

## Not Every Pulmonary Nodule From The Farm Is Infection: An Atypical Presentation Of Pediatric Bronchial Carcinoid

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### Abstract

**Background:** Bronchial carcinoid tumors are the most common primary malignant pulmonary neoplasm in children yet remain exceedingly rare. They typically present as centrally obstructing endobronchial lesions causing recurrent pneumonia or wheezing.

**Case Presentation:** A previously healthy 15-year-old male presented with progressive constitutional symptoms, fever, and a right upper lobe pulmonary nodule following travel to the Ohio River Valley. Initial evaluation favored endemic fungal infection. Chest CT demonstrated a rounded right upper lobe mass centered within a segmental bronchus but presenting as a parenchymal nodule without post-obstructive collapse. Comprehensive infectious workups were inconclusive. Bronchoscopic biopsy confirmed a typical carcinoid tumor. Gallium-68 DOTATATE PET/CT showed no metastatic disease. The patient underwent the right upper lobectomy. Final pathology showed a 2.4 cm typical carcinoid, and no lymph nodes were submitted for pathology. At approximately 3 months of postoperative follow-up, chest CT showed no adenopathy, and subcentimeter lung nodules are being followed with imaging.

**Conclusion :** Bronchial carcinoid should remain in the differential diagnosis for solitary pulmonary nodules in adolescents, even when clinical features initially suggest infection.

**Keywords:** bronchial carcinoid, pediatric, pulmonary nodule, neuroendocrine tumor, DOTATATE PET/CT, case report

### Background

Among primary malignant lung tumors in children, bronchial carcinoids are the most frequently encountered, accounting for approximately 42–63% of cases, although the overall incidence is less than 0.2 per 1,000,000 children per year [1, 2, 3]. These tumors are classified as either typical (low-grade) or atypical (intermediate-grade) carcinoids [4, 5, 6], with most pediatric cases being typical carcinoids that demonstrate favorable outcomes following complete surgical resection [7, 8].

Diagnosis is frequently delayed because presenting symptoms often mimic more common respiratory conditions such as asthma, recurrent pneumonia, or other infectious and inflammatory pulmonary diseases [1, 9, 10]. Most pediatric bronchial carcinoids present as centrally located endobronchial lesions, with typical carcinoids rarely demonstrating peripheral distribution [7, 10, 11]. We describe a 15-year-old male with a typical bronchial carcinoid presenting atypically as a rounded right upper lobe pulmonary nodule rather than the classic

centrally obstructing endobronchial lesion, which led to an initial diagnostic evaluation focused on infectious etiologies.

### Case Presentation

A previously healthy 15-year-old male presented with progressive constitutional and respiratory symptoms. Approximately one month before presentation, he had travelled to Ohio. Upon returning, he developed upper respiratory symptoms. Over the following days, his symptoms progressively worsened, with development of chest pain, sore throat, chills, nausea, and fever to 101°F, prompting presentation to the emergency department. Additional history was notable for an unintentional weight loss of approximately 6–10 pounds over the preceding 2–4 weeks. The family additionally reported prolonged exposure to farm animals and pond water during travel.

On physical examination, the patient appeared ill with tachycardia but otherwise had stable vital signs. Breath sounds were clear bilaterally

without wheezing, rhonchi, or crackles, despite an endobronchial mass identified on subsequent evaluation. Chest wall tenderness and generalized abdominal tenderness were present on palpation; the remainder of the examination, including cardiovascular, musculoskeletal, skin, and neurological assessments, was unremarkable. Family history was noncontributory. He had no history of tobacco or substance exposure.

## Investigations

Initial laboratory evaluation showed mild leukocytosis with neutrophil predominance and elevated inflammatory markers, suggesting an acute inflammatory process. C-reactive protein was elevated at 22.8 mg/L on admission (reference range 0.0–5.0 mg/L) and normalized to 0.5 mg/L by day 5.

An extensive infectious evaluation, including testing for tuberculosis (QuantiFERON-TB Plus and MTB PCR), endemic fungal infections (Histoplasma, Blastomyces, and Coccidioides), HIV, CMV, Bartonella, and Mycoplasma, was unrevealing. EBV serologies showed positive VCA IgG and EBNA IgG, indeterminate VCA IgM, and negative EA antibody. Mycoplasma IgM was equivocal by EIA with negative Mycoplasma PCR. Serum chromogranin A was mildly elevated at 107 ng/mL.

Chest radiography demonstrated a right upper lobe perihilar circumscribed soft tissue density nodule measuring  $2.3 \times 2.6$  cm (**Figure 1A, B**). Chest CT demonstrated a  $2.3 \times 1.9 \times 2.1$  cm rounded right upper lobe mass centered within and expanding the right upper lobe anterolateral segment bronchus (B2b), with an adjacent enlarged right hilar lymph node measuring  $2.5 \times 1.4$  cm (**Figure 2A- B**). Despite its endobronchial origin, the lesion demonstrated a predominantly rounded parenchymal nodular appearance without evidence of post-obstructive collapse, an atypical radiographic presentation for pediatric bronchial carcinoid, which more commonly presents with atelectasis or recurrent pneumonia.

After five days of inconclusive infectious workup, bronchoscopic assessment identified a circumferential endobronchial mass involving the anterior segment of the right upper lobe, and biopsy specimens were obtained. Histopathologic examination confirmed a low-grade neuroendocrine tumor consistent with typical carcinoid (**Figure 3**). Immunohistochemistry was positive for synaptophysin, chromogranin, and AE1/AE3. The tumor demonstrated fewer than 2 mitoses per  $2 \text{ mm}^2$ , no necrosis, and a Ki-67 proliferation index of approximately 3%, consistent with a typical carcinoid tumor [4].

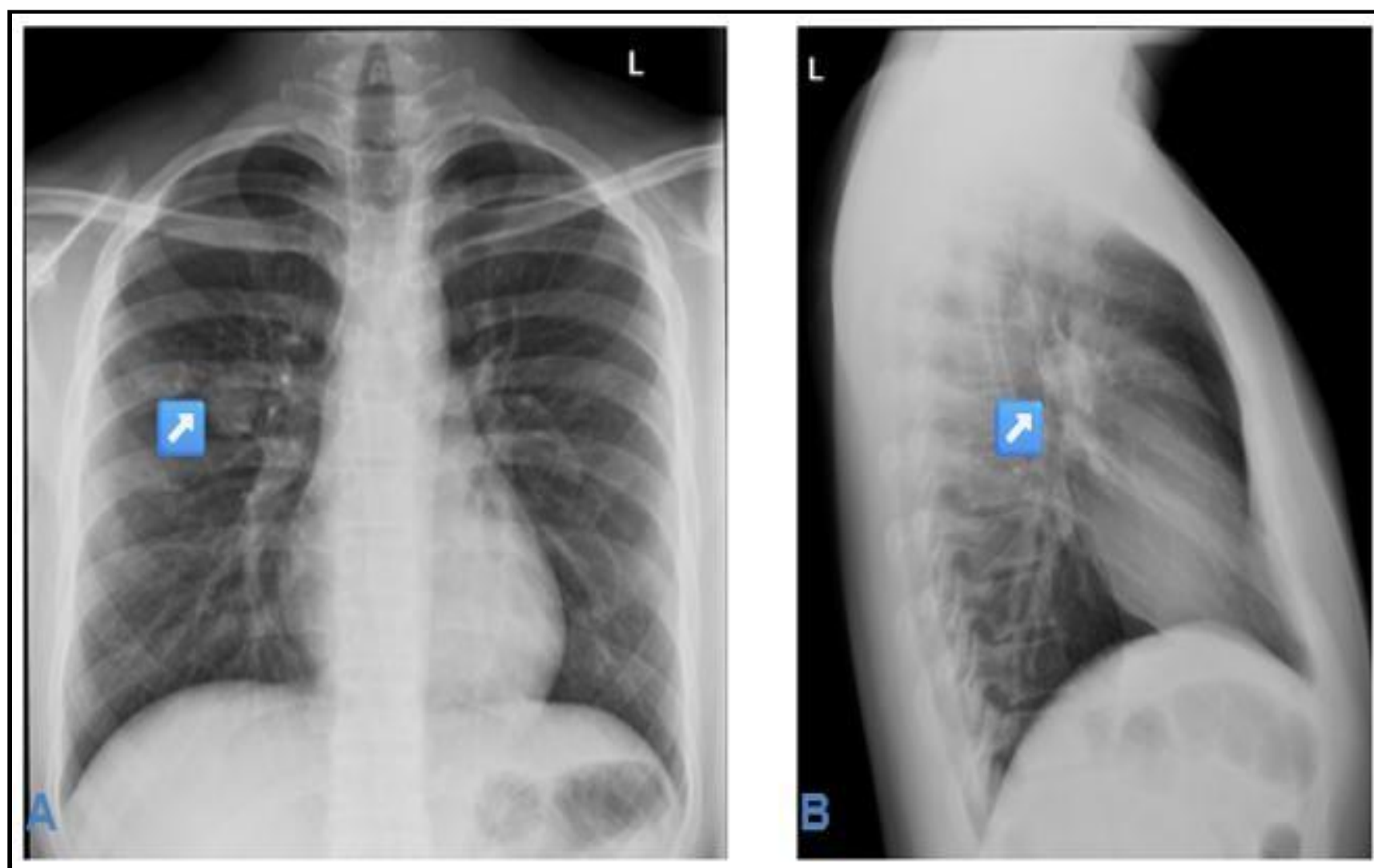


**Figure 1:** Chest X-ray, PA (A) and lateral (B) views showing a right upper lobe (RUL) nodular opacity (arrow)

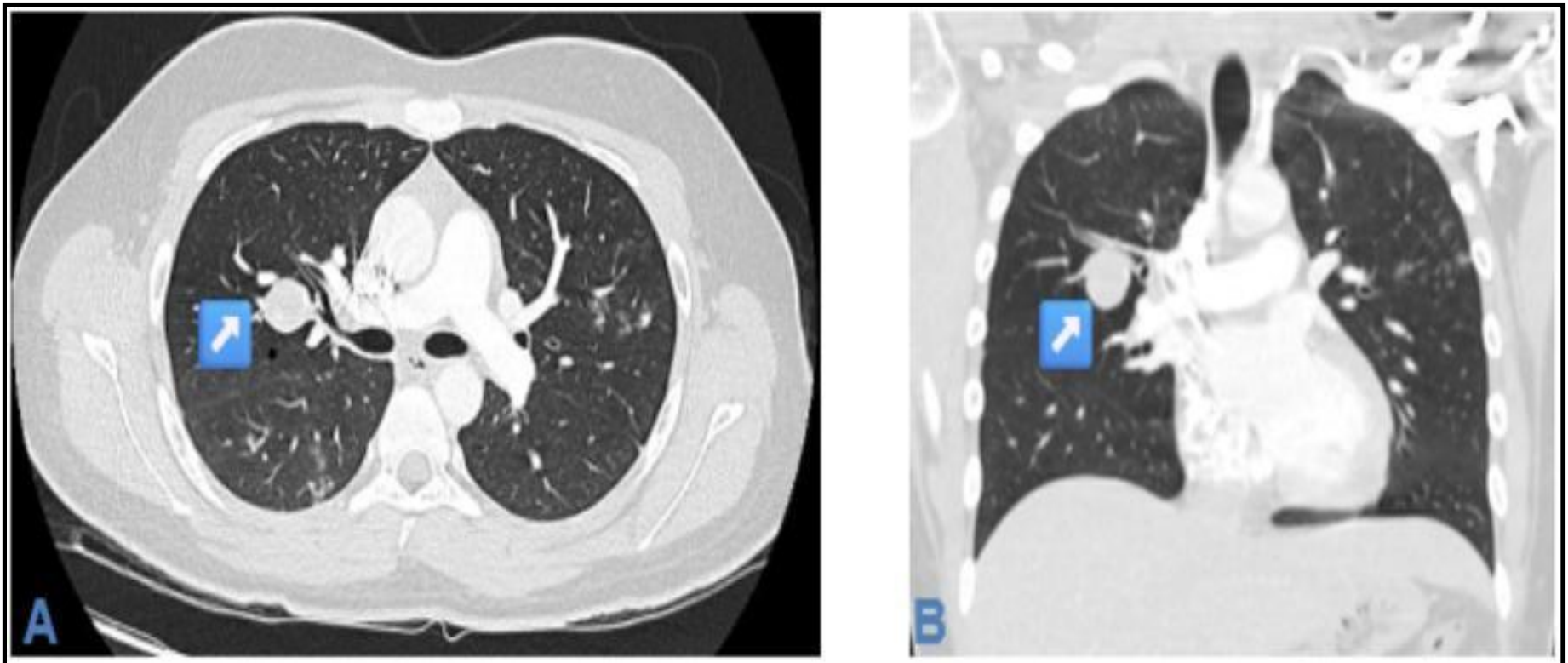


**Figure 2:** Chest CT scan, axial (A) and coronal (B) views showing a well-circumscribed RUL mass abutting the segmental bronchus (arrow)



**Figure 3:** Flexible bronchoscopy demonstrating a circumferential endobronchial mass involving the anterior segment of the right upper lobe bronchus.

Gallium-68 DOTATATE PET performed one month later demonstrated a hyperintense tracer-avid right upper lobe mass with tracer activity markedly above the spleen, consistent with a carcinoid tumor (**Figure 4**). Two distinct foci of tracer activity projecting over the sellar/pituitary area were interpreted as probable misregistered

physiological uptake. The enlarged right hilar node seen on CT showed no tracer avidity, and no other suspicious tracer-avid lesion was identified to suggest nodal or distant metastases. A repeat chest CT before surgery showed the right hilar node had decreased to  $1.8 \times 1.3$  cm.



**Figure 4:** Gallium-68 DOTATATE PET scan showing a hyperintense tracer-avid right upper lobe mass (arrow) with activity markedly above the spleen, consistent with a carcinoid tumor. No suspicious tracer-avid lesion to suggest nodal or distant metastases.

