Title
Continuous Positive Airway Pressure Use for Obstructive Sleep Apnea in Pediatric Patients

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CPAP use for OSA in Pediatric patients

Introduction

Pediatric obstructive sleep apnea (OSA) is a sleep breathing disorder that is quickly becoming better recognized and diagnosed in the pediatric population (Sudarsan et al., 2014). This disorder differs significantly from that of adults by way of presentation, diagnosis criteria, treatment, and prognosis. Unlike its adult counterpart, pediatric OSA has been associated with multiple signs, symptoms and comorbidities that are unique to the pediatric population including attention deficit hyperactivity disorder, nocturnal enuresis, craniofacial abnormalities, genetic syndromes, and neuromuscular disorders. These other signs, symptoms, syndromes and comorbidities can frequently lead to delays in OSA diagnosis and treatment (Alsubie & BaHammam, 2017).

The prevalence of this disorder is estimated at 5-6% and this prevalence is expected to rise with the worsening epidemic of childhood obesity (King et al., 2019). In addition, the prevalence can be significantly higher in children with certain disorders such as trisomy 21 and mucolipidosis, where the prevalence can be as high as 50-100% (Sudarsan et al., 2014). The incidence ranges widely from newborns to teenagers and has two key peaks during the course of childhood. The first peak is in children ages 2 to 8 years, while the second peak is during adolescence (Katz & D'Ambrosio, 2008). Pediatric OSA can also lead to the development of notable neuro-behavioral and medical sequela and long-term can increase the risk of cardiovascular and metabolic morbidity into early adulthood (Alonso-Álvarez et al., 2017; Khaytin et al., 2020; Whitla & Lennon, 2017). As a consequence, treatment of OSA in children is imperative.

Adenotonsillectomy is recommended as the first line of therapy, based on the American Academy of Pediatrics (AAP) and the American Academy of Sleep Medicine (AASM) guidelines. This surgical therapy has been shown to improve and sometimes completely alleviate the symptoms of OSA. Adenotonsillectomy can also improve behavior and quality of life (Marcus et al., 2013). A significant number of children require no further treatment/therapy; however, up to 73% of children continue to have residual symptoms of OSA postoperatively. These residual symptoms of OSA include unchanged or only slightly improved symptoms of snoring, neurobehavioral problems including hyperactivity and inattention, daytime sleepiness, and polysomnographic evidence of OSA after surgery. In addition, a significant number of children diagnosed with OSA are not ideal candidates for surgery. For these two groups of children (those with residual OSA and those who are not surgical candidates), the AAP and AASM recommend a trial of continuous positive airway pressure (CPAP) (Marcus et al., 2012).

There is another subset of children in which obstructive sleep apnea is more common and more severe, and is also associated with specific comorbidities such as congenital craniofacial malformations (e.g. Pierre Robbin syndrome and Treacher Collins syndrome), complex craniofacial abnormalities, syndromic craniostenosis, metabolic/endocrinology disorders (e.g., Prader-Willi syndrome), storage diseases (e.g., mucopolysaccharidosis), genetic conditions (e.g., Trisomy 21). The disorders usually present with the so-called 'complex pediatric OSA', where the airway obstruction is regarded as multifactorial and multileveled. Children with complex OSA are much more likely to experience persistent residual OSA after upper airway surgery and will most often require CPAP after surgery.

There are no clear evidence-based pediatric guidelines for the duration and timing recommended for CPAP so current recommendations must be followed with caution as they are lifted from the adult guidelines literature. Currently, ideal CPAP utilization in children includes using the device during total and all physiological sleep time, which may exceed 12 hours especially in infants and should include napping preferably. Minimal use follows the adult guidelines of 4hr/night for at least 70% of nights over a 30 day period OR 50% of sleep time.

Barriers to successful CPAP implementation in children include limited mask size options, limited titration capabilities in hospitals, and limited sleep specialists with pediatric expertise (Wang et al., 2021). Furthermore, compliance with CPAP therapy can be a major obstacle to treatment of OSA (Whitla & Lennon, 2017). In addition, there are significant limitations associated with inferences made from CPAP-related research studies when extrapolated from the adult studies to the pediatric population as they fail to address pediatric specific changes associated with growth, which can affect the risk of airway obstruction over time including changes in tone, airway caliber, and amount of lymphoid tissue (King et al., 2019). Based on this information, frequent reevaluation of children on CPAP therapy is warranted to check and adjust the fitting of the CPAP equipment and the pressure settings. Furthermore, more research on CPAP use in children is necessary.

