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Obstructive sleep apnea in pediatric patients

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Abstract
Obstructive sleep apnea is a highly prevalent disorder in children manifested as an obstruction of the upper airway during sleep.
Objective: To analyze in the literature the etiology, diagnosis, risk factors and treatment of the systemic illness.
Methodology: Articles found at PubMed, SCOPUS and Google scholar were analyzed, with an emphasis on the last 5 years. Articles were evaluated with the PRISMA and AMSTAR guidelines. The search was carried out using the words “sleep apnea” related with “tonsillar hypertrophy”, “sleep”, “upper airway”, “obstruction”.
Results: Etiology: It’s a multifactorial disease, mainly caused by an obstacle in upper airway due to tonsillar hypertrophy. Diagnosis: Performed with clinical or instrumental examinations, overnight polysomnography is the gold standard for the diagnosis of this disorder. Risk factors: Tonsillar hypertrophy, iron deficiency, disturbances in craniofacial growth and childhood obesity. Treatment: It can be performed surgically or non-surgically and can be supported by orthodontic treatments.
Conclusion: Obstructive sleep apnea is a common respiratory disorder in children, usually caused by tonsillar hypertrophy, it can be diagnosed by clinical or instrumental examinations. It is related to risk factors such as childhood obesity, and the treatment can be surgical or non-surgical.

Keywords: Sleep apnea, tonsillar hypertrophy, sleep, upper airway, obstruction

1. Introduction
Obstructive sleep apnea is the most common respiratory disorder in children. It is characterized by recurrent episodes of total or partial collapse of the upper airway during sleep [1]. It is defined as "sleep breathing disorder characterized by prolonged partial upper airway obstruction [hypopnea] and/or intermittent complete obstruction (obstructive apnea) that disrupts normal ventilation during sleep along with normal sleep patterns" [2]. It is common in healthy children with higher incidence in infants and preschoolers, resulting in daytime sleepiness, cognitive and behavioral disorders, as well as poor performance [3, 4, 5, 6, 7].
Both the diagnosis and treatment of obstructive sleep apnea in children is often delayed due to the high prevalence, in addition to limited diagnostic tests [8]. Sleep apnea is related to craniofacial anatomy that is associated with several oral manifestations such as tonsillar hypertrophy, narrow dentoalveolar width, increased horizontal overbite, reduced vertical overbite and malocclusion, which result in a series of changes in craniofacial or occlusal development, as well as triggering a tendency to breathe through the mouth [9, 10, 11]. Children with this sleep disorder may present problems in the school years such as insomnia, which tend to aggravate their mood and decrease their ability to pay attention [12].
Obstructive sleep apnea is a highly prevalent disorder in the pediatric population, which can have repercussions in the patient's life, both in their intellectual and personal development, so it is important to identify it to establish an adequate diagnosis and treatment. The aim of this work is to analyze the etiology, diagnosis, risk factors and treatment of obstructive sleep apnea in pediatric patients in the literature.

2. Materials and Methods

Articles on the subject published through the PubMed, SCOPUS and Google Scholar databases were analyzed, with emphasis on the last 5 years. The quality of the articles was evaluated using PRISMA guidelines, i.e., identification, review, choice and inclusion. The quality of the reviews was assessed using the measurement tool for evaluating systematic reviews (AMSTAR-2) [13]. The search was performed using Boolean logical operators AND, OR and NOT. It was realized with the words "sleep apnea" related with "tonsillar hypertrophy", "sleep", "upper airway", "obstruction". The keywords were used individually, as well as each of them related to each other.

3. Results & Discussion

3.1 Etiology

Obstructive sleep apnea is multifactorial and caused by repeated episodes of upper airway collapse and obstruction during sleep [14, 15]. In children it usually occurs due to an imbalance between upper airway load and neuromuscular tone, although the most common cause is soft tissue hypertrophy, craniofacial discrepancies also play an important role [2, 3, 16, 17]. The primary sites of anatomical obstruction can be found at the level of the nasal, palatal and hypopharyngeal pathways [18]. Adenotonsillar hypertrophy, enlarged lingual tonsils and obesity during early childhood and adolescence also stand out [19, 20]. Recent studies have identified vitamin D deficiency as one of the causes of obstructive sleep apnea, since it is involved in neurochemical mechanisms that intervene in the regulation of sleep, as well as in the serotonergic and dopaminergic pathways [21]. This disorder can be associated with cardiovascular diseases, neurocognitive diseases and metabolic syndromes [22].

Obstructive sleep apnea is of multifactorial etiology, generally caused by an obstruction of the upper airways at the level of the nasal, palatal and hypopharyngeal passages.

3.2 Diagnosis

Under the suspicion of obstructive sleep apnea, the assessment can be performed clinically and instrumentally by a multidisciplinary team, clinically evaluating children with typical symptoms such as snoring, restless sleep and nocturnal hyperactivity [21]. Instrumental evaluation can be performed by nocturnal pulse oximetry in situations where polysomnography is not an option, this provides a timely performance in the diagnosis and detection of the disease, but it is not completely accurate, so nocturnal polysomnography should be used [22, 23, 24, 25, 26]. Nocturnal polysomnography, which refers to a systematic process in which physiological parameters are collected during sleep, is considered the gold standard for the diagnosis of apnea in children [27, 28]. The objective of the evaluation is to diagnose, differentiate and quantify apneas, it is a costly test, can only be performed in a hospital setting and can cover two complete sleep cycles, without premedication or sleep deprivation [29].

The diagnosis of obstructive sleep apnea can be made by clinical and instrumental examinations, with nocturnal polysomnography being the gold standard for the diagnosis of this disorder.

3.3 Risk Factors

Tonsillar hypertrophy is considered the main risk factor in infantile patients, these begin to grow from birth and reach their maximum point of development at 2 and 4 years of age, decreasing after 4 years of age, to have another growth peak in adolescence. However, there are studies that rule out an absolute relationship between the size of the tonsils and adenoids with obstructive sleep apnea [30, 31]. Craniofacial growth disturbances, a short lingual frenulum and the state of maturity of the neural centers have also been associated as risk factors for obstructive sleep apnea in children, and studies have shown a significant correlation between these factors and sleep disturbances, as they cause a reduction in nasopharyngeal width and abnormal orofacial development expressed by airway collapse and poor responsiveness of the pharyngeal muscles [32, 33, 34, 35]. Childhood obesity also presents with upper airway narrowing [36, 37, 38]. Iron deficiency develops this systemic alteration [39].

The most representative risk factors in children are tonsillar hypertrophy, iron deficiency, craniofacial growth disorders and childhood obesity.

3.4 Treatment

With a correct diagnosis of obstructive sleep apnea, a timely plan can be made, the first-choice clinicians consist of surgical and non-surgical therapies [40].

3.4.1 Surgical treatment

Adenotonsillectomy is the first line treatment, in some cases apnea usually persists after surgery due to a lack of knowledge of the severity of the disease, so other alternatives should be sought [31, 41]. More conservative methods have been developed, such as adenotonsillectomy, which has a lower morbidity [42]. There is also maxillary disjunction, which helps to increase the width of the palate and improve breathing [43].

3.4.2 Non-surgical treatments

These include anti-inflammatory drugs, non-invasive ventilation, and orthodontics. The French Society of Otorhinolaryngology and Head and Neck Surgery proposes intranasal corticosteroids in children for use in cases of nasal obstruction, their combination with leukotrienes tends to improve their efficacy. Another indicated treatment is non-invasive ventilation, which refers to the provision of ventilatory support through the upper airway by means of a mask or some similar device [40, 44, 45]. Continuous positive pressure is the standard non-surgical treatment, two other ventilation methods that emerged from this are: bi-level positive airway pressure and self-treating positive airway pressure [22].

3.4.3 Orthodontic and orthopedic treatments

Palatal narrowing in the premolar region is often related to severe obstructive sleep apnea, so several orthopedic and orthodontic treatments such as rapid and semi-rapid palatal expansion can be performed. These treatments help to decrease the depth of the palate and increase upper airway space [46, 47]. Functional orthodontic appliances help stimulate palatal growth by positioning the mandible forward and are a therapeutic option for growing patients [48].

Treatment of obstructive sleep apnea can be performed surgically or non-surgically and can be supported by orthodontic treatments that help widen the width of the palate and improve breathing.

4. Conclusions

Obstructive sleep apnea is of multifactorial etiology and may be related to different risk factors such as tonsillar hypertrophy, iron deficiency, craniofacial growth disorders and childhood obesity. Therefore, the clinician must be able

to identify them in order to establish a suitable diagnosis using tools such as nocturnal polysomnography. Apply the appropriate treatment, whether surgical or non-surgical, or the need for orthodontic treatment to increase the patient's quality of life.

References

1. Sica E, De Bernardi F, Nosetti L, Martini S, Cosentino M, Castelnuovo P *et al*. Catecholamines and children obstructive sleep apnea: a systematic review. Sleep Med. 2021 Nov;87:227-232.
2. Perez C. Obstructive sleep apnea syndrome in children. Gen Dent. 2018 Nov-Dec;66(6):46-50.
3. Garg RK, Afifi AM, Garland CB, Sanchez R, Mount DL. Pediatric Obstructive Sleep Apnea: Consensus, Controversy, and Craniofacial Considerations. Plast Reconstr Surg. 2017 Nov;140(5):987-997.
4. Paglia L. Respiratory sleep disorders in children and role of the paediatric dentist. Eur J Paediatr Dent. 2019 Mar;20(1):5.
5. Lee YH, Huang YS, Chen IC, Lin PY, Chuang LC. Craniofacial, dental arch morphology, and characteristics in preschool children with mild obstructive sleep apnea. J Dent Sci. 2020 Jun;15(2):193-199.
6. Eastwood P, Gilani SZ, McArdle N, Hillman D, Walsh J, Maddison K, Goonewardene M, Mian A. Predicting sleep apnea from three-dimensional face photography. J Clin Sleep Med. 2020 Apr 15;16(4):493-502.
7. Huang YS, Hsu JF, Paiva T, Chin WC, Chen IC, Guilleminault C. Sleep-disordered breathing, craniofacial development, and neurodevelopment in premature infants: a 2-year follow-up study. Sleep Med. 2019 Aug;60:20-25.
8. Heath DS, El-Hakim H, Al-Rahji Y, Eksteen E, Uwiera TC, Isaac A, *et al*. Development of a pediatric obstructive sleep apnea triage algorithm. J Otolaryngol Head Neck Surg. 2021 Jul 15;50(1):48.
9. Grillo C, La Mantia I, Zappala G, Cocuzza S, Ciprandi G, Andaloro C. Oral health in children with sleep-disordered breathing: a cross-sectional study. Acta Biomed. 2019 Jul 10;90(7-S):52-59.
10. Markkanen S, Niemi P, Rautiainen M, Saarenpää-Heikkilä O, Himanen SL, Satomaa AL *et al*. Craniofacial and occlusal development in 2.5-year-old children with obstructive sleep apnoea syndrome. Eur J Orthod. 2019 May 24;41(3):316-321.
11. Marino A, Nota A, Caruso S, Gatto R, Malagola C, Tecco S. Obstructive sleep apnea severity and dental arches dimensions in children with late primary dentition: An observational study. Cranio. 2021 May;39(3):225-230.
12. Licis A. Sleep Disorders: Assessment and Treatment in Preschool-Aged Children. Child Adolesc Psychiatr Clin N Am. 2017 Jul;26(3):587-595.
13. Shea BJ, Reeves BC, Wells G, Thuku M, Hamel C, Moran J, *et al*. AMSTAR 2: a critical appraisal tool for systematic reviews that include randomised or non-randomised studies of healthcare interventions, or both. BMJ. 2017;358:j4008.
14. Rundo JV. Obstructive sleep apnea basics. Cleve Clin J Med. 2019 Sep;86(9 Suppl 1):2-9.
15. Lajoie AC, Lafontaine AL, Kimoff RJ, Kaminska M. Obstructive Sleep Apnea in Neurodegenerative Disorders: Current Evidence in Support of Benefit from Sleep Apnea Treatment. J Clin Med. 2020 Jan 21;9(2):297.
16. Gulotta G, Iannella G, Vicini C, Polimeni A, Greco A, de Vincentiis M *et al*. Risk Factors for Obstructive Sleep Apnea Syndrome in Children: State of the Art. Int J Environ Res Public Health. 2019 Sep 4;16(18):3235.
17. Lin SY, Su YX, Wu YC, Chang JZ, Tu YK. Management of paediatric obstructive sleep apnoea: A systematic review and network meta-analysis. Int J Paediatr Dent. 2020 Mar;30(2):156-170.
18. Coughlin K, Davies GM, Gillespie MB. Phenotypes of Obstructive Sleep Apnea. Otolaryngol Clin North Am. 2020 Jun;53(3):329-338.
19. Lo Bue A, Salvaggio A, Insalaco G. Obstructive sleep apnea in developmental age. A narrative review. Eur J Pediatr. 2020 Mar;179(3):357-365.
20. Abdel-Aziz M, Ibrahim N, Ahmed A, El-Hamamsy M, Abdel-Khalik MI, El-Hoshy H. Lingual tonsils hypertrophy; a cause of obstructive sleep apnea in children after adenotonsillectomy: operative problems and management. Int J Pediatr Otorhinolaryngol. 2011 Sep;75(9):1127-31.
21. Bitners AC, Arens R. Evaluation and Management of Children with Obstructive Sleep Apnea Syndrome. Lung. 2020 Apr;198(2):257-270.
22. Tingting X, Danming Y, Xin C. Non-surgical treatment of obstructive sleep apnea syndrome. Eur Arch Otorhinolaryngol. 2018 Feb;275(2):335-346.
23. Savini S, Ciorba A, Bianchini C, Stomeo F, Corazzi V, Vicini C, Pelucchi S. Assessment of obstructive sleep apnoea (OSA) in children: an update. Acta Otorhinolaryngol Ital. 2019 Oct;39(5):289-297.
24. Montevecchi F, Bellini C, Meccariello G, Hoff PT, Dinelli E, Dallan I, *et al*. Transoral robotic-assisted tongue base resection in pediatric obstructive sleep apnea syndrome: case presentation, clinical and technical consideration. Eur Arch Otorhinolaryngol. 2017 Feb;274(2):1161-1166.
25. Villa MP, Bellussi LM, De Benedetto M, Garbarino S, Passali D, Sanna A. The "Italian way" to counteract obstructive sleep apnoea syndrome in children. Acta Otorhinolaryngol Ital. 2018 Aug;38(4):393-394.
26. Joosten KF, Larramona H, Miano S, Van Waardenburg D, Kaditis AG, Vandenbussche N *et al*. How do we recognize the child with OSAS? Pediatr Pulmonol. 2017 Feb;52(2):260-271.
27. Jonas C, Thavagnanam S, Blecher G, Thambipillay G, Teng AY. Comparison of nocturnal pulse oximetry with polysomnography in children with sleep disordered breathing. Sleep Breath. 2020 Jun;24(2):703-707
28. Rundo JV, Downey R. 3rd. Polysomnography. Handb Clin Neurol. 2019;160:381-392.
29. Berry RB, Brooks R, Gamaldo C, Harding SM, Lloyd RM, Quan SF *et al*. AASM Scoring Manual Updates for 2017 (Version 2.4). J Clin Sleep Med. 2017 May 15;13(5):665-666.
30. Wang J, Zhao Y, Yang W, Shen T, Xue P, Yan X *et al*. Correlations between obstructive sleep apnea and adenotonsillar hypertrophy in children of different weight status. Sci Rep. 2019 Aug 7;9(1):11455.
31. Iwasaki T, Sugiyama T, Yanagisawa-Minami A, Oku Y, Yokura A, Yamasaki Y. Effect of adenoids and tonsil tissue on pediatric obstructive sleep apnea severity determined by computational fluid dynamics. J Clin Sleep Med. 2020 Dec 15;16(12):2021-2028.
32. Galeotti A, Festa P, Viarani V, Pavone M, Sitzia E, Piga S *et al*. Correlation between cephalometric variables and

