macroscopic residual disease, although its efficacy remains controversial. Complete surgical excision is the recommended treatment, which gives long-term survival benefits. Whenever a mass is resectable, lobectomy and pneumonectomy are better options than wedge resection or endobronchial resection for preventing local recurrence and metastasis. Also, this can be controverted in the pediatric area given the growing period in childhood and the associated morbidity. A total lobectomy or pneumonectomy vs. local resection is an essential decision in a pediatric patient; when technically feasible, a sleeve resection of the involved bronchus is also recommended [21].

Recurrence is a rare phenomenon, occurring in only 14% of cases. Recent evidence suggests a 5 to 10-year disease-free survival rate of 89% following complete resection. The prognosis is good in up to 95% of the cases. The risk of recurrence justifies a long-term clinical follow-up. Indeed, bronchoscopy should be performed only in cases of severe respiratory symptoms [23–26].

Treatment received and available clinical and imaging follow-ups were noted to look for the presence or absence of local recurrence, transformation to sarcoma, and metastasis to assess malignant potential. Patients with multiple lesions at presentation were presumed to be multifocal in origin. Subsequent presentation with

a new focal lesion at a different site was considered metastatic.

Conclusion

Endobronchial IMT is a rare but morbid condition, especially among pediatric patients.

This case underscores the complexities associated with diagnosing and managing IMT within this population, emphasizing the critical importance of interdisciplinary collaboration to develop effective treatment strategies.

It's worth noting that the choice of surgical approach impacts the risk of recurrence and metastasis for resectable lesions. Lobectomy and pneumonectomy are often associated with lower recurrence rates, contrary to wedge resection via bronchotomy or bronchoscopic removal.

Due to the rarity of the disease among the pediatric population, further research and collective experience are needed to enhance our knowledge of IMT and refine treatment strategies for these cases.

Abbreviations

IMT	Inflammatory myofibroblastic tumor
WHO	World Health Organization
HRCT	Chest high-resolution computer tomography

Acknowledgements

Not applicable.

Authors' contributions

IVG were responsible for data collection, data management, sequence alignment, and initial manuscript drafting. contributed to the clinical aspects of the study and provided patient treatment. IVG, ASG, BAV participated in patient treatment, sequence alignment, and manuscript drafting. SB contributed to the study design, performed statistical analysis, and provided critical input. SB contributed to the study design, coordination, and manuscript drafting. All authors have read and approved the final manuscript.

Funding

Not applicable.

Availability of data and materials

The data and materials used in this study are available upon request. Due to restrictions on sharing the data publicly, a direct link to the dataset cannot be provided. However, all relevant data and materials necessary to replicate the study's findings will be made available upon reasonable request to the corresponding author. Please contact Sofia Brenes Guzmán at sofcped@gmail.com for further inquiries regarding data and materials access.

Declarations

Ethics approval and consent to participate

This article presents a case report involving a pediatric patient with a rare presentation of an endobronchial myofibroblastic inflammatory tumor and its management. The study complied with ethical principles, including those outlined in the Declaration of Helsinki. Written informed consent was obtained from the patient's parents or legal guardians for the publication of their cases and accompanying images. The need for ethics approval was waived by the Hospital Inner Committee (Mexican Social Institute), as per their guidelines (17 CI 09 015 042). The confidentiality of patient information was strictly maintained, and all data were de-identified prior to analysis. This study adheres to the ethical standards of our institution and ensures the privacy and rights of the patients involved.

Consent for publication

Written informed consent was obtained from the patients' parents or legal guardians for the publication of their cases and accompanying images.

Competing interests

The authors declare that they have no competing interests.

Received: 15 November 2023 Accepted: 21 February 2024

Published online: 29 March 2024

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