Management of a child with laryngeal papillomas

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Goals for participants

1. The participant should understand the signs and symptoms of the child with pre- and intraoperative laryngeal obstruction and be able to describe a coherent plan for managing airway obstruction.

2. The participant will understand the etiology, epidemiology and natural course of this disease including current medical and surgical treatments and anesthetic implications.

3. The participant will be able to discuss the specific anesthetic concerns of carbon dioxide laser airway management including specific anesthetic techniques, waste gas and pollution issues, and airway fire.

STEM CASE and KEY QUESTIONS

A four year old child with a three month history of worsening stridor was started on an albuterol inhaler by her family physician, without improvement. She now has a hoarse, whispery, “hot potato” voice. An otolaryngologist tried to evaluate her airway with a fiberoptic nasopharyngoscope, but she was not cooperative. His working diagnosis is vocal cord papillomas.

ROS: She was a full term infant, previously healthy, although she was treated for gastroesophageal reflux from age 3 months to six months.

Physical exam: 20 kg child, BP 80 sys, p100, RR22, S_pO_2_ 97%, T 37°C

Hoarse voice, barely speaks above a whisper, being held on her mother’s lap

HEENT: baby teeth, normal jaw, mild retractions above the sternal notch with inspiration

Pulm: inspiratory and expiratory stridor audible over the suprasternal notch

Cor: RSR; normal S1 and S2; no S3 or S4; no murmurs.

Extremities: Nailbeds pink, no clubbing. Superficial veins easily seen on dorsum and volar aspects of hands.

1. Is this a typical presentation for vocal cord papillomas? Why? What other entities might present this way? What makes you put these lower on your list of differential diagnosis?

2. What will you look for on physical exam to help assess her degree of airway compromise? How reliable is the degree of stridor? The respiratory rate? Should you obtain an arterial blood gas before you start? How about a venous blood gas? Why or why not? Does she need any preoperative laboratory work at all? How about a chest x-ray?
She cries when she sees you. Mom says she heard from her family physician that you would premedicate her child so she would not have post traumatic stress disorder.

3. **Will you premed this anxious child?** Why? If so, how? If not, why not?

4. **Will you start an IV before you begin her anesthetic induction?** Why? **Will you use the IV for induction?** Does this patient need any additional intravenous medications prior to induction? **Which ones?** Why?

Her surgeon arrives and says he’d first like to take a look at her airway once she is anesthetized and breathing spontaneously. If he sees papillomas, he’s planning to use the CO\textsubscript{2} laser for the case.

5. **How should the OR prepare for a CO\textsubscript{2} laser case?** What safety materials should the OR team have readily available? Why? Are there any preparations the surgeon must make?

6. **Once you are in the operating room with the child, you begin an inhalation induction. Which agents will you choose?** Why? **Is there any advantage to using nitrous oxide when you are planning a sevoflurane induction?** Why / why not?

Her sternal retraction worsens after about one minute, and you don’t feel she is moving any air.

7. **Why do you think this is happening?** Now what? **What steps might you take to relieve the airway obstruction that has occurred during induction?** Anything else you want to do? **What about a nasal airway? Oral airway? LMA? CPAP? Muscle relaxant (if so, which one?)**

Your maneuvers were successful, and you continue to deepen the inhaled anesthetic.

8. **What is your end point? How do you know when she is “deep?”** Why is that important anyway? **Would a BIS monitor help in this regard?** Why or why not?

You turn the OR table 90 degrees and the surgeon positions (suspends) the child for laryngoscopy.

9. **Will you intubate prior to suspension?** Why / why not? **Is this age-dependent? Any other criteria you use?**

10. **What anesthetic technique will you use?** **Specific anesthetic agents?** **Will you use total intravenous anesthesia?** If so, which agents will you choose? **Can you do this and maintain spontaneous ventilation?** **What about dexmedetomidine?** If you plan to deliver inhaled agents, **how will you do this?** **How will you scavenge waste gas?** **What F\textsubscript{1}O\textsubscript{2} will you choose?** Why?

Laryngoscopy confirms many papillomas above and on the vocal cords. In fact, it is difficult to see the vocal cords because of the extensive grape-like mass. The patient begins to cough and desaturate.

11. **Now what? Why? What is the quickest way to deepen the anesthetic?** **Is this the same as the quickest way to stop the patient from coughing?** **What are the risks of coughing at this point?**
The surgeon passes a small endotracheal tube to allow for better air exchange and deepening of the anesthetic. The laser is now brought into position.

12. What precautions must be taken for the patient, and for the personnel in the room? Should the endotracheal tube be replaced with a “laser safe tube”? Are they truly “laser safe”? What varieties are there? Do they come in small enough sizes? What other surgical treatments might be used for this patient?

13. The surgeon asks you to “jet” this patient? How is that done? Is there any special equipment you need? Is this safe in a four year old? How do you judge the effectiveness of the ventilation? What are the risks? What can you as an anesthesiologist do to reduce these risks? Is this ventilation strategy less risky than ventilation with an endotracheal tube? What F\textsubscript{1}O\textsubscript{2} will you use? Why? If the injector is powered by 100% oxygen from the wall source, is there anything you can do to reduce the F\textsubscript{1}O\textsubscript{2}? Could you blend the oxygen with nitrous oxide in order to reduce the F\textsubscript{1}O\textsubscript{2}? 

