Obstructive Sleep Apnea Syndrome (OSAS) in children is a disorder of breathing during sleep characterized by upper airway obstruction that disrupts normal ventilation during sleep and normal sleep patterns. Childhood OSAS is common with a prevalence of 2%. The American Academy of Paediatrics recommends that all children should be screened for snoring. History and physical examination are poor at discriminating between primary snoring and OSAS. Nocturnal polysomnography (sleep study) is the gold standard for diagnosis of childhood OSAS. Adenotonsillectomy is the first line of treatment for most children.

Childhood OSAS is associated with important sequelae including cardiovascular, growth and neurobehavioural complications.
DEFINITION

Obstructive Sleep Apnea Syndrome (OSAS) in children is a disorder of breathing during sleep characterized by prolonged partial upper airway obstruction and/or intermittent complete obstruction (obstructive apnea) that disrupts normal ventilation during sleep and normal sleep patterns.

OSAS needs to be differentiated from primary snoring, which is defined as snoring without obstructive apnea, frequent arousals from sleep, or gas exchange abnormalities.

PREVALENCE

Table 1: Prevalence of snoring, habitual snoring and OSAS in children

<table>
<thead>
<tr>
<th></th>
<th>Worldwide</th>
<th>Singapore</th>
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</thead>
<tbody>
<tr>
<td>Snoring</td>
<td>9 - 31%</td>
<td>28.1%</td>
</tr>
<tr>
<td>Habitual Snoring</td>
<td>3 - 12%</td>
<td>6.0%</td>
</tr>
<tr>
<td>OSAS</td>
<td>0.7 - 2.9%</td>
<td>2.4%</td>
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</tbody>
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From a recent local questionnaire study of 11,114 children aged 4-7 years old, the prevalence of snoring was significantly associated with male gender, Chinese race, obesity, atopy, maternal atopy, maternal smoking and breastfeeding. The prevalence of habitual snoring was significantly associated with obesity, atopy, maternal smoking and breastfeeding.

OSAS occurs in children of all ages, from neonates to adolescents. However, it is most common in preschool-aged children, which is the age when the tonsils and the adenoids are the largest in relation to the underlying airway size.

Predisposing factors for childhood OSAS include adenotonsillar hypertrophy, obesity, craniofacial disorders, Down syndrome, cerebral palsy, neuromuscular disorders, genetic diseases, metabolic diseases, storage diseases and laryngomalacia.

HISTORY AND PHYSICAL EXAMINATION

The American Academy of Paediatrics clinical practice guideline on the diagnosis and management of childhood obstructive sleep apnea recommends that “All children should be screened for snoring. As part of routine health care maintenance for all children, paediatricians should ask whether the patient snores. An affirmative answer should be followed by a more detailed evaluation”. The evidence for this recommendation is good and the strength of the recommendation is strong.
Childhood OSAS is very unlikely in the absence of habitual snoring. If a history of habitual snoring is elicited, a more detailed history should be obtained regarding laboured breathing during sleep, restless sleep and neurobehavioural problems.

Physical examination may be normal. There may be non-specific findings related to adenotonsillar hypertrophy such as mouth breathing, nasal obstruction and hyponasal speech. There may be complications of OSAS such as pulmonary hypertension and poor growth.

History and physical examination are useful to screen patients to determine which patients need investigations for OSAS. However, history and physical examination have been shown to be poor at discriminating between primary snoring and OSAS.

There are reasons why history can be misleading:

1) The loudness of snoring does not correlate with the degree of obstructive apnea. There may be very noticeable snoring without apnea.

2) Children with OSAS experience obstruction primarily during rapid eye movement (REM) sleep, which occurs predominantly in the early hours of the morning when their parents are not observing them, thus leading to an underestimation of apnea.

3) Some children have obstructive hypopnea with persistent partial airway obstruction associated with gas exchange abnormalities, rather than discrete cyclic obstructive apneas. These children will not manifest pauses and gasps in their snoring, and the condition may be misdiagnosed as primary snoring.

Examination can also be misleading: There is no relation between the size of the tonsils and adenoids and the presence of OSAS. This is because OSAS is thought to be attributable to a combination of adenotonsillar hypertrophy and the neuromuscular tone of the upper airway during sleep rather than to structural abnormalities alone. Thus, the presence of large tonsils and adenoids does not necessarily indicate that the patient has OSAS.

**DIAGNOSIS**

Nocturnal polysomnography (sleep study) is the gold standard for diagnosis of childhood OSAS. Polysomnography can 1) distinguish primary snoring from OSAS, and 2) objectively determine the severity of OSAS and associated gas exchange and sleep disturbances.

Polysomnography can be performed satisfactorily in children of any age. It should be performed without the use of sedatives or sleep deprivation. For most indications, a single night study is sufficient. However, if the child does not experience at least 1
REM period or the parents report that what was observed during the study did not reflect a typical night’s sleep or the chief complaint, consideration should be given to repeating the study. If the sleep study is found to be technically inadequate, then it should be repeated.

Pediatric sleep studies should be scored and interpreted using age appropriate criteria as outlined in the American Thoracic Society consensus statement on pediatric polysomnography.

Most studies have shown that abbreviated screening techniques such as videotaping, nocturnal pulse oximetry, and daytime nap polysomnography tend to be helpful if results are positive but have a poor predictive value if results are negative. Thus children with negative results would still require more comprehensive evaluation in the form of nocturnal polysomnography.

TREATMENT

A. Tonsillectomy and Adenoidectomy

Adenotonsillectomy is the most common treatment for childhood OSAS. Adenoidectomy alone may not be sufficient. In otherwise healthy children with adenotonsillar hypertrophy, polysomnographic resolution occurs in 75% to 100% after adenotonsillectomy. Although obese patients may have less satisfactory results, many will be adequately treated with adenotonsillectomy, and it is generally the first line treatment for these patients.

The benefits of adenotonsillectomy in childhood OSAS include: 1) resolution of obstructive apnea, 2) relief of snoring and other clinical symptoms, 3) improvements in cognition and behaviour, growth, cardiovascular function, and 4) quality of life.

A local study was recently conducted to evaluate the quality of life of children before and after tonsillectomy and/or adenoidectomy as curative surgery for paediatric OSAS. The OSAS-18, a validated quality of life survey of paediatric OSAS, was used. Cases of childhood OSAS proven by overnight polysomnography in the National University Hospital (Singapore) and who received curative surgery were reviewed; the parents of these children were then contacted to fill in questionnaires to grade, via simple observation questions, various aspects of their children’s lives that together constitute a reasonable deduction of their quality of life.

All children experienced an improvement in QOL after the operation. The mean total QOL score decreased significantly from a pre-op score of 79.0 to a post-op score of 40.3, registering a decrease of 49.0%. There was an improvement in 4
domains including sleep disturbance, physical symptoms, daytime symptoms and caregiver concerns. The greatest improvement was observed from the results of the domain of sleep disturbance, with the mean score decreasing 65.2% from 21.4 to 7.4.

Potential complications of adenotonsillectomy include anaesthetic complications, immediate postoperative problems such as pain and poor oral intake; and haemorrhage. In addition, patients with OSAS may develop respiratory complications, such as worsening of OSAS or pulmonary edema, in the immediate postoperative period. Death attributable to respiratory complications in the immediate postoperative period has been reported in patients with severe OSAS. Patients with severe OSAS at high risk of post-operative respiratory complications should be monitored continuously with pulse oximetry after surgery.

Children with mild to moderate OSAS who have complete resolution of snoring and disturbed sleep after treatment do not need a repeat polysomnography. Repeat polysomnography is recommended for children who have continued symptoms and signs, who have severe OSAS, or who are obese. The repeat study should be deferred until 6-8 weeks post-surgery to allow for resolution of postoperative edema and to ensure that upper airway, cardiac and central nervous system remodeling is complete.

B) Continuous Positive Airway Pressure (CPAP)

CPAP is a treatment option in childhood OSAS for patients with 1) specific surgical contraindications, 2) minimal adenoidal tissue, 3) persistent OSAS after adenotonsillectomy or 4) preference for non-surgical alternatives. However, unlike adenotonsillectomy, which is usually curative, CPAP will need to be used indefinitely. CPAP must be titrated in the sleep laboratory before prescribing the device and periodically adjusted thereafter.

C) Other Modalities

1) Weight loss
   In obese patients, weight loss strategies should be used.

2) Avoidance of allergens
   Avoidance of environmental tobacco smoke and avoidance of indoor allergens may be helpful.

