ARTP SLEEP: S-NEWS

Dreaming of a better night's sleep

In this issue:

- Updates from our sleep manufacturers
- Sleep in Research
- Sleep in the news

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Send your articles to S-NEWS@artp.org.uk

Editor's Welcome

Welcome to the latest edition of S-NEWS magazine. Apologies that this edition comes slightly late due to the current situation with Coronavirus. I hope that you are all ok, and coping with the significant changes we have seen over the last few months, both personally and professionally.

Given the current situation I have removed the dates for your diary section from this edition. However, this edition is still packed with research and case studies presented at this years ARTP Annual Conference, and gives those of you that were unable to attend a chance to catch up on the brilliant research of your colleagues.

This edition will also keep you up to date on sleep in the news, as well as research from two of our ARTP grant winners.

Thank you all for reading, and please keep sending your articles and research to us!

Take care & stay safe!

Best wishes,

Alison

S-NEWS@artp.org.uk

A review of cardiopulmonary sleep studies in Noonan syndrome

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Introduction

We occasionally see paediatric patients with Noonan syndrome referred for a sleep study. A PubMed search did not uncover any previous studies investigating sleep in patients with this condition and Zaffanello M et al[1], in 2018, stated "*Data on incidence and prevalence of OSAS in Noonan Syndrome are unavailable*". In 2012, Khirabi et al[2] presented a case report of life-threatening obstructive sleep apnoea associated with adenoid hypertrophy in a child with Noonan syndrome.

Van der Burgt[3] described Noonan syndrome as a relatively common genetic disorder with an incidence in the UK estimated to be between 1:1000 and 1:2500 live births. It is characterised by short stature, typical facial dysmorphology and congenital heart defects. Table 1 details selected associated features of the syndrome (adapted from Marco Tartaglia et al[4]) combined with the % incidence (adapted from Roman et al[5]).

Feature	Example(s)	% Incidence
Facial dysmorphism	Ptosis, webbed neck	
Sensory	Strabismus Hearing loss	48-63 15-40
Dental	High arched palate	55-100
Cardiovascular	Congenital heart defects Valve stenosis ASD VSD	>80 50-62 6-10 5
Skeletal	Pectus excavatum Scoliosis	70-95 15
Lymphatic	Lymphangiectasia	20
Haematological	Leukaemia	65
Feeding difficulties		63
Postnatally reduced growth		50-70

Table 1. Associated features of Noonan Syndrome. Adapted from [4, 5]

Methods

A retrospective review of cardiorespiratory sleep recordings (Embla S4000, 4500, Stowood Scientific Instruments (SSI, UK) and TOSCA500/TCM5, transcutaneous carbon dioxide $TcCO_2$ (Radiometer, Den) performed between June 2009 and October 2019 on patients with Noonan syndrome as identified by the hospital Electronic Patient Record system (EPIC). Sleep studies had been analysed according to adapted AASM paediatric criteria[6] using REMLogic 1.0-3.4. Statistical analysis was performed using Microsoft Excel 2016.

Results

We identified 18 patients with the syndrome, 10 were male. 17 of the patients had sleep studies, eight of whom had >1 study. There were 50 studies retrieved in total. Five of the studies were oximetry-only and three studies had been recorded on an incompatible system so were excluded from analysis (one of these was the sole study for one patient). It was possible to calculate Body Mass Index (BMI) in 23 studies (Table 2).

	Age, years at study Mean (SD)	BMI, Kg/m^2 Mean (SD)	Sex (M/F)
All 16 patients, 42 studies	8.9 (6.0)	17.4 (2.3)	10/6
Baseline (Air-only) 9 patients, 13 studies	8.7 (5.8)	17.6 (2.9)	5/4

Table 2. Summary of patients

Two patients were now deceased (4 years and 3 months following their last sleep study respectively). Two patients had previous ENT surgery. Six had used supplemental oxygen during at least part of their (15) studies. Two were using Non-invasive Ventilation during 4 studies. One patient had a nasopharyngeal airway in situ (3 studies). Two patients had tracheostomy in situ (6 studies). Four patients were referred for suspected Sleep-disordered breathing. Figure 1 shows the most common associated conditions for our cohort, with examples.

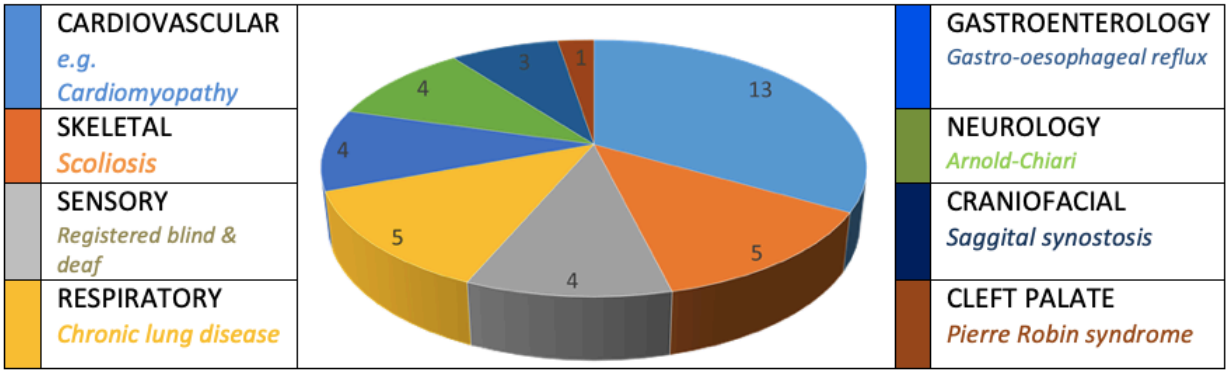

Figure 1. Types of Comorbidity in our cohort

Table 3 shows selected parameters recorded during the sleep studies. Of the 42 sleep studies, 22 included the patient using some form of respiratory support (non-invasive ventilation, nasopharyngeal airway, tracheostomy, supplemental oxygen). The 'ALL STUDIES WITH AIR' column displays only the 20 studies where respiratory support was not required. Of this group, 13 of the studies were on 9 patients who never required respiratory support and the 'BASELINE' column shows these in order to determine if there was a difference between those patients who required respiratory support and those who did not.

	ALL STUDIES (n-42)	ALL STUDIES IN AIR (20)	BASELINE (13)
Parameter		**Mean (SD)**	
SpO_2 mean (%)	94.4 (4.1)	96.1 (1.8)	96.2 (1.9)
SpO_2 mean nadir (%)	91.4 (4.3)	93.0 (1.8)	93.1 (1.9)
SpO_2 ODI (≥3% dips/hour)	15.1 (22.5)	9.6 (19.5)	5.2 (7.0)
SpO_2 nadir (%)	87.0 (6.7)	90.3 (3.6)	90.8 (3.1)
TST $TcCO_2$>6.7kPa (%)	15.8 (30.2)	11.0 (24.7)	0
Active sleep (%)	29.0 (10.1)	29.4 (8.4)	29.6 (9.6)
		Median (IQR)	
$TcCO_2$ mean (kPa)	5.3 (4.7-5.7)	5.2 (4.7-5.4)	4.9 (4.7-5.3)
$TcCO_2$ max. (kPa)	5.7 (5.3-6.5)	5.5 (5.2-6.2)	5.5 (5.2-6.1)
AHI (events/hour)	1.6 (0.5-5.9)	1.5 (0.7-3.0)	1.6 (0.8-2.7)
oAHI (events/hour)	1.6 (0.0-9.2)	0.1 (0.0-1.6)	1.2 (0.0-1.6)
CnAHI (events/hour)	0.7 (0.0-1.7)	1.2 (0.2-3.6)	1.2 (0.2-1.2)

Table 3. Sleep Study Results. ODI=Oxygen Desaturation Index, TST=Total Sleep Time, AHI=Apnoea-Hypopnoea Index, oAHI=obstructive AHI, CnAHI=central AHI

Conclusion & Discussion

We could find no previous studies investigating sleep in patients with Noonan syndrome. Our cohort of patients displayed a wide range of co-morbidities. Although 4 studies were requested to investigate for sleep-disordered breathing, the majority were peri-operative or related to the comorbidity and possible impact on respiratory status during sleep. Looking solely at the 48% of our studies where respiratory support was not required, we found that sleep-disordered breathing was mild and there was no evidence for hypercarbia in our cohort.

A preliminary look at lung function studies at the time of preparation of the abstract found few data on this group, with the majority occurring in earlier patients, perhaps suggesting a change in referral patterns for this group although this requires further investigation.

