CCI JOURNAL CRITICAL CARE INNOVATIONS

CASE REPORT

Crit. Care Innov. 2024; 7(2): 55-60

ISSN 2545-2533

Received: 24.01.2024
Accepted: 13.02.2024
First online: 15.02.2024
Published: 30.06.2024

# Emergency bronchoscopy in a child with critical airway stenosis after tracheostomy: a case report.

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**Author Contributions (CRediTTaxonomy):**

Conceptualization - **A**
Data Curation - **B**
Formal Analysis - **C**
Funding Acquisition - **D**
Investigation - **E**
Methodology - **F**
Project Administration - **G**
Resources - **H**
Software - **I**
Supervision - **J**
Validation - **K**
Visualization - **L**
Writing (Draft Preparation) - **M**
Writing (Review & Editing) – **N**
Approved the final version - **O**

## ABSTRACT

Tracheal stenosis can develop as a consequence of prolonged endotracheal intubation or tracheostomy. A 14-year-old child had a history of left frontotemporal craniotomy after a fall from height one month later and tracheostomy was performed on the sixth postoperative day and decannulation was performed 20 days later. On the fifth day of post-decannulation, the child came to the emergency department with a complaint of difficulty breathing since three days. The patient was immediately moved to emergency operation theater. The patient was intubated with a 6 mm endotracheal tube, but no adequate tidal volume was delivered. Bronchoscopy was performed in the operating room. It showed a smooth, circumferential web 2 cm above the carina (supracarinal stenosis). To achieve ventilatory goals, a 6 mm endotracheal tube was removed and a microlayrngoscopy tube (MLS) of size 5.5 mm was negotiated with deflated cuff. Since the MLS tube was longer, it reached the proximal limit of the narrowed portion of the trachea. There was improvement in ventilation. To achieve proper ventilation, circumferential web was planned. The patient underwent emergency balloon dilation of trachea through rigid bronchoscopy. The balloon catheter was introduced into the bronchoscope, and the balloon was then inflated. As the balloon was inflated, it leads to stretching of the soft tissue and widening of the supracarinal space. The dilatation procedure / ballooning improved the ventilation dynamics. An endotracheal tube of 6mm size was inserted, and endotracheal tube was fixed beyond the stenotic segment above the carina to prevent recurrence of narrowing due to edema after the procedure. After balloon dilation, the patient was shifted to intensive care unit (ICU). The patient was extubated 24 hours after surgery. On the second postoperative day, the patient shifts from the ICU to the ward and on the fifth postoperative day, the patient was discharged from the hospital with the advice that repeated dilation may be required and dates for future follow-up. We present a case of emergency bronchoscopy in a child with critical airway stenosis after tracheostomy that was successfully managed.

**KEY WORDS**: Endotracheal intubation, tracheostomy, supracarinal stenosis, bronchoscopy.

## INTRODUCTION

The most common causative factors leading to tracheal stenosis include iatrogenic (50%) which involves tracheostomy, intubation, autoimmune (18.5%) such as sarcoidosis, Wegener's granulomatosis and external trauma (8%) [1]. Stenosis is believed to be associated with ischemia caused by direct mechanical pressure on the tracheal wall due to overinflation of the cuff (>30mmHg) or by the tube itself [2,3]. The blood flow to the trachea in over-inflation of the cuff becomes compromised within the first few hours after securing an airway by endotracheal intubation. This leads to edema, necrosis, and ulceration, which ultimately leads to fibrosis of that tracheal area with 3-6 weeks [4]. In addition, it is exaggerated by the decrease in the motility of the cilia that causes stasis of the tracheal secretions. Emergency rescue modalities include oxygenation, reintubation, balloon dilation followed by definitive form of treatment such as stenting and laser ablation [5]. Balloon dilatation must be done as an emergency procedure to relieve the expiratory obstruction after extubation. It is an anaesthetic challenge to maintain ventilation and oxygenation of such a patient until ballooning is over. We present a case of emergency bronchoscopy in a child with critical airway stenosis after tracheostomy who was successfully managed in emergency operation theater and intensive care unit.

## CASE REPORT

**PATIENT INFORMATION:** We present a case of a 14-year-old child with post-tracheostomy expiratory obstruction without any signs of bronchospasm. The child came to the emergency department with complaints of difficulty breathing since three days that was progressive in nature.

**CLINICAL FINDINGS:** There were no complaints of wheezing or any history of asthma. The parents gave a history of surgery (left frontotemporal cranialotomy) after falling from height one month back. The surgery was performed under general anaesthesia. Tracheostomy was performed on the sixth postoperative day and decannulation was performed 20 days later. On the fifth day after decannulation, the child was taken to hospital with the above complaints. On physical examination, the patient was irritable with the Glasgow Coma Scale (GCS) of 15/15, a pulse rate of 120 beats per minute and a blood pressure of 100/80 mmHg in the supine position of the right arm. The respiratory rate was 42 per minute. The saturation in room air was 80% and increased to 90% when using a non-rebreathing reservoir mask with 10 Litres/minute of oxygen.

