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1. What does a sleep disorders physician do?

Diagnose and treat numerous sleep related conditions:

a) Snoring/Sleep apnoea:
   - 2-4% of the middle aged adult population have obstructive sleep apnoea
   - snoring is a very common condition

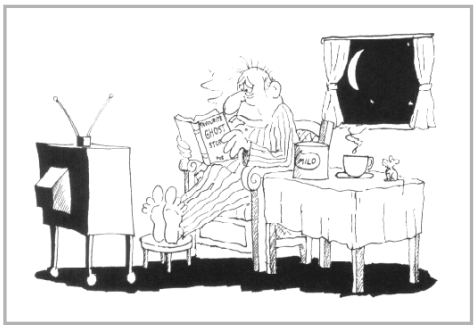
b) Insomnia

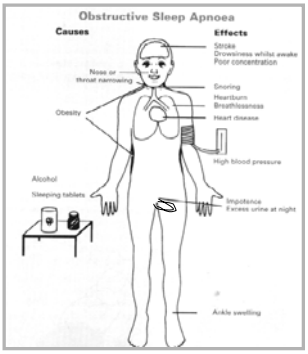
c) Parasomnias:
   - night leg movements
   - sleep walking
   - others

d) Circadian rhythm disorders:
   - shift work
   - others

e) Sleep (nocturnal) epilepsy

d) Other diseases associated with difficulty of initiating and maintaining sleep



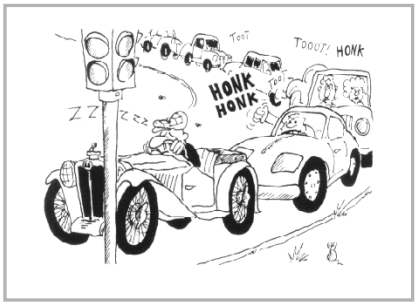


2. How do we make a diagnosis?

a) History:
   - what are the patient's subjective symptoms (problems)

b) Examination of the patient

c) Investigations:
   - polysomnography (PSG)
   - limited sleep studies
   - surrogate markers of sleep e.g: actigraphy and sleep diaries
   - surrogate markers of sleep disordered breathing events



3. Treatments

Depend on the diagnosis:

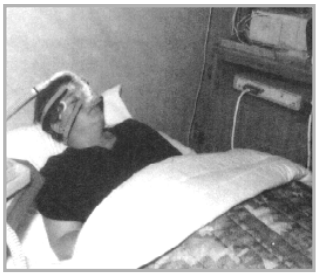
a) snoring:
   - weight loss
   - continuous positive airways pressure (CPAP)
   - various oral devices
   - surgery

b) Obstructive sleep apnoea - as above

c) Insomnia:
   - behavioural therapy
   - pharmaceutical therapy
   - light therapy

d) Parasomnias:
   - pharmaceutical therapy
   - behavioural therapy

e) Epilepsy:
   - pharmaceutical therapy



The PSG

Continuous overnight monitoring (≈ 8 hour) of:

a) Sleep:
- electroencephalogram (EEG)
- electrooculogram (EOG)
- submental electromyelogram (EMG)

b) Respiration:
- surrogate for oronasal airflow (nasal pressure signal; thermal sensor signal; end-tidal CO_2 monitor)
- abdominal and chest movement sensors (effort to breathe)
- oxygen saturation monitor (via surface electrode - oximetry)
- transcutaneous blood or end-tidal breath CO_2 tension
- pneumotachograph (airflow)
- oesophageal pressure monitor (surrogate for intrathoracic pressure changes = effort to breathe)
- diaphragm EMG (effort to breathe)

The PSG …..

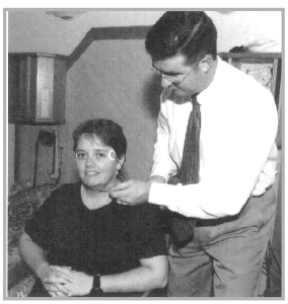
c) Body position sensor

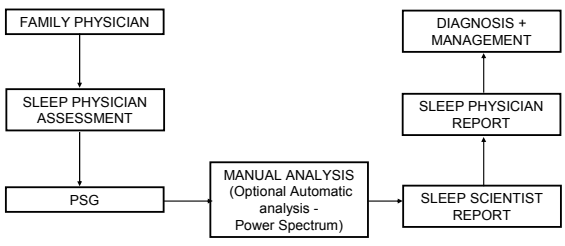
d) Legs/arm EMG (for abnormal movements)

e) CPAP recordings (if patient having therapy)

f) Electrocardiogram

g) View patient in bed:
- either VCR recording
- digital video recording





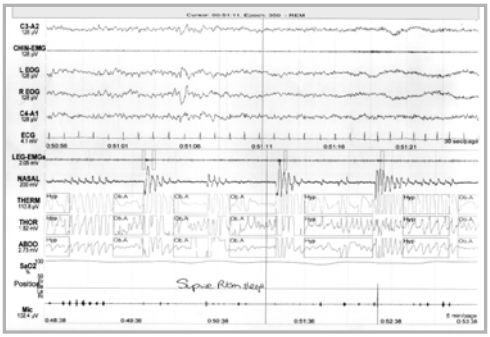
Major issues regarding PSG

- Patient comfort.
- Usually only monitor for one night - how good is it in terms of real life?
- Expensive:
  - technical staff
  - hardware requirements
  - interpretation/reporting

