Ordering a Sleep Apnoea Test and the Basics of Interpretation

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Introduction

Sleep apnoea is the cessation of respiration during sleep for more than 10 seconds which can extend to a few minutes in severe cases. It may also be accompanied by several episodes of hypopnoea i.e., a partial reduction in airflow and resulting hypoxia. for more than 10 seconds. Often this follows loud snoring and may have associated snoring and choking sounds as breathing resumes. The individual thereby does not get refreshing sleep due to repeated disruptions in normal sleep and consequently feels excessive day time sleepiness and tiredness.

Broadly, there are 3 types of sleep apnoeas:

1. Obstructive Sleep Apnoea Hypopnoea Syndrome'(OSAHS)
2. Central Sleep Apnoea (CSA) and
3. Mixed Sleep Apnoeas which is a combination of the above two.

Obstructive sleep apnoea is by far the most common of the sleep apnoeas accounting for approximately 85% of cases. Central sleep apnoea accounts for less than 1%.

When and in whom to suspect sleep apnoea?

Signs and Symptoms of Sleep Apnoea

1. Snoring

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Whenever there is partial obstruction to the flow of air through the upper airways, vibrations are produced which gives rise to loud snoring. Chronic loud snoring is one of the most commonly cited symptoms of sleep apnoea.

Many people who snore may not even be aware that they do so. It is often the spouse/bed partner whose sleep is disturbed by this loud snoring that brings it to the notice of the individual and others. All people who snore may not have sleep apnoea and also some people with sleep apnoea do not snore.

If however loud snoring is disruptive and occurs on a nightly basis, it could signal the presence of sleep apnoea. Such individuals must consult their Family Physician/Sleep Specialist for further advice.

2. Frequent breaks or pauses in breathing

Due to mechanical obstruction of the upper airways which restricts airflow, there may be frequent breaks or short/long pauses in breathing.

3. Unexplained tiredness all the time and EDS

The frequent disruptions in nocturnal sleep with pauses and interruptions lead to a loss of quantity and the quality of nightly sleep. Excessive daytime sleepiness (EDS) is one of the most common symptoms and is manifested as a

chronic feeling of daytime fatigue and is best assessed by using the Epsworth Sleepiness Scale (ESS). The latter is a questionnaire to help determine how frequently a patient is likely to doze off in 8 frequently encountered situations. The score ranges from 0 to 24 and an ESS score of greater than 16 is considered to be very sleepy.

4. Waking up with frequent headaches

Due to stoppage of breathing frequently during the night, there is resulting hypoxia which leads to vascular dilatation in the brain and gives rise to vascular headaches. Along with EDS headaches are the most common symptoms that the individuals with sleep apnoea syndrome complain of.

5. Unexplained Hypertension

For the same reason as the cause of frequent headaches, hypoxia, may lead to increase in the blood pressure which is initially only during night sleep but gradually begins to persist even during the day.

6. Overweight/Obesity

Persons with excessive body weight or obesity are more likely to have sleep apnoea than those who are non-obese. If neck circumference is > 17 inches for men and >15 inches for women, one has higher risk of suffering from sleep apnoea. Of course, hypothyroidism needs to be excluded in all these individuals.

7. Unexplained depression, irritability or mood swings

If one thinks that his mood swings, irritability and often depression are due to improper or poor quality of sleep, he should consult his family Physician for advice.

8. Problems with memory, concentration and cognitive function

9. History of motor vehicle accidents

10. Impotence

11. **Family history** - Having family members with sleep apnoea might increase ones risk.
12. **Use of alcohol, sedatives or tranquillisers** - These substances relax the muscles in throat, which can worsen obstructive sleep apnoea.
13. **Smoking -** Smokers are three times more likely to have obstructive sleep apnoea than are people who've never smoked. Smoking can increase the amount of inflammation and fluid retention in the upper airway.
14. **Nasal congestion.** lf one has difficulty breathing through nose - whether from an anatomical problem or allergies - he is more likely to develop obstructive sleep apnoea.

Physical Examination

The following features on general examination have been associated with the presence of OSAHS

1. Obesity defined as BMI > 30 kg/sqm
2. Enlarged neck circumference-males > 17 inches and females > 15 inches
3. Hypertension
4. Mallampati score 1-4 based on anatomic features of the airway. For each 1 unit increase in the Mallampati score, the odds ratio of having OSAHS increased by 2.5 and the AHl increased by 5 events per hour.

5. Narrowing of the lateral walls of the oropharynx.
6. Enlarged "kissing" tonsils
7. Retrognathia or micrognathia.

If one experiences any of the above symptoms, it is advisable to consult his Family Physician, Sleep Specialist for a Sleep Study. Untreated sleep apnoea can cause a whole slew of medical diseases that can increase the risk of contracting cardiac failure, arrhythmias, gastro-oesophageal reflux disease, diabetes, cardio-vascular accidents and even heart attacks.

BASICS OF INTERPRETATION OF A SLEEP STUDY REPORT

Components of a Sleep Report

lt is arranged in various sections

1) Patient information including sleep related symptoms
2) The technical details
3) Quantitative data regarding distribution of different stages of sleep called sleep architecture and sleep staging.

The technical details document the number of Electroencephalogram (EEG), electro-oculogram, chin and leg electromyogram, electrocardiogram, and air flow at nose and mouth. The chest and abdominal movements are recorded by plethysmographics traps and belts.

Snoring and its intensity are recorded by a snoring microphone. The oxygen saturation is recorded by a pulse oxymeter.

Multiple simultaneous parameters are recorded using an arrangement of wires and belts called a Montage.

The patient's complaints, medical history, sleep related problems and all their current medications including the indication for the study are recorded.

Some basic definitions to interpret the sleep report

Obstructive sleep apnoea (OSA) is the cessation of airflow for at least 10 seconds with persistent respiratory effort.

Central sleep apnoea is the cessation of air flow for at least 10 seconds with no respiratory effort.

Mixed apnoea is an apnoea that begins as a central apnoea and ends as an obstructive apnoea.

Hypopnoea is the partial reduction of airflow by 30% or more for at least 10 seconds with a desaturation of oxyhaemoglobin by 4% or more.

Respiratory event related arousal (RERA) is an event in which the patient has a series of breaths with increasing respiratory effort or flattening of the nasal pressure waveform leading to an arousal from sleep that does not otherwise meet the criteria for an apnoea or hypopnoea.

The Apnoea Hypopnoea Index (AHI) is derived from the total number of apnoeas and hypopnoea divided by the total sleep time. The severity of OSAHS is graded as:-AHI less than 5 is normal, 5-15 is mild, 15-30 is moderate and more than 30 is severe.

Respiratory Distress Index (RDI) is the sum of total apnoeas, hypopnoeas and RERAs divided by the total sleep time.

Total recording time is the total amount of time the patient is in bed with recording equipment activated.

Total Sleep time is the total amount of sleep time scored during the total recording time. This includes all the 3 stages of NREM sleep and REM sleep.

Sleep latency is the time between turning off the lights and till the time the patient actually falls asleep as evidenced by the EEG.

Sleep efficiency is calculated as the sum of stages N1, N2, N3 and REM sleep divided by the total time in bed, multiplied by 100.

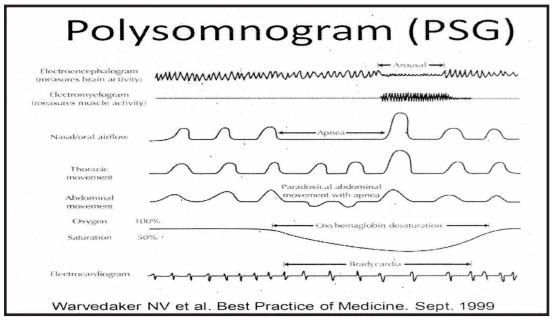
WASO is the wakefulness occurring after defined sleep onset.

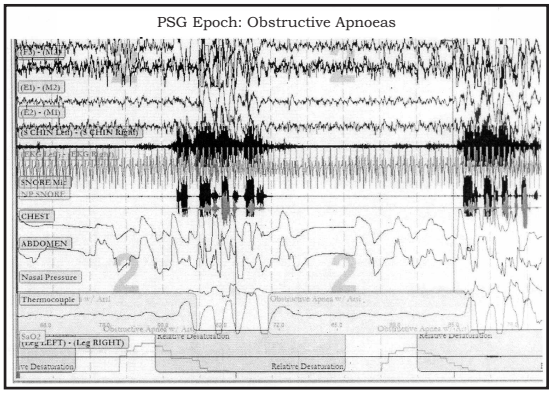
WASF is the wake time after sleep offset. Long periods of wakefulness especially after an atypical early morning awakening could signal one of the classic diagnostic signs of depression.

REM latency is the time of sleep onset to the first epoch of REM sleep; therefore it depends on the patient's sleep latency.

Stages of sleep: The sleep study report indicates the percentage of the various sleep stages. In adults approximately 5% of the total sleeptime is in NREM stage Nl, 50% in stage N2, 20% in stage N3. The remaining 25% is REM stage sleep.

Below is a diagrammatic representation of a typical Polysomnogram: -





In-lab PSG Date

Respiratory Data

- Includes number of Central, obstructive apnoeas, hyponoeas & RERAs
  - AHI & RDI by position and sleep stage
  - Central apnoea index and if Cheyne-Stokes pattern
- Oxymetry: includes
  - Oxygen Desaturation Index
  - Mean O_2 saturation & nadir (lowest O_2 saturation)
- Hypoxaemic burden
- Cumulative % of sleep time spent under 90%

EEG Data : includes

- Sleep efficiency & latency
  - Normal 80% efficient
  - Latency < 30 min, REM latency 60-120 min
- Sleep stages & architecture
  - Normal about 5% N1, 50% N2, 20% N3 (slow wave sleep) and 20-25% REM (rapid eye movement)
- Arousal Index (AI): sleep disruption
  - Normal AI < 10-25 (large variation by age)

- Norms are all age dependent
  - In general less REM & SWS (Slow Wave Sleep), more arousals, WASO (wake after sleep onset)) and lower sleep efficiency as age increases.
- EEG abnormalities
  - Epileptiform activity, alpha intrusion

Sample PSG Result

- Sleep Architecture
  - Sleep latency 13 min
  - Sleep efficiency 64%
  - WASA 28%
  - REM latency 143 min
- Arousal index 53
  - Predominantly respiratory
- Limb Movements
  - PLM (Periodic Leg Movements) index 7
- EEG Data: sleep architecture & arousals

Sleep Summary - Whole Night

Time at Lights Off	21:50:57
Time at Lights on	05:50:42
Total Recording Time (TRT)	479.8 min
Sleep Period Time (SPT)	452.0 min
Total Sleep Time (TST)	413.5 min.
Sleep Efficiency (SE)	86.2%
Sleep Onset Latency (SL)	27.8 min
Number of Stage N1 Shifts	36
Number of Stage Shifts	206
Number of Awakenings	17
REM Latency	141.0 min

Sleep Stage Summary - Whole Night

Stage	Duration	% TST	% SPT	Latency (min)
WASO	38.5	-	8.5	-
Stage N1	30.0	7.3	6.6	0.0
Stage N2	242.0	58.5	53.5	2.0
Stage N3	64.5	15.6	14.3	22.5
Stage REM	77.0	18.6	17.0	141.0

Sleep Continuity - Whole Night

Source of Arousals	NREM Count	NREM Index	REM Count	REM Index	Total Count	Total Index
Spontaneous	0	0.0	0	0.0	0	0.0
Apnoeas/ Hypopnoeas	72	12.8	31	24.2	103	14.9
RERAs	45	8.0	7	5.5	52	7.5
Snoring	0	0.0	0	0.0	0	0.0
PLM / Limb Mvmnts	0	0.0	0	0.0	0	0.0
Total Arousals	**117**	**20.9**	**38**	**29.6**	**155**	**22.5**

This patient has relatively normal sleep stages and efficiency and latency for the sleep lab. She did not increased arousals due to respiratory events.

