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Review

The Impact of Tonsillectomy on Sleep Apnea and Quality of Life in Children and Adults

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Abstract

Tonsillectomy, performed with or without adenoidectomy, involves the complete removal of the tonsils and has long been a cornerstone in the management of obstructive sleep apnea (OSA) and related sleep-disordered breathing conditions. Sleep apnea is classified into obstructive, central, or mixed types, with mixed apnea combining obstructive and central features, often linked to severe OSA. Sleep apnea is associated with various risk factors and leads to significant consequences, including cardiovascular morbidity, neurobehavioral deficits, increased healthcare utilization, and reduced quality of life. A primary contributing factor, particularly in pediatric OSA, is the proliferation of the adenoids and tonsils, resulting in upper airway obstruction during sleep. Adeno-tonsillectomy is an established first-line treatment for pediatric OSA, effectively improving apnea indices and quality of life, though residual central sleep apnea may persist in some cases. In adults, tonsillectomy reduces apnea severity; however, its effectiveness is influenced by factors such as body mass index. The impact of tonsillectomy on the quality of life of adults with sleep apnea remains underexplored. This review aims to assess the impact of tonsillectomy on various types of sleep apnea in both children and adults, while identifying gaps in current research and future directions. Further studies are needed to investigate the long-term outcomes of surgical interventions and the role of obesity in determining surgical success, to optimize diagnostic, therapeutic, and management strategies for sleep apnea across diverse populations.

Keywords: *Sleep apnea, Obstructive sleep apnea, Central sleep apnea, Mixed sleep apnea, Tonsillectomy, Quality of life*

Introduction

Tonsillectomy, one of the most commonly performed surgical procedures worldwide, involves surgically removing the tonsils, either with or without adenoidectomy (adeno-/tonsillectomy) (1). It has been a cornerstone in managing obstructive sleep apnea (OSA), a condition marked by recurrent episodes of upper airway obstruction during sleep (2, 3). Sleep apnea is classified as obstructive, central, or mixed, with mixed apnea combining features of both obstructive and central types, often associated with severe OSA due to ventilatory instability and airway collapsibility (4, 5). The prevalence of OSA is about 4–18% of healthy children, central sleep apnea (CSA) is 1-37%, and mixed sleep apnea (MSA) is 0–6% (6, 7). The indices of three types are higher in neonates and decrease with age (8).

Sleep apnea is linked to various risk factors and is associated with cardiovascular morbidity, neurobehavioral deficits, increased health care utilization, and poor quality of life (9-12). In pediatric populations, sleep apnea is frequently associated with adenotonsillar hypertrophy, resulting in airway blockage and manifesting as symptoms including snoring, disrupted sleep, and increased daytime somnolence. Therefore, screening for sleep apnea is recommended by the American Academy of Pediatrics at routine medical visits. Sleep apnea can be diagnosed with overnight polysomnography, which is the gold standard measurement (5). In adults, however, the outcomes are more variable, as sleep apnea in this population often arises from a combination of anatomical and non-anatomical factors, necessitating a more tailored and multidisciplinary approach.

To date, OSA has been extensively studied in children, with tonsillectomy and adenoidectomy commonly recognized as effective first-line treatment options. However, the characteristics of CSA and MSA in children presenting with sleep-disordered breathing remain largely unexplored. Adeno-tonsillectomy has long been established as an effective treatment for most pediatric cases of OSA. In contrast, most adults do not experience tonsillar hypertrophy as the primary cause of airway obstruction, as tonsillar tissue naturally decreases with age.

Despite the well-documented benefits of tonsillectomy, several challenges persist. In pediatric populations, the variability in outcomes based on age, severity of OSA, and comorbid conditions underscores the need for personalized treatment plans. Similarly, in adults, the limited effectiveness of tonsillectomy as a standalone procedure in addressing more complex cases of OSA highlights the importance of combining surgical and non-surgical therapies. Additionally, gaps in research exist regarding the long-term effects of tonsillectomy on sleep apnea and its impact on QoL metrics, particularly in diverse populations.

This review aimed to explore the impact of tonsillectomy on different types of sleep apnea in children and adults while identifying current gaps in knowledge and potential directions for future research.

Methods

The following databases were used in systematic research: Medline (PubMed), Web of Science, and Scopus till January 17, 2025. The MeSH database was used to retrieve the synonyms of the search strategy. Search terms were then combined by (“AND” and “OR”) Boolean operators according to the Cochrane Handbook for Systematic Reviews of Interventions (16) as follows: “Sleep Apnea” OR “Sleep-Disordered Breathing” OR “Central Sleep Apnea” OR “Obstructive Sleep Apnea” OR “Mixed Sleep Apnea” AND “Tonsillectomy” OR “Tonsillectomies” AND “Children” OR “Adult”. Summaries of the found studies were exported by EndNote X8, and duplicate studies were removed. Any study that discusses the impact of tonsillectomy on sleep apnea and quality of life in children and adults and is published in peer-reviewed journals was included with the inclusion of full-text articles, abstracts, and case series with the related topics included. All languages are included. Case reports, letters, and comments were excluded.

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Discussion

Obstructive sleep apnea

Obstructive sleep apnea occurs in 1–2% of women and 2–4% of men from the general population, according to the latest studies (13), while it is estimated that 4–18% of healthy children are affected by OSA (5). Among middle-aged adults in the US, 10% have mild OSA, 3.8% have moderate OSA, and 6.5% have severe OSA (13). Multiple factors contribute to the pathophysiology of OSA. The excessive growth of tonsils and adenoids is considered the most common contributing factor, as it leads to airway narrowing during sleep (14).

Male gender, obesity, increasing age, and the menopause are risk factors for this pathology (15). Obesity or being overweight leads to macroglossia, increased fat surrounding the pharynx, a retropositioned tongue due to a mandibular retrognathia, tonsillar hypertrophy, a redundant pharyngeal mucosa, and excessive or elongated soft palatal tissues, all of which can narrow the upper airway (16, 17). Other risk factors include bad habits such as smoking and alcohol, endocrine imbalance such as thyroid gland disorders, and hereditary lifestyle (17, 18).

There are two categories of symptoms associated with OSA: day symptoms and night symptoms. Snoring, arousal with a short and acute dyspnea sensation, and apneas are the most recognized nocturnal symptoms (16). Other symptoms are encountered, such as diaphoresis, somniloquy, choking, nocturne restless sleep, salivation, xerostomia, and bruxism (15, 16, 19). Daytime symptoms include fatigue, excessive daytime sleepiness, morning headaches, mood disturbances, and a decrease in cognitive performance. Patients with OSA also find difficulty in controlling medical comorbidities such as hypertension, type 2 diabetes, and obesity. Additionally, obstructive sleep apnea is associated with gastroesophageal reflux, apathy, depression, memory loss, and decreased libido (15, 16, 19).

Cardio-Respiratory Polygraphy Overnight polysomnography (PSG) is the gold standard measurement of OSA diagnosis. It integrates data from the electrocardiogram, electroencephalogram, electromyography, and electrooculogram with the measurement of the patient’s tidal volume, respiratory rate, and expiratory and inspiratory volumes to calculate the apnea–hypopnea index of the patient (20). In addition, there are various questionnaires and screening tools used to detect OSA, such as the STOP-Bang Questionnaire, the Berlin Questionnaire, and the Epworth Sleepiness Scale (13).

Imaging can also be used to detect OSA; however, the conventional cephalometric images offer limited dimensions (15). Due to this limitation, magnetic resonance imaging (MRI) or cone-beam computed tomography (CBCT) are usually recommended.

There are different modalities in the treatment of OSA such as Continuous Positive Airway Pressure (CPAP) Therapy, Orthodontic Management, Behavioral Therapy, and medical therapy. As mentioned, overgrowth of adenoids and tonsils is the most common cause of OSA in children and adults. Thus, tonsillectomy is essential in treating OSA (21). Franco Jr et al. developed the OSA-18 questionnaire to evaluate the effect of OSA and tonsillectomy on the quality of life (QoL) of children at three different stages: preoperatively, 2 months, and 6 months postoperatively (22). This questionnaire evaluates five domains: physical symptoms, sleep disturbances, daytime symptoms, emotional distress, and parents' concerns. Recent studies evaluated the impact of tonsillectomy on the QoL of children using the OSA-18 questionnaire. Sukumaran et al**.** found that OSA is predominant in males (72%) and a male-to-female ratio of 2.6:1 (21). Previous studies reported the same results (23-25). It also found that the OSA-18 mean score before tonsillectomy was 77, which is a moderate QoL impact. De Lima Junior et al. reported a comparable result (mean score of 82.83) (26).

According to Sukumaran et al**.**, the mean of postoperative OSA-18 scores reduced to 28.6 at 2 months and 22.5 at 6 months, showing remarkable QoL improvements (21). De Lima Junior et al. also found a decrease to 34.3 one month after surgery

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(26). Additionally, Franco et al. demonstrated better QoL results after adenotonsillectomy (22). Among the OSA-18 domains, physical symptoms, parents' concerns, and sleep disturbances were associated with the greatest improvement in 2 months post-surgery (21, 22). Improvement in QoL at 6 months was inconsistent among different studies. Recurrence of symptoms was documented especially in female children >6 years. This recurrence was attributed to inadequate parental perception and incomplete therapeutic responses (21). On the other hand, recent studies found an improvement in QoL in children with OSA after adenotonsillectomy up to 6 months (21, 27).

Furthermore, the impact of tonsillectomy on obstructive sleep apnea in adults was assessed. Smith et al. (28), Camacho et al. (29), and Holmlund et al. (30) reported a reduction in Apnea-Hypopnea Index mean in adults after tonsillectomy from 31.57 to 8.12, from 40.6 to 8.8, and from 40 to 7, respectively. Smith et al. showed a surgical response in 78% of patients and complete surgical cure in 50% of them. Surgical response is defined as AHI reduction > 50% and total AHI < 20, while complete surgical cure is AHI < 5. Similarly, Tan et al. (31) and Senchak et al. (32) demonstrated a surgical response rate of 73.5% and 94.7%, respectively. Furthermore, Smith et al. used various validated QoL measures such as Epworth Sleepiness Scale (ESS), Insomnia Severity Index (ISI), and Functional Outcomes of Sleep Questionnaire-10 (FOSQ-10) and showed a significant improvement in all of them. It showed a reduction in ESS from 10.94 to 5.0, a reduction in ISI from 16.64 to 6.15, and an increase in FOSQ-10 from 9.91 to 14.26. Camacho et al. 17 also observed a reduction in ESS from 11.6 to 6.1. Notably, higher BMI was found to be associated with lower surgical response rates (28).

Central sleep apnea

Central sleep apnea can occur in healthy children and children with underlying conditions. Central apneas (CAs) are common in newborn infants and preterm infants, as 25% of apneas are central among these populations. In healthy infants, brief central apneas <20 seconds are considered physiologic during sleep, particularly during REM sleep, sighs, or movements. Polysomnographic studies were done in healthy term infants. The results demonstrated that at the age of one month, the median central apnea index (CAI) was 5.5–8.8/hour, and apneas lasted from 3.1 to 20.1 seconds. By the second and third months of life, central apneas reduce significantly and continue to decrease until the second year. Repeated oxygen desaturations leading to respiratory incidents and higher CAI with a median of 12.4/hour at one month of age were observed in healthy term infants at high altitudes. While in 1 to 18 years, healthy children have a prevalence of central apneas of 30%, which lasts 10-18 seconds. The mean CAI in healthy children older than one year is <1/hour; however, it can reach 6/hour.

In children with underlying disorders, the general prevalence of CSA is 4-6%. Neurologic disorders such as Arnold-Chiari Malformations, achondroplasia, Prader-Willi Syndrome (PWS), and brain tumors are commonly associated with CSA in children. Additionally, there is an increased prevalence of CSA in Down syndrome children. In obese children, BMI may affect CSA; however, results are debatable. Higher prevalence observed in younger children, such as toddlers and preschoolers. Declines in CSA prevalence occur from childhood to adolescence. In adults, CSA is classified based on $PaCO_2$ levels into non-hypercapnic CSA ($PaCO_2$ < 35 mmHg) and hypercapnic CSA ($PaCO_2$ > 45 mmHg).

