Obstructive Sleep Apnea, Pediatric

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• Recurrent episodes of oxygen desaturation secondary to airflow limitation, which can be intermittent or sustained (characterized as obstructive hypoventilation); with preserved thoracic and abdominal efforts.
Epidemiology

- Prevalence in children, 1-4%.
- May be higher because of obesity epidemic.
- Most common in preschool children [adenotonsillar hypertrophy] and Adolescents [obesity].
- Males = Females [children], Males > Females [Adolescents], African American > Caucasian [prevalence among other races unknown].
Risk Factors

- Adenotonsilar Hypertrophy
- Obesity
- Craniofacial Anomalies
- Neuromuscular Disorders
- Family History
- Infants with GERD
- Environmental Smoke Exposure
Risk Factors continued...

- Other disorders like Mucopolysaccharidosis, Sickle Cell Disease.
- Pharyngeal Flap operation for cleft palate repair.
Pathology

- Upper airway narrowing:
- Increased upper airway collapsibility, due to adenotonsillar hypertrophy, obesity, neuromuscular problems.
- Craniofacial anomalies leading to midfacial hypoplasia and retrognathia/micrognathia.
Cycle of Obstructive Sleep Apnea

Sleep Onset Snoring
Sleep Disrupted
Breathing Stops
Airway Collapses

Non-Obstructed Airway
Open Airway

Obstructed Airway

Signs and Symptoms

- Snoring or heavy breathing
- Mouth breathing
- Bedwetting
- Restless sleep
- Night sweats
- Confusional arousals
- Daytime hyperactivity/Aggressive behavior
- Daytime Sleepiness
Signs and Symptoms continued...

- Adenotonsillar Hypertrophy
- Developmental Delay
- Paradoxical breathing
- Craniofacial anomalies: Midfacial Hypoplasia, retrognathia
- Pectus excavatum
- Turbinate Hypertrophy, nasal polyps
- Dolicocephaly, High arched palate
Complications

**NEUROBEHAVIORAL**: AFFECTS LATERAL PREFRONTAL CORTEX, LEADS TO IRRITABILITY AND HYPERACTIVITY.

**CARDIOVASCULAR**: SYSTEMIC HYPERTENSION, PULMONARY HYPERTENSION LEADING TO COR PULMONALE [RIGHT HEART FAILURE]

**GROWTH DELAY**: HEIGHT AND WEIGHT AFFECTED THE MOST, POOR FEEDING DUE TO ADENOTONSILLAR HYPERTROPHY OR CRANIOFACIAL ANOMALIES, SUPPRESSION OF SLOW WAVE SLEEP MAY LEAD TO DECREASED GROWTH HORMONES RELEASE.
Diagnosis
Polysomnogram
Objective Findings

Sleep Architecture: Generally preserved, children have very high cortical arousal threshold. Other findings like autonomic arousals or movements may be seen.

Respiratory: Obstructive Apnea Hypopnea Index > 1, may be graded as mild, moderate and severe based on AHI [ OAHIC cut offs 1-4, 5-9, 10 or above].

CO2 monitoring: Hypoventilation, CO2 > 50 mm Hg for more than 25% of Total Sleep Time.
• Criteria A & B must be met:
  • Criteria A. Presence of one or more of the following:
    1. snoring
    2. Labored, paradoxical or obstructed breathing during child’s sleep.
    3. Sleepiness, hyperactivity, behavioral problems or learning problems.
  • Criteria B. PSG demonstrates one or both of the following:
    1. OAHI > 1 OR
    2. Obstructive Hypoventilation with one or more of the following: snoring, flattening of inspiratory nasal pressure curve or paradoxical thoracoabdominal motion.
  • AASM guidelines give an option of using adult criteria for age groups 13 and above.