- Respiratory Data:
  - Apnoea Hypopnoea Index: AHI 17
    - 12 obstructive apnoeas, 45 hypopnoeas
    - RERA index 34
  - Oxygenation Desaturation Index: ODI 13
    - Nadir O_2 Saturation: 86%
    - Hypoxaemic Burden: 13% of study O_2 sat < 90%
  - Most severe supine, REM sleep (AHI 53)
  - Total RDI: 55

Notice difference in RDI 55 from AHI 17 - moderate vs. severe OSA. The patient does not desaturate frequently but clearly has sleep disruption from respiratory events.

- Events by sleep stage & position

Respiratory Summary - Pre-Treatment

Types of Respiratory Events		
Respiratory Events	**Number**	**Index**
Obstructive Apnoeas	65	22.3 /hr
Mixed Apnoeas	0	0.0 /hr
Central Apnoeas	0	0.0 /hr
Total Apnoeas	65	22.3 /hr
Total Hypopnoeas*	48	16.5 /hr
Apnoeas+Hypops*	113	38.9 /hr

Respiratory Effort Related Arousal (RERA) Events		
Parameter	**Total**	**Index**
Total	24	8.3
Non-REM	23	8.3
REM	1	6.7
Supine	24	8.3
Lateral	N/A	N/A
Prone	N/A	N/A

Oxygen Saturation Summary - Pre-Treatment:

Mean SaO_2: 95.2%
% TST SaO_2 < 90%: 2.3%
% TST SaO_2 < 89%: 1.7%
Minutes SaO_2 < 90%: 4.0
Minutes SaO_2 <= 88%: 5.5
Lowest SaO_2: 79.0%
Desaturation 4% or >: 91
Desaturation Index: 31.3
NREM Desaturations Index: 28.6
REM Desaturations Index: 80.0

This patient had severe obstructive sleep apnoea (AHI 39), no central events and had frequent desaturation.

Home Sleep Study (Out of Centre Sleep Testing)

- Respiratory data only (estimated AHI, ODI) calculated from recording time
  - Underestimates AHI as recording time is often more than time asleep
  - Problematic if there is associated insomnia
- No EEG is done to determine sleep or arousal. Hence the following cannot be scored:
  - No arousal associated hypopnoeas scored
  - No respiratory effort related arousals (RERAs)
  - No information by sleep stage (REM/NREM or if asleep)
- Higher rates of technical failure
- Appropriate for high likelihood OSA and no other sleep disorders or respiratory/cardiac disease

Sample Home Sleep Study (OCST)

- Total recording time: 423 minutes
- Supine sleep: 34%
- AHI 8.4
  - 3 obstructive apnoeas, 2 central apnoeas
- Oxymetry
  - ODI 7
  - Nadir saturation 87%, mean 94%
- Same patient as in sample PSG but lower AHI estimated because of poor sleep efficiency and less REM

Summary

- In lab PSG provides details regarding EEG, EMG to give more complete evaluation of sleep disorder
- When interpreting sleep study results, remember to consider:
  - % supine, REM sleep captured
  - AHI often underestimated in OCST
  - RDI vs. AHI & hypopnoea criteria used
- A CPAP titration study is done on the second night with a tight fitting face mask connected to CPAP machine, once you have been diagnosed to have OSA. It derives the exact CPAP pressure in cmH_20 needed to keep the airways open and normalise the airflow in the index patient.
- A Split-Night study is one in which a conventional sleep study is done in the first half of the night followed by CPAP titration in the second half of the night.
- An MSLT (Multiple Sleep Latency Test)

is considered an objective measurement for EDS. It consists of 4-5 naps of 20-minute duration every 2 hours during the day. The daytime sleep latency is thus derived at by averaging the latency to sleep onset for each nap. Normal daytime sleep latency is greater than 10-15 minutes. OSAHS is generally associated with sleep latencies of less than 10 minutes. The MSLT is generally used to confirm the diagnosis of narcolepsy in whom this sleep disorder is suspected.

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Exercise can prevent depression

Depression not associated with poor glycaemic control in new diabetes cases

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