

USE OF A SLEEP LABORATORY IN THE DIAGNOSIS AND MANAGEMENT OF NEUROLOGICAL DISORDERS

The sleep laboratory makes sleep disorders accessible to clinical study.

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Kevin Rosman has been in private practice since 1987. He started the first private sleep laboratory in South Africa 13 years ago. He is the current President of the Sleep Society of South Africa. In addition to dealing with general neurology, he has a particular interest in sleep disorders.

Although sleep disorders have probably always been common conditions, and major causes of both morbidity and mortality, it has only been in the last 20 - 30 years that they have started to be intensively studied. Surveys have consistently shown that 15 - 20% of the population have some form of sleep disorder. Since the advent of clinical sleep laboratories these disorders have become accessible to clinical study and so to logical and effective management. However, like any other test procedure, the usefulness of the sleep laboratory tests are only as good as the laboratory doing the testing, and the clinician interpreting the test.

It has only been in the last few years that sleep disorders have received any attention at all in the medical school curriculum. As a result, when faced with a suspected sleep disorder, tests may be inappropriately requested. The test results are then, quite naturally, of only very limited use.

The second edition of the *International Classification of Sleep Disorders* (Table I) lists more than 80 recognised sleep disorders. It will become clear that laboratory testing alone will be useful in only a proportion of these. However, for that proportion, the condition may be undiagnosable in the absence of sleep laboratory testing.

COMMON SLEEP DISORDERS

The 3 most common conditions of excessive daytime sleepiness diagnosed in any sleep laboratory are probably obstructive sleep apnoea, periodic limb movement disorder, and narcolepsy.

Obstructive sleep apnoea

This is a common condition, affecting about 8% of men over the age of 45, and about half that number of women.

The most common presenting features are severe snoring, which is often the factor that precipitates the initial consultation, as well as excessive daytime sleepiness. It is estimated that about 50% of snorers suffer from this condition. The percentage will increase if the neck circumference is greater than 43 cm.

In this condition, the upper airways collapse during inspiration. The resultant negative pressure in the thorax typically causes nocturnal heartburn, and the patient may also complain of nocturnal urinary frequency.

The frequent reduction in oxygen saturation during the episodes of apnoea may ultimately result in hypertension, and is considered to be the primary cause of non-valvular cardiac arrhythmias.

The sleep interruption as a result of the apnoeas results in excessive daytime sleepiness, memory problems, and mood problems.

Apnoea is defined as a cessation of breathing for at least 10 seconds, associated with a reduction in the oxygen saturation by a minimum of 4%. Up to 5 apnoeas per hour is considered to be within the normal range. Finding a minimum oxygen saturation overnight of less than 50%, together with more than 50 apnoeas per hour, is not unusual in cases of severe obstructive sleep apnoea.

Table I. *International Classification of Sleep Disorders***I. Insomnia**

- a. Adjustment insomnia (acute insomnia)
- b. Psychophysiological insomnia
- c. Paradoxical insomnia
- d. Idiopathic insomnia
- e. Insomnia due to mental disorder
- f. Inadequate sleep hygiene
- g. Behavioural insomnia of childhood
- h. Insomnia due to drug or substance
- i. Insomnia due to medical condition
- j. Insomnia not due to substance or known physiological condition, unspecified (nonorganic insomnia, NOS)
- k. Physiological (organic) insomnia, unspecified

