Title: “It is just a tonsil….” The 6-year-old patient with Obesity and Obstructive Sleep Apnea

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Learning objectives:

1. Describe the pathophysiology of childhood obesity and OSA
2. Discuss the use of opioids and adjuvants in the analgesic management of obese pediatric patients with OSA presenting for tonsillectomy
3. Discuss the peri-operative considerations in the pain management of pediatric patients with OSA and obesity
4. Develop strategies for post-operative discharge in pediatric patients with OSA and obesity

CASE STEM:

A 6 year old boy presents for tonsillectomy. He has history of OSA. He weighs 45 kg and height 116 cm, weight 48 kg, BMI=35.7 kg/m² (99th percentile). Parents have noted that the child has loud snoring at night and also has had multiple ear infections in the past.

Questions:

What more information do we need? Why?

What is OSA? What is the gold standard for diagnosis of OSA?

Case progression: The child is not on CPAP. The child’s has had sleep studies that revealed an AHI of >15 and oxygen nadir of 78%

Questions: What are your concerns? Why? What is the difference between OSA in child vs Adult OSA?

Case progression: The child has a history of reactive airway disease. A year ago, the child was admitted to the PICU for severe asthma for 3 days. Since then the child is on albuterol inhalers and montelukast. The child has no current active upper respiratory tract infection. The child is very tearful in mom’s lap. Mom is also very anxious. Other than features of significant obesity, rest of the exam is normal.

Questions: Would you premedicate this child? Why? What are the anesthetic induction strategies?

Case progression: The child is anesthetized via inhalational induction with sevoflurane and undergoes general endotracheal anesthesia. Intubation is facilitated by rocuronium. Fentanyl, total 0.5 mcg/kg is
administered for pain intraoperatively. Dexamethasone is administered in the dose of 0.5 mg/kg. Intraoperatively, the child is also administered acetaminophen intravenously 15 mg/kg.

**Questions:** What dose of fentanyl would you use? Is fentanyl adequate for post-operative pain management? Should a longer acting narcotic be use? Why? What is the evidence? What is the role of dexamethasone in this situation? What are the potential concerns with the use of acetaminophen? What are the dosing regimens for acetaminophen?

**Case progression:** The child is extubated in the operating room and transferred to the recovery room. Immediately upon arrival to the recovery room, the pulse oximetry reading is 88% and upper airway obstruction is noted. A nasopharyngeal airway is inserted, humidified oxygen is administered. The SpO2 increases to 97%.

**Questions:** What are the risk factors for respiratory complications following tonsillectomy? What are opioid requirements of patients with OSA compared to normal patients?

**Case progression:** Subsequently, in the PACU, the child is very agitated and complains of pain.


**Case progression:** The child is observed in the PACU for 4 hours. The child pulls out the nasopharyngeal airway but is now maintaining saturations 95-97% on humidified oxygen given as ‘blow by’.

**Questions:** Would you consider discharging patient from the PACU? Why? Where? To PICU?

**Case progression:** The child is observed overnight with pulse oximetry monitoring in the same day admissions unit. The child has an uneventful recovery and stable. He is discharged 2 days later.

**Questions:** What are the home medications that this child should be prescribed? Why would you consider combination drugs with acetaminophen? Why?

**DISCUSSION:**

**OSA and Obesity:**

OSA is defined as sleep apnea in a sleep-related breathing disorder in children characterized by a periodic cessation of breathing, apnea episodes despite respiratory effort. The gold standard for diagnosis of OSA is polysomnography. An apnea-hypopnea index (AHI) > 10 is predictive of post-tonsillectomy respiratory complications. However, not all patients with OSA may have sleep studies done pre-operatively. In one study, the sensitivity of a pre-operative questionnaire to detect hypoxemia during sleep was only 40%. Obesity is frequently associated with OSA. The identified risk factors for OSA include – obesity, history of reactive airway disease, congenital airway anomaly, congenital syndromes, male gender and enlarged tonsils. In pediatric patients, symptoms may include loud snoring, gasps at night,
pauses in breathing, mouth breathing, difficult to awaken in the morning, daytime irritability, morning headache, enuresis and poor school performance\(^1\).

The risk of adverse post-operative events is increased in this scenario because of a combination of factors mainly: obesity, history of OSA and the need for post-operative opioid. It is possible that the airway obstruction may worsen on the first night of surgery.

