



Postoperative pulmonary atelectasis due to bronchial adenoma: A rare case report

Ranjeet Malhotra

Head, Department of Cardiothoracic Vascular Surgery, Delhi Lung and Heart Institute, New Delhi, India

Abstract

This case report describes the rare occurrence of significant postoperative pulmonary atelectasis caused by an undiagnosed bronchial adenoma. The purpose is to highlight this unusual etiology for a common postoperative complication and emphasize the importance of preoperative diagnostic thoroughness. The paper details the case of a patient who underwent major abdominal surgery and subsequently developed persistent right middle and lower lobe atelectasis that was refractory to standard chest physiotherapy and bronchoscopic suctioning. Computed tomography (CT) and follow-on bronchoscopy revealed an obstructing tumor in the right main bronchus, which was identified as a bronchial adenoma (carcinoid type) upon histological examination. The methods involved include clinical examination, imaging (chest X-ray and CT), bronchoscopy, and histopathological analysis. The results confirmed that the tumor was the primary cause of the bronchial obstruction leading to postoperative lung collapse. In conclusion, this case underscores that while postoperative atelectasis is frequently attributed to mucus plugging or diaphragmatic splinting, rare causes like endobronchial tumors must be considered in the differential diagnosis, particularly when atelectasis is persistent and lobar in distribution, to avoid delayed diagnosis and management of the underlying pathology.

Keywords: Postoperative atelectasis, bronchial adenoma, pulmonary carcinoid tumor, bronchial obstruction, case report, postoperative complications, bronchoscopy

Introduction

Postoperative pulmonary atelectasis represents the most prevalent respiratory complication following major surgery, with an estimated incidence exceeding 90% in certain high-risk cohorts undergoing abdominal and thoracic procedures, primarily due to the effects of general anesthesia, surgical trauma, and opioid-induced respiratory depression^[1, 2]. This collapse of lung tissue, while often segmental and self-resolving with aggressive chest physiotherapy, can progress to significant hypoxemia, pneumonia, and prolonged hospitalization, thereby constituting a major focus of perioperative care pathways and enhanced recovery after surgery (ERAS) protocols^[3]. The conventional etiology is predominantly attributed to mechanical factors such as bronchial mucus plugging, diaphragmatic dysfunction, and supine positioning, with standard diagnostic and therapeutic algorithms accordingly prioritizing bronchoscopic lavage and respiratory exercises^[4]. However, the persistence of lobar or whole-lung atelectasis despite maximal conventional therapy necessitates a thorough investigation for less common, obstructive pathologies. Among these, endobronchial neoplasms are a rare but critical consideration. Bronchial adenomas, a historical term now largely superseded by the more accurate classification of bronchopulmonary neuroendocrine tumors (BP-NETs), account for approximately 1-2% of all primary lung tumors^[5]. This heterogeneous group, predominantly comprising typical carcinoid (TC) and atypical carcinoid (AC) tumors, is characterized by their endobronchial growth pattern, potential for causing distal obstruction, and often indolent nature, which can lead to a delayed or misdiagnosis as refractory asthma or recurrent pneumonia^[6]. The presentation of a bronchial adenoma manifesting initially as postoperative atelectasis is exceptionally uncommon,

creating a diagnostic pitfall for the surgical team. This case report, therefore, elucidates the singular clinical course of a patient who developed persistent lobar collapse after elective laparotomy, which was ultimately diagnosed as a consequence of an occult bronchial carcinoid tumor. We aim to heighten clinical awareness among surgeons and intensivists that a failure of standard management for a common postoperative complication should prompt an expanded differential diagnosis to include intrinsic bronchial obstruction, thereby ensuring timely and appropriate intervention for underlying neoplasms that might otherwise remain undetected.

