Catastrophic air leak after tracheocutaneous fistula repair in an infant with Treacher-Collins syndrome

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**Objectives:**

**Upon completion of this learning activity, participants:**

1. will be aware of the common surgical approaches to the repair tracheocutaneous fistula and the use of the “airtight” tracheal closure test in the operating room which the anesthesiologist may be called upon to perform;
2. will be able to differentiate the major causes of respiratory insufficiency in the PACU after a surgical procedure on a pediatric airway;
3. will be able to develop an effective plan of interventions for a cyanotic child in the PACU after airway surgery complicated by catastrophic air leak;
4. will be able to apply pediatric advanced life support guidelines to the initial and subsequent evaluations of a pediatric patient suffering cardiac arrest in the PACU following airway surgery and not responding to initial resuscitative efforts.
PBLD - Case history

A 10 kg 25 month old female with Treacher-Collins syndrome underwent direct laryngoscopy (DL), bronchoscopy and repair of tracheocutaneous fistula (TCF). She had a tracheostomy placed as a neonate due to upper airway obstruction. Her trachea was successfully decannulated at 15 months of age. Because of speech difficulties and chronic skin irritation and inflammation, she underwent TCF repair.

Intraoperative course:

After midazolam premedication and uneventful inhalation induction with sevoflurane and oxygen, an intravenous catheter was inserted and the child received fentanyl 10 mcg IV. Direct laryngoscopy (DL) with Wis-Hipple (WH) 1.5 blade revealed the larynx and vocal cords without difficulty. LTA (laryngotracheal topical anesthesia) with lidocaine was administered.

Bronchoscopy showed a large granuloma on the anterior tracheal wall at the site of the TCF. A 1.5 LMA was subsequently placed, and the patient breathed spontaneously throughout the procedure. The TCF was excised and the granuloma removed by an external approach after enlarging the defect in the trachea slightly. The surgeon elected to leave the trachea open, place a rubber band drain over the trachea in the midline, and take the child to the PACU with a natural airway spontaneously breathing prior to admission to the PICU for observation over night. Soft tissue was loosely approximated over the trachea with 2 interrupted sutures. The drain was secured with a suture. The dermis was closed with interrupted sutures and then the skin was closed with interrupted sutures. The neck was palpated and there was no subcutaneous air present. 2x2 gauze was taped over the wound. The patient emerged rapidly from anesthesia and the LMA was removed in the operating room. She cried intermittently en route to the PACU.

Questions: What are the other surgical approaches to repair TCF? If the surgeon had elected to close the trachea, how would you determine if the closure was airtight while still in the operating room? Under what circumstances would you consider leaving a child intubated post-operatively?

Postoperative Course:

On admission to the PACU the child is awake, well-perfused, intermittently crying and breathing spontaneously with a heart rate (HR) of 148, blood pressure (BP) of 118/78, respiratory rate (RR) of 24 and oxyhemoglobin saturation (O2Sat) of 97% with blow-by oxygen. However, after the anesthesiologist’s report is given, the patient progressively becomes more agitated and, immediately after cyanotic with noisy respirations. Five minutes after PACU admission, her O2Sat is 82% (with 100 % oxygen blow by) and her HR is 180. The PACU nurse pages the anesthesiologist to return and help and she is now applying 100% oxygen by face mask and
attempting to control ventilation with a Mapleson. The anesthesiologist arrives at the bedside. The patient is bradycardic (HR drops from 140s to 80s, O2Sat is 70%), listless and apneic. The surface anatomy of the child’s chest, neck and face looks normal. The dressing is intact and dry. The PACU nurse pushes the code button as the anesthesiologist takes over the airway, and delivers positive pressure ventilation by mask, Mapleson and 100% oxygen.

**Questions:** What are the most common causes of respiratory insufficiency in children shortly after admission to the PACU? What is your differential diagnosis of respiratory insufficiency in children following airway surgery? Does crying play any role in the development of hypoxia and bradycardia in this child? What additional information would you like to know now?

**Postoperative course continued:** The anesthesiologist does not see the chest rising, and the nurse states that she cannot hear breath sounds over either the left or right chest. The anesthesiologist requests intubation equipment at the bedside, and immediate surgical evaluation in the PACU.