The literature[3] indicated a scoring system for Noonan severity, which might be used to further categorise these results, as could classification by gene mutation status.

References

1.Zaffanello M et al. Sleep disordered breathing in paediatric setting. Ann Transl Med 2018;6(17): 343. doi:10.21037/atm.2018.07.13

2.Khirabi S, Leboulanger N, Ramirez A, Fauroux B. Case Reports in Pediatrics 2012. artID: 514514. doi: 1155/2012/514514

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5.Romano A et al. Noonan syndrome:Clinical Features, Diagnosis, and Management Guidelines. Pediatrics 2010; 126; 746-759. doi:10.1542/peds.2009-3207

6.The AASM Manual for the Scoring of Sleep and Associated Events: Rules, Terminology and Technical Specifications, Version 2.3.

A clinical quality improvement project to assess co-existing nocturnal hypoventilation alongside obstructive sleep apnoea

Shirley Coelho, Elizabeth Green, Allan- Alhelou, Rahul Mukherjee
Heartlands Hospital, Birmingham

Foreword:

We all have come across that one referral that makes us roll our eyes far into their sockets.

Picture this: patient walks in, young (late 40s), wheezing, panting after walking from the waiting room into your clinic, wobbling from side to side and he is purple.

You check his weight: 180 Kg, and it turns out his BMI is 55. He can't talk in full sentences and you let him have a rest. Already in your mind you are diagnosing this person (I do it on the bus. Much fun). You check his sats (94% at rest) and, because you don't really have the time (you're allowed 10-15 min in this appointment) you explain what the test is going to be. A limited channel sleep study is set up and you send him on his way.

A few weeks go by (not more than 18!) and he is back. You see him, struggling as ever, falling asleep while waiting to see the consultant. He has an AHI of 80 events/hour, an ESS of 21. He is set up on CPAP and sent on his way.
That niggling feeling that he needs more than a CPAP stays with you: you would want to do a spirometry (is he obstructive?), you would want to do a blood gas on air (does he have a raised CO_2?), you want to send him for bloods (does he have polycythaemia?)…

What was overlooked in this particular patient was the time he spent with sats below 90% overnight(T90): **80%** of his night! He sleeps propped up, he feels lethargic and he is not compliant on CPAP because he feels suffocated – his pressure is now up to 16 cmH_2O.

This is one of the extremes, but he also is one of 179 patients with severe OSA and a significant T90 that was not followed up sooner. Thankfully this is not the rule, however we can do better.

Out of approx. 1700 studies performed between July 2017 and July 2018, 23% had severe OSA and 45% had a raised T90. 15% were followed up with an overnight oximetry once settled on CPAP. When compared to the first audit this is a 62% improvement in the number of people we have seen with these characteristics – and they were all flagged by physiologists.

Let's not treat sleep apnoea in isolation.

Authors: Shirley Coelho, Elizabeth Green, Allan- Alhelou, Rahul Mukherjee

A clinical quality improvement project to assess co-existing nocturnal hypoventilation alongside obstructive sleep apnoea

Background

Nocturnal hypoxia and obstructive sleep apnoea (OSA) are associated with increased risk of atrial fibrillation, hypertension and increased risk of diabetes. However, OSA is typically treated as an isolated pathology. An original survey in our department showed that, due to lack of clear guidance, failure to recognise hypoventilation leads to under diagnosing conditions like OSA/COPD and OSA/OHS overlap[1].

Aim

To assess how many patients with a diagnosis of OSA that spend > 20% of the night with SpO_2 below 90%, were followed up with an overnight oximetry once on CPAP. This is to ascertain the need for NIV and/or supplemental oxygen.

Method

We performed an internal audit to check how many patients with severe OSA were followed up with overnight oximetry once settled on CPAP. Patients that had an AHI > 30 and SpO2 < 90% for more than 20% of the night were included.

Results

A total of 1632 studies were performed between July 2018 and July 2019. 382 (23%) had severe OSA; in this severe OSA group, 174 individuals (45%) spent > 20% of the night with SpO_2<90% and 131 (34%) spent >30% of the night SpO2 < 90%. In the group of patients with a significant time spent under 90%, only 15 individuals (8%) were followed up with overnight oximetry on CPAP and 4 (27%) of those were managed with CPAP pressure increase and still showed evidence of hypoventilation.

Conclusion

At the time of the first audit cycle, none of the patients that fit the above criteria were identified. By raising internal awareness during departmental meetings, there was some recognition of nocturnal hypoventilation. Through the period of the second audit cycle, the number of overnight oximetry tests on CPAP increased by 62%. Further guidance on how to manage this group of patients is needed.

Reference: [1]Cachada N, Daniels M, Chakraborty B, et al. The strength of association of nocturnal hypoventilation with severity of sleep apnoea. ERJ 2016; 48:PA2200

Tools for sleep apnoea management: a case report of post-APAP central apnoea

HM Engleman[1], N Derashri[1], S Hacking[1], N F Cachada[1], S Martin[1], L Creswick[1], T Kelly [1], P Sankaran[2]

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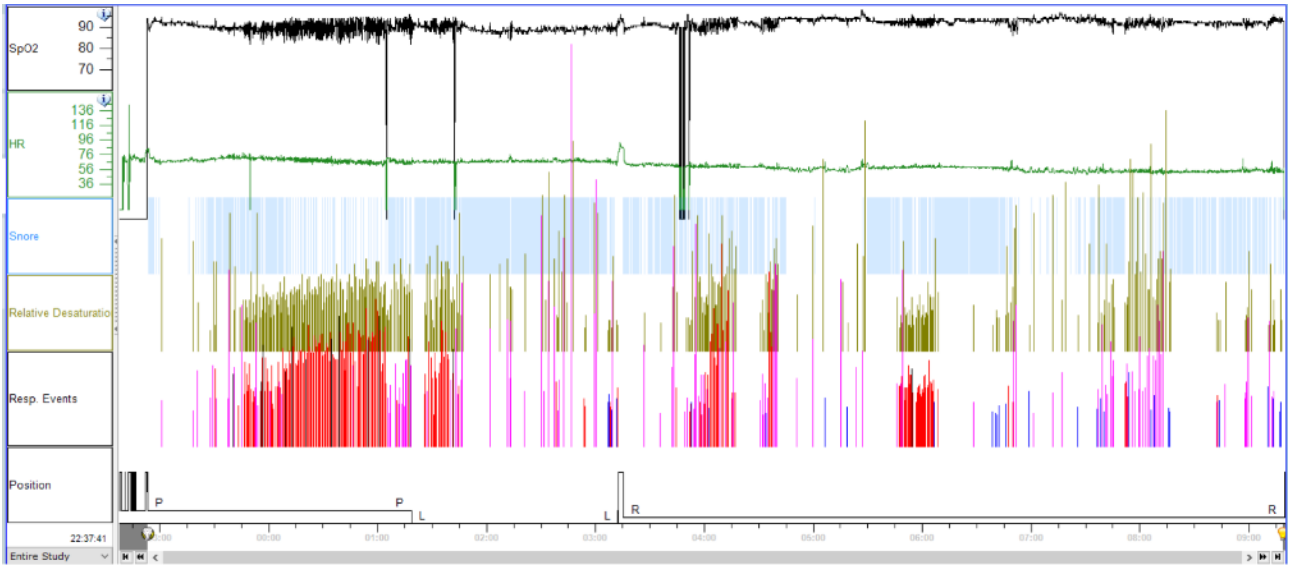
[2] Sleep Clinic, Norfolk and Norwich University Hospital, Colney Lane, Norwich, NR4 7UY

Mr. AB, a 62 year-old man, was assessed at Norfolk and Norwich Hospital's Sleep Clinic, having been referred for excessive daytime sleepiness and snoring.

A home cardio-respiratory sleep study (Alice Night One™, Philips Respironics, USA) showed a severely raised apnoea+hypopnoea index (AHI) of 35 per hr (Fig 1), consisting of 92% obstructive-pattern events.

Fig 1: **Diagnostic cardio-respiratory study: AHI 35 (CAI 3) per hr**



Medications reported with the diagnostic questionnaire were; inhaled therapy for COPD, an oral anti-psychotic and an anti-depressant. Mr. AB was diagnosed with obstructive sleep apnoea syndrome and prescribed auto-adjusting positive airway pressure (APAP) therapy.

Mr. AB's care pathway including periodic remote monitoring via device modem and specialist reporting of objective profiles of therapy, in collaboration with Philips Sleep Support Service (PSSS).

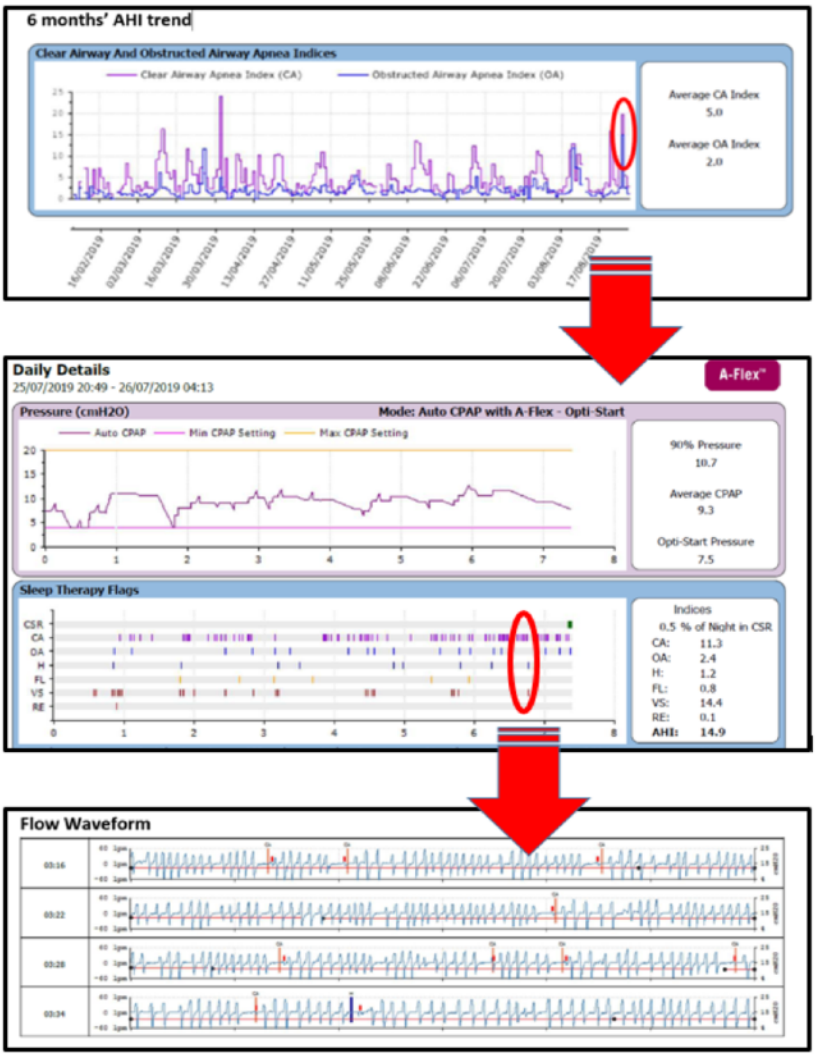
Initially poor, unstable mask fit was detected and resolved in the first week by PSSS (Fig 2), with APAP used thereafter on 98% nights for an average 9.7 hrs/night. Mr. AB's Epworth sleepiness score was 11/24 when first on therapy, reducing to 7/24 the next month.

Fig 2: Early patterns of APAP use. *Black bars represent system leaks, red bars non-compliant use and green bars compliant use*

During periodic APAP data reviews, average residual AHI was found to be mildly raised at 7-10 per hour, with 50% clear-airway (central) apnoeas. Cheyne-Stokes respiration was not detected. Echocardiogram showed no cardiac abnormality.

To assess further the residual sleep-disordered breathing (SDB), summary and daily detailed therapy graphs were inspected, as well as breath-by-breath flow waveforms (Fig 3).

Fig 3: Data inspection over increasingly focused timebases



Summary trend graphs showed semi-regular peaks in residual central apnoeas. Detailed hour-by-hour graphs from peak nights showed little snoring during central apnoeas, and associated waveforms showed qualitative pattern typical of Biot's (opiate) breathing.

A telephone consultation with Mr. AB confirmed that in addition to the previously noted medications, he is also prescribed a transdermal buprenorphine patch for chronic hip pain.

We speculate that central apnoea peaks may be associated with fresh application of the buprenorphine patch. This case shows the value of remote monitoring to not only detect and intervene promptly in early mask leaks, but also to assess type and frequency of residual respiratory events through data inspections at different levels of granularity.

Disclosure:

All authors except Dr. Sankaran are employees of Philips Respironics UKI.

Reference:

Randerath. ERJ Open Res. 2017 *Oct; 3(4):* 00078.

Case Study - Successful Use Of Adaptive Servo Ventilation To Treat Opioid Induced Central Sleep Apnoea

Claire Pitcher, Advanced Clinical Physiologist, Clinical Measurement, Royal Derby Hospital

Patient Demographics

- Male
- 51 year old
- Body Mass Index 29
- Epworth Sleepiness Scale 19/24

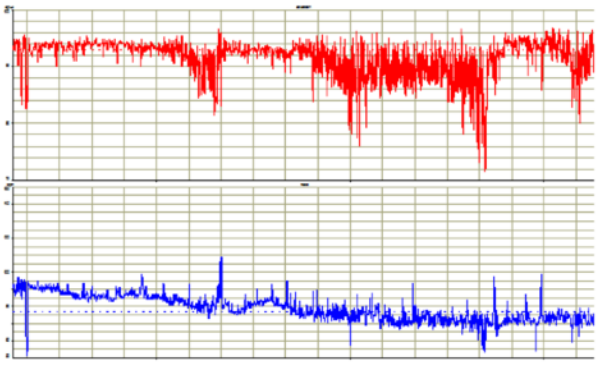


Figure 1. Overnight Oximetry showing cyclical desaturations which become more profound during the night.

Presenting Symptoms

- Excessive daytime tiredness
- Low mood
- On Methadone for previous addiction to Oxycodone,

Overnight Pulse Oximetry

- Performed prior to initial clinic appointment – see Figure 1.
- Oxygen Desaturation Index (ODI)(4%) 40
- Mean SpO_2 93%

Report

Cyclical desaturations becoming more profound throughout the night. Results are suggestive of moderate obstructive sleep apnoea.

Diagnosis

- Moderate obstructive sleep apnoea
- Methadone may be contributing to symptoms.

Treatment

CPAP – December 2016

- Setup on fixed pressure Continuous Positive Airway Pressure (CPAP) with remote monitoring
- Pressure titrated to a pressure of 15cmH_2O
- Persistently high Apnoea Hypopnea Index (AHI) mainly due to central events see Figure 2.
- ESS 18/24
- Good compliance, averaging 6.5 hours/night with good mask fit.

Presented in Sleep MDT – January 2017

- AHI 40.8, obstructive index 8.2, central index 27.8
- Methadone most likely cause of central apnoeas
- Actively reducing Methadone dose
- Motivated patient
- No symptomatic benefit from CPAP despite good usage.
- Good candidate for Adaptive Servo Ventilation (ASV) device
- Ordered an echocardiogram to rule out left ventricular dysfunction (SERVE-HF Trial, 2015)

Figure 2. Detailed data report generated from the remote monitoring system, shows high number of central events despite CPAP pressure of 15cmH2O.

ASV – April 2017

- Adaptive Servo Ventilation (ASV) device issued 4 months after commencing CPAP
- Methadone dose reduced to 50mg/day with limited symptomatic benefit
- ESS 18/24
- Auto settings used: EPAP 4cmH_2O - 15cmH_2O, PS 3cmH_2O –15cmH_2O

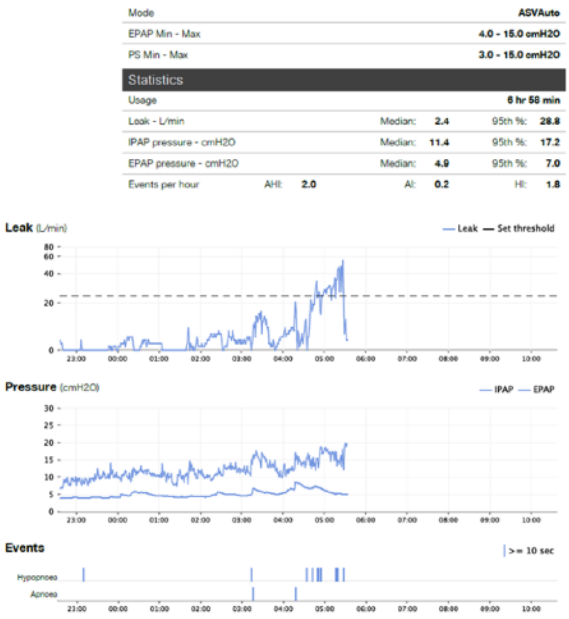


Figure 3. Detailed data report generated from the remote monitoring system. Auto ASV shows varying pressures required throughout the night with minimal events.

1 month follow up

Huge symptomatic improvement - ESS 6/24 , minimal events - AHI 2 , average use 7 hours/night

ASV Annual Review – February 2018

All ok –good usage low AHI low ESS, continuing to wean Methadone down.

ASV Annual Review – February 2019

Fully weaned off Methadone January 2019. Patient chose to delay retesting off treatment until the summer.

LSS off Treatment - August 2019

AHI 8.9, Central index 0.4, Obstructive index 0.2, Hypopnea index 8.3 , ODI 9.8

Episodic hypopneas, probably REM related, minimal central events. Results are in keeping with mild OSA. Central sleep apnoea appears to have resolved.

Outcome

- Central sleep apnoea resolved once the Methadone stopped.
- Mild obstructive sleep apnoea present.
- Patient trialled one month with no treatment and remained asymptomatic.
- ASV returned September 2019

Discussion

- Pulse oximetry missed the central aspect at diagnosis, a limited sleep study (LSS) may have demonstrated centrals.
- Local protocol for CSA is to trial CPAP for 3 months and monitor central events and symptoms. If the patient remains symptomatic with unresolved central events a trial of ASV would be considered.
- Treatment for this patient would not have changed if a LSS was performed initially.
- The algorithm from the CPAP device was used to determine the presence of central events - a LSS recording on treatment was not deemed necessary as there was already a strong indication for the cause of central events.
- Once the patient had weaned off Methadone a LSS was performed to assess the need for continued treatment.
- ODI shows a significant improvement from diagnostic ODI 40 to 9.8 off methadone. Effort and flow channels showed the remaining events to be flow limited hypopneas giving an AHI of 8.9.
- We can conclude that discontinuing narcotics eliminated the central events.

Can anthropometric indices and Epworth Sleepiness Score (ESS) predict type of diagnostic test to investigate OSA?

Hepple, D V and Cliff I J; University Hospital of North Midlands, Royal Stoke University Hospital (RSUH), Stoke-on-Trent.

Introduction

Obstructive sleep apnoea (OSA) is a condition where there is a decrease or cessation of airflow whilst asleep despite effort being made to breathe. This occurs by the relaxation of the muscles during sleep causing the soft tissue at the back of the neck to collapse and block the airway. The transient arousal from deep sleep to a lighter stage allows restoration of muscle tone. It is estimated that 1.5 million adults are affected [1], with a possible 85% of those undiagnosed [2]. It is more common in middle age males with a collar size greater than 17 inches [3].

The Sleep service at Royal Stoke University Hospital (RSUH) has seen an exponential increase in the number of referrals to the service, with on average a 17% increase per annum over the last 5 years, with a total increase of 58%. The current pathway involves patients initially having overnight oximetry however, if this is inconclusive, a limited sleep study (LSS) follows.

The aim of this study was to assess if anthropometrics could be used to predict the first line investigation and streamline the diagnostic pathway.

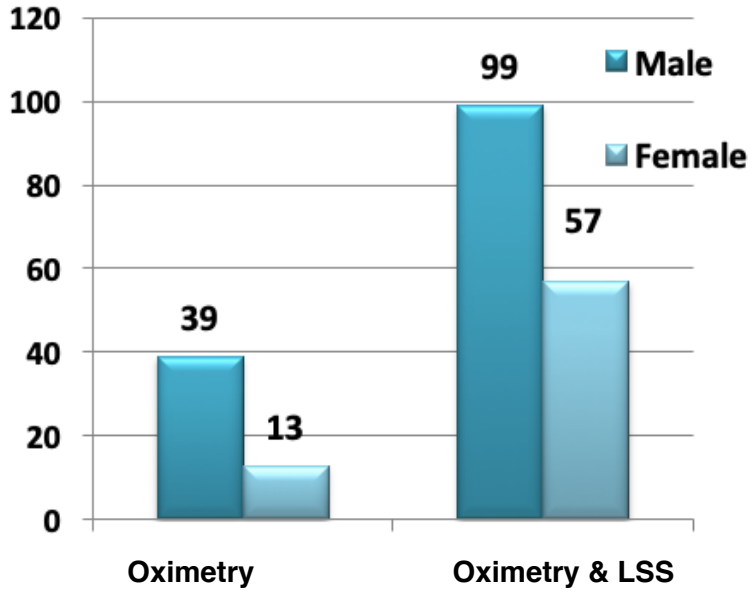
Method

A retrospective three month audit of 208 patients - 138 male, 70 female (graph 1) referred to the sleep service was conducted. Information regarding diagnostic investigations and anthropometric values were obtained and compared. A p value of 0.05 was used as the level of significance.

Results

Table 1: Comparison of anthropometric values between the two diagnostic tests.

	Oximetry	Oximetry + LSS		CPAP after oximetry + LSS	Discharged after oximetry + LSS	
Parameter	Mean (SD)	Mean (SD)	*p-value*	Mean (SD)	Mean (SD)	*p-value*
Age	54.78 (1.86)	50.65 (1.08)	*0.0504*	53.07 (13.04)	48.60 (14.04)	*0.0246**
BMI	37.63 (1.23)	32.237 (0.576)	*0.0001**	33.59 (6.586)	30.75 (7.83)	*0.0052**
ODI	51.59 (3.65)	7.110 (0.634)	*<0.0001**	9.939 (9.272)	3.293 (1.94)	*<0.0001**
Collar size	17.673 (0.263)	16.513 (0.594)	*<0.0001**	16.444 (1.731)	16.76 (11.81)	*0.9020*
ESS	10.615 (0.666)	9.195 (0.447)	*0.0878*	9.820 (5.710)	8.068 (5.298)	*0.0724*
AHI		21.00 (1.63)		32.05 (20.45)	6.060 (4.570)	*<0.0001**



Graph 1: **Showing the distribution of gender referred to the sleep service and the diagnostic undertook**

From the 208 patients, 52 (25%) went onto CPAP following oximetry. The remaining 156 (75%) required a limited sleep study (LSS), which confirmed CPAP was required in 88 cases (56%). 61 (39%) were discharged and the remaining 7 (5%) went on to have a full Polysomnography (PSG). The oximetry confirmed CPAP group had increased BMI, ODI and collar size and were generally older. When comparing the LSS confirmed CPAP with discharge or PSG, differences in BMI, ODI and AHI were seen.

Those patients who required a full PSG were generally younger (mean age; 38 years) and had significantly increased ESS (mean score; 12). These results showed that three patients were advised to trial a Mandibular Advancement Device (MAD), two are having further investigation for Narcolepsy, and one has been started on medication for RLS / PLMD. One patient is still awaiting a PSG.

Outcome

The results show that age, BMI and collar size are useful predictors of OSA and a requirement for CPAP therapy. However, the measure of ODI and AHI remain the best measures for adherence to current guidance. As expected those who were discharged had a significantly lower ODI and AHI, and were also younger. ESS does not prove to be a good predictor of the presence of OSA.

The results of the audit showed that majority of the patients whom undertook oximetry had to have a follow-up limited sleep study and formed the basis of a change in service. From September 2019, RSUH sleep service no longer offers overnight oximetry as a first line diagnostic. As well as the results from this audit, other reasons for this include the availability of oximeters that allow storage of data for overnight studies. Importantly, this has improved patient waiting times by offering a more sensitive detailed diagnostic test.

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3. Sleep Apnoea Trust 2016 www.sleep-apnoea-trust.org

A comparison of sleep parameters measured by limited multichannel polysomnography and full polysomnography.

Callis, D., O'Reilly, L and Goodlad, M. Complex Sleep Unit (CSU), University Hospital Coventry and Warwickshire NHS Trust, UK.

Complex Sleep Unit (CSU), University Hospital Coventry and Warwickshire NHS Trust, UK.

Introduction

In most adult sleep disorders including Obstructive sleep apnoea hypopnea syndrome (OSAHS) the gold standard of testing is considered Polysomnography (PSG) [1]. Due to innovations in diagnostic equipment, clinical capacity, financial-constraints and expertise, most centres around the UK use at home sleep studies to diagnose sleep disordered breathing.

An at home study requires patients to attend clinic to be shown how to apply the equipment to use at home over night and return the following day to the department. This allows patients to perform diagnostic studies in their own environment allowing a true reflection of an individual's sleep.

A PSG requires the patient to attend as an inpatient to be wired up by a trained Associate Healthcare Scientist. This allows for a more detailed analysis of sleep to be performed with a trained profession applying the sensors to improve signals. The healthcare scientist will also monitor the patient throughout the night replacing probes and sensors as required ensuring good quality signals for the full study that may influence overall sleep study scoring.

Both diagnostic tests provide measurements of oxygen desaturation index (ODI), apnoea-hypopnoea index (AHI) and oxygen saturation (SpO2) but can be influenced by factors as mentioned above.

Aims

My aim was to see if the ambulatory AHI matched the AHI gathered by an inpatient PSG. I hypothesised that they should be within the same severity of sleep disordered breathing.

Method

All 17 patients recruited to this audit were referred for investigation of OSAHS as part of their routine ongoing medical management. Inclusion criteria was for those who scored positive for excess day time sleepiness (Epworth score ≥11) [2] and received a diagnosis of mild OSAS (AHI 5-14/hr) on an at home study continued to inpatient PSG. All studies were performed within either the Respiratory Physiology & Sleep department at UHCW NHS trust or the CSU (Complex Sleep Unit) at St Cross Hospital Rugby. All at home studies were performed using NOX T3 and all PSG

studies using NOX A1 (Nox Medical, Katrínartún, Iceland) . All studies were manually scored by one qualified Specialised Healthcare Scientist in accordance with AASM guidelines version 2.3. Comparisons of data sets was performed using SPSS statistical software. All subjects were recruited in line with an approved local ethics policy.

Table 1: Anthropometric data for all 17 subjects recruited to current study.

	Mean (SD)
Age	44.94 (12.66)
Sex	M
BMI	32.83 (7.60)
Collar size	16.12 (1.90)
Epworth Score	14.35 (2.80)
sleep latencey	19.22 (23.85)
PLMS index	25.56 (31.93)
SpO2 T3 (%)	93.28 (2.13)
ODI T3 (/h)	8.82 (3.54)
AHI T3 (/h)	9.56 (3.10)
SpO2 A1 (%)	92.36 (2.76)
ODI A1 (/h)	15.38 (9.80)
AHI A1 (/)	16.29 (9.55)

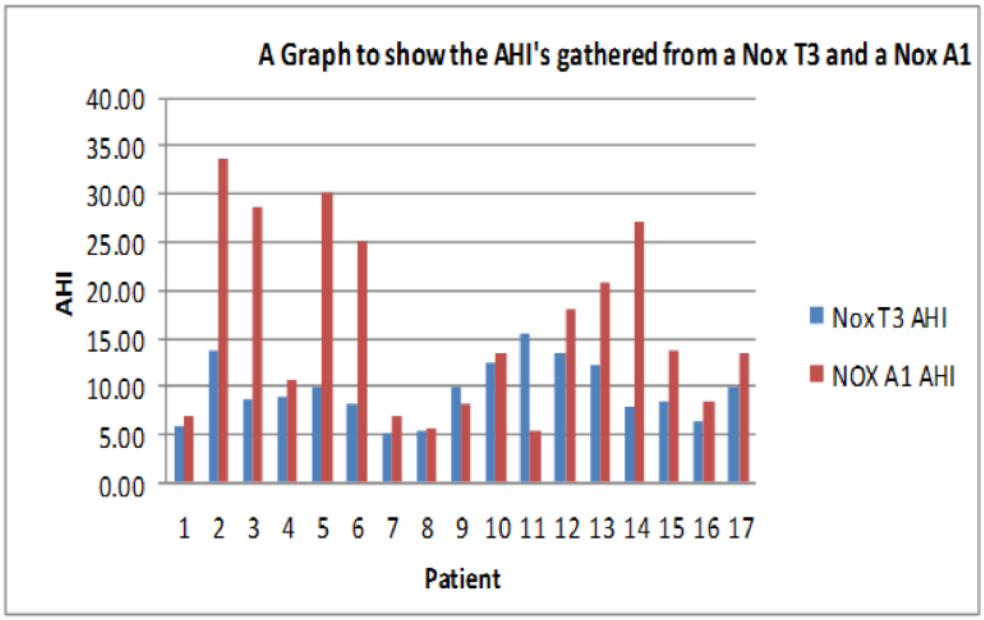

Figure 1: Comparison of AHI (events per hour) obtained from an at home using NOX T3 and an inpatient PSG study using NOX A1 in 17 recruited subjects.

Results

All patients scored a higher AHI on PSG compared to ambulatory PSG. Mean PSG AHI and ODI were significantly higher than ambulatory PSG (16.29/hr; 9.56/hr and 15.38/hr; 8.82/hr, p=<0.05 respectively). SpO2 was comparable between PSG and ambulatory PSG (92% and 93%, p=0.2862, respectively).

Discussion

The data collected was from a single centre and this small sample study showed that a high percentage of patients were found to have a higher AHI and ODI from PSG compared to at home Nox T3 in symptomatic mild OSAS patients. Therefore in this patient group it may be advised that PSG is required in order to confirm a diagnosis of OSAS and severity in order to select the most appropriate treatment modality and optimisation of treatment selections.

Conclusion

It was found that 7 out of 17 patients had a moderate to severe AHI on the PSG study rather than the mild AHI that was found on the at home study.

There were also results gathered that showed that the AHI/ODI was higher on the PSG as opposed to the at home study, although still stayed in the moderate or mild category.

Some of the reasons for the difference in the data collected from the at home study as opposed to the PSG study may include location/environment of sleep and clinical support with sleep study setup as opposed to the patient putting the equipment on themselves at home.

In conclusion within our department we have adopted that symptomatic patients suspected of OSAS that have had a mild AHI Nox T3 are put through a PSG to fully rule out Sleep disordered breathing. If we didn't this may affect the patients care/ treatment due to under diagnosing. As our PSG lab has not been open long in terms of testing I will continue collecting data and comparing my findings. Larger multi-centre studies may be required to substantiate the results from this study .

References

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2. British Lung foundation website. BLF.org.uk. May 2019 .

An Evaluation of Concordance of Sleep Stage Scoring: Evidencing Standards and Quality Assurance in NHS Lothian

Laura Jess, Lead for Sleep Medicine, NHS Lothian

Introduction

In 2013, the American Academy of Sleep Medicine (AASM) published results from the Inter-Scorer Reliability (ISR) programme in the Journal of Clinical Sleep Medicine [1]. The conclusions detailed suggest that whilst using AASM guidelines for scoring, concordance and inter-scorer agreement of sleep stage scoring should exceed 83%. As a method of monitoring quality assurance in sleep stage scoring in NHS Lothian, required concordance should exceed 85% with comparison to a Senior Sleep Physiologist in possession of the RPSGT certificate. This standard conforms and exceeds the expected concordance stipulated by the AASM.

The purposes of this evaluation are to ensure inter-scorer agreement standards continue to exceed AASM recommendations and local concordance protocol levels, and to provide an ongoing record of quality assurance for the Sleep Service in NHS Lothian.

Method

Between April 2018 and January 2019, four concordance studies were set by the Chief Physiologist. Sleep Physiology staff (n = 8; n = 1 Chief Physiologist and n = 7 Sleep Physiologists), were required to score the set studies and concordance of Apnoea Hypopnoea Index (AHI) and sleep stage scoring (total concordance, N2 and N3, Wake, NREM, REM) were compared to the Chief Physiologist study. Trends in data were identified and discussed.

Results

	Study 1 (±SD)	Study 2 (±SD)	Study 3 (±SD)	Study 4 (±SD)	Four-Study Average (±SD)
Sleep Staging Total Concordance (%)	91.00% (±1.26%)	79.50% (±4.59%)	90.80% (±1.92)	81.00% (±1.41%)	85.58% (±6.18%)
Sleep Staging Concordance N2 and N3 (%)	92.17% (±0.75%)	82.33% (±4.76%)	92.80% (±1.92)	83.00% (±1.41%)	87.58% (±5.68%)
Sleep Staging Concordance Wake, NREM and REM (%)	95.00% (±0.89%)	89.17% (±3.49)	95.20% (±1.30)	88.50% (±0.71%)	91.97% (±3.63%)
AHI (Absolute/Average)	22.43/16.59	13.21/11.47	20.00/27.20	10.39/7.01	12.11/9.59

Discussion

Concordance over the four-study average indicates inter-scorer agreement standards continue to exceed AASM recommendations and local concordance protocol levels (range 85.58% - 91.97%). Minimal variations in AHI were noted between the Chief Physiologist and

inter-scorer agreement, indicating no difference in treatment options or variation in patient outcome.

References

1.Rosenberg RS; Van Hout S. The American Academy of Sleep Medicine inter-scorer reliability program; sleep stage scoring. *J Clin Sleep Med* 2013;9(1):81-97.

Do you know someone who may benefit from being an ARTP Sleep member?

“ARTP Sleep" is now being developed to represent and support all healthcare professionals in the delivery of care, training and development of sleep services.

Who Should Join ARTP Sleep?

ARTP Sleep represents and supports all healthcare professionals in the delivery of care, training and development of sleep physiology measurement and therapeutic services. This includes but is not limited to:

-ATOs and HCAs working in oximetry clinics

-Sleep physiologists and technologists involved in PSG units

-Sleep and NIV nurses

- Physiotherapists involved in sleep apnoea services

-Physicians in sleep medicine

-Orthodontists and maxillofacial technicians who support sleep and snoring clinics

-General Practitioners with an interest in sleep medicine (GPwSI & non-GPwSI)

Registration forms and FAQs can be viewed here

Congratulations

ARTP Sleep Award Winners

Congratulations to those who received ARTP awards, for Sleep, at the ARTP 2020 Annual Conference:

Best Sleep Poster Award:

Claire Pitcher (Presented by Rosie Fillingham & Julie McWilliam)

Sleep Diagnostics Manufacturer:

ResMed

Sleep Therapy Manufacturer:

Fisher & Paykel

ARTP GRANT AWARD WINNER ARTICLE:

Service Review: Comparison of APAP Titration and CPAP Pressure Prediction Equations

L. Attewell, J. Smith, A. Tuck, H. Hunt. *University Hospital Llandough*

OSA affects 2-4% of the adult population and the most effective treatment for this is CPAP (continuous positive airway pressure). Standard practice for CPAP treatment requires pressure titration during an attended laboratory polysomnography. The aim of this procedure is to identify an effective pressure to remove apnoeas, hypopnoeas, snoring, and arousals. However, polysomnographic titration is expensive and time-consuming. The implementation of auto adjusted titration with autoCPAP (APAP) aims to overcome these disadvantages. APAP devices detect respiratory events and adjust the CPAP pressure. They also calculate the optimal pressure automatically, which is referred to as the 90th percentile pressure. The final method of pressure titration is the use of predictive equations, which consists of a formula involving the AHI/ODI and various anthropometric parameters in order to calculate an estimated CPAP pressure (1).

The current CPAP titration method in University Hospital Llandough is to issue the patient with an APAP device for two weeks, the 90th percentile pressure is then used to establish a CPAP pressure. They are then issued a CPAP device for long-term treatment, and they are monitored in compliance clinic.

The number of patients seen for PAP set up is determined by the number of machines available. Due to ever increasing demand and waiting times, an audit was carried out to investigate the effectiveness of predictive equations to estimate a CPAP pressure.
A retrospective observational study was carried out where the pressure used for patients already established on CPAP via the APAP titration method was analysed. Also, their diagnostic and demographic information was used in several different predictive equations to determine any similarities between the outcome of the prediction equations and the 90th percentile pressure.

Patients were selected from the UHL Sleep database, documenting all patient CPAP set ups with over a 12-month period from June 2017- May 2018.

Inclusion criteria was as follows:

Moderate or severe OSA (i.e. ODI or AHI >15/hr)

AHI controlled via APAP titration method (<5/hr)

Exclusion criteria included;

Mild OSA

No neck circumference recorded

Failed APAP trials, inaccurate/insufficient data

Uncontrolled AHI via APAP titration e.g. inadequate pressure or central events

No diagnostic data i.e. transfer from another hospital

The diagnostic data included patients who had either overnight oximetry or limited polysomnograpy (LPSG). There were a total of 218 patients adhering to inclusion criteria. When applying the exclusion criteria this reduced the number to 117 patients (36 females, 81 males).

Each patient's demographics were entered into the equations (as per each equations requirements), the resultant pressure was then compared to the 90th centile pressure from their 2 week APAP titration via Philips Respironics System One APAP. A pressure was considered agreeable if it was +/- 3cmH_2O of the 90th percentile pressure from the APAP titration, to allow for changes made by CPAP Check mode (6).

First analysis involved the use of three predictive equations: Stradling *et al* (3), Basoglu & Tasbakan (4) and Series *et al* (5). The 4% ODI was used where oximetry had been carried out, and the AHI was used with LPSG studies. Preliminary research involved modifying the Stradling *et al* equation by using a calculation of the 3% ODI in addition to the 4% ODI on overnight oximetry studies as an approximate AHI. However, it was not found to be significant in affecting the predicted pressure so this was discontinued (2).

On observational analysis, Stradling *et al* proved the most effective as it had a 61% correlation with the APAP titration pressure, so this data was selected for statistical analysis. However, it demonstrated that for many severe OSA patients, Stradling's equation would often underestimate the APAP pressure. Therefore, we adapted the equations and trialled the addition of 1, 1.5, 2, 2.5 and 3cmH_2O to each equation and compared the correlation with the APAP titration method.

This showed that the addition of an extra 2.5cmH_2O of pressure was the most effective as it had an 83% correlation with the APAP titration pressures for this population.

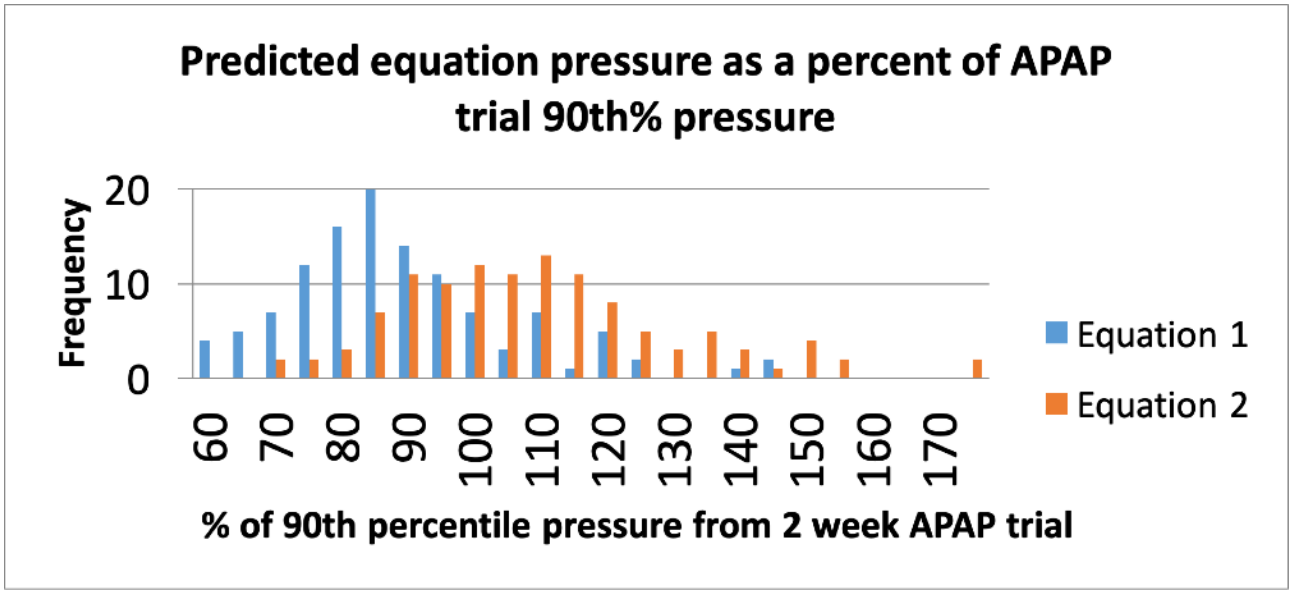
Equation 1: Stradling *et al*: (0.048 × 4% saO_2 dips/h) + (0.128 × NC) + 2.

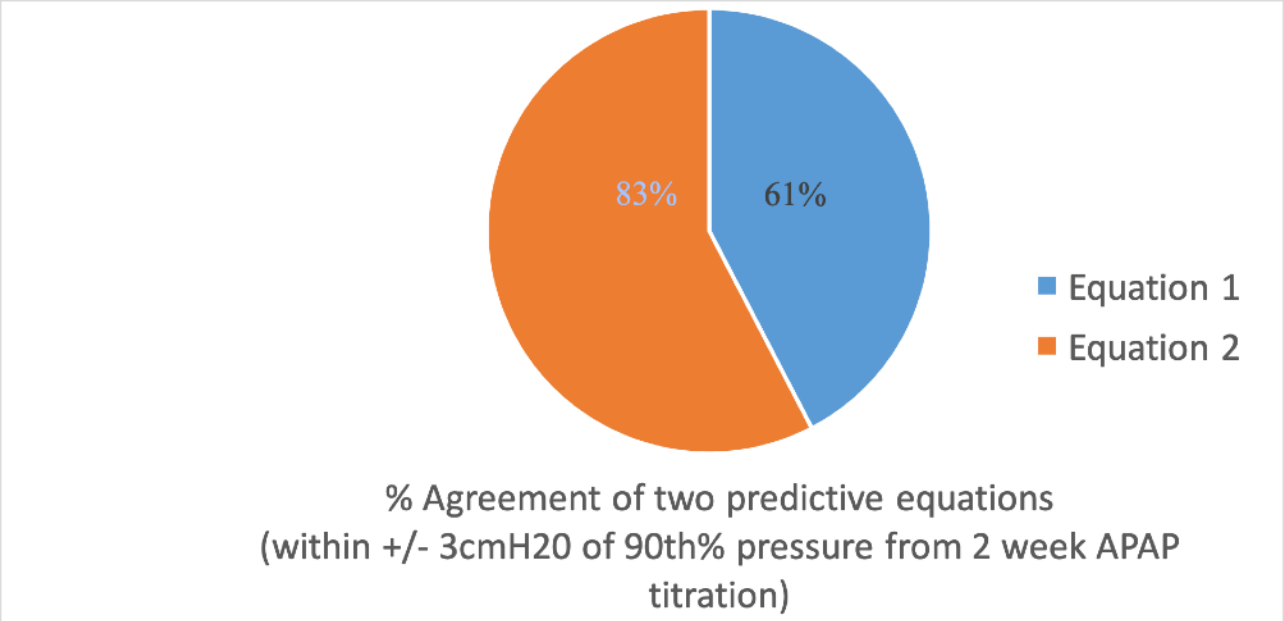
Equation 2: Llandough equation: (0.048 × 4% saO_2 dips/h) + (0.128 × NC) + 4.6

n=	**117**
Male:Female	81:36
Average ESS/24	10
Average BMI (kg/m^2)	39
LPSG:Oximetry	38:79
Average Neck Circumference (cm)	46
Average 90th% pressure from APAP (cmH_2O)	12.2
Average pressure from Equation 1 (cmH_2O)	10.2
Average pressure from Equation 2 (cmH_2O)	12.7

A Student's t-test carried out between the APAP 90th percentile pressure and each of the predictive equation pressures showed a significance of:

- **7.86663E-12 for Equation 1 (<0.05*)**
- **0.0839804302 for Equation 2 (>0.05)**





The data showed that equation 1 was significantly different from the APAP titration pressure, and therefore not as agreeable. Equation 2 was not significantly different and had a closer agreement to the APAP titration pressure and could be used as a suitable replacement to 2 week APAP titration.

As a result of the initial audit, a new CPAP initiation protocol was implemented from the 1st April 2019. The Llandough pressure prediction equation was used to estimate CPAP pressure, patients were issued Phillips Dreamstation CPAP machines set at the pressure from the equation. CPAP check is enabled for all patients, along with CFlex+, mask fit check and info menu on for patients to monitor their progress.

To ensure that the new algorithm is working adequately, a further audit was performed to review the 40 patients with moderate/severe OSA that were set up on CPAP during the first two months of the new protocol implementation.

n=	**40**
Average AHI	8/hr
Amount of pressure changes via CPAP check mode	10%
Average pressure change via CPAP check mode	1cmH_2O
Manual pressure changes needed during appointment (to achieve AHI <5/hr)	10%
Perceived benefits	68%
Average compliance (usage >4hrs)	67%

The second audit showed that 80% of the patients set up on CPAP during this time had an AHI of <5/hr as a result of titration with the Llandough equation. 10% of them were managed via the CPAP check mode on their Dreamstation device, whilst the other 10% required a manual titration of the pressure on their first compliance appointment with a Physiologist.

Essentially showing a 90% success rate for CPAP set up via the Llandough equation when a Philips Respironics Dreamstation is used with CPAP check mode enabled.

As a result of both audits, we are now able to offer patients more flexibility in appointments, less disruption in swapping from APAP to CPAP so they have more continuity on the same machine, reduced infection control risks between patients and a more successful, audited service.

References

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2. *Schlosshan D, Elliott MW Sleep 3: Clinical presentation and diagnosis of the obstructive sleep apnoea hypopnoea syndrome Thorax 2004;59:347-352*
3. (Stradling J. R., Hardinge M., Paxton J., Smith D. M. Relative accuracy of algorithm-based prescription of nasal CPAP in OSA. *Respiratory Medicine*. 2004;98(2):152–154. doi: 10.1016/j.rmed.2003.09.009)
4. O. K. Basoglu and M. S. Tasbakan, “Determination of new prediction formula for nasal continuous positive airway pressure in Turkish patients with obstructive sleep apnea syndrome,” *Sleep & Breathing*, vol. 16, no. 4, pp. 1121–1127, 2012
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British Sleep Society Update:

FENS Mini Conference

REGISTRATION OPENING SOON!

Saturday, 11 July 2020, SEC Centre, Exhibition Way, Glasgow, G3 8YW

BSS Symposium

We are delighted to announce this mini-conference entitled “Sleep across the Lifespan” as part of the 12th FENS Forum of Neuroscience in Glasgow on the 11th July 2020.

The importance of sleep for the development and memory and the impact of sleep quality on daytime functioning in infants and children will be covered discussed and up-to-date research will be presented. The conference will also focus on cognitive neuroscience, new sleep circuitries and memory function in adults, before concluding on the importance of sleep and ageing, neurodegeneration and sleep-wake regulation in disease.

The content will be brought to you by a multi-disciplinary faculty of basic scientists and clinicians. The mini-conference is organised by the British Sleep Society (BSS) in collaboration with the European Sleep Research Society (ESRS).

For more details on the FENS Mini Conference, click here

Research in Sleep:

By Gavin Comber, Respiratory Clinical Scientist

This addition of S-NEWS follows on from an excellent ARTP conference that showcased some great research and audit that is being conducted in sleep departments around the UK. A big congratulations to all those who presented. Away from the ARTP, here are some of the most recent pieces of work published in the field of sleep physiology and medicine.

Donovan et al (2020) have investigated whether nursing staff are able to determine correct diagnostics when triaging new OSA referrals, compared to sleep specialists. Of 280 consultations, 17 were passed onto the physicians leaving 263 where there was an 88% agreement on test choice. https://doi.org/10.5664/jcsm.8182

Eastwood et al (2020) have added to the growing body of evidence showing that hypoglossal nerve stimulation is a valid method of reducing OSA severity, reducing average AHI from 23.7 to 12.9 with an associated reduction in bed partners reporting loud, intense snoring. No serious adverse events associated with the device were recorded. https://doi.org/10.1183/13993003.01320-2019

Redhead et al (2019) have explored the links between OSA and depression during pregnancy finding that women with OSA had 8 times the odds of having symptoms of depression. Their recommendations include the possibility of improved screening for OSA in pregnancy to help identify those most at risk of future depression, allowing early intervention. https://doi.org/10.1093/sleep/zsz270

There is a long list of risks associated with OSA and Seijo et al (2019) have demonstrated that and AHI of >15 leads to an increased risk of developing lung cancer by 8%. Nocturnal hypoxaemia was also found to have a statistically significant association. https://doi.org/10.1016/j.sleep.05.011

Kim et al (2020) have investigated the relationship between OSA and the risk of developing atherosclerosis. It was found that those with moderate or severe OSA had an increased risk of developing atherosclerosis, particularly if they had higher epicardial fat. https://doi.org/10.1183/13993003.00959-2019

Allen et al (2020) have researched the link between OSA severity and risk of occupational injury. This prospective, observational study included 1109 workers over an 8 year period and concluded that those with an AHI >15 where twice as likely to suffer from an occupational injury. https://doi.org/10.1007/s00408-020-00325-6

Also, don't forget to take a look at the new Research and Innovation area on the new ARTP website. It is full of practical guides and information to help you with your projects. There will be more added over time but if you have an ideas on other tools that may be useful, get in touch by emailing research@artp.org.uk

Sleep In the News:

Fatty Tongues cause OSA

Recent research suggests that fat deposits in the tongue increase the risk of OSA, the BBC reports. Researchers at Perelman School of Medicine in Pennsylvania examined changes to the upper airway in obese patients who had lost body weight and improved their OSA symptoms. It appeared that there were significant changes in tongue fat and also the size of the jaw muscle. Now that this research has come to light it may be possible to target therapies and treatments for OSA at this particular area. For more information please click **here**.

New wearable monitor for OSA

Wearable Technologies reports on a new bioimpedance device which has been manufactured by Onera Health to detect OSA. This device is a wearable, credit-card sized patch that sits on the patient's chest and is fairly unobtrusive. The device has so far been trialled on 25 participants and is said to be as accurate as auto-scoring on polysomnography respiratory channels. For more information click **here.**

Bad dreams may help to control fears

A recent study suggests that bad dreams improve our effectiveness to deal with frightening experiences whilst awake, the BBC reports. A recent study conducted jointly by the University of Geneva and the University of Wisconsin suggests that dreams are a way of coping with anxiety and preparing us for real life situations.

Data obtained within this study showed that after a bad dream the area of the brain which deals with fear was more effective. However there does appear to be a threshold of severity, with significantly frightening dreams disrupting sleep and having an adverse effect. For more information click **here.**

ARTP GRANT AWARD WINNER ARTICLE:

Implementation of the One CPAP Mask Per Year Policy

H. Hunt, A. Tuck, L. Attewell, J. Smith

University Hospital Llandough, Cardiff and Vale UHB

Introduction

Continuous positive airway pressure (CPAP) therapy is the first line treatment for moderate and severe Obstructive Sleep Apnoea Syndrome (OSAS) (National Institute for Health and Care Excellence [NICE], 2008)[1].

CPAP therapy consists of a machine, mask and tubing that is used by the patient whilst they are asleep to provide support to the upper airway. The aim of this treatment is to prevent significant airway narrowing and subsequent arousals from sleep that are caused by repetitive episodes of obstructive hypopnoea and/or apnoea.

During the CPAP setup appointment, the Physiologist is responsible for ensuring that an appropriate mask is selected, which provides a good seal on the patient's face, yet is comfortable and easy to fit and adjust. Patients are advised on the appropriate cleaning regime for the mask and the usage criteria that they are required to achieve in order to be compliant with treatment.

Once established on CPAP treatment, patients are seen in an annual compliance clinic. Within the University Hospital Llandough, a patient must meet the following criteria in order to progress to annual follow up appointments:

- Compliant on CPAP - Usage over 4hrs for >70% of nights
- OSA under control - AHI < 5/hr
- Good mask fit
- Any other issues addressed (e.g. dryness)
- Commenced CPAP at least 18 months prior

Methods

An audit was carried out on long term CPAP patients attending clinic between 1st January 2017 and 30th June 2017.

A total of 338 patients were included in this timeframe and their electronic CPAP notes were reviewed for any contacts including telephone consultations, booked in compliance checks and walk-in requests.

The information reviewed included the number of masks each of the patients had received over the previous 12 months, the type of mask they were issued and any

reason for failure/replacement. This information was grouped and reviewed for any patterns.

The masks used were Philips Respironics, Resmed and Fisher and Paykel.

The CPAP machines were Resmed and Philips Respironics.

There were no patient groups that were excluded and patients that did not attend the appointment were also included in the analysis.

The manufacturers of the CPAP masks used by the patients in this review, recommend that the masks can last between 12 and 18 months with regular and appropriate cleaning. Therefore it is reasonable to expect to replace a patient's CPAP mask after a minimum of 12 months of usage. The data collected was analysed to identify how many CPAP masks patients were requesting over a 12 month period, and what reasons they were giving for any additional masks that were requested within 1 year of the previous mask issue.

In November 2017, a new policy was implemented within the department which stated that all CPAP patients would be issued with one mask per year and any additional masks required would need to be purchased by the patient directly from the supplier. The data was then reviewed following the policy implementation to identify whether there had been a reduction in the number of additional masks being issued to patients.

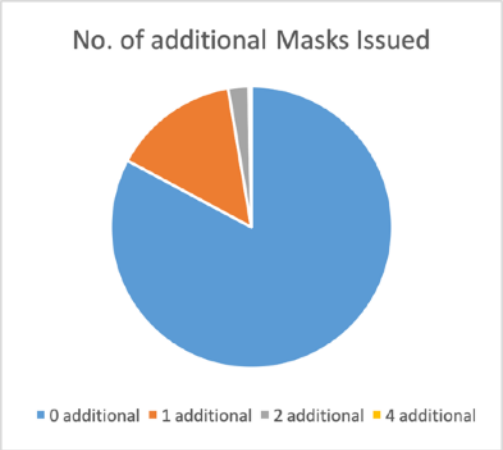
Results

Findings of initial audit

The audit of patients attending clinic between 1st January 2017 and 30th June 2017, identified that of the 338 patients reviewed:

- 280 patients required 0 additional* masks within a 12 month period
- 49 patients required 1 additional* mask within a 12 month period
- 8 patients required 2 additional* masks within a 12 month period
- 1 patient required 4 additional* masks within a 12 month period

*(*additional to the 1 per year they were expected to use)*



An additional 69 masks were issued to 58 of the 338 patients audited, in addition to the 1 mask per year they were allocated as per manufacturer's guidance, which is 17% of the total number of patients audited.

The patient's CPAP records were also reviewed to identify the reason given for the issue of an additional mask, which were as follows:

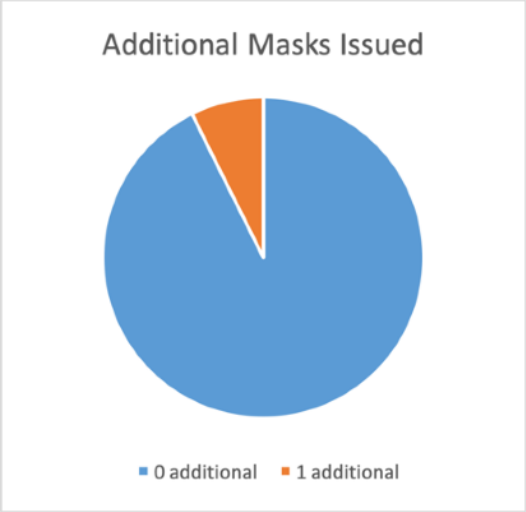
- 49% were issued at the patient's request
- 41% were replaced due to breakage as a result of inadequate care by the patient
- 10% were replaced due to poor mask fitting

Findings of follow up audit

A sample of 150 patients attending clinic between August 2018 and February 2020 was taken and again the data was reviewed to identify the number of masks issued to these patients over the previous 12 months. The findings were as follows:

- 139 patients required 0 additional* masks within a 12 month period
- 11 patients required 1 additional* mask within a 12 month period
- 0 patients required more than 1 additional* masks within a 12 month period

*(*additional to the 1 per year they were expected to use)*



The results of the follow up audit indicated that only 7.3% of the patients reviewed required additional masks to the one they were expected to use over a 12 month period. The reasons for additional issuing were also reviewed and were found to include accidental breakage, patient discomfort and loss of seal as a result of inadequate cleaning.

Conclusion

Using an average mask price of £82 per mask, the 17% increased mask issuing resulted in an additional £5,658 spend on masks for the patients included in the initial audit.

In February 2020, the sleep database at the University Hospital Llandough contained 2450 active CPAP patients. If we generalise the findings of the initial audit to the entire CPAP population within Cardiff & Vale UHB, £34,153 would be spent on additional CPAP masks each financial year.

The results of this audit were presented to the clinical board and a patient guidance letter was written advising patients of the appropriate cleaning and fitting instructions that needed to be followed. The letter also detailed that that department would provide one mask per year to each CPAP patient and any additional masks required would need to be purchased by the patient directly from a supplier.

A follow up audit was then undertaken to identify if the implementation of the mask policy had actually reduced the number of patients that were being issued more than one mask per year, therefore reducing the amount spent on additional CPAP masks. As described in the results section, the issuing of additional masks reduced from 17% to 7.3%. Therefore, if we again generalise these findings to the entire CPAP population, the amount spent on additional masks would reduce to £14,063, indicating that a saving of £20,090 would be made over a 12 month period.

One factor that needed to be considered is that the mask policy cannot be applied to all patients and so an exemption clause can be applied at the Physiologists discretion. This clause may be applicable if the patient is unable to fit their mask as per the fitting guidance provided (e.g. reduced mobility in one or both arms), if the patient is reliant on additional support to clean and wash their mask (e.g. a patient in a residential home or extended inpatient stay) or if the patient has any cognitive impairment that may impact on the way the mask is fitted and removed.

Given the potential saving to be made and the ever increasing demand on the sleep service, this mask policy has now been fully implemented within the University Hospital Llandough. All new CPAP setup up patients are given a copy of the policy letter at their first appointment and all existing patients have received copies at their next scheduled appointment within the department in order to give the Physiologist an opportunity to explain why the change has been made and answer any questions the patients may have about the policy. The policy serves not only as a reminder of the correct cleaning and fitting techniques but also as a reminder to patients that they have an element of personal responsibility to look after the equipment issued to them in order to ensure they get the best shelf life out of it.

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