**TIMELINE:** History of the left frontotemporal craniotomy following a fall from height a month back. Tracheostomy was performed on the sixth postoperative day and decannulation was performed 20 days later. On the fifth day of post-cannulation, the child admitted with complaints of difficulty breathing since three days. The patient was then assigned for emergency balloon dilation of trachea through rigid bronchoscopy. After balloon dilation, the patient was transferred to the intensive care unit (ICU). The patient was extubated 24 hours after surgery. On the second postoperative day, the patient shifts from ICU to the ward and on the fifth postoperative day, discharged from the hospital with the advice that repeated dilation may be required and dates for future follow-up.

**DIAGNOSTIC ASSESSMENT:** Chest examination showed the use of accessory muscles and reduced bilateral chest expansion. The chest was barrel-shaped and hyperinflated. At palpation, trachea was centrally placed. The cultatory findings showed bilaterally reduced breath sounds. The chest was in the end inspiratory hold position. The chest radiograph showed bilateral hilar opacity and fluffy areas of consolidation. Therefore, tracheal stenosis was suspected. Indirect laryngoscopy did not show any obvious growth.

**THERAPEUTIC INTERVENTION:** The patient was immediately transferred to the operating room. The patient was intubated with a 6mm endotracheal tube, but no adequate tidal volume was delivered and not improve patient saturation. The end tidal carbon dioxide was 60 mmHg. There was minimal visible chest expansion. On chest auscultation bilateral air entry was reduced with the inspiratory component prominently heard and shortened expiratory time. The maximum pressures were 64 mmHg. The patient was kept in volume-controlled ventilation mode with tidal volume of 220 ml, respiratory rate of 22/min, inspiratory: expiratory ratio of 1:3 and positive end expiratory pressure of 4 cm$H_2O$. The inspiratory tidal volume was 100 ml and 25 ml being the expiratory tidal volume when the actual tidal volume set on the ventilator was 220 ml. Patient arterial blood gas (ABG) showed pH of 7.1, $PaCO_2$: 91 mmHg, $PaO_2$: 70 mmHg. Bronchoscopy was performed in the operating room. It showed a smooth, circumferential web 2 cm above the carina (supracarinal stenosis) (Figure 1). Multiple blood clots were removed during bronchoscopy. To achieve ventilatory goals, a 6mm endotracheal tube was removed and a microlayrngoscopy tube (MLS) of size 5.5 mm was negotiated with deflated cuff. Since the MLS tube was longer, it reached the proximal limit of the narrowed portion of the trachea. Although this tube could not be negotiated to pass through the circumferential web, there was improvement in ventilation. The ventilator settings were changed to a low respiratory rate of 12/min, inspiratory: expiratory ratio of 1:3 and a positive end expiratory pressure of 5 cm $H_2O$. The peak pressures were reduced to 34 mmHg. ABG analysis showed a pH of 7.37 from 7.01, $PaCO_2$ from 91 to 37 mmHg and the $PaO_2$ values were 70 to 136 mmHg also improved.

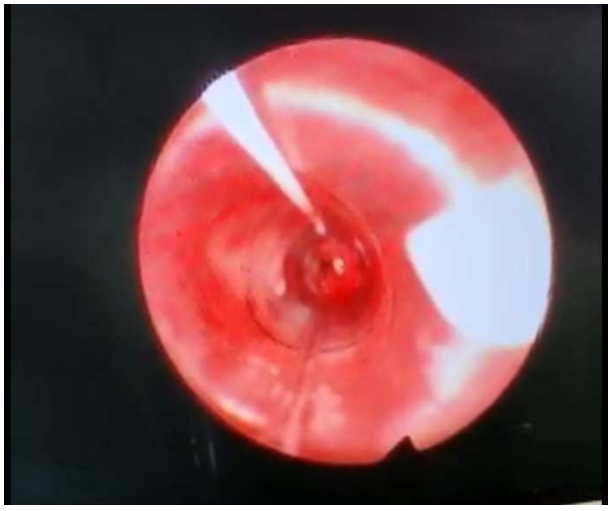

**Figure 1.** Bronchoscopy showed web-shaped supracarinal stenosis.

**Figure 2.** Dilatated trachea after balloon dilatation.

To achieve proper ventilation, circumferential web was planned. The patient underwent emergency balloon dilation of trachea through rigid bronchoscopy. ENT surgeons performed rigid bronchoscopy and MLS tube was removed. The balloon catheter was a 7F dilation catheter with size of 14mm*4cm*120cm. The balloon inflator was set at a pressure of 6 atmospheres prior to introduction into the trachea. The balloon catheter was introduced into the bronchoscope and the balloon was then inflated with the hand-help pump. As the balloon was inflated, it leads to stretching of the soft tissue and widening of the supracarinal space (Figure 2). The procedure was repeated three times. The inflation and deflation of the balloon was targeted towards the fall in the saturation. Since the balloon did not allow ventilation in the inflated state, it deflated on desaturation of the patient. After that, the balloon was deflated and the catheter was removed.

