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Intra-operative management of an occluded south polar endotracheal tube in a child posted for cleft palate repair

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Abstract
Background: Endotracheal tube obstruction by a mucus plug causing ball-valve effect is a rare but significant complication of invasive ventilation, since mucociliary clearance is impaired. High peak and plateau pressures, with rising EtCo2 levels are classical features (1). Endotracheal tube obstruction causes complications including cardiovascular instability, pneumothorax and pulmonary edema.(2) Early detection of intraoperative airway events is essential to prevent postoperative sequelae.
Case Report: A 2 year old child, posted for Cleft Palate repair under general anaesthesia, was previously considered for the same procedure 4 weeks prior but was deferred due to cough with expectoration. He was treated for the URTI. During pre-anesthetic evaluation, the mother gave no current history of symptoms of URTI. Auscultation and Xray were clear. Pediatric fitness was obtained. Intraoperatively, an hour after induction, there was a steady rise in EtCO2, Peak Pressures and decrease in SpO2. Immediate decision to extubate and then reintubate was taken. Upon extubation a large mucus plug was seen obstructing the ETT.

Keywords: Pediatrics, South Polar ETT, Cleft palate, ETT obstruction

Introduction
Endotracheal tube obstruction by a mucus plug causing ball-valve effect is a rare but significant complication of invasive ventilation, since mucociliary clearance is impaired. High peak and plateau pressures, with rising EtCo2 levels are classical features. Endotracheal tube obstruction causes complications including cardiovascular instability, pneumothorax and pulmonary edema. Early detection of intraoperative airway events is essential to prevent postoperative sequelae [1].

Case Report
A 2-year-old child weighing 8.3kgs was posted for cleft palate repair under general anesthesia. The child was previously considered for the same procedure 4 weeks prior but was deferred due symptoms of Upper Respiratory Tract Infection (URTI) such as cough with expectoration, sneezing and mild fever. The Child was treated for the cough and fever, and was cleared by the pediatrician for surgery. During pre-anesthetic evaluation mother didn't give information of symptoms of current URTI. Upon auscultation, breath sounds were bilaterally equal and clear. Chest X-ray was obtained and showed a normal picture. On the day of surgery, after confirming patient identity and adequate NPO, the child was premedicated with Inj Glycopyrrolate 0.004mg IV and was sedated with Inj Ketamine 8mg IV before shifting to the Operation Theatre. Standard monitors like Pulse Oximeter, ECG leads, NIBP were attached. Anesthesia was induced with Inj Ketamine8mg IV and Inj Atracurium4mg IV.4.5mm ID south polar ETT was used to secure the airway of the child. Tube position was confirmed with auscultation and EtCO2. Anesthetic maintenance was with sevoflurane 0.8 vol % along with O2 50% and N2O 50%. 1 hour into the surgery, EtCO2 steadily started to increase. The Peak Pressures also began to rise, and reached up to 45cm H2O. Kinking of the ETT or circuit was initially suspected and ruled out. SpO2 began to decrease, the surgeons were requested to with-hold the surgery. Mechanical Ventilation was switched to manual ventilation, and passage of a suction catheter was tried, but failed. Decreased breath sounds were noted on both the lung fields. An immediate decision was

taken to extubate and reintubate the patient with a 4.5 mmID South Polar Endotracheal tube. The removed ETT showed complete obstruction of the distal lumen with a mucus plug. Surgery commenced, and no further adverse events occurred. The child was extubated after reversal with neostigmine 0.4mgIV. Minimal blocking by mucus plug was seen in the second ETT as well. Secretions were also noted in the ear. The child-maintained saturation and was monitored in the PACU, no further events occurred. He was discharged 2 days later without any adverse postoperative course.