### Differential Diagnosis

Given the patient's constitutional symptoms, fever, elevated inflammatory markers, recent travel history, and pulmonary lesion, the initial differential diagnosis included infectious, inflammatory, and neoplastic etiologies. Infectious considerations included bacterial pneumonia, tuberculosis, and endemic fungal infections, while sarcoidosis was considered a less likely inflammatory cause. However, the persistence of the rounded endobronchial lesion despite clinical improvement and normalization of inflammatory markers raised suspicion for a neoplastic process. The differential included bronchial carcinoid, inflammatory myofibroblastic tumor, and lymphoma based on the patient's age and imaging characteristics.

### Treatment and Outcome

Following multidisciplinary discussion and preoperative DOTATATE PET/CT demonstrating no radiotracer-avid lymphadenopathy or distant metastases, the patient underwent definitive surgical resection. Flexible bronchoscopy performed immediately prior to resection confirmed that the endobronchial tumor was seen in the right upper lobe bronchus extending into the anterior segmental bronchus, with no tumor in the other segmental bronchi or remaining airways. The right upper lobectomy was performed via right posterolateral thoracotomy. The anterior segmental bronchus containing the tumor was divided sharply under direct visualization to achieve a grossly negative bronchial margin; uninvolved segmental bronchi were divided with staplers. Small, soft lymph nodes were noted around the right hilum, and no abnormal hilar lymph nodes were identified on intraoperative inspection. No