Assume that you are using jet ventilation. The surgeon begins to use the laser for excision of the papillomas. The child has episodic desaturation and requires intermittent reintubation. While he is swinging the laser arm back into the field, the aperture has unfortunately remained open, the laser fires, and a puff of smoke followed by a flame is visible on the video screen.

14. What are the steps in extinguishing an airway fire? How do you evaluate the extent of the injury?

After the fire is extinguished, you both agree that the case is over.

15. Should you extubate the child? Why / why not? What additional monitoring or treatment might you need in the perioperative period? Should you just go straight to the PICU?
PROBLEM BASED LEARNING DISCUSSION

1. What is the typical presentation of vocal cord papillomas? What is its epidemiology? What are current treatment options?

Papillomas are benign epithelial tumors of the upper respiratory tract that are caused by infection with the Human Papilloma Virus (HPV) type 6 or 11. They occur in children and adults. The diagnosis is usually made in children between age two and five and requires inspection of the larynx. Infants and children may present with wheezing, hoarseness, or stridor. Pediatric patients require multiple treatments, most commonly with the CO\textsubscript{2} laser, but the 585 – nm pulse dye, argon plasma, and Potassium-Titanyl-Phosphate (KTP) lasers or the powered microdebrider may be used. Some children have regression of the lesions with puberty. Adult disease is often more localized and less severe. The goals of treatment are debulking, improvement of the voice and remission of the papillomas. Surgical therapy may result in airway stenosis secondary to scarring or laryngeal web formation. There is an association between gastroesophageal reflux disease and laryngeal papillomas in children. Adjuvant medical treatments that have been investigated include recombinant alpha interferon, inole-3-carbinol, methotrexate, ribavarin, and cidovir. The lesions recur because the virus is not eradicated from the tissues. Adults may rarely have progression to squamous cell carcinoma.

2. How do you evaluate a child for airway obstruction?

Patients may have profound airway obstruction secondary to papilloma growth on the vocal cords or epiglottis. Assessment of the degree of obstruction is typically accomplished clinically by evaluating the patient’s use of accessory muscles, quality of voice (hoarse or silent), respiratory rate, and resting oxygen saturation. Elective tracheostomy is avoided to limit the spread of the virus. A surgical airway is still part of the emergency airway algorithm for these patients.

3, 4, 5, 6, 7, 8. Is it ever appropriate to premedicate a child with airway compromise? How will you manage the induction of this child? What equipment needs to be available before you begin the case? How will you treat airway obstruction during the case?

Pediatric patients may need premedication if not in profound respiratory distress. These children return for frequent OR visits and may be very anxious about the entire process. You must weigh the risk/benefit of premedication in each situation and for each patient. IV placement may be facilitated with a topical cream; indeed, many children with laryngeal papillomatosis prefer an IV induction to a mask because of the development of mask aversion. If you do not have skilled IV help in the OR, starting the IV before you proceed is the safest choice. The child may develop airway obstruction with the induction of anesthesia, regardless of the method used for induction. The IV will allow for prompt delivery of resuscitation medication should it be necessary. Spontaneous ventilation will allow an airway examination of the non-instrumented airway, something the surgeon will often request. However, you must be ready to intervene promptly should airway obstruction occur, and proceed through the difficult airway algorithm. Close cooperation between the surgeon, anesthesiologist, and OR team is required. All lasers, bronchoscopes, jet ventilation devices must be prepared before the case begins. In the event of airway obstruction, supraglottic devices would not be successful if the papillomas completely occlude the glottic aperture.

9, 10, 11, 12, 13. What anesthetic techniques do you use and what complications are associated with them?
Airway management for laser laryngeal microsurgery includes the use of a “laser safe” tube (Xomed, Mallinckrodt, Biova), jet ventilation, an apneic technique or spontaneous breathing. Laser safe tubes usually have silicon as a component. Silicon is still combustible, so typical laser precautions must be used (FiO₂<30%, protective goggles, filter facemasks). Jet ventilation above or below the vocal cords allows adequate ventilation at the risk of barotrauma, pneumothorax, pneumomediastinum, and gastric insufflation. Driving pressure utilized for children must be significantly lower than that used for adults. The technique relies upon an adequate glottic aperture for air entry and egress to prevent “breath stacking”. The use of an apneic technique involves periodic extubation and reintubation. Most surgeons prefer the patient to have immobile vocal cords once laser resection or microdebridement has begun. TIVA may be a more effective anesthetic technique because the use of suction during laser treatment can render the inspired volatile anesthetic concentration quite variable. In addition, waste anesthetic gas pollution is reduced.

14, 15. What are the steps in extinguishing an airway fire? How do you evaluate the extent of the injury?

In the event of an airway fire, disconnect the oxygen source and remove any burning material from the airway including the ETT. Irrigate with sterile water or saline, and mask ventilate or reintubate immediately. Evaluate the extent of the injury with laryngo/bronchoscope and closely monitor the patient with pulse oximetry, serial ABGs, and CXR for at least 24 hours. In the absence of an airway fire, recovery from airway surgery may still be problematic, especially in a child. At the conclusion of the procedure, careful assessment of hemostasis and tissue edema is done. Extubation should occur when the patient is fully awake. Supplemental humidified oxygen and racemic epinephrine may be given in the recovery room to ease breathing and treat airway edema. Careful monitoring for several hours prior to discharge is necessary and occasionally the patient will require hospital admission.

References


10. Recurrent Respiratory Papilloma Task Force  
Guidelines@www.rrpf.org/rrpf/publications/taskforce guidelines.

Syllabus Questions

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