PBLD – Table # 29

Throat Slashed: Near Complete Tracheal Laceration in a 3-year-old boy. Is Airway the only problem?

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Objectives:

1. Review acute major airway injuries in pediatric patient population.
2. Discuss pre operative and intra operative management of complex airway injury with emphasis on effect of head manipulation.
3. Discuss airway fire as a potential risk to maintain oxygenation in the setting of hypovolemia, pneumomediastimum and pneumothorax during spontaneous ventilation undergoing neck exploration.
4. Discuss intra operative complications that can impact postoperative course.
5. Explore the need for appropriate communication in the operative room.

Case history:

A 3-year-old boy brought by EMS to trauma bay with stab wound to the neck. Upon arrival, he is alert, calm and not in apparent distress. His neck is covered with gauze dressing. Patient has 20G peripheral IV and still not examined by trauma team yet.

Questions:

What are the most common neck injuries in children? What are the structures at risk due to penetrating neck injury? What are the differences in major airway injuries between an adult and a child?

Case history and physical examination (continued):

Subsequent examination reveals no further injuries. Patient is cooperative but unable to phonate due to injury. He would nod appropriately to "yes/no" questions. Further past medical history was difficult due to absence of family members at bedside. Vitals signs on arrival are: HR: 130/min, BP 78/42, RR: 32/min, SpO2: 96% on blow by oxygen, T: 35 degree Celsius. On examination, neck wound covered with saline soaked gauze, exposure revealed a large laceration to the anterior mid-neck with the gaping trachea and visible bubble through tracheal wound. There was little active bleeding but slow oozing noted. This examination caused anxiety and pain along with respiratory distress to the kid. Lungs are clear to auscultation with subcutaneous emphysema palpated over anterior chest, lower neck and supraclavicular region bilaterally. Auscultation of heart reveals no murmur. But coughing was associated with chest discomfort.

Questions:

What are the expected clinical manifestations of penetrating and blunt airway injury? How are respiratory mechanics and ventilation changed due to open tracheal wound? Is it easy to breathe through fresh tracheal wound? In penetrating neck injury, what portion of trachea – anterior/posterior is vulnerable to injury? Why? Will you use sedation or anxiolytic in the ER for agitated uncooperative behavior? What agents will you use? Who should be notified after initial assessment? Will you take him to CT scan or Chest X ray? What findings are suspected? What types of injury require CT scan? Will you take him directly to the operating room? What special surgical and anesthesia set up should you have in the OR? Will you need any further pre operative work up?

Case Progression:
The patient is surprisingly very calm and transported directly to OR for emergent neck exploration without any sedation.

Questions:
So what is your anesthetic plan? Sedation (MAC) vs. general anesthesia? How will you induce anesthesia? Is this patient at risk for aspiration? What are your goals to manage this patient? After induction, patient's oxygen saturation drops to 88. What will you do? Will you ventilate the patient with bag and mask? How? Will you increase FiO2? Upon reduction of anesthetics, patient's saturation improves and spontaneous ventilation is maintained. Examination of neck revealed almost complete tracheal laceration with only posterior 2-3 mm intact membrane. 4.0 mm ETT passed into distal trachea via "stoma" and neck exploration continues for surgical hemostasis of bleeding vessels. What complication is patient at risk for? How will you prevent this? Is ET tube through distal stoma a secure airway? Will you make patient apneic to reduce the risk airway fire? What is "fire triad"? Can you give me few examples of each? What preventive measures apply to our case?

Intraoperative course:
Decision is made to pursue surgical repair of anterior tracheal tear. The operating table is turned 90 degree to the ENT surgeon for suspension laryngoscopy and rigid bronchoscopy. If examination shows bilateral vocal cords in Para median position, how will it change your management? Does management change if it is unilateral? Which side of recurrent laryngeal nerve is at risk of damage in our patient?

Patient will need endotracheal intubation for the remainder of the case. What type of ET tube will you choose? Cuffed, no cuffed, reinforced? Which size ETT will you use? Is nasal route better than oral intubation? In what situation, tracheostomy should be considered over oral intubation? How will management be different if tracheal tear is close to carina? What is the ASA modified trauma algorithm for key management of airway disruption?

