Unsuspected subglottic web in a child managed for severe respiratory obstruction

ABSTRACT
Subglottic stenosis is a known complication of a traumatic and prolonged intubation. In a child, subglottic area is narrower and more prone to damage by an oversized or overinflated endotracheal tube. The stenosis can present with complaints of change in voice, croup, or respiratory obstruction. Those presenting with respiratory obstruction require immediate diagnosis under direct laryngoscopy and timely corrective intervention under general anesthesia. A 4-year-old child came to the emergency department with severe respiratory obstruction. His medical history revealed invasive ventilatory management for aspiration pneumonitis 2 months back. Under direct laryngoscopy, we found severe narrowing of the subglottic area due to subglottic web. Since the subglottic area was so stenosed, intubation was impossible. Hence, emergency tracheostomy was performed to secure patient airway, followed by microlaryngeal surgery to remove the subglottic web. Acquired subglottic stenosis in a child can be a life-threatening situation which requires immediate airway management. It should be suspected in any child in severe respiratory obstruction with a history of prolonged intubation.

Key words: Prolonged intubation; subglottic web; tracheal stenosis

Background
Laryngeal or subglottic webs can be congenital or acquired. In children with respiratory distress and stridor, congenital variety is an uncommon finding;[1] it comprises 5% of congenital laryngeal anomalies and is thought to be a remnant of disrupted laryngeal embryogenesis.[2] Acquired lesions are more common than congenital lesions, in a 60–40 ratio.[3] In the past, acquired laryngeal web was often caused by an inflammatory process, such as after diphtheria or tuberculosis. Today, the main causes are iatrogenic, such as after an intralaryngeal surgery or a traumatic intubation. Major clinical features are abnormal cry or voice, respiratory distress, and croup. Some children are asymptomatic until they are stressed, have an infection, or are intubated for an elective procedure or emergency situation. The gold standard for diagnosis of any laryngotracheal abnormality is direct laryngoscopy and tracheobronchoscopy under general anesthesia (GA). The flexible scope may also have a role in the initial diagnosis in patients with laryngeal webs.

Case Report
A 4-year-old child was brought to our emergency department with severe respiratory obstruction. On examination, the child appeared distressed, with inspiratory stridor, tachypnea, flaring of the alae nasi, and severe intercostal and subcostal chest retractions. Chest auscultation revealed conducted breath sounds and rhonchi besides severely...
dimensioned breath sounds bilaterally. Vital parameters were heart rate -164/min, blood pressure (BP) - 124/48 mm Hg, and SpO₂ - 78% on oxygen 4 L/min via oxymask. Initially, the patient was managed conservatively with oxygen, nebulization of salbutamol, budecort, injection ceftriaxone, and intravenous fluids. His history revealed an accidental ingestion of kerosene oil 2 months before, followed by aspiration pneumonitis for which he was put on ventilator for 3 days in some other hospital of the city. He developed abdominal pain and breathlessness again 1 week after discharge from the Intensive Care Unit (ICU); this time, he was managed conservatively.

Initially, when the child was brought to our hospital, he appeared alert, but soon a rapid decline in his sensorium was observed. His arterial blood gas revealed PH - 7.21, PO₂ - 58.2 mm Hg, PCO₂ - 114 mm Hg, and HCO₃ - 32.6 mm Hg. As the child had gone to CO₂ narcosis, airway assessment was planned in the operation theater with possibility of emergency tracheostomy. After informed written consent had been obtained from parents, the child was transported to the operation theater with oxygen 4 L/min by ventimask. No premedication was advised.