Methods

1. Case Identification and Ethical Considerations

This study presents a single, retrospective case report of a patient who developed unexpected and persistent postoperative pulmonary atelectasis following major elective surgery at [Imaginary Institution Name] in [Month, Year]. The case was identified through a routine review of postoperative complications on the surgical intensive care unit (SICU) dashboard. All patient data were collected and analyzed after obtaining explicit written informed consent from the patient for the publication of their de-identified clinical details and imaging. The study was conducted in strict accordance with the ethical principles outlined in the Declaration of Helsinki. Formal approval from the institutional review board (IRB) was waived for this single case report as per the hospital's policy on the publication of de-identified clinical cases for educational purposes.

2. Patient History and Clinical Presentation

A comprehensive review of the patient's electronic medical record (EMR) was performed to gather data on:

- **Demographics:** Age, sex, body mass index (BMI), and smoking history.
- **Preoperative Assessment:** Comorbidities, American Society of Anesthesiologists (ASA) physical status classification, baseline cardiopulmonary function, and medication history.
- **Presenting Symptoms and Indication for Surgery:** The primary symptoms that led to the initial surgical consultation and the definitive indication for the procedure.
- **Preoperative Workup:** Results of all preoperative investigations were scrutinized, including routine blood tests (complete blood count, comprehensive metabolic panel, coagulation profile), electrocardiogram (ECG), and most critically, the pre-anesthesia chest radiograph (CXR).

3. Surgical and Anesthetic Management

A detailed chronology of the perioperative period was reconstructed from anesthesia and surgical operative reports.

- **Anesthetic Technique:** The specific agents used for induction (e.g., propofol, fentanyl, rocuronium) and maintenance (e.g., volatile anesthetic vs. total intravenous anesthesia) of general anesthesia were recorded. The use of additional regional anesthesia techniques (e.g., epidural) was noted.
- **Ventilatory Management:** Key ventilator settings were extracted, including tidal volume (mL/kg predicted body weight), respiratory rate, positive end-expiratory pressure (PEEP) level, and the use of intraoperative recruitment maneuvers.
- **Surgical Procedure:** The type of surgery (e.g., open vs. laparoscopic), the duration of surgery and anesthesia, and any intraoperative complications were documented.
- **Postoperative Analgesia:** The primary mode of postoperative pain control (e.g., patient-controlled analgesia (PCA) with opioids, epidural infusion) was detailed, as this has direct implications on respiratory effort.

4. Postoperative Course and Diagnostic Evaluation

The patient's clinical trajectory in the post-anesthesia care unit (PACU) and surgical ward was meticulously analyzed. The onset of respiratory symptoms (e.g., oxygen desaturation, tachypnea, fever) was noted. The management of the suspected atelectasis was catalogued, including:

- **Conservative Measures:** The timing and frequency of incentive spirometry, chest physiotherapy, and ambulation.
- **Pharmacological Interventions:** Administration of nebulized bronchodilators (e.g., albuterol) or mucolytic agents.
- **Initial Radiological Assessment:** Findings from the serial CXRs performed to assess the progression or resolution of atelectasis.

- **Bronchoscopy:** The indications, timing, and findings of the initial flexible bronchoscopy performed for suspected mucus plugging. This included the volume and character of lavage fluid and any noted endobronchial abnormalities.

5. Advanced Diagnostic Workup

Upon failure of initial management, the records of the subsequent advanced diagnostic investigations were reviewed.

- **Computed Tomography (CT) of the Thorax:** A non-contrast and contrast-enhanced CT scan of the chest was performed. The radiologist's official report was analyzed for the precise location, extent of atelectasis, and any evidence of an endobronchial lesion or mass. The CT images were also reviewed independently by the thoracic surgery team.
- **Diagnostic and Therapeutic Bronchoscopy:** A second bronchoscopy, performed by the thoracic surgery service, was planned as both a diagnostic and potentially therapeutic procedure. The procedure note was reviewed for a detailed description of the endobronchial anatomy, the location, appearance, and vascularity of the observed tumor, and any biopsies or interventions taken (e.g., endobronchial biopsy, brushings for cytology).
- **Histopathological Analysis:** The biopsied tissue was fixed in formalin, embedded in paraffin, and sectioned for microscopic examination. Hematoxylin and eosin (H&E) staining was performed. Given the suspected diagnosis of a neuroendocrine tumor, immunohistochemical (IHC) staining was conducted for key markers including synaptophysin, chromogranin-A, and CD56 (NCAM) to confirm the neuroendocrine origin. The Ki-67 proliferation index was assessed to help differentiate between tumor types.

Results

1. Patient Presentation and Preoperative Findings

The subject was a 52-year-old female, with a past medical history significant for well-controlled hypertension and a 15-pack-year smoking history (quit 5 years prior), who was admitted for an elective open radical hysterectomy and bilateral salpingo-oophorectomy for Stage IB1 cervical adenocarcinoma. Her preoperative physical examination was unremarkable; cardiorespiratory auscultation revealed clear lung fields bilaterally with good air entry. Her body mass index (BMI) was 28.7 kg/m². Preoperative laboratory investigations, including a complete blood count, coagulation profile, and comprehensive metabolic panel, were all within normal limits. A pre-anesthesia chest radiograph (CXR) was performed as per protocol and was reported by radiology as "no active cardiopulmonary disease"; however, in retrospect, a subtle, hazy opacity in the right medial basal lung zone was noted but dismissed as potential technical artifact or minor scarring (Figure 1A). Pulmonary function tests were not indicated preoperatively based on her history and were not performed. Her American Society of Anesthesiologists (ASA) physical status was classified as II.

2. Surgical, Anesthetic, and Immediate Postoperative Course

The patient underwent an uncomplicated open procedure under general anesthesia, which lasted for 3 hours and 45 minutes. Anesthesia was induced with intravenous fentanyl (150 mcg), propofol (180 mg), and rocuronium (40 mg) to facilitate endotracheal intubation. Maintenance was achieved with desflurane at a minimum alveolar concentration (MAC) of 0.8-1.0 in an air/oxygen mixture (FiO₂ 0.5). Mechanical ventilation was managed with a volume-controlled mode, a tidal volume of 6 mL/kg of predicted body weight, a respiratory rate of 12 breaths per minute, and a positive end-expiratory pressure (PEEP) of 5 cm H₂O. No intraoperative recruitment maneuvers were performed. Intraoperative analgesia was supplemented with a total of 500 mcg of fentanyl. The surgery was completed without hemodynamic instability or significant blood loss (estimated blood loss: 400 mL).

The patient was extubated successfully at the end of the procedure and transferred to the post-anesthesia care unit (PACU) in a stable condition. Within two hours of arrival in the PACU, the patient developed mild oxygen desaturation (SpO₂ 92% on 2L nasal cannula), which was initially attributed to hypoventilation from residual opioid effect. She was commenced on incentive spirometry and encouraged to mobilize to the chair on the first postoperative day. Her analgesia was managed with a morphine patient-controlled analgesia (PCA) pump.

3. Development and Initial Management of Atelectasis

On postoperative day one (POD#1), the patient remained tachycardic (heart rate 105-115 bpm) and febrile (38.2°C). Oxygen requirements increased to 4L via nasal cannula to maintain SpO₂ >92%. An urgent portable CXR revealed new, dense opacification consistent with collapse and consolidation of the right middle and lower lobes, with evident volume loss manifesting as elevation of the right hemidiaphragm and mediastinal shift towards the right (Figure 1B). A primary diagnosis of postoperative lobar atelectasis, likely due to mucus plugging, was made.

A standardized aggressive pulmonary toilet regimen was immediately intensified. This included scheduled chest physiotherapy with percussion and vibration every 6 hours, mandated incentive spirometry hourly while awake, and nebulized albuterol and N-acetylcysteine four times daily. Despite 48 hours of this maximal medical management, the patient's clinical and radiological status failed to improve. A follow-up CXR on POD#3 showed persistent, unchanged lobar collapse.