II. Sleep-related breathing disorders

- a. Central sleep apnoea syndromes
 - i. Primary central sleep apnoea
 - ii. Central sleep apnoea due to Cheyne-Stokes breathing pattern
 - iii. Central sleep apnoea due to high-altitude periodic breathing
 - iv. Central sleep apnoea due to medical condition not Cheyne-Stokes
 - v. Central sleep apnoea due to drug or substance
 - vi. Primary sleep apnoea of infancy (formerly primary sleep apnoea of newborn)
- b. Obstructive sleep apnoea syndromes
 - i. Obstructive sleep apnoea, adult
 - ii. Obstructive sleep apnoea, paediatric
- c. Sleep-related hypoventilation/hypoxaemic syndromes
 - i. Sleep-related nonobstructive alveolar hypoventilation, idiopathic
 - ii. Congenital central alveolar hypoventilation syndrome
 - iii. Sleep-related hypoventilation/hypoxaemia due to medical condition
 1. Sleep-related hypoventilation/hypoxaemia due to pulmonary parenchymal or vascular pathology
 2. Sleep-related hypoventilation/hypoxaemia due to lower airways obstruction
 3. Sleep-related hypoventilation/hypoxaemia due to neuromuscular and chest wall disorders
- d. Other sleep-related breathing disorders
 - i. Sleep apnoea/sleep-related breathing disorder, unspecified

III. Hypersomnias of central origin not due to a circadian rhythm sleep disorder, sleep-related breathing disorder, or other cause of disturbed nocturnal sleep

- a. Narcolepsy with cataplexy
- b. Narcolepsy without cataplexy
- c. Narcolepsy due to medical conditions
- d. Narcolepsy, unspecified
- e. Recurrent hypersomnia
 - i. Kleine-Levin syndrome
 - ii. Menstrual-related hypersomnia
- f. Idiopathic hypersomnia with long sleep time
- g. Idiopathic hypersomnia without long sleep time
- h. Behaviourally induced insufficient sleep syndrome
- i. Hypersomnia due to medical condition
- j. Hypersomnia due to drug or substance
- k. Hypersomnia not due to substance or known physiological condition (nonorganic hypersomnia, NOS)
- l. Physiological (organic) hypersomnia, unspecified (organic hypersomnia, NOS)

IV. Circadian rhythm sleep disorders

- a. Circadian rhythm sleep disorder, delayed sleep phase type (delayed sleep phase disorder)
- b. Circadian rhythm sleep disorder, advanced sleep phase type (advanced sleep phase disorder)
- c. Circadian rhythm sleep disorder, irregular sleep-wake type (irregular sleep-wake rhythm)

- d. Circadian rhythm sleep disorder, free-running type (nonentrained type)
- e. Circadian rhythm sleep disorder, jet lag type (jet lag disorder)
- f. Circadian rhythm sleep disorder, shift work type (shift work disorder)
- g. Circadian rhythm sleep disorder due to medical condition
- h. Other circadian rhythm sleep disorder (circadian rhythm disorder, NOS)
- i. Other circadian rhythm sleep disorder due to drug or substance

V. Parasomnias

- a. Disorders of arousal (from NREM sleep)
 - i. Confusional arousals
 - ii. Sleepwalking
 - iii. Sleep terrors
- b. Parasomnias usually associated with REM sleep
 - i. REM sleep behaviour disorder (including parasomnia overlap disorder and status dissociatus)
 - ii. Recurrent isolated sleep paralysis
 - iii. Nightmare disorder
- c. Other parasomnias
 - i. Sleep-related dissociative disorders
 - ii. Sleep enuresis
 - iii. Sleep-related groaning (catathrenia)
 - iv. Exploding head syndrome
 - v. Sleep-related hallucinations
 - vi. Sleep-related eating disorder
 - vii. Parasomnia, unspecified
 - viii. Parasomnia due to drug or substance
 - ix. Parasomnia due to medical condition

VI. Sleep-related movement disorders

- i. Restless legs syndrome
- ii. Periodic limb movement disorder
- iii. Sleep-related leg cramps
- iv. Sleep-related bruxism
- v. Sleep-related rhythmic movement disorder
- vi. Sleep-related movement disorder, unspecified
- vii. Sleep-related movement disorder due to drug or substance
- viii. Sleep-related movement disorder due to medical condition

VII. Isolated symptoms, apparently normal variants and unresolved issues

- i. Long sleeper
- ii. Short sleeper
- iii. Snoring
- iv. Sleep talking
- v. Sleep starts (hypnic jerks)
- vi. Benign sleep myoclonus of infancy
- vii. Hypnagogic foot tremor and alternating leg muscle activation during sleep
- viii. Propriospinal myoclonus at sleep onset
- ix. Excessive fragmentary myoclonus

VIII. Other sleep disorders

- i. Other physiological (organic) sleep disorder
- ii. Other sleep disorder not due to substance or known physiological condition
- iii. Environmental sleep disorder

Although sleep disorders have probably always been common conditions, and major causes of both morbidity and mortality, it has only been in the last 20 - 30 years that they have started to be intensively studied.