The dilation procedure / ballooning improved the ventilation dynamics and the peak pressures were reduced. End tidal cardon dioxide became normal. Injection Adrenaline 1:100000 1 ml was instilled at the balloon site to decrease bleeding and edema. Using laryngoscopy, a 6 mm cuffed endotracheal tube of size 6mm was inserted and fixed at 16 cm. The endotracheal tube was fixed beyond the stenotic segment above the carina to prevent recurrence of narrowing due to edema after the procedure. Flexible bronchoscopy was done to check the position of the tube.

**FOLLOW UP AND OUTCOMES:** The patient was observed in the postoperative unit for an hour. The patient was shifted back with an endotracheal tube of 6mm in situ to the ICU. The patient was weaned off the ventilator and the trachea was extubated 24 hours after surgery. The chest radiograph showed normal expanded lung fields. The patient was kept for monitoring and monitoring of saturation was kept. The patient maintained saturation in the air of the room. ABG analysis showed pH: 7.4, $PaCO_2$: 36 mmHg, $PaO_2$: 110 mmHg. On the second postoperative day, the patient shifts from ICU to the ward and on the fifth postoperative day, discharged from the hospital with the advice that repeated dilation may be required and dates for future follow-up.

## DISCUSSION

Tracheal stenosis was first understood as a complication of intubation in the year 1880, when MacEwen had performed endotracheal intubation in four patients for a prolonged period [1]. The incidence of tracheal stenosis after tracheal intubation is 6 to 21% while the same after tracheostomy constitutes to about 0.6% to 21% [2]. There are various classifications that divide tracheal stenosis into various grades - Grade 1: <50% obstruction, Grade 2: 51%-70% obstruction, Grade 3: 71%-98% obstruction and Grade 4 - there is no detectable lumen.

Correcting tracheal stenosis is a challenge. Location, severity of the stenosis, trigger agent to formation of stenosis (endotracheal tube vs. tracheostomy), type of stenosis and associated comorbid conditions determines the treatment of tracheal stenosis. The correct ventilator settings play a very important role in achieving adequate ventilation in these patients [6].

In this case report, the bronchoscope showed a smooth edged web 2 cm above the carina (supracarinal stenosis). Tracheal stenosis can be simple, involving mucosa only, a soft short segment with web-like narrowing or it can be complex, which is a hard stricture involving a long segment of the trachea associated with destruction of the tracheal cartilages and ultimately fibrosis. Preoperative assessment is required in detail by CT scan of neck and chest or fibre optic bronchoscopy. It is necessary to know the site, the length of the segment involved, the integrity of the vocal cords, the association of mucosal inflammation or the extent of edema around the stenosis, tracheomalacia [7].

The conventional or initial settings of the ventilator set by us in the patient led to carbon dioxide retention and inadequate lung expansion. This was due to supracarinal obstruction and failure of gas delivery and escape in both the directions through the stenosed area. This only caused the pressure to build up proximal to the stenosis. Due to inadequate expiration, air trapping was occurring leading to generation of auto PEEP and increased airway pressure, which could subsequently lead to barotrauma [6]. In this case study, the respiratory rate was kept low to allow more time for expiration to avoid air trapping. Since inspiration is an active process and expiration is passive, so we changed the inspiratory: expiratory ratio (I:E ratio) in favour of expiration.

The removal of circumferential stricture or excess granuloma due to endotracheal intubation or tracheostomy can be performed by dilation or radical procedures (laser, electrocautery, or argon plasma coagulation). Stent implantation is another therapeutic modality. Definitive surgery for lengthy stenosis segment includes resection of the stenosis segment creating clear margins and anastomosing between healthy mucosa [8]. Nonsurgical techniques are preferred to treat tracheal stenosis and surgical options are reserved for recurrent and refractory cases. Interventional bronchoscopy should be the first approach in the treatment sequence of these patients. In this case report, dilation was done with rigid bronchoscopy using a balloon catheter which showed positive results.

**PATIENT PERSPECTIVE:** In this patient, bronchoscopic balloon dilation provided long-lasting relief of symptoms and a better prognosis. However, in other cases, the stenosis may recur over time, requiring additional treatments or interventions.

## CONCLUSIONS

Interventional bronchoscopy and balloon catheter dilation played an important role in the treatment of patient with Supracarinal Tracheal Stenosis which was expected after prolonged intubation and tracheostomy. Correct ventilation management could be play a key role in achieving adequate ventilation in these patients because due to supracarinal stenosis, decrease of delivery and escape of gases in both directions through the stenosis area.

## SUPPLEMENTARY INFORMATION

***Funding:*** *No fund was received related to this study.*
***Institutional Review Statement:*** *The study was conducted according to the guidelines of the Declaration of Helsinki.*
***Informed Consent Statement:*** *Not applicable*
***Data Availability Statement:*** *The datasets generated and analyzed during the current study are available from the corresponding author on reasonable request.*
***Conflicts of Interest:*** *The authors declare no conflicts of interest.*

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