3) Medication
   A recent randomized, triple-blind, placebo controlled, parallel group trial of nasal fluticasone propionate versus placebo was conducted in 25 children aged 1 to 10
years old with obstructive sleep apnea proven on polysomnography. Nasal fluticasone decreased the apnea hypopnea index from 11/h to 6/h, suggesting that topical corticosteroids may be helpful in ameliorating pediatric obstructive sleep apnea.

However, there were limitations in the above study: The sample size was small, patients with other medical conditions were excluded, patients with severe OSAS were excluded, patients with markedly enlarged tonsils were excluded and the improvement in OSAS was only modest.

An otherwise healthy child with mild OSAS may benefit from a trial of nasal steroids, particularly if there are additional risk factors for surgery or if the parents particularly want to avoid surgery. However, it would be prudent to repeat a sleep study after the trial to ensure a positive response; and also to repeat sleep studies periodically, because the duration of effect is not known. Children with severe apnea should undergo surgery, because the apnea index was only halved with the use of nasal steroids.

Larger, multicenter studies evaluating the efficacy of steroids and the duration of their effects are required before their use can be generally endorsed.

4) Other Surgical Options

Other surgical options are available for patients not responding to usual treatment. These include craniofacial surgery and tracheostomy.
ALGORITHM FOR THE DIAGNOSIS AND MANAGEMENT OF UNCOMPLICATED CHILDHOOD OSAS
(modified from American Academy of Pediatrics Clinical Practice Guideline on the Diagnosis and Management of Childhood Obstructive Sleep Apnea Syndrome)

Findings associated with OSAS include:
1. History
   • Habitual snoring with labored breathing
   • Observed apnea
   • Restless sleep
   • Daytime neurobehavioral abnormalities or sleepiness
2. Physical examination
   • Growth abnormalities
   • Signs of nasal obstruction, adenoidal facies, enlarged tonsils
   • Increased pulmonic component of second heart sound
   • Patient may have no abnormalities on examination

Children screened for snoring during health visit

Are symptoms or examination suggestive of OSAS present?

No
Continue screening during visits

Yes
Refer to Pediatric sleep specialist

Polysomnography (gold standard)

Polysomnography demonstrates OSAS

Yes
Clinician forms treatment plan

Is patient candidate for adenotonsillectomy?

No
Further clinical evaluation and treatment as warranted

Yes
Treatment options include:
*CPAP
*other surgical treatment
*weight loss if obese

Clinician considers factors such as:
•obesity
•tonsil/adenoid hypertrophy

Was surgery successful?

No

Yes
All patients should undergo clinical re-evaluation. High-risk patients should undergo repeat PSG after 6 weeks.

Physician continues appropriate follow-up and monitoring

High risk patients may require pre-op CPAP and should be monitored as inpatient post-operatively

KIV

No
COMPLICATIONS

A. Cardiovascular

Cardiovascular complications of untreated childhood OSAS include:

- Right heart strain
- Reduced right ventricular ejection fraction
- Right ventricular hypertrophy
- Leftward shift of the interventricular septum
- Cor Pulmonale
- Systemic hypertension

B. Growth

Complications of OSAS include poor growth. Post treatment, sleeping energy expenditure decreased and weight increased. Treatment of OSAS results in increases in weight and height, even in children who were initially obese.

C. Cognitive and Behavioural

The American Academy of Paediatrics Subcommitee on Obstructive Sleep Apnea Syndrome pooled 6 cross-sectional studies that examined the cognitive and behavioural abnormalities in childhood OSAS. The combined neurobehavioural abnormalities in snoring children is 2.93 (95% CI 2.23-3.83). Abnormalities include decreased school performance, decreased vigilance, inattention, excessive daytime sleepiness, aggression, hyperactivity and ADHD.

Young children who snore loudly and frequently are at higher risk for having lower grades in school several years after the snoring has resolved. These findings suggest that the adverse neurocognitive outcome and diminished academic performance in sleep disordered breathing may be only partially reversible, particularly when the sleep disordered breathing occurs during critical phases of brain growth and development.

CONCLUSION

OSAS is not uncommon in children and all children should be screened for snoring. History and physical examination are poor at discriminating between primary snoring and OSAS. Nocturnal polysomnography is the gold standard for diagnosis of childhood OSAS. Adenotonsillectomy is the first line of treatment for most children. Childhood OSAS is associated with important sequelae including cardiovascular, growth and neurobehavioural complications.