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Case Report

Acquired Bronchial Stenosis in a Pediatric Patient, with Surgical Management by Bronchoplasty: Case Report

Paola Palomares Capetillo[1]*, Marco Antonio Cruz López[1], Rosangela Del Razo Rodríguez[2] and Marco Antonio Iñiguez García[3]

[1]Postgraduate Unit of the Faculty of Medicine of the National Autonomous University of Mexico, Mexico

[2]Pediatric Bronchoscopy Service of the National Institute of Respiratory Diseases Dr. Ismael Cosío Villegas, Mexico City, Mexico

[3]Thoracic Surgery Service of the National Institute of Respiratory Diseases Dr. Ismael Cosío Villegas, Mexico City, Mexico

***Corresponding Author:** Paola Palomares Capetillo, Postgraduate Unit of the Faculty of Medicine of the National Autonomous University of Mexico, Mexico.

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Abstract

Lower airway obstructions in children are usually caused by various conditions. In acute scenarios, the main differential to rule out is foreign body aspiration. Less frequent causes can be classified as congenital or acquired, with the latter being much less common in the pediatric population and often underdiagnosed due to mild symptoms. We present the case of an 8-year-old male, born prematurely and requiring orotracheal intubation during the neonatal period, with recurrent respiratory infections during the first two years of life. He was later diagnosed with tracheal and bronchial stenosis, requiring multiple bronchoscopies and a right middle and lower bilobectomy with upper lobe bronchoplasty. He continues follow-up with favorable evolution three years post-surgery.

Keywords: *Bronchial Stenosis; Bronchoplasty; Pediatrics; Bronchoscopy; Case Report*

Introduction

Lower airway stenosis in children is rare, especially when compared to subglottic or tracheal stenosis, and even rarer when acquired rather than congenital [1]. Clinical manifestations may be mild and go unnoticed, delaying diagnosis. A common finding in pediatric patients with bronchial stenosis is wheezing that does not improve with bronchodilators [2,3]. We present the case of a male patient who required advanced airway management during the neonatal period and later presented with wheezing and recurrent pneumonias. He was diagnosed with acquired bronchial stenosis and underwent successful surgical management. This manuscript was prepared following the CARE guidelines (https://www.care-statement.org).

Case Presentation

We present the case of an 8-year-old male, born to a diabetic father and healthy mother, second pregnancy. He was delivered via cesarean section at 35.2 weeks of gestation due to premature rupture of membranes, after receiving a full course of antenatal corticosteroids. APGAR scores were 8/9, birth weight was 2250g, and length was 46 cm. He developed neonatal sepsis and congenital pneumonia, with

three episodes of cardiopulmonary arrest lasting 30, 10, and 15 minutes, respectively. He required advanced airway management and invasive mechanical ventilation for 15 days. He was discharged at 54 days of life with supplemental oxygen at 1.5 L/min.

From 6 months to 2 years and 7 months of age, he experienced 8 episodes of community-acquired pneumonia, treated with multiple antibiotic regimens ranging from ampicillin with clarithromycin to cefepime. At 2 years and 8 months, he was referred to our institution for evaluation of recurrent pneumonia (Figure 1a). A first bronchoscopy was performed on March 21, 2019, revealing distal tracheal stenosis (Cotton I), right main bronchus stenosis (Cotton III), and bronchomalacia of the left lower lobe bronchus (Figure 1b). Balloon dilations (5 mm x 2 cm at 3 atmospheres) were performed in three 30-second sessions, achieving a 50% residual lumen of the right main bronchus. Tuberculosis was ruled out via bronchoalveolar lavage. A scheduled dilation one month later showed recurrent stenosis (70%), leaving a 30% residual lumen.

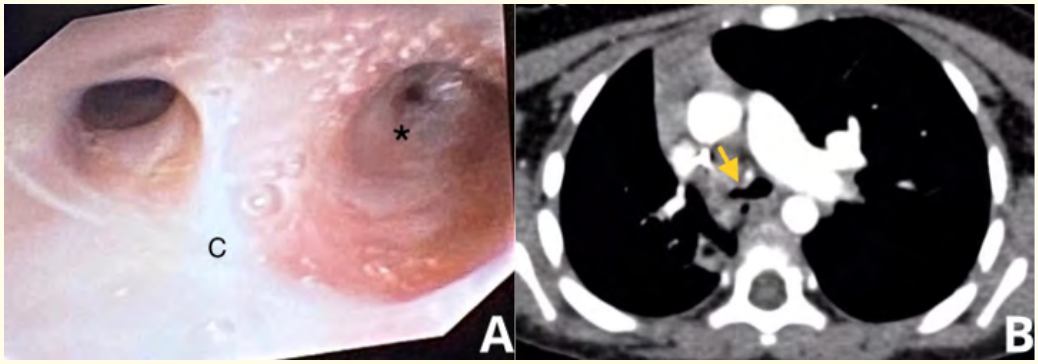

Figure 1: *A) Preoperative bronchoscopy showing significant stenosis of the right main bronchus (*). C: Carina. B) Initial CT scan demonstrating right main bronchus stenosis (yellow arrow), secondary atelectasis, mediastinal shift, and compensatory hyperinflation of the left lung.*

At 3 years of age, he had another episode of pneumonia. A follow-up bronchoscopy was planned for March 2020 but was postponed due to the COVID-19 pandemic; as he was asymptomatic, outpatient follow-up was continued. He returned to our hospital at age 5 in March 2022, with a diagnosis of asthma exacerbation and insulin resistance, and obesity. A new bronchoscopy showed distal tracheal stenosis (Cotton I) and right main bronchus stenosis (Cotton II), which was dilated up to 10 atmospheres, leaving a 20% residual lumen. One month later, he had another pneumonia episode with right pleural effusion, which resolved without complications. A multidisciplinary team decided to proceed with surgical management.

On June 28, 2022, a right thoracotomy was performed. Intraoperative findings included a 1 cm-long stenosis of the right main bronchus and hypoplastic middle and lower lobes. A middle and lower bilobectomy with bronchoplasty (modified Okada classification type D) was performed (Figure 2). Intraoperative bronchoscopy confirmed adequate bronchial lumen. The patient was discharged two weeks postoperatively without complications.

In October 2022, four months after surgery, follow-up bronchoscopy revealed Cotton III stenosis of the right main bronchus. Balloon dilation was performed, achieving a 50% residual lumen. He remained stable, with no further respiratory infections or hospitalizations

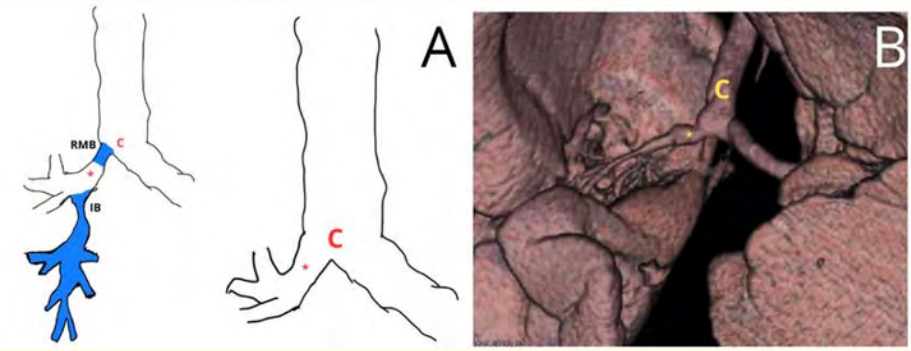

Figure 2: *A) Diagram depicting the patient's stenosis (left) and its resection (right), type D bronchoplasty. B) CT reconstruction three years postoperatively, showing a patent right airway. C: Carina; RMB: Right Main Bronchus; IB: Intermediate Bronchus; *: Right upper lobe bronchus.*

until February 2025, when he presented with increased dyspnea and cough. A follow-up bronchoscopy showed Cotton I distal tracheal stenosis, 30% stenosis of the right main bronchus, 20% stenosis of the left main bronchus, and dynamic collapse of the left lower lobe bronchus (Figure 3). Given these findings, which have minimal clinical impact, and considering the negative influence of obesity, the multidisciplinary team decided not to perform further dilations and instead emphasized the importance of strict weight control in order to improve malacia.

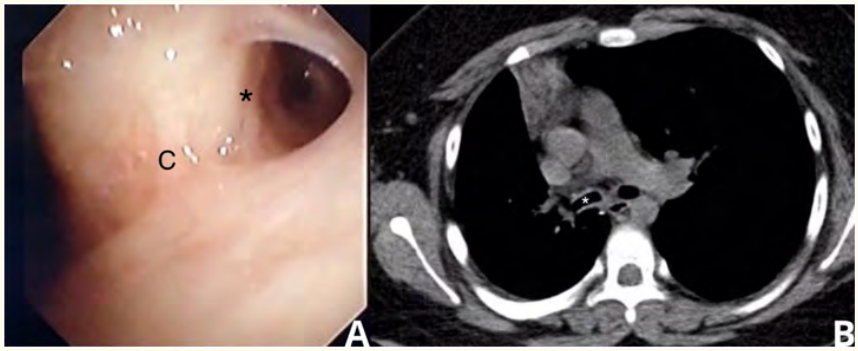

Figure 3: *A) Most recent follow-up bronchoscopy from February 2025, showing membranous Cotton II stenosis of the right main bronchus (*) without impact on ventilatory mechanics. C: Carina. B) Latest CT scan at three years post-surgery, demonstrating significant improvement in the distal right airway lumen compared to the preoperative study (*).*

The patient continues to do well nearly three years after surgery, he remains healthy without the need for supplemental oxygen or drug treatment for respiratory symptoms.

Discussion

As mentioned by Delorimier., *et al*. in their series of 45 patients with tracheobronchial obstruction, diagnosis is often delayed, as seen in our case, where the patient was referred to a tertiary center only after experiencing eight episodes of recurrent pneumonia. Delorimier emphasizes that all infants and neonates with stridor and increased work of breathing should undergo immediate airway evaluation. We would add that children with recurrent pneumonias and bronchodilator-resistant wheezing should also be promptly referred.

Anton-Pacheco., *et al*. describe isolated bronchial stenosis as an unusual lesion and suggest that acquired stenosis due to selective intubation of a bronchus may be more frequent than congenital forms [3]. Congenital stenosis is often associated with other anomalies such as cartilaginous dysplasia, malacia [4,5], and cardiovascular malformations [6,7]. Based on this, we classified our patient's stenosis as acquired, likely due to inadvertent selective intubation of the right main bronchus, with the stenosis being the result of an inflammatory process [8] secondary to prolonged or traumatic intubation, as reported by Jaffe., *et al.* in the 1990s [9].

Recent studies have shown that tracheal and bronchial mucosal trauma may result not only from the endotracheal tube itself but also from suction catheters, which can induce granulation tissue and a vicious cycle leading to stenosis [10]. The incidence of acquired bronchial stenosis has increased in recent years due to the growing use of bronchoscopy in managing respiratory diseases, now estimated at 2 - 12%, though milder cases often go undiagnosed [11].

Symptoms vary depending on location and degree of airway narrowing but usually appear when the lumen is reduced to less than 50% [1], as was the case with our patient, who had 80% stenosis of the right main bronchus on initial bronchoscopy. Some patients may remain asymptomatic or present only with wheezing. Diagnosis should be confirmed with chest CT and bronchoscopy, which provides dynamic information on malacia, localization, extent, and severity of the stenosis [2,3].

Due to the rarity of this condition, there is limited data on optimal management [4]. Surgical intervention is often described as challenging due to the small size of pediatric airways and proximity of the lesion to the lung [5,6]. Although successful management with stents, balloon dilations, or lasers has been reported [4,9-11], many cases are refractory to conservative treatment, as seen in our patient, who required several balloon dilations with subsequent restenosis, leading to surgery.

Considering life expectancy, bronchoplasty-based reconstructions are ideal to preserve as much normal bronchial and lung tissue as possible. These procedures, described since 1952, demand greater surgical expertise than simple resection and anastomosis and are mostly reported in adult populations [12-14].

Surgical approaches are traditionally via thoracotomy or, more recently, minimally invasive surgery, although sternotomy was more common in the past [12-14], sometimes requiring cardiopulmonary bypass or ECMO. In our case, open surgery was chosen due to institutional resources, using a posterolateral thoracotomy under selective bronchial intubation.

Bronchoplasty was performed following the same principles as for tracheal surgery: careful tissue handling, minimal mucosal manipulation, clear resection margins, bronchial blood supply preservation, and most importantly, a tension-free anastomosis [6,12]. The most common complication is atelectasis (up to 20%), followed by restenosis (up to 9%) [6], which occurred in our patient but improved after balloon dilation and remained stable.

The ideal age or timing for surgery has not been clearly established [7], but thorough preoperative evaluation and patient optimization are essential [3]. The left bronchial stenosis was attributed to post-obstructive atelectasis on the right, causing posterior deviation of the left bronchus, a rare but documented occurrence [15]. Over time, and following surgery, the left bronchial stenosis improved. The malacia observed in the last bronchoscopy was attributed to the patient's obesity, and recent respiratory symptoms were considered secondary to malacia rather than stenosis.

Conclusion

The management of tracheobronchial stenosis in children requires an individualized, multidisciplinary approach. Resection should be limited to non-viable tissue, with careful reconstruction to preserve lung function and avoid major procedures such as pneumonectomy.

Informed Consent

Informed consent was obtained from the guardian.

Authorship

All authors attest that they meet the current ICMJE criteria for authorship.

Ethical Approval

Ethics committees didn't require ethical approval for reporting such cases.

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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