The Child with Sleep-disordered Breathing for Tonsillectomy (T&A)

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T&A is one of the most commonly performed pediatric surgical procedures worldwide. In the US, it is the 2nd most common ASC procedure in children (> 500,000 cases / yr., second only to myringotomy and ear tube insertion) and one in eight American children will undergo adenotonsillectomy. Sleep-disordered breathing (SDB) and obstructive adenotonsillar hyperplasia are now the primary indications for surgery. Chronic or recurrent tonsillitis are less frequent indication in young children. Recent experience indicates that ambulatory T&A for *appropriately selected children* is safe and cost-effective and that there is little benefit in keeping these patients in the facility once they achieve predetermined discharge criteria which at minimum should include absence of bleeding, adequate hydration, absence of PONV, and adequate pain relief.

In North America, the indication for adenotonsillectomy in 77% of children is obstructive sleep apnea syndrome (OSAS) or sleep-disordered breathing (SDB). SDB describes a spectrum of abnormal breathing patterns during sleep. These include snoring, paradoxical chest wall motion and increased respiratory effort, apneas, hypopneas and arousals leading to recurrent episodes of hypoxia, hypercarbia, and sleep disruption. The obstructive events that characterize OSAS occur most often during rapid eye movement (REM) sleep. The frequency and severity of obstructive

events worsen after midnight, a finding that may reflect the greater proportion of REM sleep in the latter part of the night and fatigue of the upper airway musculature.

Accordingly, the single most important task during the preoperative evaluation of the child for adenotonsillectomy is to distinguish the child with the OSAS from the child with benign snoring or obstructive breathing, because the former is at greater risk for developing severe perioperative respiratory adverse events (PRAEs), possibly including death, after adenotonsillectomy and are not appropriate candidates for ASC scheduling. Recent studies have reported unexpected deaths following adenotonsillectomy from presumed sleep apnea following discharge from a monitored setting; including at home. A meta-analysis of 3 retrospective studies (N = 371 children) revealed that children with OSAS proven by polysomnography (PSG) criteria have a 5-fold increase in the odds for PRAEs compared with children without OSAS. In contrast they were less likely to have postoperative hemorrhage (odds ratio 0.4, 95% confidence interval 0.2 – 0.7).

Patino et al identified three important factors that can be used to determine whether an individual child can be an appropriate candidate for ambulatory T&A or scheduled for overnight monitored observation. These include the severity of OSA, age less than 3 years, and presence of co-morbidities. (Fig.). The recognized co-morbidities that will increase the risk of postoperative respiratory events, including life-threatening apnea, are (but not limited to) craniofacial abnormalities, severe obesity, Down syndrome, neuromuscular diseases, history of prematurity, failure to thrive, chronic lung disease, right ventricular hypertrophy and sickle cell disease.

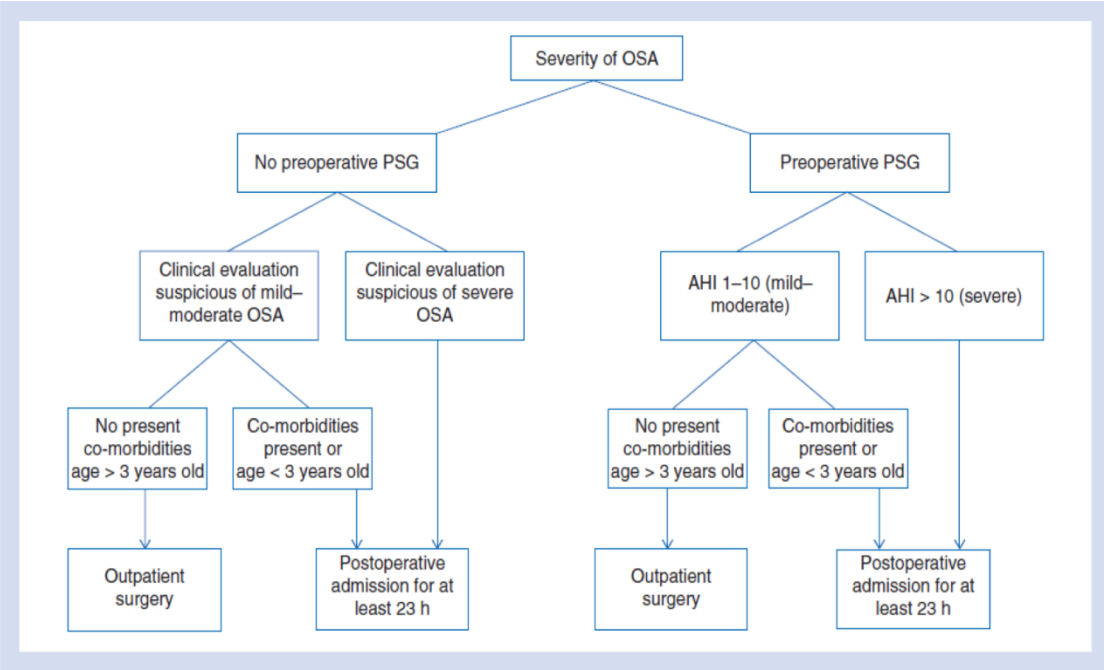

Fig. Post T&A disposition of Children with OSA. From Patino M, et al. Br J Anaesth 2013;111 (S1):i83-95.