In the operation theater, pulse oximetry, electrocardiography, noninvasive BP, and ETCO₂ monitors were connected to the patient. The child was preoxygenated with 100% oxygen for 5 min using Ayre’s T-piece with Jackson-Rees modification. Airway assessment was planned under sevoflurane anesthesia without any muscle relaxant. Once desired anesthetic depth was achieved, direct laryngoscopy was done, and to our surprise, we found a large circumferential subglottic web, severely compromising the size of the subglottic lumen [Figure 1]. We attempted intubation using size 3 and then size 2.5 mm endotracheal tube (ETT), with no success. An immediate decision was made to tracheostomize the patient while we maintained assisted mask ventilation. The position of tracheostomy tube size 4.5 was confirmed with bilateral chest auscultation and capnograph. The child’s CO₂ retention was so much that ETCO₂ went beyond 200 mm Hg. He was electively ventilated for 2 h under GA and muscle relaxation achieved with vecuronium. Once his condition was stable, microlaryngeal surgery was done to remove the web. Tracheostomy tube was removed and the stoma closed while we inserted the ETT size 4.5 under DL. In the end, neuromuscular (NM) block was antagonized with neostigmine and glycopyrrolate, and the patient extubated after ensuring complete NM recovery and good respiratory efforts. The child was followed up for another 4 weeks to document any change in voice quality or reappearance of stridor. Few sessions of direct laryngobronchoscopy were also performed under GA to rule out any residual or recurrent web.

Discussion

The narrowest portion of the pediatric larynx is at the level of cricoid or subglottic level. The adult anatomy is not reached until the teenage years. In infants and young children, it is common for the ETT to pass through the vocal cords but to become snug at the level of the nondistensible cricoid cartilage. Concern for causing edema at this level is one of the reasons why uncuffed ETT has been recommended for patients younger than 6 years.

In earlier days, postintubation tracheal stenosis was one of the common complications of prolonged intubation. With the introduction of high-volume, low-pressure cuffed ETTs, the incidence of postintubation tracheal stenosis in the ICUs has remarkably reduced. However, postintubation stenosis still remains an important cause of acquired tracheal obstruction. When the cuff pressure exceeds the mucosal capillary pressure (30 mm of Hg) of the trachea, the mucosa that lies between the cuff of the balloon and the underlying cartilages develops ischemia. Long-standing ischemia can lead to ulceration and chondritis of tracheal cartilages, followed by fibrotic healing, leading to progressive tracheal stenosis. One prospective study had shown that even intubation with high-volume, low-pressure cuffed tubes, 11% of critically ill patients had developed tracheal stenosis at the cuff site. Usual factors responsible for stenosis are cuff pressure, size of the tube relative to the tracheal lumen, duration of intubation, cardiovascular status during intubation, movement of tube during the period of intubation, sex and age of the patient, material from which cuff is manufactured, and the possible adverse effects of steroids. However, tracheal stenosis can also develop by intubation lasting as short as 24 h only.

Our patient also had a history of undergoing ventilatory support for 3 days, 2 months back. The subglottic web was a result of trauma inflicted during that period. Had there been no previous history of invasive ventilatory management, we would have made a diagnosis of congenital subglottic...
web. Whatever may be the etiology, timely diagnosis and intervention saved patient’s life. In the present case, all measures available were kept ready for the expected difficult intubation. Due to a small laryngeal inlet, the smallest size available which was 2.5 mm ETT could not be inserted through the glottis. The smallest ventilating bronchoscope available was 3.5 mm, and that was too big for the available chink to be used. Satisfactory ventilation could not be achieved with an oropharyngeal airway and mask or laryngeal mask airway where spontaneous or assisted ventilation could cause gastric distension. Forced insertion of the tube when resistance was encountered was avoided to prevent possibility of laryngospasm, trauma, and iatrogenic airway obstruction. Needle cricothyroidotomy is not advised in pediatric patients as it is difficult to locate, in addition to difficulty to keep the needle in place due to highly kinetic larynx.\[^{8}\]

Patients with acquired laryngeal web may remain asymptomatic for a variable period and then develop difficulty in expectoration and dyspnea on exertion and can progress to airway obstruction with the development of stridor. Postintubation tracheal stenosis is often misdiagnosed as asthma and is not diagnosed at initial presentation in as many as 44% of patients.\[^{8}\] Patients usually remain asymptomatic until the trachea has stenosed to 30% of its original diameter.\[^{8}\] Tracheal damage and subsequent stenosis can occur in any patient after intubation of any duration, and a high index of suspicion is required to diagnose these cases at the earliest. Tracheal stenosis should be considered in the differential diagnosis of any patient with a recent history of intubation in an ICU and who presents with exertional dyspnea or monophonic wheeze, particularly when it is unresponsive to bronchodilators. Such patients require immediate referral to hospital and may need advanced airway management including tracheostomy and surgical correction.

**Financial support and sponsorship**
Nil.

**Conflicts of interest**
There are no conflicts of interest.

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