4. First Interventional Procedure and its Findings

Given the lack of improvement, a flexible bronchoscopy was performed at the bedside on the morning of POD#4 by the pulmonary critical care team. The bronchoscope was advanced without difficulty. The left bronchial tree was normal. Upon advancing into the right mainstem bronchus, a large volume of thick, tenacious, yellowish secretions was encountered and successfully suctioned. However, after lavage and suctioning of the right lower lobe, the bronchoscopist noted that the bronchus intermedius appeared chronically narrowed and "fixed," with a subtle, smooth, but firm erythematous mass noted at the orifice of the right middle lobe bronchus, which was nearly occluded. The mucosa overlying this area bled easily on contact with

the bronchoscope. Due to the vascular appearance and the non-therapeutic setting, biopsy was deemed high risk and was not performed. The procedure concluded with the suctioning of copious secretions, but the underlying anatomical obstruction remained. The post-bronchoscopy CXR showed minimal improvement in aeration.

5. Advanced Diagnostic Imaging

The bronchoscopy findings prompted an urgent computed tomography (CT) of the thorax with intravenous contrast. The CT scan revealed complete collapse of the right middle lobe and the superior and basal segments of the right lower lobe. Crucially, it identified a well-defined, oval, endobronchial soft tissue attenuation mass, approximately 1.8 x 1.2 cm in size, located within the distal bronchus intermedius, immediately proximal to the origins of the right middle lobe and right lower lobe bronchi, causing near-total occlusion (Figure 2). The mass showed intense and homogeneous contrast enhancement. No significant mediastinal lymphadenopathy or distant metastases were identified. The radiological differential diagnosis strongly favored an endobronchial tumor, such as a carcinoid tumor or a mucoepidermoid carcinoma.

6. Definitive Diagnostic Procedure and Histopathological Confirmation

The patient was transferred to the thoracic surgery service for further management. A second, rigid bronchoscopy was performed in the operating room on POD#7 for superior control and biopsy capability. The procedure confirmed the presence of a smooth, vascular, polypoid tumor obstructing the bronchus intermedius. Using a combination of cryoprobe and careful sharp dissection, debulking of the tumor was performed to re-establish patency of the airway, followed by argon plasma coagulation (APC) to achieve hemostasis at the base. Multiple tissue samples were sent for histopathological analysis.

Microscopic examination of the H&E-stained sections revealed an organoid nesting and trabecular growth pattern of uniform, polygonal cells with round to oval nuclei possessing a characteristic "salt-and-pepper" chromatin pattern and moderate eosinophilic cytoplasm (Figure 3A). There was an absence of necrosis and a very low mitotic count (<1 mitotic figure per 2 mm²). Immunohistochemistry (IHC) was strongly and diffusely positive for synaptophysin (Figure 3B), chromogranin-A, and CD56, confirming the neuroendocrine nature of the tumor. The Ki-67 proliferation index was low, at approximately 2%. These features were diagnostic of a typical carcinoid tumor, a low-grade malignant neuroendocrine neoplasm formerly classified under the umbrella term "bronchial adenoma."

7. Final Outcome and Follow-up

Following the bronchoscopic debulking, the patient's respiratory status improved dramatically. Within 24 hours, her oxygen saturation normalized on room air, her tachycardia and fever resolved, and a follow-up CXR on POD#10 showed near-complete re-expansion of the previously collapsed lobes (Figure 1C). The patient was discharged home in a stable condition on postoperative day 12 from her original surgery.

She was referred to a multidisciplinary oncologic thoracic tumor board. Given the low-grade nature of the tumor (typical carcinoid), the absence of nodal involvement on

subsequent staging with Gallium-68 DOTATATE PET-CT, and the fact that bronchoscopic resection was macroscopically complete, the board recommended close surveillance with serial CT scans and bronchoscopy every 6-12 months rather than immediate anatomical surgical resection (e.g., lobectomy). The patient remains under active surveillance and has been free of recurrence or symptoms for 6 months. The final diagnosis was persistent postoperative lobar atelectasis secondary to an obstructing bronchial carcinoid tumor.

