Case Report

Intermittent apnoea and manual jet ventilation: A successful anesthetic management for infant with acquired Myer-Cotton class III subglottic stenosis undergoing endoscopic balloon dilatation

ABSTRACT

Acquired subglottic stenosis is a common complication of endotracheal intubation in infants. The risk increases in trisomy 21, patients undergoing bypass surgery, and having gastroesophageal reflux disease. Less invasive endoscopic balloon dilatation of subglottic stenosis has become a more common treatment modality compared to open surgical technique. Airway-related surgery needs meticulous preparation and good communication between the anesthetist, surgeon, and staff. More precaution and more effective preparation and communication are needed in neonatal airway surgery as it is physiologically easier to desaturate and develop hypoxemia compared to adults. We report a case of successful balloon dilation of Myer-Cotton class III subglottic stenosis with intermittent supraglottic jet ventilation and bag-mask ventilation in infants with trisomy 21.

Key words: Balloon dilatation, jet ventilation, subglottic stenosis

Introduction

Endoscopic balloon dilatation (EBD) is a widely accepted treatment modality by pediatric ear, nose, and throat (ENT) surgeons worldwide for acquired causes of subglottic stenosis. This method offers a minimally invasive option to manage pediatric subglottic stenosis and preclude the need for tracheostomy and laryngotracheal reconstruction (LTR) surgeries.

However, pulling this technique requires the delivery of oxygen and anesthetic agents as well as vigilant manipulation of the airway by anesthesiologists and surgeons, referred to as "shared airway." This operation requires continuous and timely communication between the anesthesiologist, ENT surgeon, and perioperative team throughout the perioperative period to ensure successful correction of the stenosed pediatric airway while preserving optimal patient safety.

Case History

We present an interesting case of a 3-month-old girl, born term via spontaneous vaginal delivery with a weight of

Access this article online	
Website: https://journals.lww.com/sjan	Quick Response Code
DOI: 10.4103/sja.sja_978_23	

How to cite this article: Esa U, Singh NG, Mohamad H, Zaini RH. Intermittent apnoea and manual jet ventilation: A successful anesthetic management for infant with acquired Myer-Cotton class III subglottic stenosis undergoing endoscopic balloon dilatation. Saudi J Anaesth 2024;18:432-4.

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Submitted: 26-Dec-2023, **Accepted:** 27-Dec-2023, **Published:** 04-Jun-2024

2.99 kg and a good Apgar score. The patient is clinically Down's syndrome with a large peri-membranous ventricular septal defect (VSD). She also had other clinical features of Down's syndrome, such as congenital hypothyroidism and gastroesophageal reflux disease (GERD).

On day 74 of life, the patient underwent open VSD closure, requiring 9 days of endotracheal intubation. Twenty days after surgery, the patient develops biphasic stridor and respiratory distress, requiring oxygen supplementation and pressure support via a high-flow nasal cannula (Opti-flow), immediate assessment using a flexible scope with findings confirming circumferential subglottic stenosis of 80–90%, Myer-Cotton class III [Figure 1].

The patient was then subjected to examination under anesthesia (EUA), direct laryngoscopy (DL), and dilatation of subglottic stenosis. Intraoperatively, standard American Society of Anesthesiologists (ASA) monitoring of vital signs was applied, and two peripheral intravenous lines were secured. Inhalation induction with sevoflurane 6% with 100% oxygen using mask ventilation and nasal airway size 2.5 is applied after minimal alveolar concentration (MAC) achieved 1.0 sevoflurane was then titrated down to 2.5%. Target controlled infusion (TCI) remifentanil, diluted at 20 µg/mL via the mass rate infusion technique, we loaded the patient with 0.5 µg/kg (weight of 4.22 kg) of remifentanil followed by a continuous infusion ranging from 0.2–0.4 µg/kg/min adjusted to the level of stimuli. This technique was done to ensure adequate depth of anesthesia with strong ultra-rapid analgesic effects while reducing the possibility of airway collapse intraoperatively.

During Parson's laryngoscopy and endoscopy, the airway was maintained with intermittent supraglottic jet ventilation using Manujet III connected through Parson's laryngoscopy ventilation port with injection pressure 0.5–1 bar and frequency of 40 per min and a pause when the endoscopic balloon inflated [Figure 2]. Intermittent mask ventilation is applied when laryngoscopy and endoscopy are removed. These require precise communication between anesthesiologists and surgeons. Only an endoscope with an outer diameter (OD) of 1.9 mm 00 (zero) can pass through the stenosis. Initial subglottic dilatation with a 15Fr dilator at a pressure of 5 atmospheres (atm) was applied for 30 s before the patient desaturated rapidly to oxygen levels of 85%. Immediate release of dilatation, endoscope, and laryngoscope followed by bag-mask ventilation applied to restore oxygen saturation to 100% oxygen levels within seconds. Then, another subglottic dilatation at higher pressures of 7 atm at 1 min was successful without desaturation. Near normal subglottic caliber was achieved with the stenotic segment flushed within the tracheal wall, and the surgeon could pass through the scope up to the carina, ensuring only single-level subglottic stenosis [Figure 3].

Postprocedure, remifentanil infusion, and inhalation agent ceased. The patient had a successful emergence postanesthesia with good spontaneous breathing effort, excellent crying, and limb activity. Preoperative tracheal tug, suprasternal, and subcostal recessions diminished. As her respiratory parameters were promising, the patient was discharged back to the neonatal intensive care unit (NICU) with a high-flow nasal cannula. She was weaned off oxygen supplementation after 2 days.

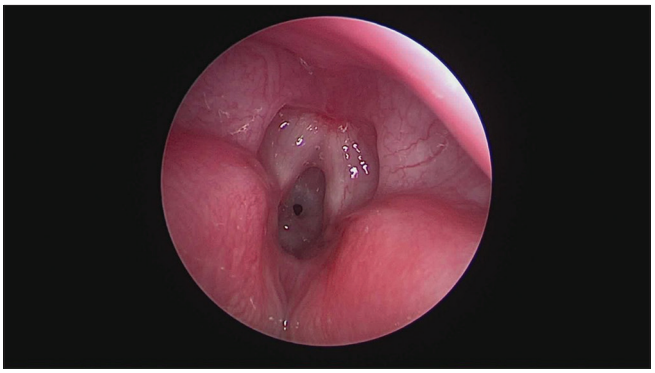

Figure 1: Subglottic stenosis- before dilatation

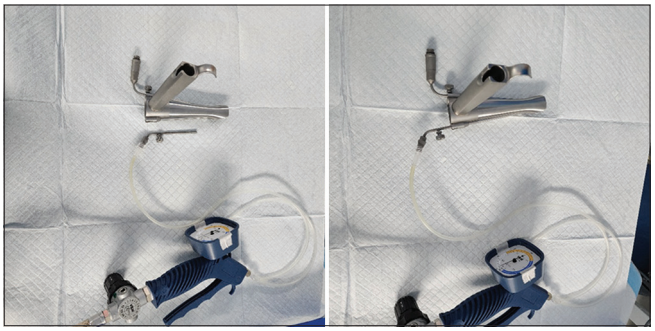

Figure 2: Jet ventilation through surgeon laryngoscope

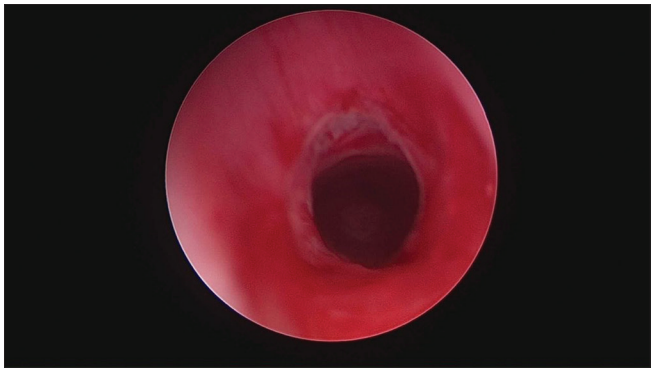

Figure 3: Post dilatation

Discussion

Subglottic stenosis is a devastating complication of intubation in neonates. The incidence of subglottic stenosis is reported to be 0–2%.[1] Congenital subglottic stenosis is less frequent than acquired, and prolonged endotracheal intubation is the most prevalent cause of acquired subglottic stenosis.[2] Associate risk factors following endotracheal intubation include low birth weight, prematurity, sepsis, trisomy 21, GERD, and heart and lung bypass surgery.[3] In this case, the patients carry a significant risk factor of subglottic stenosis as the patient underwent bypass surgery for VSD closure and suffering from GERD.

Subglottic stenosis can be classified using the Myer-Cotton classification, which was originally used to predict the reduction of lumen surface after endotracheal tube insertion but later used to describe subglottic stenosis in adult and pediatric populations.[4] The classification describes Grade I: less than 50% obstruction, Grade II: obstruction between 51–70%, followed by Grade III: 71-99% obstruction, and Grade IV total obstruction with no remaining visualized lumen.[4]

Surgical management of subglottic stenosis generally includes open neck surgery, endoscopic dilatation either with balloon or rigid dilator, and tracheotomy.[5,6] Though endoscopic surgery shows better outcomes,[7] thorough assessment and issues need to be considered to determine the appropriate management, which includes type and stage of surgery, timing, patient-related condition, nutrition, and comorbidities.[4] It is crucial to select the appropriate therapy because failure to do so could undermine the success of the entire course of treatment.

To ensure safety and successful oxygen delivery during EBD surgery, the anesthesiologist, surgeon, and staff must collaborate fully. The patient's life could be in danger with the smallest error. Maintaining spontaneous ventilation is crucial in this procedure because of the possible difficulty of bag-mask ventilation and intubation.[8] Oxygenation can be maintained by various techniques, as listed by Mangahas *et al*.[9] in her systematic review, which includes intermittent face mask ventilation, small endotracheal tube/extra-small diameter tube, intermittent apnea technique, nonocclusive airway balloon dilator, Evone Flow-Controlled Ventilation with Tritube, laryngeal mask air, spontaneous ventilation via bronchoscope (Trachealator) and jet ventilation. The systematic review found that newer modalities such as Evone Flow-Controlled Ventilation with Tritube had a lower risk of technique failure and intraoperative hypoxia,[9] but the accessibility of this newer machine is not widely available yet. Another study by Knight *et al.* demonstrated that there is no significant difference in intraoperative hypoxemia comparing the four most common techniques of ventilation in subglottic stenosis: jet ventilation via a rigid bronchoscope, jet ventilation via Hunsaker, intermittent apnea technique, and ventilation using a small endotracheal tube.[10]

Subglottic stenosis is a cause of extubation failure. Duration for weaning post-dilatation varies, and limited data is available. In this case, the patient was weaned back to a high-flow nasal cannula immediately after the procedure, and no reintubation was required.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the legal guardian has given his consent for images and other clinical information to be reported in the journal. The guardian understands that names and initials will not be published and due efforts will be made to conceal identity, but anonymity cannot be guaranteed.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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