The goal of this chapter is to explore the use of CPAP in the pediatric population as a whole and within specific subsets of the pediatric population and also evaluate specific benefits, challenges and potential future uses of CPAP within the pediatric OSA population.

History of CPAP use in Children

CPAP is increasingly being utilized as treatment for obstructive sleep apnea in children (Amaddeo et al., 2020). This therapy was first introduced into the pediatric population back around 1984 to 1986 (Wang et al., 2021). In 1986, it was initially used in ten children ages 3 to 11 years with a diagnosis of OSA. It was used to stent open the airway as these children had different types of congenital anomalies and developmental disorders (Guilleminault et al., 1986). By 1995, pediatric CPAP masks had increased in commercial availability (Marcus et al., 1995) especially for large pediatric sleep disorders centers. At that time, CPAP was specifically utilized for OSA associated with obesity, craniofacial anomalies, trisomy 21 and residual OSA symptoms post-surgery. At the time, it was generally only initiated during a CPAP titration study in a pediatric sleep lab at one of these large sleep centers for children. Over the next decade, sleep centers began to introduce a two-week mask acclimatization period prior to the CPAP titration study to improve the chances of tolerating the mask and the CPAP pressure during the overnight titration study. In 2021, improvements in CPAP use in the pediatric population have been limited but continue to advance. In addition, there is exciting research in the pipeline and potential auto CPAP options on the horizon, which will be discussed further in this chapter.

Disorders associated with complex OSA requiring early/first-line CPAP treatment

As briefly discussed above, there is a group of disorders and syndromes associated with pediatric OSA where in CPAP is often considered the first-line treatment of choice, see table 1 (Girbal et al., 2020). These children tend to experience significant upper and sometimes lower airway obstruction including those with ***tracheobronchomalacia or bronchopulmonary dysplasia*** (Amaddeo et al., 2020). Increased elasticity of the soft tissues in the upper and lower airway lumen may play a significant role in the clinician's choice as to whether to start CPAP as a first-line treatment (Subramaniam et al., 2016). ***Pediatric laryngomalacia*** is a disorder where up to 78% of patients develop OSA. Treatment, possibly initially with surgical intervention, and subsequently certainly with CPAP is crucial to long-term care (Verkest et al., 2020).

Infants with craniofacial malformations such ***as Pierre Robin sequence, Goldenhar's syndrome, trisomy 21, treacher collins syndrome, velocardiofacial syndrome, and cleft lip and palate*** require close monitoring due to the concern of OSA development and recurrence over time which can be especially taxing and can quickly lead to deterioration of health (Amaddeo et al., 2021). Children with ***Schwartz-Jampel syndrome*** can end up with very severe OSA and often require some surgical intervention initially such as rapid maxillary expansion so as to improve the benefits of CPAP therapy, as seen in Figure 1 (Peanchitlertkajorn et al., 2021).

Pediatric OSA should also be considered in certain genetic disorders including ***DiGeorge's syndrome*** (22q11.2 syndrome), which is associated with velopharyngeal insufficiency (VPI) as well as ***Prader-Willi syndrome and trisomy 21***, which are associated with significant hypotonia. Several neuromuscular disorders also require CPAP as first-line treatment. These syndromes frequently require initial surgical treatment for the VPI/airway obstruction and post-surgical CPAP for the residual moderate to severe OSA (Crockett et al., 2014; Gillett & Perez, 2016; Waters et al., 2020). These children with genetic disorders and OSA often have behavioral and developmental delays which can lead to difficulty in initiating and implementing CPAP post-surgery for residual OSA. Disorders such as Prader-Willi are also associated with excessive daytime sleepiness and extreme weight gain. Weight loss is often considered as a major therapeutic option in this population, however, this can take time and can be quite variable as the child grows and matures so CPAP remains a mainstay of therapy in these sub-populations of children with persistent (residual) OSA.