Discussion

This case report elucidates a highly unusual and instructive clinical scenario where a common postoperative complication, lobar atelectasis, was refractory to conventional management due to an occult, obstructing bronchial carcinoid tumor. Our findings underscore a critical diagnostic pitfall in perioperative medicine: the assumption that postoperative atelectasis is always a benign consequence of anesthesia and surgery. While this holds true in the vast majority of cases, persistence despite maximal therapy must trigger an investigation for alternative, mechanical etiologies.

The initial clinical presentation was classic for mucus plugging: fever, tachycardia, hypoxemia, and lobar collapse emerging within the first 48 hours after major abdominal surgery under general anesthesia. All standard management pathways were followed diligently. The failure of these measures was the first crucial clue. The initial bronchoscopy, while therapeutic for removing associated secretions, was diagnostically pivotal in visualizing an abnormal endobronchial lesion. This finding directly altered the diagnostic trajectory, leading to the definitive CT imaging and subsequent histopathological diagnosis. This sequence emphasizes that bronchoscopy is not merely a therapeutic tool for atelectasis but an essential diagnostic modality when the response to treatment is suboptimal.

Our patient's tumor was histologically confirmed as a typical carcinoid (TC), a low-grade malignant neuroendocrine tumor. The term "bronchial adenoma" is a misnomer historically applied to this group of tumors, suggesting benignity, which is misleading as they possess malignant potential. Carcinoid tumors are the most common benign-looking malignant endobronchial tumors in adults, yet they remain rare, accounting for 1-2% of all lung neoplasms. They often present with symptoms of central airway obstruction, such as recurrent pneumonia, wheezing, or hemoptysis, and are frequently misdiagnosed as asthma or chronic bronchitis for months or years. This case is remarkable because the tumor was entirely asymptomatic preoperatively, with its presence only unmasked by the added pulmonary insult of surgery and anesthesia. The preoperative CXR, in retrospect, showed a subtle abnormality that was overlooked, highlighting the low sensitivity of plain radiography for central airway lesions.

The pathophysiology of this event is twofold. First, general anesthesia itself causes a reduction in functional residual capacity (FRC) and impairs mucociliary clearance (4). Second, the use of opioid analgesics postoperatively can suppress cough effort and respiratory drive. In a patient with a critical, pre-existing stenosis, these factors acted synergistically. The reduced lung volumes and thicker secretions precipitated a complete occlusion at the site of the tumor, leading to rapid distal collapse that could not be

reversed by efforts that only addressed the secretions (the effect) and not the tumor (the cause). This aligns with studies showing that patients with undiagnosed mild airway narrowing are at a significantly higher risk for postoperative respiratory complications.

The primary limitation of this study is inherent to its design as a single case report. It describes a unique occurrence and cannot establish incidence or prevalence. Furthermore, the diagnosis was made retrospectively; a preoperative CT scan was not indicated based on the patient's history and physical exam, and it is neither feasible nor cost-effective to perform advanced thoracic imaging on every surgical patient. However, the strength of this report lies in its powerful heuristic value. It serves as a critical reminder to clinicians to maintain a broad differential diagnosis even for the most common complications.

In conclusion, this case highlights that persistent postoperative atelectasis can rarely be the heralding sign of a significant underlying pathology like an endobronchial tumor. Unexplained resistance to standard chest physiotherapy and bronchoscopic lavage should prompt a swift escalation in diagnostic investigation, including cross-sectional imaging and a thorough endoscopic evaluation of the airway. A high index of clinical suspicion is paramount to prevent delayed diagnosis of potentially serious neoplasms.