lymph node sampling is described in the operative note, and no lymph nodes were submitted for pathologic examination, so the pathology of the enlarged hilar node seen on CT is unknown. Final pathology of the lobectomy specimen showed a single 2.4 cm typical carcinoid (neuroendocrine tumor, grade 1, well-differentiated) without spreading through air spaces, visceral pleural invasion, or lymphatic/vascular invasion. The bronchial margin was grossly free of tumor per the operative report and was not independently assessed by pathology. No regional lymph nodes were submitted or found in the specimen, so nodal status was not assessable (pNX). The postoperative course was notable for a moderate pneumothorax identified on chest radiography; the patient remained asymptomatic and was managed conservatively with incentive spirometry and serial chest radiographic monitoring. A follow-up CT performed approximately 3 months postoperatively demonstrated resolution of the pneumothorax, with no pleural effusion or adenopathy and expected postoperative changes in the right middle lobe and along the fissure. A 0.4 cm right lower lobe nodular density and several subcentimeter nodules ( $\leq 0.3$  cm) were also noted, and continued imaging follow-up is planned.

### Discussion

Pediatric bronchial carcinoid tumors are rare neuroendocrine neoplasms that often present with nonspecific respiratory symptoms, contributing to delayed diagnosis. Only limited pediatric case series have been reported in the literature [1, 9]. Most children present with recurrent pneumonia, persistent cough, wheezing, or respiratory distress secondary to airway obstruction by a centrally located

endobronchial lesion [1, 9, 10].

Our patient presented with constitutional symptoms, fever, a rounded pulmonary nodule, recent travel history, and elevated inflammatory markers, leading the initial differential diagnosis toward infectious etiologies, particularly endemic fungal disease. Although the tumor originated within the segmental bronchus, it demonstrated a predominantly rounded parenchymal appearance without post-obstructive atelectasis or recurrent pneumonia, representing an atypical radiographic presentation of pediatric bronchial carcinoid. In addition, physical examination revealed clear bilateral breath sounds without wheezing or rhonchi despite the presence of a circumferential endobronchial mass, further masking the underlying diagnosis. Previous pediatric series have consistently described bronchial carcinoids as centrally located endobronchial tumors with secondary obstructive changes [1, 9, 10]. Reports of pediatric bronchial carcinoid presenting as a rounded pulmonary nodule without associated obstructive changes appear to be exceedingly uncommon. The EBV serologic pattern—positive VCA IgG and EBNA IgG with indeterminate VCA IgM and negative EA antibody—may reflect nonspecific or residual IgM reactivity rather than acute infection. However, this profile can occasionally occur in active infection or reactivation [12]. Similarly, equivocal Mycoplasma IgM with negative PCR is of limited diagnostic value, as IgM can persist for months and be detected in healthy children [13]. These findings underscore the importance of interpreting serologic results in clinical context, particularly when molecular confirmation is available.

Histopathologic examination confirmed a typical carcinoid tumor, characterized by fewer than 2 mitoses per 2 mm<sup>2</sup> and absence of necrosis, distinguishing it from atypical carcinoid [4, 5]. The Ki-67 proliferation index was approximately 3% [4]. Although Ki-67 is not incorporated into the current WHO grading criteria for pulmonary carcinoids [6], it may provide complementary prognostic information and should be interpreted alongside established histopathologic features [4, 14]. Serum chromogranin A was mildly elevated, consistent with a low-grade neuroendocrine neoplasm [15].

Somatostatin receptor imaging contributed significantly to diagnostic evaluation and staging. Following histopathologic confirmation of a neuroendocrine tumor, Gallium-68 DOTATATE PET/CT demonstrated intense uptake within the primary pulmonary lesion with no evidence of nodal or distant metastases, providing whole-body staging that informed surgical planning [16]. Two foci of tracer activity projecting over the sellar/pituitary area were interpreted as probable misregistered physiological uptake, highlighting the importance of recognizing physiological and artifactual uptake patterns in pediatric patients [17]. Although increasingly established in adult neuroendocrine tumors, evidence supporting DOTATATE PET/CT in pediatric bronchial carcinoids remains limited, and further studies are needed to define its role in staging, surveillance, and treatment planning [16, 18].