Table 1 Distribution of patients according to primary diagnosis, presence of associated hypoventilation and age at NIV start.

Nosologic group	Patients (*N* = 68) *n* (%)[b]	OSA plus hypoventilation syndrome *n* (%)[b]	Age at NIV start in months Median (IQR)
Congenital malformations/genetic disorders	34 (50)	7 (10)	42.5 (5–144)
Prader–Willi syndrome	6	2	176 (158–187)
Pierre–Robin syndrome	5	0	1 (0–2)
Trisomy 21	5	2	120 (46–180)
Craniofacial malformation[a]	10	0	40 (7–45)
Airway malacia	5	0	13 (2–15)
Other	3	3	60 (40–96)
Cerebral palsy	9 (13)	2 (3)	168 (89–173)
Central nervous system tumor	8 (12)	1 (1.5)	171 (94–180)
Inborn errors of metabolism	6 (9)	2 (3)	59 (20–135)
Mucopolysaccharidosis	5	2	59 (46–156)
Gaucher disease	1	0	2
Adenoid/tonsil hypertrophy	3 (4)	0	15 (12–31)
Obesity	3 (4)	0	166 (154–194)
Others	5 (8)	0	106 (85–110)

[a] Including choanal atresia, craniosynostosis, pycnodysostosis, achondroplasia, Charge Syndrome.
[b] All percentages refer to the total number of patients (*N* = 68).

Table 1. Distribution of patients by primary diagnosis (Girbal et al., 2020; *Non-invasive Ventilation in Complex Obstructive Sleep Apnea – A 15-year Experience of a Pediatric Tertiary Center | Elsevier Enhanced Reader*, n.d.)

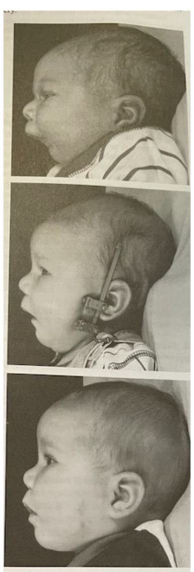

Figure 1. Surgical interventions over time which improves CPAP usefulness (Sleep Secrets).

Obesity is rapidly becoming the disorder most commonly associated with pediatric OSA **(Alonso-Álvarez et al., 2017)**. Depending on the country, prevalence levels of obesity can be as high as 7 to 22% and this disorder can adversely affect multiple organ systems. As such, the prevalence of pediatric

OSA in obese children can be as high as 21-40%. Neurocognitive and behavioral problems, cardiovascular abnormalities (increased nocturnal SBP, sustained diurnal HTN, and left ventricular changes), and endothelial and metabolic dysfunction, are frequent consequences of OSA, which are further worsened by the combination of obesity and OSA. Specifically, the combination of obesity and OSA in children can lead to significant metabolic co-morbidities including dyslipidemia, insulin resistance, metabolic syndrome and cardiovascular morbidity which can lead to significant metabolic and physiologic problems into adulthood (Amini et al., 2017).

CPAP titration

The use of CPAP to treat OSA in children has been increasing over the years (Mihai et al., 2020).

In general, initiation of CPAP is achieved in a pediatric sleep lab where a CPAP titration study is performed overnight. Two weeks prior to the CPAP titration study night, the child undergoes mask acclimatization. CPAP has been shown to be efficacious in improving polysomnogram parameters including apnea hypoxia index, respiratory-effort related arousals, as well as patient and caregiver daytime sleepiness (Wang et al., 2021). CPAP is not yet approved by the Food and Drug Administration for use in children weighing less than 30 kg; however it is frequently used in a wide range of ages from newborns to adolescent years, especially in the setting of complex OSA and associated comorbidities. Fitting of the CPAP equipment and adjustment of the pressure settings must be individualized for each child and should be managed by health care professionals with expertise in management of pediatric sleep patients (Rana et al., 2020). A recently published algorithm can assist in correctly assessing the CPAP titration plan, see Figure 2 (Amaddeo et al., 2020). It is very important to also ensure the device settings correspond with prescribed settings. Infant CPAP devices may often underestimate the real use of the device. Continuous monitoring of CPAP equipment includes frequent periodic polysomnogram evaluation especially if the child’s symptoms change, significant growth/puberty occur, and/or if the body mass index increases or decreases (Marcus et al., 2012). Unlike in adult studies, CPAP pressure requirements in children rapidly change with growth. Up to a quarter of children started on CPAP will need an adjustment within as quickly as 3 months (Marcus et al., 1995, 2012).