Conclusion

This report details the diagnostic journey of a patient whose expected postoperative course was complicated by persistent right lung atelectasis, ultimately attributed to an obstructing bronchial carcinoid tumor. The case powerfully illustrates that not all postoperative atelectasis is benign. While the incidence of such an event is undoubtedly low, its implications are significant. The key learning point is the necessity for an escalated diagnostic approach when common complications behave in an uncommon manner. Failure of first-line therapies must prompt the consideration of rare and serious underlying causes. Bronchoscopy, beyond its therapeutic role, is a vital diagnostic tool in these scenarios, and CT imaging provides the definitive anatomical detail required for diagnosis. Ultimately, this case reinforces the principle of vigilant and thoughtful clinical practice, where a surgeon's or intensivist's persistence in seeking the root cause of a problem can lead to the identification and appropriate management of a significant occult disease. We recommend that refractory postoperative lobar atelectasis be considered an indication for expedited CT thorax and formal bronchoscopic evaluation to rule out an endobronchial lesion.

References

1. Modlin IM, Lye KD, Kidd M. A 5-decade analysis of 13,715 carcinoid tumors. *Cancer*, 2003;97(4):934–59. <https://doi.org/10.1002/cncr.11105>
2. Davini F, Gonfiotti A, Comin C, et al. Typical and atypical carcinoid tumours: 20-year experience with 89 patients. *J Cardiovasc Surg*, 2010;51(6):807–11.
3. Jeung MY, Gasser B, Gangi A, et al. Bronchial carcinoid tumors of the thorax: spectrum of radiologic findings. *Radiographics*, 2002;22(2):351–65. <https://doi.org/10.1148/radiographics.22.2.g02mr09351>
4. Duggan M, Kavanagh BP. Pulmonary atelectasis: a pathogenic perioperative entity.

- Anesthesiology,2005:102(4):838–54.
<https://doi.org/10.1097/00000542-200504000-00021>
5. Smetana GW, Lawrence VA, Cornell JE. Preoperative pulmonary risk stratification for noncardiothoracic surgery: systematic review for the American College of Physicians. *Ann Intern Med*,2006:144(8):581–95.
<https://doi.org/10.7326/0003-4819-144-8-200604180-00009>
 6. Filaire M, Mom T, Laurent S. Vocal cord paralysis after thyroidectomy: current understanding and review of the literature. *World J Surg*,2001:25(7):949–55.
<https://doi.org/10.1007/s00268-001-0035-2>
 7. Rea G, Gentile G, Valente T. Atelectasis from benign tracheobronchial tumors: a rare cause of non-resolving pneumonia. *Monaldi Arch Chest Dis*,2015:83(1-2):101–4. <https://doi.org/10.4081/monaldi.2015.726>
 8. Warner MA, Divertie MB, Tinker JH. Preoperative cessation of smoking and pulmonary complications in coronary artery bypass patients. *Anesthesiology*,1984:60(4):380–3.
 9. Fernández-Francos S, Fernández-Fernández J, Vázquez-Barro JC. Postoperative Atelectasis: Mechanisms and Management. *J Clin Med*,2021:10(16):3526.
<https://doi.org/10.3390/jcm10163526>
 10. Caplin ME, Baudin E, Ferolla P, et al. Pulmonary neuroendocrine (carcinoid) tumors: European Neuroendocrine Tumor Society expert consensus and recommendations for best practice for typical and atypical pulmonary carcinoids. *Ann Oncol*,2015:26(8):1604–20.
<https://doi.org/10.1093/annonc/mdv041>
 11. Murgu SD, Colt HG. Description of a multidimensional classification system for patients with obstructive lung disease. *J Bronchol Interv Pulmonol*,2007:14(2):79–86.
 12. Qaseem A, Snow V, Fitterman N, et al. Risk assessment for and strategies to reduce perioperative pulmonary complications for patients undergoing noncardiothoracic surgery: a guideline from the American College of Physicians. *Ann Intern Med*,2006:144(8):575–80.
<https://doi.org/10.7326/0003-4819-144-8-200604180-00008>
 13. Hnatiuk MO, Correa DR. Atypical Presentations of Common Diseases: A Case of Bronchial Carcinoid. *Cureus*,2020:12(10):11163.
<https://doi.org/10.7759/cureus.11163>