Complete surgical resection remains the treatment of choice for bronchial carcinoid and is associated with excellent long-term

outcomes. Lung-sparing procedures, including sleeve resection and segmentectomy, are preferred in pediatric patients whenever feasible to preserve pulmonary function during growth and development [7, 8]. In our patient, lobectomy was performed rather than a lung-sparing approach because the tumor involved the anterior segmental bronchus with extension into the right upper lobe bronchus, precluding a parenchyma-sparing resection with adequate margins. Preoperative DOTATATE PET/CT showed no tracer-avid lymphadenopathy, and no abnormal hilar nodes were identified intraoperatively, consistent with the favorable staging profile typically observed in pediatric typical carcinoids [1, 10]; however, because no lymph nodes were examined histologically, nodal status could not be confirmed pathologically. Pediatric patients generally demonstrate excellent outcomes following complete resection, with reported 5-year survival approaching 95% for typical carcinoids [7, 8].

Long-term post-resection surveillance is recommended for patients with resected pulmonary carcinoids. Adult-derived guidelines suggest chest CT with abdominal imaging at 3–6 months post-resection, followed by imaging every 6–12 months for at least 7 years [19]; somatostatin receptor-based imaging is reserved for suspected progression [18]. More recent guidance suggests surveillance may be omitted for lymph node-negative typical carcinoid, but nodal status was not assessed pathologically in our patient [18]. Pediatric-specific surveillance recommendations are lacking. Although bronchial carcinoids are a recognized manifestation of MEN1 syndrome, recent pediatric series have not identified genetic predisposition syndromes in children with bronchial carcinoid tumors [20]. Nevertheless, given the young age at diagnosis and the evolving understanding of hereditary cancer predisposition in pediatric solid tumors, referral for genetic counseling may be considered on a case-by-case basis [21]. This report is limited by its single-case design, and the findings may not be generalizable. Follow-up is limited to approximately 3 months postoperatively and is ongoing, limiting assessment of long-term outcomes. Because no lymph nodes were submitted, nodal status (pNX) and the pathologic status of the enlarged hilar node could not be determined, and the bronchial margin was assessed grossly by the surgeon rather than independently by pathology.

This case highlights the importance of maintaining a broad differential diagnosis when evaluating pediatric pulmonary nodules. Bronchial carcinoid may present without the classic obstructive features of recurrent pneumonia or atelectasis and instead appear as a rounded pulmonary nodule that clinically mimics an infectious process. Bronchial carcinoid should therefore remain in the differential diagnosis of persistent pulmonary nodules in adolescents, even when the initial clinical presentation suggests infection. This case also supports the potential value of DOTATATE PET/CT as an adjunctive staging modality in pediatric bronchial carcinoid. However, larger studies are needed better to define its role in this population [16, 18].

## Learning Points

1. Bronchial carcinoid tumors in adolescents may present as rounded parenchymal nodules mimicking infectious granulomas rather than the classic centrally obstructing endobronchial lesion.
2. A persistent pulmonary lesion despite clinical improvement and normalization of inflammatory markers should raise suspicion for a neoplastic process, even when initial features favor infection.
3. Gallium-68 DOTATATE PET/CT is a valuable adjunct for staging once a neuroendocrine neoplasm is confirmed, though its role in pediatric bronchial carcinoids requires further study.
4. Complete surgical resection of typical bronchial carcinoid in pediatric patients is associated with 5-year survival rates of approximately 95%; lung-sparing procedures should be considered when feasible.
5. Adult-derived guidelines vary on post-resection surveillance (risk-stratified, with chest CT and abdominal imaging for at least

7 years when used), and pediatric-specific recommendations are lacking; genetic counseling may be considered given the young age at diagnosis.

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## Author Contributions:

**Mahesh Kumar Athwani:** Conceptualization, investigation, data curation, literature review, writing - original draft, and writing - review and editing.

**Aneela Bidiwala:** Supervision, conceptualization, writing, and editing. Reviewed and approved the final manuscript.

**All authors:** Contributed to patient care, literature review, and final manuscript review and editing.

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