The very first line of investigation must be a comprehensive sleep history, including information such as the time spent in bed, inappropriate sleepiness, and unusual behaviour in bed.

Since 50% of snorers may be suffering from obstructive sleep apnoea, an apnoea screen is often recommended in cases of snoring before a surgical solution is sought. This is probably an ideal way of using this test.

Severe obstructive sleep apnoea has been associated with a 23 times normal risk of heart attack, and a 7 times normal risk of motor vehicle accident.

Recurrent reduction in oxygen levels during sleep has been shown to cause a suppression of the hormone orexin, which is thought to be responsible for some of the weight gain seen in patients with this condition.

The condition is treated by using a continuous positive airways pressure (CPAP) device overnight. This has very high levels of both compliance and effectivity.

Periodic limb movement disorder

This disorder is characterised by recurrent small movements of a limb, and includes teeth grinding, associated with a partial arousal, which is seen on polysomnography.

The recurrent arousals cause fatigue the following day, and the patients may complain that they are 'light sleepers'.

There is often a family history of this condition, which has been associated with low serum iron levels, and is quite frequently found during pregnancy, in certain renal conditions, and in mild neuropathies. The most common treatment, if iron supplementation does not work, is the use of DOPA agonists at night.

The condition has a correlate during the waking hours, which is usually referred to as restless legs syndrome. The sufferer will complain of indescribable discomfort in the legs at night, relieved only by movement. It is often a lifelong condition.

Narcolepsy

Narcolepsy was the first disorder of excessive sleepiness to be recognised as a specific medical disorder. The underlying pathophysiology is thought to be the non-suppression of the REM sleep cycles during wakefulness. This results in a periodic irresistible urge to sleep during the day, following a good night's sleep.

Episodes of sleep paralysis are characteristic of the condition, during which the patient may wake up from sleep and be paralysed for a few seconds before recovering. This experience usually causes a high degree of anxiety, and may be the factor that propels the patient to seek medical advice.

The patients may also complain of either hypnagogic or hypnopompic hallucinations. These are, in effect, dreams which occur either just before falling asleep, or just after waking. In other words, the dreams occur concurrently with an awareness of reality.

The most distressing symptom may be cataplexy. This is a sudden loss of muscle tone, sometimes to the extent that the patient may fall to the floor, in association with an emotional stimulus. The stimulus is often laughter, which

may cause a severe limitation in the patient's ability to socialise.

Small doses of tricyclic drugs are useful for cataplexy, and various stimulant medications are used to maintain wakefulness during the day. Brief timed naps are also very useful.

The condition appears to have a genetic basis. It generally presents in the teenage years, and is then a lifelong condition. It can sometimes occur simultaneously with other sleep disorders.

USING A SLEEP LABORATORY

It is appropriate to comment that a sleep laboratory does not perform 'sleep therapy' – this is a discredited form of treatment for psychiatric conditions, and should not be performed under any circumstances.

In choosing the appropriate diagnostic tool for a patient who presents with a sleep disorder it is firstly most important to have some type of clinical differential diagnosis in order to guide the selection of the best testing techniques.

For this reason, the very first line of investigation must be a comprehensive sleep history, including information such as the time spent in bed, inappropriate sleepiness, and unusual behaviour in bed. Associated medical and psychiatric conditions must be carefully sought. By the time a sleep test is requested, the doctor should already have formed a relatively limited differential diagnosis after a careful and directed physical examination.