While in pediatrics, it is classified into physiologic CSA, idiopathic CSA, and CSA associated with specific medical conditions. Physiologic CSA is a normal phenomenon during sleep and includes central apneas that occur with phasic REM sleep, post-sigh events, sleep onset, and body movement. Idiopathic CSA is the occurrence of CSA in the absence of any medical disorders. It is manifested by daytime sleepiness and frequent awakenings at night. Multiple inherited and acquired medical disorders are associated with CSA in children. As mentioned above, neurologic disorders are common causes of acquired CSA in children, while Congenital Central Hypoventilation Syndrome

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(CCHS) and Late-onset Congenital Central Hypoventilation Syndrome (LO-CCHS) are examples of inherited disorders associated with CSA. Furthermore, CSA may occur with other sleep disorders, especially obstructive sleep apnea, in both healthy children and those with underlying conditions.

Central sleep apnea can remain asymptomatic despite positive diagnosis via PSG. This may occur especially in children with chronic kidney disease, Arnold-Chiari malformations, achondroplasia, and Down syndrome. On the contrary, children may complain of sleep-disordered breathing symptoms that are not consistent with PSG findings. It can also be an incidental finding during investigating symptoms such as hypersomnolence and apnea. The idiopathic CSA can manifest as restless sleep, snoring, daytime sleepiness, and frequent night awakenings. Similar manifestations are observed in conditions like Chiari malformations.

The consequences of CSA are not as clear as those of OSA; however, oxidative stress, systemic inflammation, and activation of the sympathetic nervous system are possible consequences of CSA. Central sleep apnea has an impact on cardiovascular health. Significant changes in heart rate and blood pressure were observed in children with movement-related central apneas. A recent study assessed the impact of tonsillectomy and adenoidectomy on CSA. Results of the study demonstrated that tonsillectomy reduces CSA in children. However, residual CSA may occur after surgery, especially in those with OSA (4). Improvement in CSA after tonsillectomy may be due to changes in upper airway resistance and ventilatory control or upper airway obstruction relief reducing central apnea events.

Mixed sleep apnea

Mixed sleep apnea has characteristics from both obstructive and central apneas. The occurrence of mixed apneas in patients with obstructive sleep apnea may be due to collapsibility of the airway and instability of ventilatory control (5). The clinical significance of MSA and the influence of MSA incidents on OSA patients have not been fully discussed. It was found that 61.3% of children with OSA have an abnormal mixed apnea index, while 51.3% have an abnormal central apnea index (5). Central apneas in children with obstructive sleep apnea may be due to post-arousal effects of obstructive apneas. A drop in $PaCO_2$ occurs after arousal leads to temporary cessation of respiratory drive, leading to central apneas. Adeno-tonsillectomy can reduce CSA in children with adeno-tonsillar hypertrophy, overlapping mechanisms between OSA and CSA. A recent study showed reductions after adeno-tonsillectomy in OAI and MAI from 7.1 to 1.1 and from 1.2 to 0.5, respectively. It also reported that only 23.8% of children had a CAI≥1/h after surgery. Furthermore, 15.0% of children had an MAI≥1/h after adeno-tonsillectomy, compared with 61.3% of children before surgery, which means a 91.7% normalization of MAI in children with abnormal value before surgery (5).

Future Directions

There is a need for further studies to explain the mechanisms behind CSA resolution post adeno-tonsillectomy. Additionally, more focus should be applied on the effects of obesity on the consequences of adeno-tonsillectomy surgery in patients with sleep apnea.

Conclusion

Obstructive sleep apnea, CSA, and MSA affect individuals across all age groups, with OSA being the most prevalent, primarily caused by adeno-tonsillar hypertrophy in children and multifactorial factors like obesity in adults. Adeno-tonsillectomy is a highly effective first-line treatment for pediatric OSA, significantly improving apnea indices and quality of life, though residual CSA may persist in some cases. In adults, tonsillectomy reduces apnea severity, but its effectiveness varies with factors such as body mass index (BMI). Future research should investigate the mechanisms behind CSA resolution, the long-term outcomes of surgical interventions, and the influence of obesity on surgical success to optimize sleep apnea management across diverse populations.

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Disclosure

Declaration

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Data Availability

All data is available within the manuscript.

Author Contribution

All authors contributed equally in the conceptualization, data collection, data analysis and writing of the paper.

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