Determining the severity of obstructive symptoms remains a challenge. Polysomnography (PSG) is the gold standard diagnostic test for evaluation of SDB. The polysomnogram simultaneously records the electroencephalogram, electromyogram, electrocardiogram, pulse oximetry, airflow, and thoracic and abdominal movement during sleep. *Apneas* are classified as central, obstructive, and mixed. A central apnea occurs when there is no apparent respiratory effort. An obstructive apnea is associated with vigorous inspiratory efforts that are ineffective because of lack of upper airway patency. A mixed obstructive apnea is diagnosed when both central and obstructive components are present. *Hypopnea* is defined as a reduction in airflow of more than 50%. The Apnea Hypopnea Index (AHI) is the

summation of the number of obstructive apnea and hypopnea events per hour and is analogous to the respiratory disturbance index (RDI). The diagnostic criteria for pediatric OSAS from the American Academy of Sleep Medicine are: mild OSAS corresponds to an AHI > 1 < 5 event per hour; moderate OSAS corresponds to an AHI >5 <10 events per hour and severe OSAS corresponds to an AHI ≥10 events per hour. However, less than 10% of patients scheduled for T&A are evaluated with a sleep test prior to surgery. Although the American Academy of Otolaryngology-Head and Neck Surgery (AAOHNS) published specific guidelines for performing sleep studies prior to T&A surgery, these are not consistently followed. The challenge therefore is to evaluate the severity of SDB / OSAS based on clinical criteria alone in the majority of children. A high index of suspicion is required since clinical criteria do not always distinguish primary snoring from OSAS in children. Parents should be asked if the child snores loudly, if the snoring can be heard through a closed door, if there are gasps or pauses in respirations, if there is daytime somnolence, night terrors, nocturnal enuresis, attention deficit disorder, or poor school performance. However parental report of symptoms has a poor positive predictive value and clinical features obtained from demography, parental report and physical findings do not robustly identify OSAS severity. There is a greater incidence of OSAS in Asian and African American populations. African American children tend to desaturate more profoundly during sleep-related obstructive airway events than do Caucasian and Hispanic children. Obese children (BMI greater than the 95ile) are at higher risk for OSAS especially if other comorbidities are present.

The general health of the child and the indications for surgery must be reviewed. URIs are frequent in these children and can interfere with the timing of adenotonsillectomy because the risk of respiratory compromise and hemorrhage is increased. Reactive airway disease or asthma are frequently present. Obese children often have sleep disordered breathing. A history of bleeding tendencies requires investigation. Medications that interfere with coagulation include aspirin, NSAIDs, and valproic acid. Discontinuation of these drugs preoperatively is sometimes problematic, and preoperative consultation with neurology, cardiology, and hematology specialists may be indicated.

A careful cardiorespiratory history and physical examination is essential. Children with chronic tonsillar hypertrophy may have long-standing hypoxemia and hypercarbia, which can lead to cor pulmonale. In some centers, a complete blood cell count is required before adenotonsillectomy. There is no evidence that routinely performed preoperative coagulation studies are beneficial unless they are indicated by history. The indications for the procedure should be clearly delineated in the surgical plan of care.

The anesthetic techniques for adenotonsillectomy are varied and include the choice of an inhalational or TIVA technique, the choice of an ETT or LMA, and the choice of spontaneous or controlled ventilation. The use of spontaneous ventilation allows titration of small opioid doses to effect while monitoring respiratory rate and end-tidal CO_2. Maintenance of anesthesia with desflurane (for those whose airway is secured with an ETT) provides a rapid emergence and recovery. In children with severe OSA , the severity of the nocturnal oxygen desaturation correlates with the

sensitivity to exogenously administered opioids. The morphine (or morphine equivalent) dose required to achieve a uniform analgesic endpoint in children with OSA who exhibited a low preoperative nSAT (less than 85%) was less than in those whose preoperative nSAT ≥85%. Children with severe OSAS who exhibit nocturnal hypoxemia require OSA-appropriate opioid regimens. Over the last decade, there has been a shift from opioids as the mainstay of perioperative analgesia to non-opioid regimens including dexmedetomidine, acetaminophen, NSAIDs, dexamethasone and ketamine. Although for hospital-based surgery, an infusion of dexmedetomidine 1-2 μg/kg *IV* may reduce postoperative opioid requirements, the duration of stay in the PACU is prolonged, and it is rarely used in ASC patients.

Despite removal of the hypertrophied tonsils and adenoids, children with severe OSAS continue to demonstrate obstructive apnea and desaturation during sleep on the first night after adenotonsillectomy. This underscores the need to admit these children to a hospital for continuous overnight monitoring postoperatively. Because the onset of respiratory complications in children with severe OSAS may be delayed, practice guidelines from the AAOHNS, the AAP and the ASA all recommend that discharge criteria from a monitored setting should include observation with saturation monitoring during sleep. However, a recent survey of North American pediatric tertiary centers showed that only 73% complied with this recommendation although 93% had a minimum time for observation with a median of 2 hours.

Further Reading:

Hannallah RS, Brennan MB. Pediatric Patient Selection for Ambulatory Surgery Centers. ASA Refresher Courses in Anesthesiology. February, 2018.

Hannallah RS, Brown KA, Verghese SV. Otorhinolaryngologic Procedures. In COTÉ, LERMAN, & ANDERSON: A PRACTICE OF ANESTHESIA FOR INFANTS AND CHILDREN, Sixth Edition. Elsevier Philadelphia, PA 2018 (March)