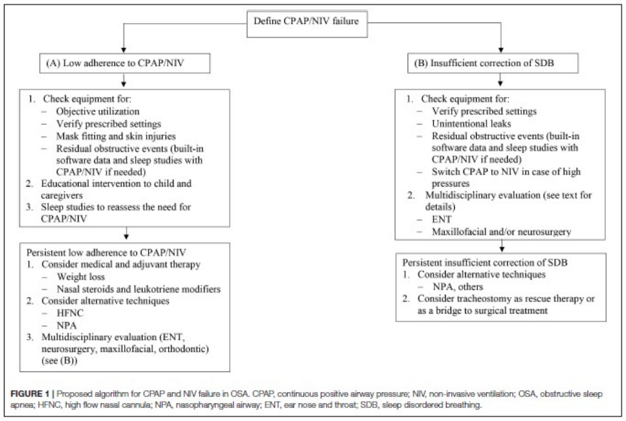

Figure 2. Proposed algorithm for CPAP titration, low adherence, and low adherence persistence (Amaddeo et al., 2020).

CPAP therapy efficacy findings can be very heterogeneous within the pediatric population (Weiss et al., 2021). In infants, data on the effectiveness of CPAP use is sparse, even though it can be standard of therapy for treatment of complex OSA in children (Cielo et al., 2021). Compared to school-aged children ages 5-10 years of age, CPAP in infants less than 6 months of age can be highly effective in treating OSA and well-tolerated, especially when utilized along with other treatment options such as surgery (Cielo et al., 2021). In addition to being efficacious, CPAP is also considered safe and fairly well-tolerated overall in children and adolescents (Marcus et al., 1995).

CPAP Auto-titration

In general, CPAP titration studies performed overnight in the sleep lab have been the standard of care to determine precise therapeutic CPAP settings for children. Currently, it is considered the gold standard for CPAP initiation and monitoring in children with OSA. CPAP auto-titration is rarely considered and is usually reserved for older children (Amaddeo et al., 2018; Khaytin et al., 2020). Recent advancements in CPAP technology may increase the chances of young children successfully initiating CPAP (auto-CPAP) in the home environment. Furthermore, these auto-CPAP devices enables an approach where monitoring can be frequently and seamlessly continued after successful CPAP commencement (Mulholland et al., 2021).

It is important to note that there are several disadvantages to having a child spend the night in sleep laboratory including discomfort, cost, inability to sleep in a new environment, which can lead to delays in achieving therapeutic CPAP settings, etc. Furthermore, the specific mechanics of the pediatric airflow – smaller airway sizes, faster respiratory rates, and other respiratory parameters make children and pediatric OSA unique such that individualizing CPAP settings is more desirable to optimize care. As such, CPAP auto-titration may be advantageous as it may function as a cost-effective and economical approach to treating obstructive sleep apnea while both initiating and monitoring treatment efficaciously at limited cost to the caregiver and reduced discomfort to the child. In other words, auto-titrating CPAP and employing remote modem monitoring over time can prove to be quite useful compared to fixed pressure CPAP alone. Though not perfectly equivalent, auto-CPAP has been shown to deliver treatment pressures that are fairly similar to the gold standard of manual CPAP titration in the lab.

It is also important to note that fixed CPAP titration pressure that is set in the lab is set high enough to eliminate all obstructive events during the night. Under ideal settings, a child may not need such a high pressure throughout the whole night as CPAP pressure needs may change depending on different sleep stages (REM, N3 deep sleep, etc.) and sleep positions (supine, lateral, prone, etc.). Auto-CPAP is set up to be more flexible so that the mean pressure (PMEAN) is an average of the required pressures titrated throughout the night to successfully eliminate all/most obstructive events and is usually lower than the fixed titration pressure derived from CPAP titration studies in the lab. Some studies have found that auto-CPAP pressures through the night tend to be adequate to treat and essentially eliminate most obstructive events while others have found that a residual but significant number of apnea and hypopnea events may remain (Khaytin et al., 2020; Mihai et al., 2017). As the CPAP technology continues to advance and algorithms get more detailed/focused to adequately and accurately address all the obstructive events in children with OSA overnight, the usefulness of auto-CPAP in childhood OSA will most likely increase.