**Questions:** Would you like to secure this patient’s airway with an endotracheal tube? How would you intubate this patient?

**Postoperative course continued:** Rocuronium 12 mg IV is administered. The anesthesiologist continues to attempt to control ventilation but he is still not able to ventilate the child. He notes that the child’s neck, upper chest and face appear to be swollen. DL with WH 1.5 blade is then performed by the anesthesiologist, but unlike earlier in the operating room, he is not able to visualize the glottis. The pharyngeal and laryngeal structures appear grossly swollen and distorted. Attempts to blindly intubate the trachea fail. Palpation of the upper chest and neck reveals crepitus.

**Questions:** Why are the pharyngeal and laryngeal structures distorted? Why is crepitus felt over the upper chest and neck? What is the most likely diagnosis now? How would you manage the child’s airway? Has prolonged positive pressure ventilation contributed to this child’s condition?

**Postoperative course continued:** It is now 10 minutes since admission to PACU. The patient is cyanotic and poorly perfused. HR is now 40 with no measurable BP and O2Sat. CPR begins. Surgeon arrives. He opens the neck wound and places a 4.5 uncuffed endotracheal tube (ETT) into the trachea. CPR is briefly interrupted during this time frame. Still there are no audible breath sounds over lung fields and there is no ET-CO2 detected. The surgeon performs a flexible bronchoscopy and confirms the correct ETT placement.

**Questions:** What drugs and doses would you administer if any at this time? Would you order a chest x-ray now? Would you perform any other diagnostic or therapeutic interventions? You decide that a diagnostic needle thoracentesis is indicated. How would you accomplish this task?
Postoperative course continued: A right-sided needle thoracentesis is performed. Air is evacuated from the right chest and, for the first time, ETCO2 is detected and there are breath sounds over the right lung field. However, the patient is now asystolic and you repeat the procedure over the left chest and again air is evacuated from the chest, and breath sounds are now audible over the left chest. A stat chest x-ray is performed and reveals: Bilateral pneumothorax, pneumomediastinum, pneumopericardium, and right main stem bronchus intubation. There is some gastric distention and massive subcutaneous emphysema over the neck and torso, and upper extremities.

Questions: How would you perform a needle pericardiocentesis? What other interventions are necessary at this time?

Postoperative course continued: Following needle pericardiocentesis with the successful evacuation of air, the patient’s heart rate returns to normal sinus rhythm. Bilateral chest tubes are inserted. The anesthesiologist places an oral cuffed ETT with the cuff below the defect in the trachea and inflated to seal. The patient is then transferred to the PICU.

Question: Is it possible that the early airway management in this case contributed in part to the extensive and catastrophic air leak?
DISCUSSION

TCF occurs in 3.3 to over 50% of decannulated pediatric patients (Geyer M, 2008). Many of these heal without surgical intervention. However, when surgical closure of TCF is required, the potential for catastrophic air leak in the post-operative period should be appreciated by the anesthesiologist. The purpose of this PBLD is to raise awareness to this complication and provide information on recognition and management. Air may enter subcutaneous tissues of the neck through a residual tracheal defect, and may track along tissue planes in the neck, face, chest wall, pharynx, larynx, mediastinum, pleural cavity, and pericardial space. Even after airtight closure of the tracheal defect in the operating room, this complication can occur if the suture lines are challenged by high endotracheal pressures that may occur during positive pressure ventilation, coughing, crying, or straining. Leakage can occur rapidly and unexpectedly. Several case reports in the literature describe the development submucosal emphysema involving laryngeal and pharyngeal structures which can lead to airway obstruction and distort the airway, making endotracheal intubation by direct laryngoscopy difficult or impossible (Wheeler WB, 1991; Mohan VK, 2003). Immediate and expert airway management or tracheostomy may be required. One surgical factor that predisposes a patient to develop a catastrophic air leak is a primary closure of the TCF without an effective drain that permits the escape of air through the skin. Patient factors may also play a role such as chronic lung disease which may predispose a patient to paroxysms of coughing. Under these circumstances it may be advisable to modify the surgical approach such that an effective drain is present, or a brief period (usually 24 – 72 hours) of recannulation of the tracheostomy is allowed or endotracheal intubation.
REFERENCES:


