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Dreaming of a better night's sleep

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Editor's welcome

Hi SNEWS-ers and welcome to your October edition of SNEWS!

In this edition we have a follow up from the WellChild piece we saw in the last edition.

We also have some insightful information around CPAP devices. If you are looking to diversify your supply this may help you decide.

In case you missed research and audits presented at the last ARTP conference we have included them here for you to catch up!

This edition continues to deliver advice and information of case studies and tips around improving sleep hygiene to share with your patients.

In other news, an article around the "Iron Lung Man" is included.

We hope you enjoy this edition!

Trish Matharu, ***Editor***
Tara Badman, ***Vice Editor***
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If you have any topics that you would like to be covered in the next or future editions, please email them to admin@artp.org.uk.

DATES FOR THE DIARY

Respiratory Professional Care Show
9th-10th October 2024
Birmingham

ARTP National Strategy Day
22nd November 2024
Birmingham

BTS Winter Meeting
27th-29th November 2024
Birmingham

All dates are subject to change.

Contents

PROFESSIONAL

Rules for healthy sleep

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Our practice has experienced an increase in individuals suffering with sleep maintenance or even initiating sleep. There are many techniques that can be adopted to promote good quality sleep in the absence of a sleep disorder. This article aims to highlight those techniques that can be adopted to try and improve sleep hygiene and sleep patterns. These are recommendations that are commonly used to advise such individuals. This may be useful and offer some information which can be passed on to your patients.

Sleep hygiene refers to the behavioural and environmental recommendations intended to promote healthy sleep and was originally developed for the use in treatment of mild to moderate insomnia.[1] It is still used in clinical practice. Here is a brief guide of the 12 rules for healthy sleep.

Rules for healthy sleep

Sleep hygiene advice can be divided into 12 recommendations:

- **Recommendation 1**
  The bedroom or place of sleep should be dark and quiet with no interruptions from lights or noise, including mobile phones.
- **Recommendation 2**
  Heavy or rich foods can cause indigestion or heart burn so should be avoided prior to going to sleep.
- **Recommendation 3**
  While alcohol is well-known to make you fall asleep faster, too much before bedtime can interrupt your sleep cycle and can act against you obtaining a good quality sleep, especially during the second half of the sleep cycle. Smoking tobacco close to bedtime can disrupt good quality sleep as nicotine is a stimulant.
- **Recommendation 4**
  A gentle walk and regular exercise during the day is good to induce sleep at night-time. However strenuous workouts and exercise should be avoided close to bedtime.
- **Recommendation 5**
  Caffeine is a stimulant, thus is designed to keep you awake and alert. Caffeine should be avoided close to bedtime, so as not to disrupt the sleep cycle and prolong sleep latency.
- **Recommendation 6**
  A comfortable sleeping environment includes a good quality mattress.
- **Recommendation 7**
  The bedroom or sleeping environment should not be too hot or too cold.
- **Recommendation 8**
  Regular going to bed and getting up times are important as the brain then gets into a routine of when to sleep and when to wake.
- **Recommendation 9 & 10**
  It is important to avoid TV, mobile phones, computer games etc. prior to bedtime. They produce blue light technology which inhibits melatonin production in the brain. Melatonin is the hormone that regulates your sleep wake cycle and is important for good quality sleep. Also, TV, mobile phones and computer games can be seen as a stimulant which may inhibit sleep latency.
- **Recommendation 11**
  If there are problems with sleep during the night, it is important not to focus onto it if possible. You can use things like the '20-minute rule'[2] to help re-initiate sleep.
- **Recommendation 12**
  Just like young children have 'bath, book and bed', adults should also try and have a bedtime routine to help the body 'wind down' prior to sleep.

References
1. Hauri,P – "Sleep Hygiene" – Current Concepts: The Sleep Disorders, The Upjohn Company, MI, 1977, p. 21-35
2. Pinkham, K – "Simple Steps to Better Sleep" – PepTalk, YouTube platform link

PROFESSIONAL

Comparing different CPAP and APAP devices available in the UK

Francois Clavaud

Due to the ongoing complications within the CPAP devices market both within the UK and globally, many NHS and private services have been exploring a range of CPAP devices to meet current demand.

This has partly been instigated by the global Phillips replacement/recall; however, further global events have exacerbated shortages in key components for CPAP production. CPAP manufacturers and NHS sleep services are continually under pressure to deliver products and efficient services. With challenging supply levels, new products have come onto the market in the UK. The tables below highlight key features of five CPAP manufacturers licensed within the UK. The aim of this is to compare key features in both fixed pressure and auto-titrating devices in order to give services information on how each may meet their current demands. However, no device is recommended over another, and all key information has been gained through publications or website sources and manuals.

Machine Brand	Philips Respironics Dreamstation one Pro	ResMed AirSense S10 Elite	Fisher & Paykel Healthcare SleepStyle	Löwenstein Medical Prisma SoftMax Fixed Pressure	Sefam S.Box
Dimensions (with humidifier) Width, Height, Depth (mm)	157x 193 x 84 (193 x 297 × 84)	205 x 116 x 150 (255 x 116 x 150)	177 x 144 x 183 (Built in humidifier)	170 x 135 x 180 (310 x 135, 180)	140 x 245 x 110 (185 x 245 x 110)
Weight (g) (with humidifier)	1330 (1980)	1111 (1248)	1700 (built in humidifier)	1340 (1400)	1400 (1700)
Capacity for remote monitoring	Modem attached at additional cost and Bluetooth	Modem Built in (Data contracts bought at additional cost)	Modem Built in and Bluetooth	Modem Built in and Bluetooth	Modem Built in and Bluetooth
Pressure Range	4-20 cmH_2O	4-20 cmH_2O	4-20 cmH_2O	4-20 cmH_2O	4-20 cmH_2O
Comfort Pressure Relief	C-flex 0-3 cmH_2O	Expiratory Pressure Relief 0-3 cmH_2O	Expiratory Relief 0-3 cmH_2O	SoftPAP 1 or 2	CC + 3 levels
Mask fit test function	Yes	Yes	Yes	Yes	Yes
Tubing types 15 or 22mm	Both 15 and 22mm	Both 15 and 22mm	Both 15 and 22mm	Both 15 and 22mm	Both 15 and 22mm
Leak Capacity	Not specified	0-60 L/min	Not specified	Not specified	Not specified
Ramp/ Adjustable Delay	Ramp function 0-45mins	Ramp function 0-45mins	Ramp function 0-45mins	Ramp function 0-45mins called SoftSTART	Ramp function 0-45mins
Pressure Display	Yes	Yes	Yes	Yes	Yes
Noise acceptance dBA	26.1 ± 2	25 ± 2	28 ± 1.5	26 ± 2	26

Continued overleaf

Machine Brand	Philips Respironics Dreamstation one Pro	ResMed AirSense S10 Elite	Fisher & Paykel Healthcare SleepStyle	Löwenstein Medical Prisma SoftMax Fixed Pressure	Sefam S.Box
Power supply 100-240v	100-240 V	100-240 V	100-240 V	100-240 V	100-240 V
Humidifier heating tubing	Built in with standard humidifier	Built in with standard humidifier	Only able to use heated tubing	Able to with purchase of heated tubing	Able to with purchase of heated tubing
Warranty period of device	2 years	5 years	2 years	2 years	2 years
Meets ARTP standards certified by independent testing	Yes	Yes	Yes	Yes	Not submitted for testing
Ventilation Measure	Weighted Peak Flow (WPF) of 20%–80% of inspiratory volume.	RMS (Root Mean Squared) of the variance of moving average scaled low-pass-filtered absolute value of respiratory flow. RMS method determines ventilation from variance of the flow throughout the entire breath by comparing individual flow points to the mean airflow over a defined time.	Under patent	Tidal volume and Relative minute volume. Forced oscillation technique (FOT) used to detect obstructive and central apnoea. FOT emits oscillatory signals into the respiratory tract during tidal ventilation.	Under patent
Pressure Range	4-20 cmH_2O	4-20 cmH_2O	4-20 cmH_2O	4-20 cmH_2O	4-20 cmH_2O
A/H flow comparison	Average of 80th–90th percentile of WPFs of prior 4 min average moving window.	Prior 1 min RMS moving average.	Under patent	Forced oscillation technique (FOT) to differentiate apnoea/hypopnea type, with an amplitude of approx. 0.4 hPa (or cmH_2O) which is superimposed by the device blower	Under patent
Comfort Pressure Relief	A-flex - Off or 1-3 cm H_2O	Expiratory Pressure Relief- Off or 1-3 cm H_2O	Expiratory Relief- 0-3 cmH_2O	SoftPAP - 1 or 2	CC+ 3 levels
Apnoea detection	WPF per breath <20% for 10s, terminating with breath >30%.	2s RMS moving average <25% for 10 s.	Under patent	Oscillating signal applied at a frequency of 4Hz and amplitude 0.4mBar No airflow with in-crease in FOT in 2 min epoch for Obstructive apnoea	Under patent
Hypopnea detection	20%–60% for 10 s and ending either with terminating breath over 75% of recent WPF or at 60sec	12s RMS scaled average 25%–50% for 10 s with at least 1 obstructed breath.	Under patent	Oscillating signal applied at a frequency of 4Hz and amplitude 0.4mBar Strong reduced airflow with flattening/snoring in 2 min epoch	Under patent
Non-OA detection	Pressure Pulses delivered during event to detect if obstructive or central in nature.	1 cmH_2O, 4Hz FOT (Forced oscillation technique) with mixed apnoea detection.	Under patent	Oscillating signal applied at a frequency of 4Hz and amplitude 0.4mBar Central Apnoea- Low reflection of pressure wave and Strong airflow response	Under patent

Continued overleaf

Machine Brand	Philips Respironics Dreamstation one Pro	ResMed AirSense S10 Elite	Fisher & Paykel Healthcare SleepStyle	Löwenstein Medical Prisma SoftMax Fixed Pressure	Sefam S.Box
Flow limitation detection	4 breath average of roundness, skewness, and flatness indices and weighted peak inspiratory airflow.	Breath-by-breath flow limitation index from breath shape index, RMS flatness index, and ventilation change and breath duty cycle.	Under patent	Measured within 2min epoch, breathes highlighted with flattening using flow contour	Under patent
Other events detection	Hypoventilation – 5 consecutive breaths with mean ventilation <40% Variable breathing – standard deviation/adjusted mean flow over 4 min window above threshold.	Undetermined apnoea – apnoea with leak >30 L/min	Under patent	Respiratory Effort \Related Arousal (RERA) in airflow, with flattening/snoring, followed by an increase in flow.	Under patent
OA/hypopnea response	If 2 apnoea's or 1 apnoea/1 hypopnea or 2 hypopneas- increases by 1 cmH_2O and holds for 30 s. Nonresponse Apnoea hypopnea logic (NRAH) limits max pressure to 11 cmH_2O or 3 higher than pre-apnoea baseline. If more apnoea's within 8 min decrease pressure by 2 cmH_2O over 15min, down to 1cmH_2O over level that prevents snore, then holds pressure for 10 min. Pressure will continue to increase in response to 2 hypopneas.	Increases pressure based on current pressure every 10s of apnoea: increment max 2.5 cmH_2O when pressure is 4 cmH_2O. Increment drops linearly down to 0.5 cmH_2O, when pressure is up to 20 cmH_2O.	Under patent	Pressure range (Pmax-Pmin) is divided into four quartiles. Response is then delivered within 3 severities and responses. eSO (epoch with severe obstruction) eMO (epoch with mild obstruction) eFL (epoch with high proportion of flow limited breaths) There are two APAP settings: Standard and Dynamic. OA/hypopneas- eSO is identified within either Standard or Dynamic settings. Therefore, there is a change in pressure between 0.5-1.5 cmH_2O	Under patent
Flow limitation response (FL)	Pressure increases by 0.5 cmH_2O per min in response to FL. Intermittent upward scans by 1.5 cmH_2O over 3 min to see if improvement in FL then decreases if no improvement. If pressure not held by snore or A/H, then enters testing protocol which collects 3–5 min data.	Uses single breath FL index: increment max 0.5 cmH_2O per breath for severely flow limited breaths. Lower increment if lower FL index, high leak or as pressure increases further above 10 cmH_2O	Under patent	eFL (epoch with high proportion of flow limited breaths) Standard response- 0-0.5 cmH_2O changed applied across 4 quarters. Dynamic response- 0- 0.2- 0.5 cmH_2O changed applied across 4 quarters. With pressure increase occurring at the end of epoch or delay in decrease.	Under patent

Continued overleaf

Machine Brand	Philips Respironics Dreamstation one Pro	ResMed AirSense S10 Elite	Fisher & Paykel Healthcare SleepStyle	Löwenstein Medical Prisma SoftMax Fixed Pressure	Sefam S.Box
Vibratory snore response	If 3 snores within 30 s from each other, increase 1 cmH_2O over 15s then hold for 1 min with higher snore, threshold at higher pressures.	Increment max 0.5 cmH_20 per breath. Lower increment if snore is less severe, high leak or as pressure increases further above 10 cmH_2O	Under patent	**Dynamic**: Snoring >6 per epoch= eSO response Snoring >3 per epoch= eMO response **Standard**: eSO-snoring >8 breaths per epoch eMO- Snoring >4 per epoch eMO response increase pressure between 0.5-1 cmH_2O depending on quarter.	Under patent
Leak Capacity	Not specified	0-60 L/min	Not specified	Not specified	Not specified
High leak detection	Leak level exceeds flow limit for a given pressure	95th percentile leak >24 L/min	Under patent	Not specified	Under patent

References
Johnson & Johnson. (2015). Treatment of sleep-disordered breathing with positive airway pressure devices: technology update. Evidence and Research, 8 425–437.
Products - Löwenstein Medical UK (loewensteinmedical.co.uk)
Sleep apnea and COPD - learn about symptoms and treatment | ResMed
Sleep and Respiratory Care | Philips

RESEARCH AND AUDITS

Optimising initial therapeutic strategy for obstructive sleep apnoea patients with nocturnal hypoventilation

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Background

Obstructive sleep apnoea (OSA) is locally diagnosed via domiciliary limited multi-channel sleep study and treated with fixed-pressure continuous positive airway pressure (CPAP) determined via Oxford algorithm (Stradling *et al*., *Respir Med* 2004; 98(2): 152-154). Some comorbidities induce nocturnal hypoventilation alongside OSA, significantly increasing morbidity. CPAP indirectly alleviates hypoventilation, but severe cases may require higher treatment pressures (Soghier *et al*., *Ann Am Thorac Soc* 2019; 16(10): 1295-1303). Though initial efficacy facilitates long-term CPAP success, clinical cutoffs for this indication are poorly defined. Previous studies have attempted predictive models using baseline study parameters (Slouka *et al*., *J Appl Biomed* 2019; 17(1): 81), but not specifically within hypoventilators on fixed-pressure devices. This study aimed to define thresholds within routinely collected diagnostic variables indicating significant probability of CPAP failure in normocapnic OSA patients with nocturnal hypoventilation.

Methods

A retrospective audit was performed on OSA patients with hypoventilation (locally defined as ≥ 10 minutes of continuous SpO_2 < 90%) and a non-hypoventilation control group commencing CPAP between September 2021 and September 2022 (n = 90/group). Assessed variables were age, body mass index, neck circumference, apnoea/hypopnoea index (AHI), oxygen desaturation index, Epworth Sleepiness Score, time spent < 90%, < 85% and < 80% SpO_2 (T90, T85 and T80), mean SpO_2 and SpO_2 nadir. Within both phenotypes, median comparisons were made between compliant (≥ 4 hours usage for 70% of nights in the third month) and noncompliant patients, controlled (average AHI < 5 events/hr in the third month) and non-controlled patients and resolved (T90 < 10%) and persistent hypoventilation via Mann Whitney U tests. Receiver operating characteristic (ROC) curve analysis was performed on statistically significant variables to identify viable predictors of CPAP failure.

Results

No assessed variables predicted CPAP non-compliance or suboptimal OSA control in either phenotype. However, baseline T90, mean SpO_2, T85 and neck circumference were significant predictors of persistent hypoventilation on CPAP, with T90 and mean SpO_2 demonstrating clinical viability (Youden index ≥ 0.5; Table 1).

Table 1. Baseline T90 and mean SpO_2 are clinically viable predictors of persistent hypoventilation on fixed CPAP with treatment pressure derived from the Oxford algorithm. Comparison table of statistically significant predictors of persistent hypoventilation on CPAP following ROC analysis including P value, AUC and optimal predictive threshold value indicated by the maximal Youden index within that variable. Patients meeting these threshold values had significantly increased risk of persistent hypoventilation on CPAP. Resolved hypoventilation n=23, persistent hypoventilation n=22

Rank and variable	P value	Area under curve	Optimal threshold	Sensitivity (95% CI) (%)	Specificity (95% CI) (%)	Youden Index
1. T90 (%)	<0.0001	0.87	> 63.8%	**81.82** (61.48 - 92.69)	**86.96** (67.87 - 95.46)	0.687
2. Mean SpO_2 (%)	0.0012	0.782	<88.5%	**86.36** (66.67 - 95.25)	**69.57** (49.13 - 84.4)	0.559
3. T85 (%)	0.0045	0.747	>14.45%	**68.18** (47.32 - 83.64)	**73.91** (53.53 - 87.45)	0.421
4. Neck circumference (inches)	0.0126	0.723	>17.75 inches	**65** (43.29 - 81.88)	**73.91** (53.53 - 87.45)	0.3891

Conclusions

Hypoventilators with severe nocturnal hypoxia may benefit from increased starting pressure relative to the Oxford algorithm (Table 1), to be further characterised in follow-up studies.

RESEARCH AND AUDITS

Impact of applying adult and paediatric scoring criteria on sleep disordered breathing grading severity in a cohort of adolescents

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Introduction

Different criteria apply when scoring respiratory events during sleep in adults and children (AASM scoring manual, 2023). In addition, severity classifications of sleep disordered breathing (SDB) also differ between adult and paediatric populations with higher thresholds applied for adults. There are no explicit guidelines for scoring adolescents; the AASM states that patients aged ≥13 years old can be scored using adult criteria if they have an adult habitus (AASM scoring manual, 2023). We aimed to assess if there is any significant effect on number or duration of respiratory events, and grading SDB severity when scoring sleep studies using paediatric compared to adult criteria in our patient cohort of adolescents.

Methods

Adolescents aged between 13-17 years (n = 25) attending for an inpatient cardiorespiratory polygraphy sleep study from January 2022-December 2023 were included. Exclusion criteria were: patients with neurodisability and studies performed using non-invasive ventilation or supplemental oxygen. Median age (range) was 14 years old (13-17). Apnoea-hypopnoea index (AHI) categories were defined using the scoring criteria defined by the AASM scoring manual (2023). Studies were retrospectively double-scored using paediatric and adult scoring criteria by the same physiologist.

Results

The mean (standard deviation) estimated total sleep time was 07:10:29 (01:19:47). Mean AHI using paediatric scoring criteria was 4.41 (6.56); mean AHI using adult scoring criteria was 4.20 (5.94). There was no significant difference in AHI between adult and paediatric scoring ($p = .364$), mean apnoea duration ($p = .690$) or mean hypopnoea duration ($p = .078$). There was no significant difference in the absolute number of events scored between adult and paediatric scoring ($p = .379$). Grading severity was lower when

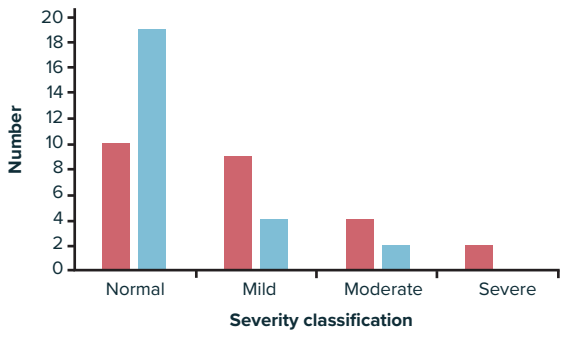

Figure 1. Grading severity classifications when using paediatric scoring criteria vs adult scoring criteria in adolescents aged 13-17 years old.

Coral bars = paediatric scoring criteria;
Blue bars = adult scoring criteria

using adult criteria compared to paediatric criteria in 14/21 studies (Figure 1).

Conclusions

This study shows that applying different scoring criteria in adolescents does not significantly affect number or duration of respiratory events, or overall AHI. However, the severity of SDB changes for the majority of patients. This could influence patients' diagnoses and subsequent treatment. A larger patient cohort is required to further understand the implications of specific age thresholds in severity grading of SDB.

RESEARCH AND AUDITS

Are we prescribing CPAP appropriately?

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Introduction

CPAP is the first line therapy for moderate and severe obstructive sleep apnoea (OSA). It is generally recommended in mild sleep apnoea only if the symptomatic burden affects quality of life (NICE, 2008). We sought to determine if CPAP was being prescribed in accordance with the recommended guidelines, with a focus on mild OSA.

Methods

The study was a retrospective audit of all new CPAP issues (following 1-week trial) within a 6-month period (n=142). Patients were grouped into “compliers” and “non-compliers” based on CPAP data at 12 months (>70% nights, >4 hours/night). Demographics, sleep apnoea severity (based on AHI or ODI for 19 patients with only oximetry), baseline Epworth, and features of CPAP set-up were compared between compliers and non-compliers. Categorical data were compared using a Fisher’s Exact test (or Chi-Squared for the 3 severity groups) and continuous data were compared using a Mann Whitney-U test. All comparisons were undertaken with IBM SPSS (version 4) with $p<0.05$ as the threshold for significance.

Results

86 patients (61%) were compliant with CPAP at 12 months and 56 (39%) were not. There were no differences in age, sex, or BMI between the two groups, nor were there any differences in disease severity. However, the proportion of patients with a positive Epworth (>11) pre-CPAP was higher in compliers ($p=0.012$). The proportion of preliminary CPAP trial extensions was higher in the long-term non-compliers ($p=0.008$). There were no differences in humidifier issue, expiratory pressure relief (EPR) activation, or number of masks tried on CPAP. However, mask leak was significantly but modestly higher on average in non-compliers ($p=0.003$).

Conclusions

In accordance with recommended guidelines, CPAP is primarily prescribed for those with moderate or severe OSA. Long-term compliance is perhaps low considering all patients had a successful preliminary trial but OSA severity does not influence this. Trial extension may be a red flag, particularly for those with a negative baseline Epworth and may instigate a franker discussion with patients before considering long-term CPAP issue. Mask leak may not be a major factor but it could warrant greater consideration to improve compliance in some.

Table 1. A summary of demographics, baseline diagnostic data, and long-term CPAP data between patients still compliant with CPAP 12 months after issue and those no longer compliant at 12 months. The proportion of patients with a positive baseline Epworth Sleepiness Score (ESS), those who had their initial 1-week trial extended, and mask leak was significantly higher in long-term non-compliers. Data are presented as ratios or median (interquartile range), except for age which is median (range).

	Compliant at 12 months	Non-compliant at 12 months	p=
N=	86	56	ns
M : F	56 M : 30 F	34 M : 22 F	ns
Age (years)	50 (19-76)	51 (22-85)	ns
BMI (kg/m²)	35.0 (29.9 - 42.2)	36.9 (30.14 - 41.7)	ns
AHI / ODI	34.9 (18.9 - 67.1)	30.4 (17.2-49.6)	ns
Severity	17 Mild : 18 Mod : 52 Sev	9 Mild : 19 Mod : 28 Sev	ns
ESS ≥ 11	63 Y : 23 N	25 Y : 31 N	0.012
CPAP trial extended	13 Y : 73 N	19 Y : 37 N	0.013
Humidifier	32 Y : 54 N	21 Y : 35 N	ns
EPR	23 Y : 63 N	21 Y : 35 N	ns
≥2 masks	43 Y : 43 N	26 Y : 30 N	ns
AHI on CPAP	1.8 (1.1 - 3.3)	1.8 (0.8 - 3.1)	ns
Mask Leak	2.7 (0.7 - 6.7)	4.7 (1.9 - 17.4)	0.003

RESEARCH AND AUDITS

A retrospective service evaluation looking into the efficacy of Watchpat referrals for the diagnosis of sleep disordered breathing

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Introduction

Patients with suspected obstructive sleep apnoea (OSA) often have negative overnight oximetry (ONO) despite presenting with daytime sleepiness. Watch peripheral arterial tonometry (WatchPat) is a more accurate alternative to measuring respiratory events during sleep using an algorithm-based approach. However, who best to refer for testing using WP needs more insight.

Aims

To find clinical indicators in groups of patients who have positive and negative WatchPats (WP) and to suggest methods to streamline referral pathways.

Methods

This is a retrospective service evaluation across a 1-year period (March 2021 – March 2022). Patients with suspected OSA completed overnight oximetry. If the results of overnight oximetry were negative, WatchPat was performed 4 weeks later to further investigate symptoms.

Results

119 patients (43.7% female) were included in this study. Of these, 62 individuals were placed onto treatment for OSA. From these, 25 (40.3%) had both negative WP apnoea hypopnea index (AHI) and ONO ODI. Bland Altman analysis showed high levels of agreement between WP AHI and ONO ODI with only 7.56% of WP patients differing based on 95% confidence intervals. ROC curve analysis found the area under the curve for ESS was 0.44% and had poor ability to discriminate patients for positive WP referrals. Males who went onto treatment had a mean body mass index (BMI) with standard deviation of 44.4 ± 10.71. For males who didn't have treatment this was 28.44 ± 3.62. In the female population the BMI was 36.81 ± 10.69 and 32.44 ± 8.99 for those who were treated and untreated respectively. This shows patients who are obese are more likely to have positive WP studies.

Conclusion

Overall, the study demonstrated a strong relationship between WP AHI and ONO ODI. Results indicated that the clinical importance of WP is based on its capacity to diagnose REM OSA, which may be overstated if autoscoring is not particularly precise. In addition, there is a high association between individuals with an obese BMI and positive WP test results. Lastly, the ESS is incapable of discriminating based on the need for WP, and there is no gender-related variation in WP results.

RESEARCH AND AUDITS

The impact of weight loss on moderate to severe obstructive sleep apnoea

Mr Thomas Trombley
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Introduction

Obesity is a common risk factor for obstructive sleep apnoea (OSA) due to increased pressure on upper airway soft tissues. Left untreated, moderate to severe OSA may contribute to cardiovascular disease including hypertension, stroke and heart failure (Drager *et al. JACC* 2013; 62(7), 569-576). Although treatment of mild OSA does not seem to impact overall cardiovascular health (Guimarães *et al. JCSM* 2021; 17(2), 149-158), weight loss and continuous positive airway pressure (CPAP) therapy is recommended for OSA and overall cardiovascular health (Epstein *et al. JCSM* 2009; 5(3), 263–276).

Objectives

- Identify any correlation between confirmed weight loss and overall OSA severity.
- Consider the amount of weight loss most beneficial to improve OSA severity.

Methods

As part of a service audit, data from adult patients who have undergone at least two limited sleep studies (LSS) between September 2020-2022 was extracted from the electronic database within the sleep department at UHNM NHS Trust. The first LSS identified their apnoea-hypopnoea index (AHI) as moderate (≥15 ≤30) or severe (>30) OSA, with the second LSS being conducted due to confirmed weight loss. CPAP was not used during either LSS. The pre and post weight loss LSS results were then compared to identify if any changes had occurred, including via a paired t-test.

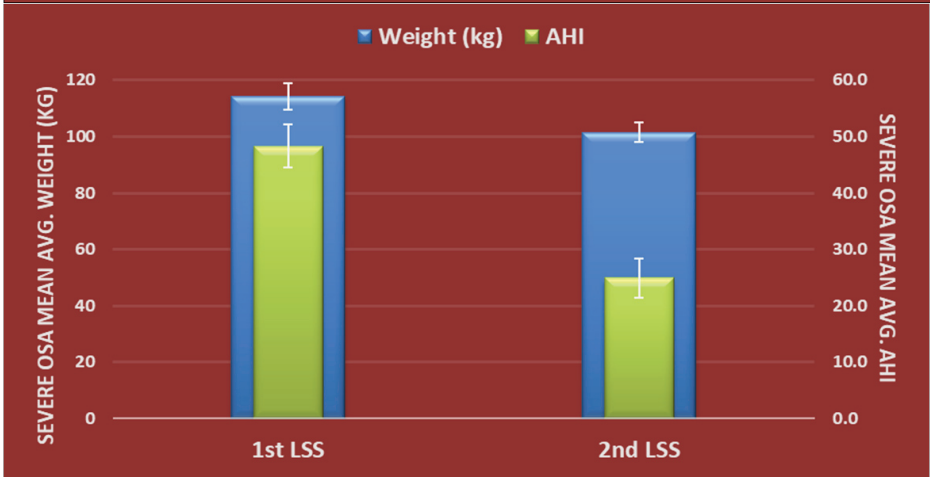
Results (see Figure 1)

On average, patients dropped into a lower category of OSA severity from severe to moderate and moderate to mild respectively. To achieve this there was a 12.8kg drop in weight in the severe category and a 10.2kg drop in weight in the moderate category. This was associated with a 0.8in and 0.5in reduction in collar size respectively, potentially reducing pressure on upper airway soft tissues. The results were statistically significant ($p<0.05$).

Conclusions

Results suggest that weight loss with collar size reduction in moderate to severe OSA can decrease OSA severity to a milder form, potentially having a positive impact on long-term cardiovascular health. The findings could possibly assist as a service improvement reference, both for local sleep services and their moderate to severe OSA patients who are considering weight loss intervention to supplement their CPAP treatment.

Severe OSA (n=23)	Mean avg.	Weight (kg)	BMI	Collar (in)	AHI
no AHI improvement (n=3)	1st LSS	114.3	36.67	17.8	48.3
	2nd LSS	101.5	32.52	17.0	24.9
no collar reduction (n=8)	difference	12.8	4.2	0.8	23.4
	% difference	11.20%	11.32%	4.49%	48.45%
	t-test (*p*)	0.0001	0.0439	0.0022	0.0002



Moderate OSA (n=23)	Mean avg.	Weight (kg)	BMI	Collar (in)	AHI
no AHI improvement (n=2)	1st LSS	105.0	35.69	16.3	22.3
	2nd LSS	94.8	32.13	15.8	13.4
no collar reduction (n=9)	difference	10.2	3.6	0.5	8.9
	% difference	9.71%	9.97%	3.07%	39.91%
	t-test (*p*)	0.0018	0.2130	0.0225	0.0005

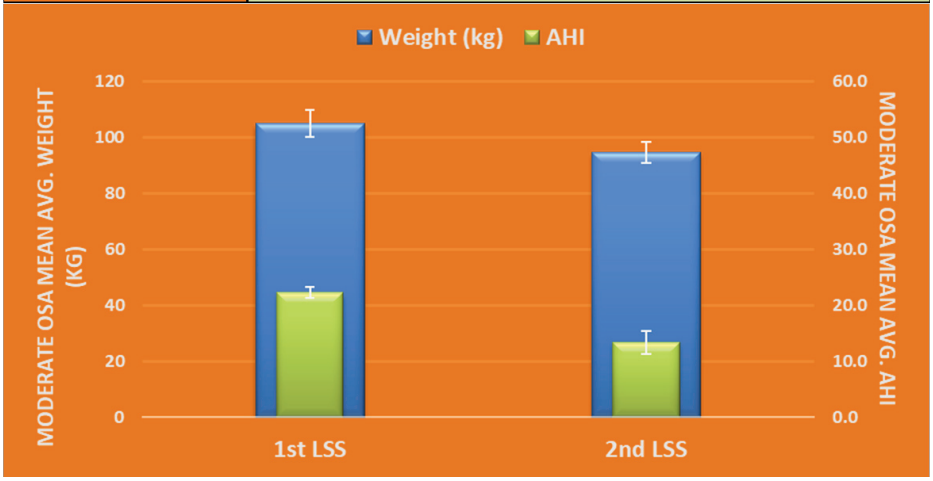


Figure 1. Change in the mean average weight and AHI pre and post weight loss in severe and moderate OSA patients

RESEARCH AND AUDITS

Discussing neuromuscular electrical stimulation therapy (NMES) as a novel treatment for OSA: a case study

Miss Charlotte Elson[1]

[1]St Georges NHS Trust, Tooting, United Kingdom, [2]Manchester Metropolitan University, Manchester, United Kingdom

Background

Obstructive sleep apnoea (OSA) is a type of sleep disordered breathing caused by reoccurring oropharyngeal collapse. Patients with untreated OSA are at increased risk of hypertension, stroke, heart failure, diabetes, depression, road traffic accidents and cognitive dysfunction. A new novel OSA treatment using neuromuscular electrical stimulation therapy (NMES) called eXciteOSA® is being trialled at St Georges University Hospitals NHS Foundation Trust for patients with mild OSA, to expand potential treatment options for patients. Prospective benefits of NEMS include treating the cause of sleep apnoea instead of a device which treats the symptoms, reducing adherence problems with nighttime appliances such as CPAP.

Case presentation

BD, a 42-year-old computing office worker was referred to the trust from Kingston hospital. He was referred to the Kingston sleep service for nighttime snoring, described by the patient as a 'gasping snore'. He sleeps seven to eight hours per night and has a midday hour nap five days a week. His sleep schedule is regular and he has cut out all caffeine. Kingston hospital conducted an overnight pulse oximetry study which showed an oxygen desaturation index (ODI) of 13 dips per hour. St Georges Hospital then took over care and treatment of the patient and the patient was started on an eXiteOSA® trial. Adherence was optimal for the first months but dropped 4% below recommended use in the final month of phase 1. In June a repeat sleep study was conducted after phase 1, showing an ODI of 22 dips per hour. The patient was reviewed and placed on the CPAP waiting list, with the device to be returned once CPAP treatment is started.

Conclusions

Lifestyle factors are likely the cause of worsening symptoms and ODI, leading to the recategorization of his condition to moderate OSA rather than mild. There is inadequate evidence on the safety and effectiveness of the device. Current research is limited in its evidence. Further research is needed to establish the effectiveness of NEMS on patients with OSA.

Key words: neuromuscular electrical stimulation, mild obstructive sleep apnoea, Intraoral device, Sleep disordered breathing.

RESEARCH AND AUDITS

The diagnostic pathway for narcolepsy type 1: a case study

Miss Kate Howard

Cardiff & Vale University Health Board, Penarth, United Kingdom

Introduction

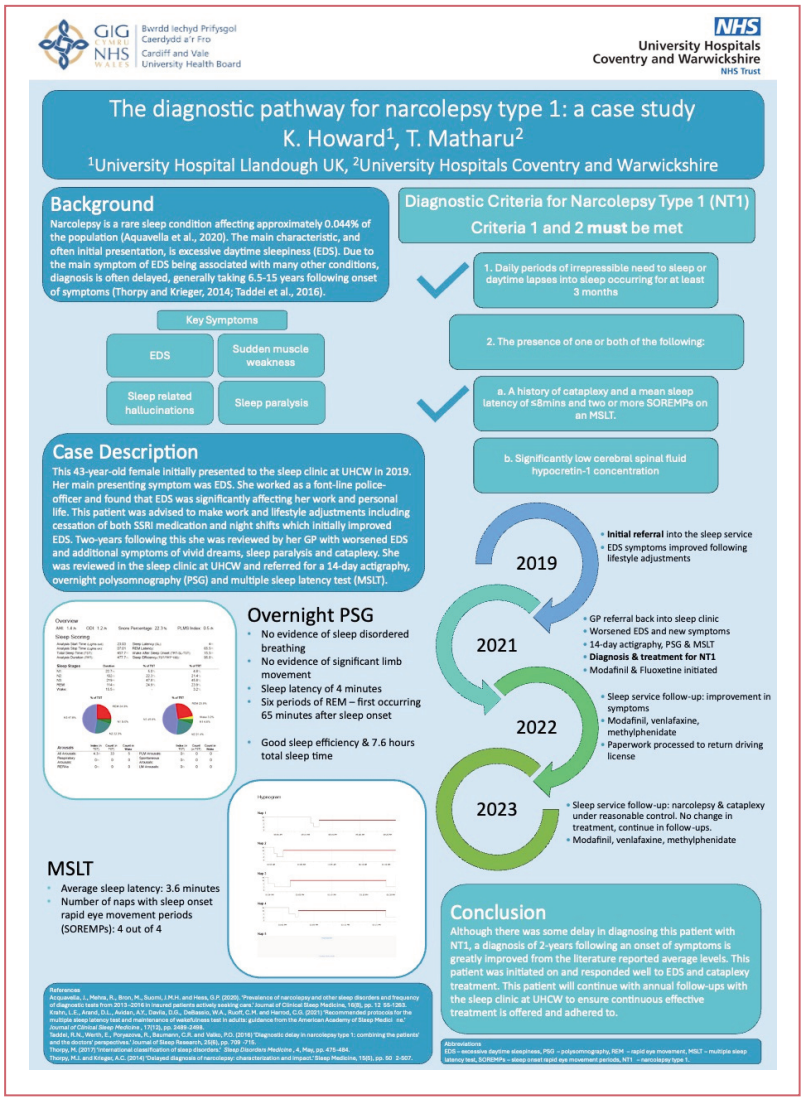
A 36-year-old female presented to their GP with EDS and was referred to the sleep service. They had a BMI of 26 kg/m^2 and an ESS of 15. Following a HSAT they were diagnosed with OSAHS. They were referred onto a dietician, offered sleep hygiene advice and discharged back to the care of the GP.

Case History

Two years following this, the patient made the appropriate lifestyle changes, however their symptoms worsened. They now had a BMI of 23 kg/m^2 and an ESS of 22. They were experiencing increased daytime sleepiness, cataplexy and sleep paralysis. They were referred for an MSLT which revealed 4 napping opportunities, all with SOREMPs and a mean sleep latency of 3.6 minutes. This patient was diagnosed with narcolepsy type 1 and initiated a treatment plan of modafinil and fluoxetine.