ICSD Criteria:
Treatment

- First line therapy is Tonsillectomy and Adenoidectomy
- Medications
- PAP therapy
- Surgical techniques for craniofacial anomalies.
Tonsillectomy and adenoidectomy

• Usually outpatient.
• Recovery time is 1-2 weeks.
• Sometimes patients can be admitted overnight for monitoring.
• Success rate: variable, mostly above 50%. Predictors of failure include high preoperative AHI, high Mallampati score, turbinate hypertrophy or deviated nasal septum.
• Adenoids can grow back rarely, due to its location, complete surgical removal might be difficult sometimes. In those cases anti-inflammatory medications can be tried, before pursuing repeat diagnostic studies.
Criteria for overnight monitoring:

- Age younger than 3 years.
- Severe OSA, AHI > 10.
- Oxygen saturation nadir 80% or less.
- Complex medical history like craniofacial anomalies, pulmonary hypertension, hypotonia etc.
Medications

- Leukotriene and other receptors present in a tonsillar or adenoid tissue. Leukotriene antagonist or inhaled nasal steroids reduce hypertrophy and may help mild OSA.
PAP therapy

• Usually through titration studies.
• Auto PAP may not accurately treat OSA.
• Please follow AASM guidelines for PAP titration.
• Mostly used in severe OSA after failure of other therapies like T&A and anti-inflammatory medications.
Other Surgical Techniques

- Rapid Maxillary Expansion:
- Used in OSA with maxillary contraction [high arched palate with unilateral or bilateral crossbites].
- Should be done before cartilage becomes bone, i.e. age 5-16 years.
- Orthodontic device anchored to two upper molars, which apply pressure to expand hard palate laterally and widen the nasal passages.
Other surgical techniques:

Other surgical techniques...

• Distraction osteogenesis: Mechanical induction of new bone within two bony surfaces that are gradually distracted or separated.

• Saw is used to create osteotomies in the mandible, either a internal or external device is used to expand the mandible.

• Used in micrognathia like Treacher Collin’s syndrome, Pierre Robins Syndrome etc.
Distraction Osteogenesis

Source: https://vimeo.com/30843938
Some recent articles....
Adenotonsillotomy Versus Adenotonsillectomy in Pediatric Obstructive Sleep Apnea: An RCT
Anna Borgström, Pia Nerfeldt, Danielle Friberg.

• RCT to compare adenotonsillotomy [ATT] to adenotonsillectomy [ATE]. 79 children, age 2-6 years were randomly assigned to each group. At the end of 1 year PSG and OSA-18 questionnaire were repeated. Both groups had similar outcomes without any statistical difference, 13% children in ATT group had recurrence of OSA and tonsillar regrowth.

• Major Drawbacks: Only non obese kids, age 2-6 years, shorter follow up [studies have shown tonsillar regrowth and OSA recurrence much later in life], power analysis: a difference in AHI changes of 5 between the groups was chosen to be clinically relevant, and this difference might be high.
A Randomized Trial of Adenotonsillectomy for Childhood Sleep Apnea: Carole L. Marcus, Reneé H. Moore, Carol L. Rosen, et al.

- 464 children age 5-9 years were randomly assigned to Adenotonsillectomy and watchful waiting group. Neuropsychological testing, PSG, behavior outcomes were tested at baseline and 7 months. No significant difference was observed in neuropsychological testing involving attention and executive function. However, statistically significant difference was seen in subjective outcomes as reported by the parents and PSG findings.

- Limitations: Excluded were; < 5 years of age, children who had prolonged oxyhemoglobin desaturation or who were taking medications for ADHD, the study results cannot be extrapolated to these vulnerable groups. Follow-up period was show, didn’t show full response to surgery.
14 year old DS patient, severe OSA with AHI 48.5. Tracheotomy was done due to CPAP intolerance, hypoglossal nerve stimulator was implanted. 5 months after the implant tracheotomy was removed, residual AHI was 3.4.
• 1. ICSD-3, AASM.
• 2. Review of Sleep Medicine, 4th edition, Dr. Avidan.
• 3. Fundamentals of Sleep Medicine, Dr. Berry.
• 4. UpToDate.
• 5. Case Book of Sleep Medicine, 2nd edition, AASM.
Questions ???
• Thank you.