Endotracheal intubation was performed orally using 5.0 mm non-cuffed ET tube. ET tube is positioned distal to the tracheal tear but above the carina. ENT surgeon plans to

perform rigid esophagoscopy to rule out esophageal injury. What are the potential problems at this point? Will you use muscle relaxant? Intraoperative course is complicated by persistent hypotension and tachycardia? What is going on? How will you approach this scenario? What further information do you need? etCO2, airway pressure? TEE?

Before instituting positive pressure ventilation, esophagoscopy and TEE were done to look for pneumomediastinum, mediastinitis and/or esophageal injury.

How will pneumomediastinum present clinically? How will you diagnose it if TEE is not available? Can pneumothorax happen in presence of pneumomediastinum?

Intraoperative course progression:
Once esophageal injury was ruled out, anterior laryngotracheal reconstruction is carried out. Vecuronium and fentanyl with inhalation agents are used for maintenance of anesthesia. Hypotension and tachycardia were due to blood loss that had happened since injury and corrected with PRBCs. Intraoperative management also included recognition of hypothermia. Surgical closure finishes uneventfully.

Postoperative care:
What are the major airway related concerns in immediate postoperative period? How long patient is kept intubated after anterior repair of LTR in your institution? Will you use non-depolarizing muscle relaxants in the ICU?

Patient has two peripheral IVs; will you place central venous access prior to transporting the child to ICU? What site will you choose? Why? What measures will you take in the ICU to prevent accidental extubation? How will you approach a scenario where accidental extubation happens while patient is still receiving vecuronium and fentanyl infusion?

5 days later, patient is extubated without any difficulty? Will he need flexible laryngoscopy? How will you manage his feeding if bilateral recurrent laryngeal palsy is found on laryngoscopy? What is the long-term risk of this injury?

Patient is discharged home on day 8 without any squeal.

Discussion:
Acute major airway injuries may be related to traumatic events, and generally are subdivided in blunt and penetrating injuries, or to medical procedure, usually during general anesthesia or tracheotomy. Tracheal trauma is an uncommon occurrence in children because of their anatomy. Their short neck, increased elasticity of tissues, and compressibility of the upper sternal area provide for the ability to absorb blunt forces without the added risk of injury. Tracheal disruption is a rare occurrence and is seen in only 14% of penetrating neck trauma cases. Posterior tracheal tears are more common

than anterior. This is because the cartilaginous rings become deformed and creates stress on the membranous portion of the posterior trachea.

Clinical signs of anterior tracheal tear include dyspnea, cough, hemoptysis, cyanosis, cervical/upper chest subcutaneous emphysema, and tracheal shift with mediastinal emphysema. Chest radiography is the standard initial screening and CT is preferred if tracheobronchial tear is suggested. Definitive diagnosis of tracheobronchial tear is made by bronchoscopy or surgical exploration. Esophagoscopy is often required in patients with penetrating injuries due to the possibility of an associated esophageal perforation. Laryngotracheal separation is frequently associated with recurrent laryngeal nerve palsy and bilateral vocal cord paralysis with risk of aspiration. The principle anesthetic consideration is ventilation and oxygenation because of loss of ventilation to the atmosphere due to the open airway. It is imperative to maintain spontaneous ventilation throughout direct laryngoscopy, bronchoscopy and esophagoscopy to prevent increasing the subcutaneous emphysema and pneumomediastinum by avoiding positive pressure ventilation. Depending upon the injury, cardiopulmonary bypass via femoral route may be needed in major tears. During wound exploration and larygnotracheal reconstruction, head movement by surgeon can increase the risk of accidental extubation or bronchial intubation.

Postoperative care is tailored towards controlled extubation based on surgical technique. Maintaining reliable intravenous access and avoiding unplanned extubation are key points as reintubation can disrupt surgical repair leading to morbidity and even mortality. Tracheal stenosis is the long-term complication of penetrating trachea repair.

In summary, penetrating neck injury has several anesthetic issues that need to be considered given major vessels, airway, esophagus and nerves that may be involved. Proper preparation and communication among all specialties taking care of major airway injuries are extremely important to facilitate a successful outcome.

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