Discussion

Although there was a delay in diagnosing this patient with NT1, a diagnosis of 2-years following an onset of symptoms is greatly improved from the literature reported average levels. This patient was initiated on the appropriate first-line treatment. This patient should maintain annual follow-ups with the sleep consultant to ensure continuous effective and relevant treatment is offered and adhered to.



RESEARCH AND AUDITS

When should patients referred for sleep apnoea screening have capillary blood gases?

Rosie Fillingham, Claire Pitcher
University Hospitals Of Derby And Burton NHS Ft Trust

Aims

Patients referred for sleep apnoea screening may have a degree of respiratory failure and require a capillary blood gas (CBG) to measure partial pressure of carbon dioxide (pCO_2). Our current practice is to use a threshold of a mean overnight saturation (SpO_2) of ≤92% to prompt measurement of capillary pCO_2. The aim of the study was to review this practice and audit capillary pCO_2 levels in patients with low mean overnight SpO_2.

Method

75 patients who were referred for sleep apnoea screening between Aug 2022 and July 2023 with a Body Mass Index (BMI) >30kg/m^2 were reviewed.

An overnight sleep study was performed. All the patients with a mean overnight SpO_2 of less than 92% on the overnight study went on to have a CBG to measure pCO_2 levels before treatment was initiated. A negative correlation scatter plot of the results was created.

Results

The data showed than no patient with a mean overnight SpO_2 of 90% or more had a capillary pCO_2 of more than 6.5 kPa.

Conclusion

Obstructive Sleep Apnoea (OSA) and Obesity Hypoventilation Syndrome (OHS) frequently co-exist, with 70% of patients with OHS also having OSA. OHS is defined by the combination of obesity, with BMI over 30kg/m^2 and increased daytime $PaCO_2$ levels. While CPAP is the treatment of choice for these patients, it is important to identify those who may require a post treatment capillary pCO_2 measurement to ensure they are adequately treated. In the acute setting an arterial pCO_2 measurement of >6.5 kPa would indicate a degree of respiratory failure and indicate initiation of PAP treatment. While this study was based on patients with chronic OSA/OHS rather than acute, a capillary pCO_2 of 6.5 kPa was chosen as a reasonable marker of risk of significant OHS. The results indicate that when reviewing patients referred to the sleep clinic for sleep apnoea screening, patients with possible OHS do not require an assessment of capillary pCO_2 levels unless the mean overnight saturation is less than 90%.

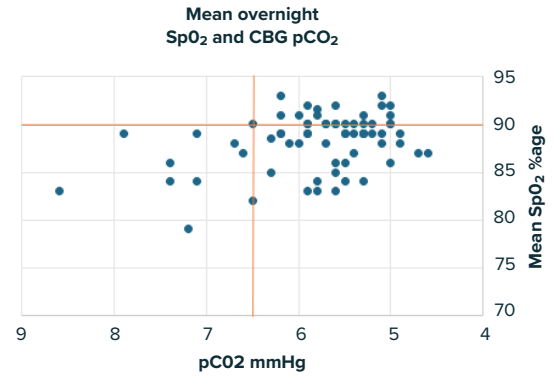


Figure 1. Correlation between mean oxygen saturations overnight (SpO_2) and pCO_2 from capillary blood gas assessment

PAEDIATRICS

Diagnostic approaches to quantify sleep-related rhythmic movement disorders

Twum B[1], Valentin S[1], Hill CM[1,2]

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Sleep-Related Rhythmic Movement Disorder (SR-RMD) is described by the ICSD-III as stereotyped, rhythmic, and repetitive movements involving large muscle groups. They mostly occur during the settling period, during wake-after-sleep onset, and upon waking up in the morning.

For these movements to be classified as a disorder, they must meet the following criteria: 1) involvement of large muscle groups, 2) be related to sleep or occurring when the patient is about to sleep or take a nap, 3) the behaviour must disrupt normal sleep and/or impair daytime functioning and 4) brings about bodily harm to the patient or could result in injuries or trauma if modifications are not made to the patient's sleep environment or interventions are not sought for the behaviour.

The diagnosis is mostly clinical and stems from history or complaints from parents and fulfillment of diagnostic criteria. Recent data suggest that the prevalence of SR-RMD in the UK is about 1% in infants and toddlers (Gogo *et al*., 2019), although in our clinical experience it is more common in children with neurodevelopmental disorders (Joels *et al*., 2023).

There are a number of semiologies seen in this condition and our clinic utilises a categorisation based on common clinical types (Joels *et al*., 2023) (Figure 1). In addition, based on our clinical experience, there are some less common semiologies observed, such as isolated prone leg banging and hitting the forehead.

Figure 1. Rhythmic movement semiologies

Diagnosing SR-RMD begins with a report from the parent about the unusual movement observed by their child at night. Although helpful and a pivotal step in diagnosing the disorder, parent reports can be misleading and erroneous in determining the severity of the condition (Kose *et al*., 2021).

Unlike other episodic sleep disorders, such as periodic limb movement disorder and sleep disordered breathing, there is no agreed metric (like the apnoea/hypopnoea index) to measure the severity of SR-RMD. The AASM specifies that

PSG is the gold standard for diagnosing SR-RMD but provides no further guidance on severity assessment.

There are several measurement techniques that can be used to diagnose and quantify SR-RMD in children. Below are some approaches currently employed within the Southampton service to objectively diagnose and assess the severity of SR-RMD.

Actigraphy

Actigraphy is a simple and non-invasive method of monitoring sleep-wake patterns. It involves a watch (Figure 2) with motion and light sensors that is usually worn on the non-dominant wrist. The watch uses an accelerometer that detects motion and converts them into electrical signals at a rate of 10 Hz per second.

Figure 2. Actigraph

In comparison with the gold standard type I polysomnography, actigraphy is less intrusive in nature, cost-effective, and can both record and store data for longer periods of time providing reliable data of the sleep-wake patterns of a child.

Concurrent use with a sleep diary provides a broad picture of the extent of sleep disruption caused by repetitive or rhythmic movements that occur during the night. These movements can be seen as high amplitude bouts of movements during the sleep onset latency period or during the sleep period that increase sleep fragmentation and decrease the total sleep time. However, these measurements lack specificity and cannot reliably discriminate SR-RMDs from other movements at night using standard commercial analysis algorithms.

Polysomnography (PSG)

Type I polysomnography (PSG) has traditionally been used for diagnosing SR-RMD. It involves simultaneous monitoring of different neurophysiologic, cardiopulmonary, and other physiologic parameters overnight (Figure 3). This is conducted in a sleep laboratory with the help of an experienced sleep physiologist.

This type of sleep study makes it easy for clinicians to determine whether the rhythmic movements arise directly from sleep or as a wake-sleep transition phenomenon; differentiates movements from epilepsy; and identifies any covert sleep disorders such as periodic limb movement disorder (PLMD) or sleep-related breathing disorder (SRBD). These insights guide best treatment options for these patients.

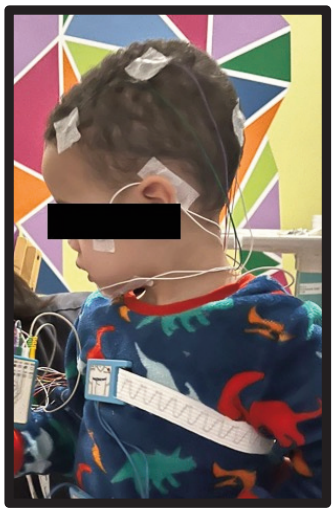

Figure 3. Type I PSG

There are, however, a few drawbacks to this diagnostic method, specifically, the use of sensors may overwhelm sensitive children and the changes in the child's natural sleep may mask the severity of SR-RMD.

Additionally, children may need safety modifications to their sleep environment (i.e., usage of safety sleepers or padded cot sides) to accommodate certain rhythmic movements, particularly head banging and therefore may not be feasible in all sleep laboratories.

Videosomnography (VSG)

Video monitoring has been used to observe sleep and sleep behaviours, mostly in babies, since the 1970s. It can be used as a solitary device or together with PSG. Over the years, technology has undergone huge advances, making it possible for high-quality infrared video to be recorded and saved within standard sleep study systems. With the use of software, the VSG can record position, movement, sound, sleep and wake states, and other variables.

Figure 5. VSG device used in patient's home

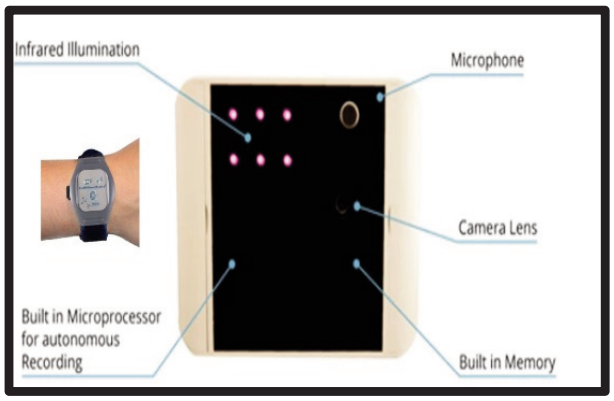

Figure 4. VSG device

The VSG device used within our clinic (SomnoMedics, Germany) (Figure 4) consists of an infrared camera and an actigraphy watch that are both pre-set by a physiologist. It doesn't need any special instructions and is easy to use within the patient's home environment (Figure 5).

This diagnostic procedure addresses some of the important limitations that come with type 1 PSG studies, namely the lack of sensors (other than actigraphy) and the ability to record sleep in the home environment. This allows the recording of more representative sleep and SR-RMs. Our practice is to always record two consecutive nights of video at home to accommodate night-to-night variability in movements.

Scoring of SR-RMD in VSG and PSG

The AASM Manual for the Scoring of Sleep and Associated Events Version 3 is utilised in analysing our Type I PSG data. The AASM scoring guideline for SR-RMD specifies the presence of at least 4 rhythmic movements with frequencies between 0.5 to 2.0 Hz, with each rhythmic burst being two times the background EMG activity. We record the frequency of RMs by counting the number of movements per 10 seconds divided by 10 (e.g., 6 movements in 10 seconds will give a frequency of 0.6 Hz).

This approach focuses on the identification of movements but provides no guidance on how to analyse SR-RMD severity. Based on our extensive clinical experience we have developed scoring modifications that are applied to both PSG and VSG recordings.

1. Inter-episode interval
   We recommend a 10-second inter-episode rule whereby a child must cease RMs for at least 10 seconds before we analyse the next movement as a new episode, even if the child remains in the same body posture.
2. Severity rating: to synthesise scoring data to generate an overview of severity we report the following variables:
   a) **% of time spent in RM** (time spent in RM divided by Time in Bed* multiplied by 100) – this can be further subdivided into % of settling time or % of sleep periods spent in RMs
   b) **Mean duration of RMs** (total time spent in RM divided by Total number of RM episodes)
   c) **RM Index** (Total number of RMs during TiB divided by TiB in hours). For example, if a child has 10 hours in bed and has 20 RM episodes the RM index is 2/h.

   *The total time in bed is determined from lights out to when the child leaves their bed.

In scoring PSG, sleep onset is defined by the AASM as the start of the first epoch scored as any stage other than Stage Wake, and for most individuals, this will usually be the first epoch of stage N1. In contrast to VSG, which is limited to an actigraphy watch and can't determine the sleep stage, our protocol is to set sleep onset as the beginning of the first 10 minutes of the study characterised by the absence of movement.

Different stages of sleep can be identified with PSG. For VSG however, we can only identify sleep and wake where Stage Wake is defined if there is more than 15 seconds of movement in line with the AASM's scoring manual.

Relationship to Sleep-Wake State

It is important to document whether RMs occur during the settling period (Figure 6) and whether those arising during the sleep period arise directly from sleep or wake after sleep onset.

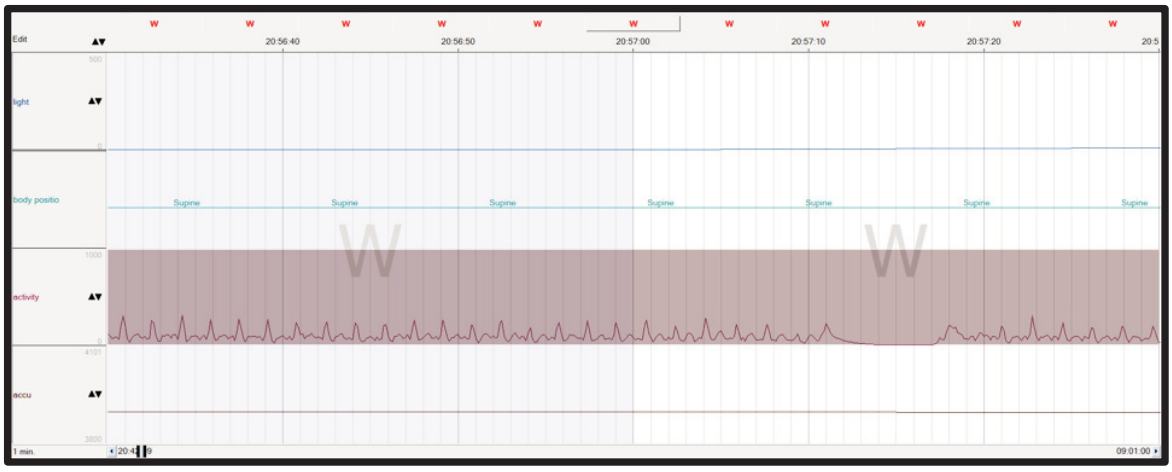

Figure 6. A one-minute epoch of VSG with RM during the settling period

For episodes arising from sleep, we document any possible triggers that precipitate RM, such as any antecedent arousal, limb movement (Figure 7), respiratory event, or external noise, any absence of this would be considered as RM arising from sleep.

We also include which stage of sleep the RM occurs in, especially if it arises directly from sleep without any antecedents in Type I PSG.

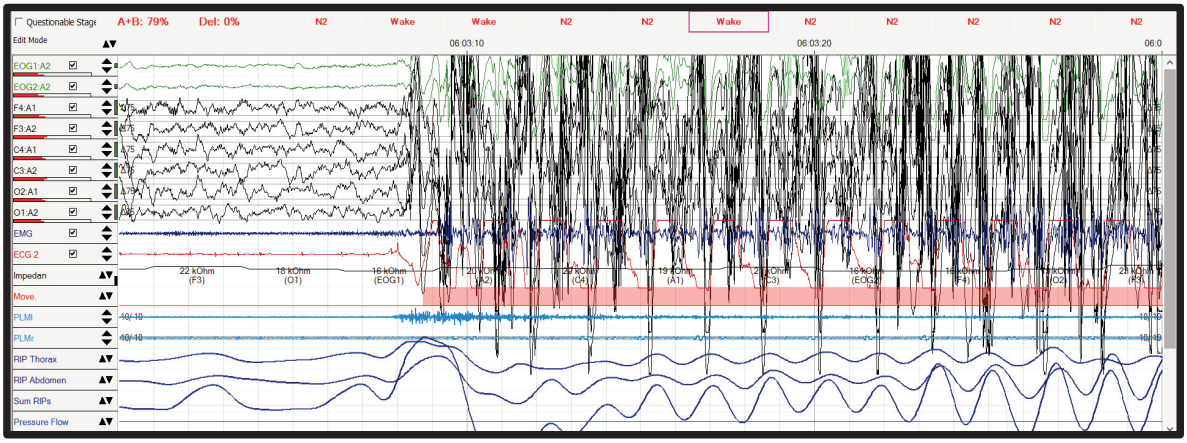

Figure 7. A 30-second epoch from PSG with an RM arising from wake due to leg movement antecedent.

Comparing the diagnostic modalities:

Table 1 provides a summary of the outcome of the various diagnostic methods on total sleep time, and quality of sleep during a study. The non-intrusive nature of actigraphy preserves the total sleep time for most patients. In contrast, sleeping time is lost to rhythmic movements during a VSG study, and in PSG reduced due to patients adjusting to a new sleeping environment and/or the presence of attached electrodes. Notably, PSG remains the only method amongst those discussed that can exclude co-morbidities potentially masking or underlining rhythmic movements and determine the specific stage during which the RM occurred.

Table 1. Comparison of the various diagnosis modalities in relation to SR-RMD *(Laganiere et al., 2020, Horger et al., 2021)*

Modality	Accurate identification of RMs	Relationship of RM to sleep stages	Presence of Co-morbidities
Actigraphy	NO	NO	NO
VSG	YES	NO	NO
PSG	YES/NO	YES	YES

Conclusion

Among the sleep-related pathologies in children, sleep-related rhythmic movement disorder remains one of the understudied areas that merit serious attention (Gwyther *et al*., 2017). Having said that, technological advancements have made it possible to assess this disorder with more accuracy, providing the foundation for severity assessment and in turn, measurement of treatment outcomes.

PSG makes it possible for us to rule out epilepsy or any other covert sleep disorders such as PLMD and SRBD among others. When children do exhibit movements in the laboratory, their relationship to sleep stages and wake can be ascertained. PSG however, cannot be relied on to assess the severity of SR-RMD as one third of children in our clinical experience suppress movements in the sleep laboratory (Joels *et al*., 2023). Actigraphy provides a more global overview of sleep patterns and sleep quality over a 2-week time frame and the home VSG paints a clearer picture of the severity of the rhythmic movements. When these diagnostic approaches are used altogether, more insights can be gathered to determine whether movements constitute a disorder and then determine the appropriate management approaches.

PAEDIATRICS

Overview: BTS Guideline for diagnosing and monitoring paediatric sleep disordered breathing 2023

Tara Badman
St George's University Hospital

Sleep is essential to a child's overall growth, development, and helps to regulate their behavioural emotions.

Sleep disordered breathing (SDB) can occur in all ages from neonates to adults. The prevalence of SDB in children is between 2% and 11%.[1] In adults, the main cause for sleep disordered breathing is obesity, however, the main cause for SDB in children is adeno-tonsillar hypertrophy. Although obesity is increasing within school age children, the National Child Measurement Programme (2022/2023) demonstrated that nearly a quarter of children in reception and Year 6 are obese, predisposing them to SDB. This and other sleep conditions can also be found in children with complex underlying medical conditions, however, these may be multi-factorial. Patients with conditions, who are predisposed to SDB are:

- Trisomy 21
- cerebral palsy
- sickle cell
- neuromuscular disorders
- metabolic disorders
- craniofacial abnormalities

With the occurrence of SDB, several behavioural and physical health concerns can arise. These include but are not limited to:

- cardiovascular risks (hypertension, pulmonary hypertension)
- failure to thrive
- developmental delays
- behavioural issues

Associated clinical symptoms are varied and can include:

- snoring
- gasping
- increased work of breathing
- tracheal recessions
- nocturia
- enuresis
- witnessed apnoeic events
- hyperextended neck

- difficulty waking, mouth breathing
- daytime tiredness
- hyperactivity
- difficulty concentrating at school
- learning difficulties
- behavioural difficulties (aggression) and moodiness
- hypotonia

Older children may be able to tell you they have difficulty waking and experience morning headaches. It is therefore important to obtain a quick and reliable clinical history when SDB is suspected in children.