Blood tests and radiological investigations may then be indicated; however, they generally have only very limited usefulness in sleep disorders.

Once this point in the process has been reached, and a diagnosis is still not possible, sleep laboratory testing should be considered. Obviously, if the clinician is uncertain, a good sleep

laboratory will be able to advise on the most useful tests, but examination by an expert in sleep medicine may be required before proceeding to tests indiscriminately – some of the sleep tests are rather expensive, although none are dangerous or invasive.

Tests performed overnight in a sleep laboratory

When obstructive sleep apnoea is strongly suspected, an apnoea screen may be appropriate. The major advantage of this is that it is simpler than some other testing, there is often a shorter waiting list, and it is not as intrusive for the patient. The major disadvantage is that sleep staging cannot be determined accurately from the equipment used to diagnose obstructive sleep apnoea, and other sleep disorders cannot be diagnosed at the same time.

Since 50% of snorers may be suffering from obstructive sleep apnoea, an apnoea screen is often recommended in cases of snoring before a surgical solution is sought. This is probably an ideal way of using this test.

Although it is tempting to use this test in the patient's home, unmonitored by a technician, this is usually not recommended. There are too many variables in an already inaccurate test to justify this, except in some very unusual and specific circumstances.

The 'gold standard' of overnight tests is the polysomnogram, with technician surveillance. Ideally this is done with simultaneous video recording of the sleep behaviour, but that is not frequently available in South Africa. The polysomnogram should have adequate electrodes recording EEG and eye movement to allow for accurate sleep staging. Breathing movements should be monitored, preferably abdominal as well as thoracic. An ECG channel should be present, especially since sleep apnoea is an important cause of cardiac arrhythmias. There should be an oximeter recording – air flow movements through the nose and

(preferably also) the mouth should be recorded. Electromyographic (EMG) activity should also be recorded, and at least an anterior tibialis muscle should be monitored to look for limb movements. A position monitor and snore monitor may also be useful.

This test will diagnose sleep apnoea, and will distinguish obstructive from central apnoeas. It will give an indication of the frequency of the apnoeas, and the extent of the drop in blood oxygen when the apnoeas occur. It will indicate the early occurrence of REM sleep, for example in narcolepsy. It will allow the diagnosis of periodic limb movement disorder. The test will suggest the presence of paradoxical sleep disorder, and may even suggest depression. Used in conjunction with a video recording, it may allow the precise diagnosis of REM behavioural disorders.

One of the most vexing problems is that of the normal polysomnogram in the presence of symptoms strongly suggestive of obstructive sleep apnoea. The not-uncommon problem of more than one disorder co-existent in a single patient can also be very difficult to diagnose and manage. In these cases, help from an experienced 'sleep doctor' should be sought.

The use of EEG channels in the polysomnogram is particularly important for certain rare but significant disorders which may otherwise be extremely difficult to diagnose. For example, electrical status epilepticus in sleep (ESES), and the Landau-Kleffner syndrome.

Once the diagnosis of obstructive sleep apnoea has been made, the sleep laboratory should be able to do a CPAP titration for those patients in whom CPAP is clinically indicated. There are various ways of doing this, but the most important reading is of the air pressure that will suppress more than 90% of apnoeas. This is generally considered adequate control for the disorder.

A good sleep laboratory should be able to offer advice about alternative treatment methods or the management of other conditions, and should be able to advise on local doctors interested in sleep, who would be able to help with the more difficult clinical problems.

Day-time sleep laboratory tests

The most commonly used day-time test in a sleep laboratory is the multiple sleep latency test (MSLT). In this test, the subject is given 4 or 5 chances to fall asleep in a quiet darkened room, at 2-hourly intervals through the day. Twenty minutes are allowed at each attempt. This is primarily a test of sleepiness but, used the night after a polysomnogram, it is the diagnostic test for narcolepsy.

It is important that a normal polysomnogram be obtained the previous night. The reason is that sleep deprivation can cause an abnormal MSLT. Since stimulant medication is used for the treatment of this condition, one needs to guard against the factitious diagnosis of narcolepsy, which has been used to obtain otherwise illegal substances.

In narcolepsy, the diagnostic finding is of rapid-onset REM sleep episodes in an individual who does not have significant sleep deprivation. Theoretically, a better test of sleepiness is the maintenance of wakefulness test (MWT). This is similar to the MSLT, except that the subject is asked to stay awake in the quiet, darkened circumstances. Unfortunately, this test has a large number of false-positives, and is seldom used clinically.

Other tests

For patients complaining of excessive daytime sleepiness, it is usually useful to document the severity of the sleepiness by means of one of the many available sleepiness scales. Possibly the best known is the Epworth sleepiness scale, but a very useful and language-independent scale is the Wits faces scale, developed locally a few years ago. It is important that

the doctor using any particular scale must understand the scale and its limitations.

Insomniacs are notoriously difficult to test. The general principle is that, if the patient is having difficulty sleeping at home, he/she will usually (although not always) have even more difficulty sleeping in a sleep laboratory, with various wires attached.

Certain specific indications do exist however, most notably for periodic limb movement disorder, which may present as insomnia, and which is really only diagnosable using a polysomnogram.

In general though, a good first step in the testing of an insomniac is a sleep diary, usually kept for about 2 weeks or even longer. A sleep diary should record the time a patient is in bed awake, the time asleep, time out of bed, how he/she functions during the day, and the use and timing of any medications, including alcohol and caffeine. The pattern of the problem revealed in this way is often highly characteristic of one of the sleep disorders.

Actigraphy may be useful, although this is rarely used in South Africa, probably mainly because there is no remuneration scale for it. This is a small device, usually worn on the wrist much like a wrist watch, which simply records movement. The idea

is that there will be less movement during sleep than wakefulness. The information can be downloaded to a computer, and the device can be used continuously for many days.

This device may demonstrate particular abnormal sleep patterns, for example sleep phase shift, which might have gone unnoticed in the clinical evaluation.

In summary, then, many sleep disorders cannot be diagnosed effectively without assistance from a good sleep laboratory. However, the results are only ever going to be as good as the indication for the test. Sleep tests should be used appropriately, but with circumspection, and not as a shotgun approach to the diagnosis of sleep disorders.

Further reading

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IN A NUTSHELL

Sleep laboratories are useful for assistance in diagnosing certain sleep disorders.

Sleep laboratories are ideal for the investigation of disorders of excessive sleep.

Polysomnography is best done in a laboratory setting, with continuous monitoring by a technician.

Multiple sleep latency tests are indicated for the investigation of narcolepsy.

After a good history, a sleep diary is usually the best investigation for insomnia.

A sleep test is only as good as the clinician interpreting it. When in doubt, get expert assistance.

SINGLE SUTURE

MULTIPLE STRAINS OF BIRD FLU IN AFRICA

H5N1 bird flu has invaded Nigeria on at least 3 separate occasions, according to the first genetic analysis of the virus. Each time wild birds were responsible, which means that the virus will probably continue to spread across Africa. Claude Muller and his team from the National Public Health Laboratory in Luxembourg have found that poultry is not the main means by which the virus spreads. After spreading west across Asia, the bird flu virus was identified in northern Nigeria in February. The virus reached Lagos in April and it is now in 14 of Nigeria's states. The team found that the Nigeria strains were not descended from the strains of the virus that are common in east Asia, in spite of the poultry trade between Nigeria and China. One Lagos strain is most closely related to H5N1 found in a buzzard in Denmark and swans in Germany, where it is only known in wild birds. The other Lagos strain is closest to one from Egypt, which is on the migration route from Siberia. Yet another strain is closest to H5N1 from central Asia. It appears that the virus is repeatedly invading African birds and so will be difficult to stop. Researchers are concerned that people in Africa may already have been infected as a result of this spread.

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