**Pathophysiology of post-tonsillectomy pain:**

Tonsillectomy (+/- adenoidectomy) is effective in relieving pediatric sleep-disordered breathing. The risk of bleeding after tonsillectomy is 2-4\% and of death 1:35000. The experience of this surgery may be traumatic to the child in terms of separation anxiety and post-operative pain. The intensity of pain after tonsillectomy may be variable and may be described as moderate to severe by most children\(^2,3\). The thermal damage involved during the dissection and tonsillar excision causes acute inflammation and surrounding edema. Following 24 hours after surgery, a thick white coating of fibrin covers this tonsillar fossa. There may be increased inflammation from the 3\(^{rd}\) to 4\(^{th}\) day postoperatively. The fibrin clot that is formed gradually peels away in the second week post-operatively\(^4\). This is when the pain gradually wears away. The tonsillectomy technique i.e. intracapsular vs extracapsular may have bearing on the intensity of pain following tonsillectomy\(^5\).

**OSA and sensitivity to narcotics:**

There is 10 times higher risk of post-operative respiratory complications in children with OSA vs non-OSA children\(^6\). Pre-clinical animal studies have demonstrated that following intermittent hypoxemia exposure, there is increased sensitivity to opioids\(^7,8\). This has also been shown in clinical studies in children undergoing adeno-tonsillectomy with OSA with pre-operative nocturnal oxygen nadir who have increased sensitivity to opioids and decreased post-operative opioid requirements\(^9\). Further, children with OSA have a flattened ventilator response to \(\text{CO}_2\) and hence risk of apnea. Because opioids cause a dose-related decreased ventilatory responses to hypoxia and hypercarbia, the effects on children with OSA who already have blunted responses to hypercarbia may be exaggerated. OSA leads to chronic intermittent nocturnal hypoxemia, hypercapnia and respiratory acidosis\(^10\). These effects lead to pulmonary vasoconstriction, pulmonary hypertension right ventricular dilatation and cor-pulmonale. There is no consensus on the criteria for cardiac evaluation or echocardiography preoperatively in these children\(^11\).

**Premedication:**

Peri-operative anxiety may have implications on the post-operative pain in children\(^12\). Hence adequate premedication and alleviation of anxiety may be important considerations. However, the risk of sedative premedication and its respiratory depressant effects may be a cause of concern. This is attributed to reduction in the pharyngeal tone muscles, decreased respiratory drive, selective decrease in hypoglossal nerve and genioglossus activity. The concomitant administration of benzodiazepines and opioids may have significant respiratory depressant effects\(^10\). Dexmedetomidine 1 mcg/kg vs oral midazolam has been found to be an effective premedication without its respiratory depressant effects\(^13\).
Post-tonsillectomy Pain management strategies:

Local anesthetic applied to the tonsillar area (topical or infiltration) may reduce post-tonsillectomy pain to some extent\(^1^4\). However, the pharyngeal numbness may upset the child; Use of a glossopharyngeal nerve block may contribute to airway obstruction\(^1^4\). The use of intra-operative dexamethasone for management of post-operative nausea and vomiting may reduce post-tonsillectomy edema and inflammation and hence the pain. Use of sucralfate or hemostatic sealants has not been proven to be effective\(^1^5\).

**Opioids analgesics:** Generally, short acting opioids such as fentanyl are popular intraoperative analgesics. Titrated doses of a long acting opioid like morphine may be given intra-operatively incremental doses during spontaneous ventilation under general anesthesia\(^1^0\). In the past codeine has been a popular medication for post-operative pain management in post-tonsillectomy patients. Recently there has been a black box warning issued by the US FDA regarding the use of this drug for pain management in post-tonsillectomy patients. This is related to the pharmacogenetic variability in the metabolism of codeine to morphine and resulting adverse respiratory event. The other oral opioids are oxycodone and hydrocodone are also metabolized by CYP2DG. However the metabolites are not primarily responsible for the analgesic effects. There is not adequate data regarding their use in children\(^1^0\).

**Non-opioid analgesics:** Acetaminophen has become very popular and considered relatively safe although there is a risk of overdose and hepatotoxicity especially related to poor communication between caregivers and use of combination drugs eg acetaminophen-hydrocodone etc. The use of NSAIDS was not popular in the past in children undergoing tonsillectomy for fear increased risk of post-tonsillar bleeding. However based on the Cochrane review the AAOL-HN surgery published practice guidelines stating that NSAIDS (excluding ketorolac) may be safely used for post-tonsillectomy analgesia\(^1^6\). Around-the-clock administration analgesic regimens may play an important part in post-tonsillectomy pain control. An educational program for the care-giver is also recommended\(^1^6\).

**References:**

1. Cote CJ, Posner KL and Domino KB, Death or neurologic injury after tonsillectomy in children with a focus on obstructive sleep apnea: houston, we have a problem! Anesth Analg 2014;118(6):1276-83.