There are however some major limitations currently to using auto-CPAP to treat pediatric OSA. Each CPAP manufacturer employs a unique proprietary algorithm to determine appropriate CPAP pressure for each CPAP device type. These algorithms are rarely tested on children prior to launch and thus may not be optimized for use in children with OSA. In addition, each different auto CPAP machine type responds differently to the same respiratory events. Given the differences in pediatric airway mechanics, the CPAP machine type may be more likely to provide an inappropriate/inaccurate response for specific respiratory obstructive events (Khaytin et al., 2020; Mihai et al., 2020).

Overall, pediatric auto CPAP is a treatment option that is yet to be fully embraced within the pediatric sleep specialist community but this is likely to change in the future. One of the major reasons for the community’s current reticence is the paucity of research available on the use of auto CPAP in children. For now, the general recommendations suggest using a traditional CPAP titration study in the lab to initiate CPAP, as this is the gold standard (Amaddeo et al., 2018), and subsequently use an auto CPAP device for frequent assessment to monitor CPAP settings in the outpatient clinic between in-lab PSG evaluations.

Benefits of CPAP

Efficacy CPAP research in children and young adolescents is limited; however, CPAP appears to be beneficial overall. Children with OSA using CPAP appear to have significant relief of symptoms of OSA and appear to have improvement in the physical, emotional, and behavioral complications especially when used consistently (Simon et al., 2012). After 6 months of CPAP treatment, systolic blood pressure can significantly decrease (DelRosso et al., 2018). In children with cerebral palsy, CPAP treatment of OSA improved the quality of life (Hsiao & Nixon, 2008). Children with epilepsy and OSA using CPAP had improvement in seizure control (Malow et al., 2003). In obese children, after using CPAP for one year to treat OSA, CRP, HDL, and LDL were significantly improved (Alonso-Álvarez et al., 2017; Amini et al., 2017). CPAP use is also associated with improvement in attention, working memory, and depression in children with OSA (Hobzova et al., 2017). A small study of 9 children with OSA and nonalcoholic fatty liver disease monitored CPAP use and metabolic markers for a total of 3 months. With CPAP treatment, participants had increased duration of sleep with improvement of their sleep apnea severity. Severity of liver injury, markers of metabolic syndrome, and reduce oxidative stress also improved significantly (Sundaram et al., 2018). In another small study evaluating obese children with OSA, leptin levels improved significantly after CPAP treatment (Nakra et al., 2008). Even with low adherence of CPAP use, CPAP benefits are still evident. With mean nightly usage of only 3 hours per night, there were significant improvements after 3 months in both the apnea-hypoxia index and neuro-behavioral assessments of attention deficits, sleepiness, and behavior. Overall, the limited evidence available indicates that CPAP therapy is beneficial for sleep parameters, daytime symptoms, quality of life, and metabolic parameters.

CPAP adherence:

As seen in adults, CPAP adherence levels in children with OSA can be quite poor, and similar to that of several other pediatric chronic illness treatments. These poor adherence levels in children and adolescents with OSA often begin soon after CPAP commencement, averaging 3.35 hours per night (Simon et al., 2012; Verhulst, 2020). In addition, the prevalence of CPAP refusal is high at 25-50% (Rana et al., 2020). One study showed that CPAP use was the highest during the first week of commencement at 79% of nights and then declined over time in a group of children with OSA (Puri et al., 2016). By the end of the first month, CPAP use had decreased to 65% of nights and was 57% of nights by the end of the 3 month period. Nightly use of CPAP also declined from 3.5 hours nightly by the end of the first week of CPAP commencement to 2.8 hours nightly at the end of the third month.

Several factors contribute to the level of CPAP adoption and adherence. Female children are more likely to have good adherence compared to male children. This pattern is also seen in other chronic pediatric illnesses.