Any literature search will demonstrate there are limited guidelines available in the diagnosis of paediatric sleep disorders. Guidelines are important as they bring together the literature to create evidence-based practice to help us provide the best possible care for our patients in addition to synchronicity of care within the NHS.

In 2023, the British Thoracic Society (BTS), published guidelines which provide clarification in the use of diagnostics tools and recordings available to aid in the diagnosis and monitoring of paediatric sleep disordered breathing.

Polysomnography (PSG) is often considered the GOLD standard for assessing SDB. However, the recent BTS guidelines provide their recommendations based on techniques which are widely available in the UK such as overnight pulse oximetry, cardio-respiratory sleep study (CRSS), carbon dioxide (CO_2) monitoring and questionnaires. The Patient, Problem or Patient, Intervention, Comparison and Outcome (PICO) framework was used to make their recommendations based on evidence-based practice and literature review.

The guidance did not look at any specific sleep disordered breathing conditions such as Obstructive Sleep Apnoea (OSA), but rather on the general population that may be affected by SDB. However, they did provide a recommended pathway and guidance for patients with suspected OSA. Throughout the guidelines they provided recommendations and good practice points. It was generally categorised as children with and without co-morbidities. The guidelines have provided recommendations of structured pathways which can be adopted into clinical practice around the UK. Some of the main recommendations and good practice points are highlighted below.

Children without co-morbidities

- Sleep questionnaires (SRBD-PSQ) or (OSA-18) in children >2 years, are useful to diagnose SDB in those with moderate to severe SDB with pulse oximetry and CRSS, or PSG required if clinical inconsistencies and/or diagnostic certainty required.
- Sleep questionnaires combined with clinical assessment can be considered.
- Pulse oximetry can be used in the first line of investigations; however, it must be noted that a normal pulse oximetry study does not exclude SDB. If there is a strong clinical suspicion, CRSS is recommended.
- Pulse oximetry should not be performed in children < 2 years. Children < 2 years of age can have central events linked to immaturity of breathing and ongoing brain development. Pulse oximetry is limited in that it is not able to differentiate the type of respiratory event.
- Continuous CO_2 monitoring, such as transcutaneous CO_2, is not recommended to diagnose SDB.

Children with co-morbidities

- Sleep questionnaires should not be used to identify SDB in these patients.
- A CRSS should be considered to diagnose SDB in those with Downs syndrome and neuromuscular disorders.
- Continuous CO_2 monitoring should be considered in those children where hypoventilation is suspected, such as neuromuscular disorders and those already on respiratory ventilation.
- If CRSS is not available, overnight pulse oximetry can be considered.

There are few paediatric sleep specialist centres across the UK, with most NHS trusts struggling with beds and inpatient capacity. It is reassuring to see that the guidelines have included the recommendation for home sleep apnoea testing (HSAT), providing appropriate teaching is given to parents and caregivers performing the tests.

The BTS guidelines also highlight what is considered as abnormal for children >2 years of age.

- An oxygen desaturation index (ODI) 4% > 4/hr or an ODI 3% >7/hr.
- An SpO_2 <95% and >90%.
- Clusters and depth of desaturations should also be considered.
- The American Academy of Sleep Medicine (AASM)[3] recommends scoring as hypoventilation during sleep when >25% of the total sleep time as measured by either the arterial PCO_2 or surrogate (transcutaneous or end tidal which is more relevant in paediatrics) is spent with a PCO_2 >50 mmHg.

The use of the ODI 3% in identifying abnormality, aligns with the previous changes made to the AASM manual for the scoring of sleep and associated events. The McGill[4] score highlights severity for pulse oximetry tracing based on clustering and depth of the desaturation with the AASM scoring manual highlighting how to score respiratory events on CRSS and PSG and the associated apnoea/hypopnea indexes (AHI).

The guidelines also recognised that the quality and quantity data available on the study is important and recommended the following as good practice points.

- Both overnight pulse oximetry and CRSS studies should both have 4-6 hours of good continuous quality data with > 6 hours if mild sleep disordered breathing is suspected. Where data is available, the quality should also be considered, e.g. missing data in later part of the night may miss cycles of rapid eye movement (REM).
- Pulse oximetry (Figure 1) should have an averaging time of 2-3 seconds.

The BTS guidelines have created clarity around diagnostic tools which can be used to diagnose and monitor sleep disordered breathing. Hopefully, these recommendations will help to streamline services and provide the best care to our patients.

Pulse oximetry optimal monitoring time/process

Optimal pulse oximetry settings for monitoring SDB in children

Oximetry variable	Optimal setting(s)
Motion artefact removal	Motion artefact removal should be used.
Averaging time	2-3 seconds
Monitoring time (hours)	4-6 hours continuous sleep duration if moderate-to-severe SDB is suspected. >6 hours continuous sleep duration if mild SDB is suspected.
Monitoring time (nights)	1 night for children without comorbidities. Consider >1 night for children with comorbidities. Consider >1 night if initial period of monitoring not representative of child's sleep.

Figure 1. BTS guidelines on use of pulse oximetry settings when monitoring presence of SDB

For the full guidelines on the diagnosis and monitoring of paediatric sleep disordered breathing, please visit:

Paediatric sleep-disordered breathing | British Thoracic Society | Better lung health for all (brit-thoracic.org.uk)

References
1. Evans HJ, Gibson NA, Bennett J, et al. Thorax 2023;78 (suppl 2):1–27
2. Neave, A. National Child Measurement Programme. NHS England. 2003
3. Berry RB, Quan SF, Abreu AR. The AASM manual for the scoring of sleep and associated events: rules, terminology and technical specifications, version 2.6. Darien, Illinois: American Academy of Sleep Medicine, 2020. http://www.aasmnet.org/ scoringmanual/
4. R.T. Brouillette et al. Nocturnal pulse oximetry as an abbreviated testing modality for paediatric obstructive sleep apnoea: Paediatrics, 2000.

FURTHER INFORMATION

Useful resources for sleep disordered breathing

Obstructive sleep apnoea/hypopnoea syndrome | Obstructive sleep apnoea/hypopnoea syndrome and obesity hypoventilation syndrome in over 16s | Guidance | NICE

Obstructive sleep disordered breathing in 2- to 18-year-old children: diagnosis and management | European Respiratory Society (ersjournals.com)

ERS statement on obstructive sleep disordered breathing in 1- to 23-month-old children | European Respiratory Society (ersjournals.com)

AASM Scoring Manual - American Academy of Sleep Medicine

PAEDIATRICS

WellChild follow up

Tara Badman
St George's University Hospital

In our previous edition of SNEWS we highlighted the fantastic work of 2 paediatric WellChild LTV and Better-at-Home nurses, Alex McClements and Charlie Perth, who with the support of the WellChild charity and St George's Hospital, created a simulation suite with scenario-based teaching for healthcare professionals, careers and parents looking after children with Long Term Ventilation (LTV) and complex needs.

Since then, they have evaluated training experiences and explored healthcare professionals' perspectives in caring for children with LTV pre- and post-LTV simulation training in the better at home suite.

Outstanding care every time

NHS St George's University Hospitals NHS Foundation Trust

A qualitative service evaluation exploring healthcare professionals' perspectives of caring for children requiring long-term ventilation after LTV skills simulation training

Charlie Perth, WellChild Paediatric LTV and Better at Home CNS, St George's University Hospitals NHS Foundation Trust
Alex McClements, WellChild Paediatric LTV CNS, St George's University Hospitals NHS Foundation Trust
Dr Richard Chavasse, Consultant Respiratory Paediatrician, St George's University Hospitals NHS Foundation Trust

Background

An increasing number of children requiring Long-Term Ventilation (LTV), specifically Non-Invasive Ventilation (NIV), in the UK has highlighted a requirement for healthcare professionals (HCPs) to be trained adequately to safely care for this group of patients. Staff shortages, lack of Paediatric Intensive Care Unit (PICU) bed capacity and delays in discharge further advance the need for training to provide safe and effective in-hospital care. Simulation training has proven to be a low-cost and effective intervention that is well received in healthcare education (Felton & Wright, 2017; Higginson & Williams, 2018; Irwin et al., 2021; Lame & Dixon-Woods, 2020; Walshe et al., 2022).

Methods

Design
A descriptive qualitative design was adopted for this single centre service evaluation. Open-ended questions in the form of a paper questionnaire were self-administered. Braun & Clarke's (2022) reflexive thematic analysis was used to analyse the data, draw conclusions and make recommendations for practice.

Sample
30 HCPs who provide care for children requiring LTV, consisting of nurses and doctors. Purposive sampling was adopted. 28 participant questionnaires were deemed suitable for analysis after exclusion criteria eliminated 2 participants.

Inclusion criteria
HCPs who provide care or have provided care to children requiring LTV at SGH

Exclusion criteria
Parents, HCPs (agency), HCPs with no experience of caring for children requiring LTV, Students, AHPs

Aims & Objectives

Aims
- To understand HCP's experiences of simulation training delivered by specialist nurses within the context of service delivery
- To improve the quality of care for children requiring LTV in hospital.

Objectives
- Explore HCP's perspectives of caring for children requiring LTV in hospital after undertaking LTV skills simulation training
- To explore if and how HCP's confidence is affected by LTV simulation skills training

Findings & Implications

Findings
Three themes were developed from the dataset:
(1) simulation is an effective education tool; (2) speaking up and speaking out: hierarchy in healthcare; and (3) inspiring confidence in care.