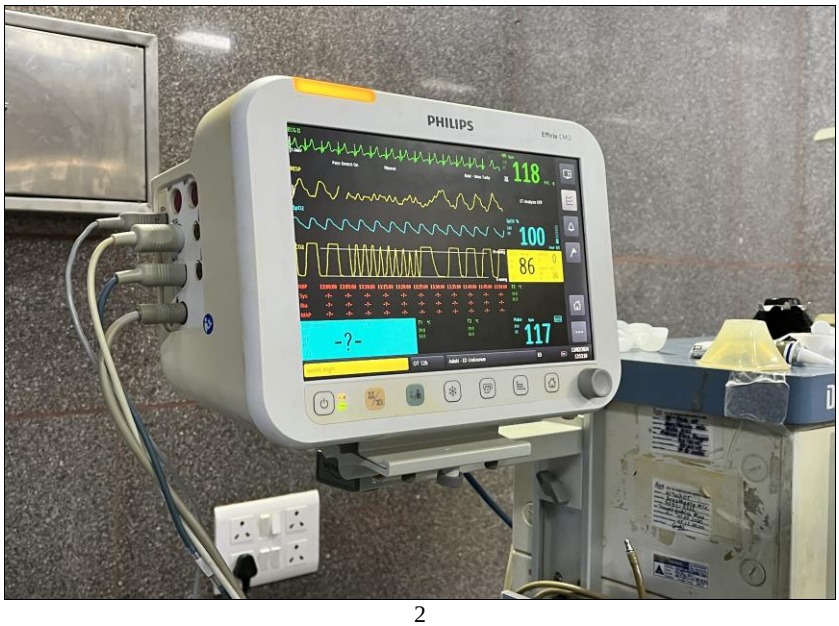
Discussion

Intraoperative complications arising from endotracheal intubation (ETT) are common; however, they must be differentiated from other potential intraoperative causes of ventilatory failure like bronchial spasm, pneumothorax, or chest wall rigidity [2]. Hence, a careful and complete physical examination coupled with detecting macroscopic capnographic patterns shifts the burden of proof for alternate ventilatory failure explanations. In our case, the patient showed signs of rising peak airway pressure (PAP) and end-tidal carbon dioxide (ETCO2) while exhaled tidal volume and oxygen saturation (SpO2) declined. The combination of changes in the respiratory and hemodynamic parameters suggested that bronchospasm and pneumothorax were even less likely. An obstruction in the ETT was suspected with the increased difficulty in passing the suction catheter and the resistance felt with manual ventilation [3].

Children who have active or recent upper respiratory infections (URIs) within the past four weeks face a higher risk of adverse respiratory events. This risk is particularly elevated in those with a history of reactive airway disease, airway-related surgeries, prematurity, exposure to environmental tobacco smoke, nasal congestion, excessive secretions, or the need for endotracheal intubation [4]. Diagnosing ETT obstruction can be more challenging when using a small-diameter nasal RAE tube, as its preformed shape may hinder the passage of a suction catheter [5].

While humidifying and warming inspired gases and ensuring adequate hydration help reduce the risk of mucoid impaction, the most effective preventive measure is to avoid administering anaesthesia in children with URIs. However, the decision to proceed with elective surgery should be individualized based on the severity of the presenting symptoms. Early recognition and intervention are crucial in preventing severe complications from tube obstruction. Key management strategies include halting the procedure, replacing the endotracheal tube, using fiberoptic techniques to remove secretions, and providing mask ventilation if obstruction occurs [2].

1



2

Fig 1 & 2: Showing raising EtCo2

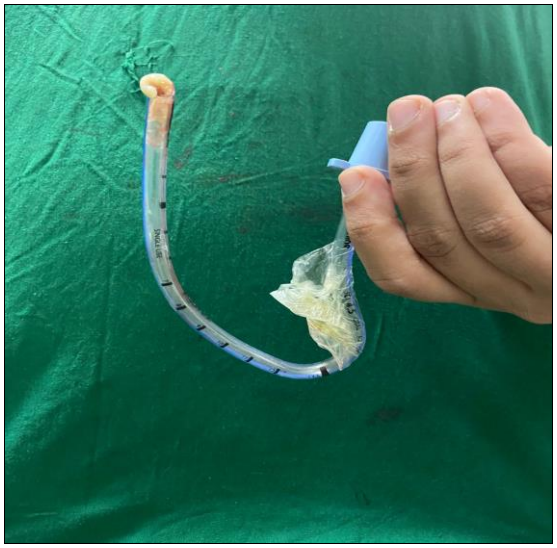


Fig 3: Showing a completely obstructed ETT

Fig 4: Ear secretions were noted in the ear post extubation

Fig 5: Minimal mucoid obstruction seen in the second ETT after extubation

Conclusion

Although mucus plugs can be cleared with proper suctioning, this was not possible as south polar ETT was used. Early management included withholding the surgery and exchange of the tube. ETT obstruction can be life threatening, especially in pediatric patients, but prompt management can result in a favorable clinical outcome with no significant sequelae.

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Nil

Conflicts of interest

There are no conflicts of interest

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