Parental behavioral management strategies, monitoring, and differing expectations for boys and girls may explain this pattern. Social economic status and increased BMI (obesity) do not appear to play a significant role in the level of CPAP adherence; however, older age of the child may be associated with lower CPAP adherence (Verhulst, 2020). Interestingly, maternal education is the one factor that has been shown consistently to be associated with increased CPAP adherence. Parental motivation and perception of CPAP benefit are some important determinants of CPAP adherence as well (Wang et al., 2021).

Interestingly, children with OSA and disabilities, especially intellectual disabilities, are a unique subset of children with OSA as their CPAP adherence and compliance levels are often quite high even though one may ordinarily presume otherwise. In a number studies evaluating children with OSA and Trisomy 21, CPAP adherence was notably high (Dudoignon et al., 2017; Trucco et al., 2018). These children were monitored over a 2 year period and CPAP adherence started at 50-57% and was 39 to 67% 2 years later. On average, nightly use was greater than 4 hours nightly. This excellent adherence that persists over a prolonged period of time may be due to increased dependence upon caregivers, increased parental perception of the need for CPAP, and perhaps a decreased ability to remove the mask at night.

Nasal complaints also contribute to poor CPAP adherence and can be improved by treating with topical nasal steroids and addition of humidification to the CPAP settings. In one study, 64 children with OSA received CPAP and 26% were intolerant initial CPAP therapy. After home mask acclimatization, change in mask size, skin cream use, and addition of passive humidification, 37% of these children eventually accepted and adhered to CPAP therapy (Massa et al., 2002). CPAP treatment post-adenotonsillectomy may also be associated with poorer adherence compared with CPAP treatment as first-line therapy (Pomerantz, 2016). In these situations, increased caregiver support and switching to Bi-level support can improve CPAP adherence (Sawunyavisuth et al., 2021). Notably, CPAP adherence improves when another family member is also concurrently using CPAP.

A number of studies have found that outpatient initiation of CPAP therapy (auto CPAP) may be associated with a higher level of adherence (Amaddeo et al., 2018). Using the home environment as the setting to initiate CPAP can also lead to more successful implementation and adherence. One study assessing the use of auto CPAP versus fixed CPAP pressure showed a trend towards longer duration of CPAP use per day in those children under age 13 who used auto CPAP compared to controls who used fixed CPAP pressure (Mulholland et al., 2021). On the other hand, other research groups suggest that starting CPAP therapy in the home (auto-CPAP) may not make much difference to CPAP adherence (Gozal et al., 2020). Another study showed that discrepancies between in-lab fixed CPAP pressure recommendations and at-home auto-CPAP device settings can result in discomfort and early reduced CPAP adherence. Ensuring similarity between the in-lab CPAP titration study pressure and the home auto-CPAP pressure settings is a key to accomplishing early adherence of CPAP treatment and reduction of discomfort (Mihai et al., 2017, 2020). Overall, troubleshooting and adjusting CPAP settings as needed can help improve adherence to CPAP that may initially have been poorly tolerated.

Studies have shown that CPAP adherence is certainly cost-effective from a financial standpoint, a healthcare utilization standpoint, and for quality of life (Hawkins et al., 2016). It is also important from a cognitive and behavioral standpoint as attention span, sleepiness, internalizing and total behavior symptoms problems, caregiver quality of life, and child quality of life are significantly improved (Gozal et al., 2020; Rains, 1995). CPAP adherence in children can certainly be improved with desensitization measures and behavioral interventions along with frequent home visits and periodic revaluations using follow-up sleep studies in the lab (Gozal et al., 2020).

These desensitization measures and behavioral interventions that have been recommended to improve CPAP adherence including parent training and modeling. Behavioral training has been proven to be efficacious, leading to continued adherence up to 9 months later (Rains, 1995). SMDTs (Shared decision-making tools) could also potentially improve CPAP adherence and health outcomes (Bergeron et al., 2019). Amongst families of children with OSA who may not be surgical candidates, SMDTs have been employed to counsel on the best treatment options. Using this strategy, families were more likely to agree to and adhere to CPAP treatment with improved health outcomes long-term (Bergeron et al., 2019). Overall, supportive interventions, educational interventions and behavioral therapy for both child and caregiver are crucial for adequate CPAP adherence in children. Age-adjusted and development-adjusted interventions must match the child’s needs to ensure successful and cost-effective CPAP implementation.