Implications
(1) The development of an LTV study day incorporating elements of theory and simulation training to embed clinical knowledge relating to LTV skills; (2) study into adverse incidents; (3) a scoping review into how best to support HCPs with access to LTV education; and (4) the incorporation of simulation 'refresher' sessions for mandatory HCP training days.

Sample

Excerpts from the dataset

Speaking up and speaking out: hierarchy in healthcare
- 'more confident and happy to have been refreshed'
- 'feeling confident in caring for these patients'.
- 'observing colleagues caring for patient'
- 'I could actually manage the scenario with seniors with me but not with junior nurses'
- 'somewhat confident with support of senior members of staff'.
- 'positive feedback from the group about decisions made during the scenario'
- 'benefit from group input and also mix of different healthcare professionals'

Inspiring confidence in care
- 'I have nursed few babies on LTV but sometimes there is a big gap in between so tend to forget about machine settings'
- 'this has made me feel more confident'
- 'useful confidence boost'
- 'It has improved my confidence'
- 'I am now more confident and happy to have been refreshed'
- 'I feel more confident now'
- 'feel more confident in looking after a baby on long term vent'
- 'has improved my confidence and validated me'
- 'minimal exposure to looking after children on LTV'
- 'haven't been involved with LTV care for a few years so don't know all vents/out of practice'

Simulation is an effective education tool
- 'extremely effective way of teaching. Realistic to practice different scenarios and discuss the decision-making process'.
- 'it has to be practical to really improve knowledge'
- 'it is a very good way of training staff and non-medical people'
- 'it was very interactive and quite informative'
- 'it was beneficial. Personally, I learn better on simulation sessions as I learn better visually'.
- 'this was quite fast and chaotic in a way'
- 'simulations require time'
- 'is a good way to learn'
- 'really amazing'
- 'I think it is a good idea and very necessary'
- 'not everyone had a turn'

Summary of Findings

Themes & characteristics:
Simulation is an effective education tool- Access to training and resources, Implications of staff shortages, Debriefing
Speaking up and speaking out: hierarchy in healthcare- Differing experiences of junior and senior HCPs, Shared learning experiences, Cultural norms and impact on simulation training, Hierarchical associations between parents and HCPs
Inspiring confidence in care-Lack of exposure leads to lack of confidence, Leadership and role modelling, Confidence versus competence

Limitations
- Some participants did not answer all questions, and methodological weakness should be considered a possible reason for this. Furthermore, if more time had been available for this project, a pilot questionnaire could have been utilised with participants, allowing for questions to be revised.
- HCPs may have additional learning needs, neurodevelopmental issues or sensory processing issues, which may have impacted on how they felt able to answer the questions and/or engage with the simulation session and this should be considered in any future studies, to ensure the methods and data collection are as inclusive as possible.
- Knowledge acquisition should be considered from an Equality, Diversity and Inclusion (EDI) perspective and facilitators should consider what can be implemented to support HCPs in their learning and understanding. In future, more consideration should be made to establish how best to ascertain data related to participants' subjective experiences in relation to LTV service evaluation.

Conclusion
- Hour-long LTV skills simulation training sessions are a low-cost and time-effective way of increasing HCP's confidence, building on and embedding previous knowledge with the aim of improving the quality of care provided to children requiring LTV in one tertiary hospital.
- Adequate time to undertake simulation training, more frequent simulation training sessions and adding theory elements were all drawn out of the dataset as recommendations for future practice.
- An LTV Study day would be a valuable addition to link theory to practice alongside incorporating simulation training to advance HCP's knowledge in LTV skills and build confidence in caring for this group of complex paediatric patients.

SCIENTIFIC

A Rare But Typical Presentation Of Pregnancy Induced Obstructive Sleep Apnoea Hypopnea Syndrome (OSAHS)

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Background

Obstetric patients have long been an 'at-risk' cohort for sleep disordered breathing (SDB) that are historically underrecognized and undertreated. For many years, research studies into SDB have excluded women of reproductive age, specifically within OSAHS studies. This is concerning largely due to the increased risk of pre-eclampsia, a condition that causes hypertension during pregnancy and encourages the body to sit in a pro-inflammatory state. Subsequently, the risk of gestational diabetes and cardiovascular disease also increase, hence pre- eclampsia is the leading cause of maternal and perinatal morbidity.

Although the pathophysiology is largely unclear, more obvious physiological changes such as weight gain play a large role but also upper airway narrowing which has been observed in some antenatal studies, once again the mechanism here is largely unclear however it is through that the increased mass displacement from the foetus, reduces the functional residual capacity (FRC) leading to tracheal shortening and decreases airway patency. There is also evidence of hormonal regulation imbalance involving oestrogen and progesterone which in turn could lead to dysregulation of breathing.

Studies as early as 2007 have reported characteristic clinical manifestations of OSAHS. A study from Kapsimalis and Kryger, 2007 reported a 45% increase in snoring comparatively between prenatal and antenatal populations, then returning to baseline post-partum.

Despite this information, there remains no optimum pathway or entry point for screening for SDB during gestation despite an estimated prevalence of 9% of pregnant women being classed as 'high risk' for OSAHS.

Case Description

A 35-year-old lady presented with snoring, recurrent daytime somnolence and an Epworth sleepiness score (ESS) of 13/24. She presented with reoccurring arousals during sleep and described waking with a choking sensation increasing in frequency over the past few weeks along with morning sickness and nausea. At the time of presentation, she was in her second trimester at 25 weeks of her first pregnancy. Her BMI prior to gestation was 28.4 kg/m^2. She has never smoked, has longstanding mild asthma that is medicated with a short-acting beta-2 agonist (SABA).

Upon examination her mallampati was grade 3, blood pressure normotensive at 113/75 mmHg and a heart rate of 80bpm. There is history of endogenous depression over 10 years prior and no other known health conditions to note.

References

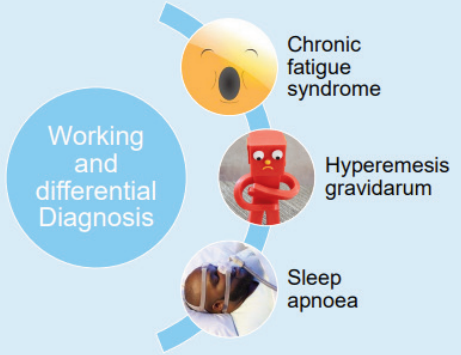
Carnelio, S., Morton, A. and McIntyre, H., 2016. Sleep disordered breathing in pregnancy: the maternal and fetal implications. Journal of Obstetrics and Gynaecology, pp.1-9.

Lapoisky, A. and Pemberton, V., 2021. Sleep-Disordered Breathing and Pregnancy-Related Cardiovascular Disease. Journal of Women's Health, 30(2), pp.194-198.

Johns, E., Denison, F. and Reynolds, R., 2020. Sleep disordered breathing in pregnancy: A review of the pathophysiology of adverse pregnancy outcomes. Acta Physiologica, 229(2).Bublitz, M., Sharp, M., Freeburg, T., Sanapo, L., Nugent, N., Sharkey, K. and Bourjeily, G., 2021. Sleep Disordered Breathing Measures in Early Pregnancy Are Associated with Depressive Symptoms in Late Pregnancy. Diagnostics, 11(5), p.858

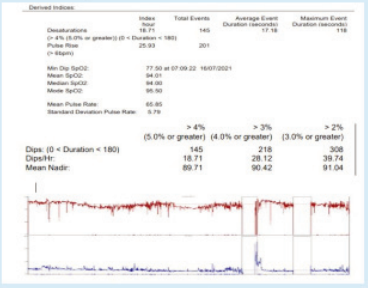
Kapsimalis, F. and Kryger, M., 2007. Obstructive Sleep Apnea in Pregnancy. Sleep Medicine Clinics, 2(4), pp.603-613.

Jaimchariyatam, N., Na-rungsri, K., Tungsanga, S., Lertmaharit, S., Lohsoonthorn, V. and Totienchai, S., 2018. Obstructive sleep apnea as a risk factor for preeclampsia–eclampsia. Sleep and Breathing, 23(2), pp.687-693.



Overnight Oximetry Report

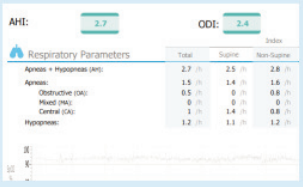
- Moderate OSA
- Mean Sp02: 94% suggesting no hypoxia
- Sleep diary showed adequate sleep hygiene



Subsequently set up on APAP therapy with controlled OSA for the remainder of her pregnancy and delivered a healthy newborn

Limited polysomnography performed without CPAP, 6 weeks post partum

- No evidence of OSA: AHI 2.7/hr. ODI 2.4/hr
- Asymptomatic
- 29.3 kg/m^2



Conclusion

- Poor recognition and screening of OSAHS within obstetric pathways
- Largely underdiagnosed and often symptoms correlate with other conditions
- Post Partum diagnostics are essential to reduce CPAP burden

Other NEWS

Changes to HCPC Standards

If you are registered on the HCPC register you should be aware of the changes that are occurring and how this will affect you. Below are links for you to explore these changes.

- What is changing? **What is changing | (hcpc-uk.org)**
- Why are the changes happening? **How and why we review the standards | (hcpc-uk.org)**

Philips Recall

Philips report it is business as usual, reporting no issues with supply of CPAP and NIV devices. This comes of the back off the global recall they are recovering from.

"The Man in the Iron Lung"

Paul Alexander, 78, "Man In the Iron Lung", dies after 70 years of living in a tank. After contacting Polio as a six year old, he was left paralysed from the neck down. See article linked here for the story behind 'The Man in the Iron Lung'

Paul Alexander - 'The Man in the Iron Lung' - dies after 70 years living in tank | US News | Sky News