obstructive sleep apnoea severity in children. Eur J Paediatr Dent. 2019 Mar;20(1):43-47.
33. Koka V, De Vito A, Roisman G, Petitjean M, Filograna Pignatelli GR, Padovani D *et al*. Orofacial Myofunctional Therapy in Obstructive Sleep Apnea Syndrome: A Pathophysiological Perspective. Medicina (Kaunas). 2021 Apr 1;57(4):323.
34. DelRosso LM, Panek D, Redding G, Mogavero MP, Ruth C, Sheldon N *et al*. Obstructive Apnea and Hypopnea Length in Normal Children and Adolescents. Brain Sci. 2021 Oct 13;11(10):1343.
35. Brożek-Mądry E, Burska Z, Steć Z, Burghard M, Krzeski A. Short lingual frenulum and head-forward posture in children with the risk of obstructive sleep apnea. Int J Pediatr Otorhinolaryngol. 2021 May;144:110699.
36. Andersen IG, Holm JC, Homøe P. Obstructive sleep apnea in children and adolescents with and without obesity. Eur Arch Otorhinolaryngol. 2019 Mar;276(3):871-878.
37. Dalesio NM, Lee CKK, Hendrix CW, Kerns N, Hsu A, Clarke W *et al*. Effects of Obstructive Sleep Apnea and Obesity on Morphine Pharmacokinetics in Children. Anesth Analg. 2020 Sep;131(3):876-884.
38. Liu AL, Zheng YJ, Su Z, Wei JR, Yang Q, Wang CC *et al*. Clinical features of obstructive sleep apnea in children with obesity. Zhongguo Dang Dai Er Ke Za Zhi. 2021 Sept 15;23(9):933-937. English, Chinese.
39. Leung W, Singh I, McWilliams S, Stockler S, Ipsiroglu OS. Iron deficiency and sleep - A scoping review. Sleep Med Rev. 2020 Jun;51:101274.
40. Xu ZF, Ni X. Debates in pediatric obstructive sleep apnea treatment. World J Otorhinolaryngol Head Neck Surg. 2021 Jun 26;7(3):194-200.
41. Chandrakantan A, Musso MF, Floyd T, Adler AC. Pediatric obstructive sleep apnea: Preoperative and neurocognitive considerations for perioperative management. Paediatr Anaesth. 2020 May;30(5):529-536.
42. Borgström A, Nerfeldt P, Friberg D. Adenotonsillotomy Versus Adenotonsillectomy in Pediatric Obstructive Sleep Apnea: An RCT. Pediatrics. 2017 Apr;139(4):e20163314.
43. Vinha PP, Thuler ER, de Mello-Filho FV. Effects of surgically assisted rapid maxillary expansion on the modification of the pharynx and hard palate and on obstructive sleep apnea, and their correlations. J Craniomaxillofac Surg. 2020 Apr;48(4):339-348.
44. Pateron B, Marianowski R, Monteyrol PJ. French Society of ENT (SFORL) guidelines (short version) on the roles of the various treatment options in childhood obstructive sleep apnea-hypopnea syndrome. Eur Ann Otorhinolaryngol Head Neck Dis. 2018;135:265-268.
45. Comellini V, Pacilli AMG, Nava S. Benefits of non-invasive ventilation in acute hypercapnic respiratory failure. Respirology. 2019 Apr;24(4):308-317.
46. Hoxha S, Kaya-Sezginer E, Bakar-Ates F, Köktürk O, Toygar-Memikoğlu U. Effect of semi-rapid maxillary expansion in children with obstructive sleep apnea syndrome: 5-month follow-up study. Sleep Breath. 2018 Dec;22(4):1053-1061.
47. Camacho M, Chang ET, Song SA, Abdullatif J, Zaghi S, Pirelli P *et al*. Rapid maxillary expansion for pediatric obstructive sleep apnea: A systematic review and meta-analysis. Laryngoscope. 2017 Jul;127(7):1712-1719.
48. Bariani RCB, Bigliazzi R, Cappellette Junior M, Moreira G, Fujita RR. Effectiveness of functional orthodontic appliances in obstructive sleep apnea treatment in children: literature review. Braz J Otorhinolaryngol. 2021 Mar 14:S1808-8694(21)00055-0.