Efficacy of CPAP vs Other OSA Treatment Options

Pediatric obstructive sleep apnea can either be treated using adeno-tonsillectomy (AT) as the first line treatment or CPAP as the first line treatment. Evidence indicates that AT and CPAP may be equally efficacious, especially in children with Trisomy 21 or mucolipidosis who have mild to moderate OSA (Sudarsan et al., 2014; Venekamp et al., 2015). CPAP may possibly be more effective than AT in moderate to severe complex OSA associated with myelomenigocele (Kirk et al., 2000). CPAP tends to show immediate sustained improvement while AT tends to show a more gradual improvement (Sudarsan et al., 2014). Furthermore, AT is more frequently associated with weight gain compared to CPAP (Verhulst, 2020).

To improve CPAP adherence, sleep specialists often recommend a trial Bi-level (BiPAP) therapy. Indeed, BiPAP shows higher adherence levels compared with CPAP at a one year follow up, especially in non-obese patients (Gozal et al., 2020; Machaalani et al., 2016). However, there were no differences were noted in efficiency between CPAP and BiPAP.

In the setting of CPAP failure, along with non-compliance and/or non-tolerance of CPAP, high flow nasal cannula (HFNC) can be considered as an option (Amaddeo et al., 2019). There is limited evidence of the efficacy comparisons between CPAP and HFNC.

Side effects of CPAP

As with adults on CPAP, children using CPAP frequently experience nasal bridge sores from masks, abdominal distention, mouth and nasal/pharyngeal dryness, nasal congestion, rhinorrhea, epistaxis, eye irritation, and overall discomfort from air leaks, especially in the setting of a poorly fitting mask (Gozal et al., 2020; Marcus et al., 1995; Rana et al., 2020). These side effects can affect at least 30% of children after 5 months of use (Cl et al., 2006). Claustrophobia and social anxiety may also develop from CPAP therapy. Depending on developmental age, very young children on CPAP can experience midface flattening, maxillary retrusion, counter-clockwise rotation of the palatal plane, and upper incisor flaring from long-standing pressure of the mask on the face (King et al., 2019). The mask pressure can significantly affect growing facial features in children with OSA on CPAP and must be carefully monitored with digital photography.

Discontinuation of CPAP

Unlike in adults, children with OSA can outgrow the diagnosis of pediatric OSA as they develop. Some children can experience full resolution of their OSA without any obvious intervention apart from the CPAP. Others can show improvement in their BMI, however, this is less likely to completely resolve the OSA. Surgical airway intervention can also significantly assist in improving OSA. As a consequence, CPAP continuation monitoring by the clinician is imperative. Evidence suggests that monitoring should be considered at least annually, and more frequently if clinically indicated. CPAP therapy may successfully be discontinued after about one year of use (King et al., 2019). More specifically, children with minimal-mild residual OSA after a year can be considered for discontinuation with close monitoring.

Future of CPAP use in children

In the next decade, it is likely auto CPAP will be used more widely amongst pediatric sleep specialists as overnight manual titration can be very costly, time consuming, resource intense and not available in all settings. CPAP predictive equations are frequently used in adults. In the last couple years, researchers have begun to evaluate predictive optimal equations to determine the best CPAP pressure settings for children with OSA based on pediatric airway and respiratory mechanics (Chong et al., 2020). The applicability will need to be tested within different age ranges to determine usefulness, validity and reliability. These findings will be necessary to advance auto CPAP use in children with OSA. Furthermore, to appropriately determine those who may or may not benefit from behavioral therapy and supportive interventions for improved CPAP adherence, researchers are beginning to utilize hierarchical clustering (Tabone et al., 2019; Weiss et al., 2021). When clustered by CPAP tolerance and use over time, obesity, CPAP setting, developmental delay and prior adeno-tonsillectomy played a role. As a result, this analysis approach may provide some insight into how to optimize CPAP therapy (Weiss et al., 2021). Over the next decade, these findings and more may become quite helpful in improving CPAP therapy and compliance.

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