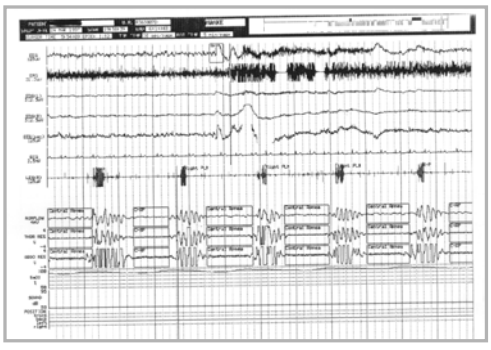
Major issues regarding PSG .....

The problems with the physiological measurements:

- The signal always comes with something on the side.
- Measure what you can and then use what is really required.
- Most monitors used are surrogate measurements of physiological parameters (patient compliance/ease of use).
- Sampling rate for data acquisition (ailasing, harmonics)
- Filter settings:
  - use of appropriate filter for differing physiological measurements.
- Phasing issues (e.g. abdomen/chest wall movement detectors).
- Analogue to digital conversions.
- Electrical interference (e.g. 50 Hz electric)
- Other interference (motors fans, etc)
- Calibration problems and the electronic integrity of the equipment.
  - "the black box phenomenon"
- Issues of linearity of output monitoring device.



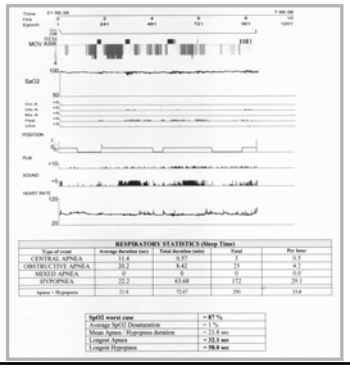
CEN APN with arousal



HYP with arousal

PLM - Periodic Leg Movement

Sleep hypnogram

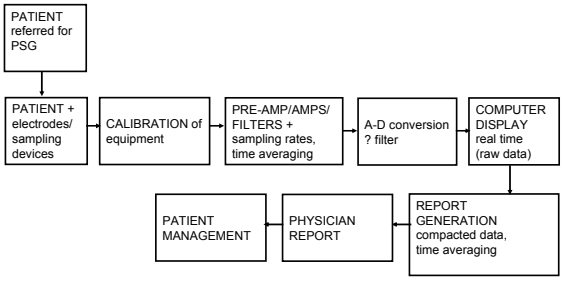


RESPIRATORY STATISTICS (Sleep Time)

Type of event	Average duration (sec)	Total duration (min)	Total	Per hour
CENTRAL APNEA	11.4	0.87	5	0.5
OBSTRUCTIVE APNEA	20.2	8.42	25	4.2
MIXED APNEA		0	0	0.0
HYPOPNEA	22.2	63.68	172	29.1
Apnea + Hypopnea	21.8	72.67	200	33.8

SpO2 worst case	= 87 %
Average SpO2 Desaturation	= 1 %
Mean Apnea / Hypopnea duration	= 21.8 sec
Longest Apnea	= 53.1 sec
Longest Hypopnea	= 58.0 sec

Potential errors



Remember

Measurement errors are:

- additive
- multiplicative

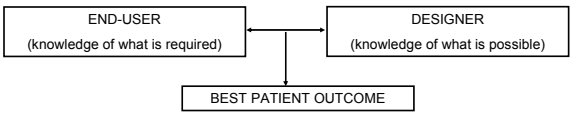
therefore small systemic errors have potential to become large over a number of handling procedures.

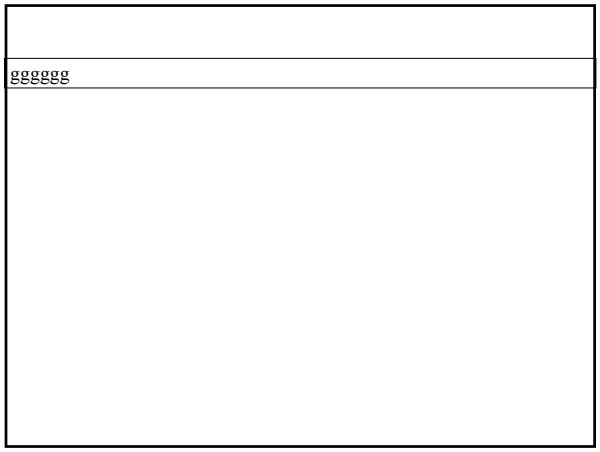
The Future

- Better techniques than PSG
- Better less cumbersome PSG techniques e.g.
  - in-hospital telemetry (no wires to amp/filters etc)
  - at home telemetry (to bedside or better still real-time to central monitoring station in sleep laboratory)
  - less surrogates for non-invasive physiological measurements

The physician / technologist are TECHNOLOGY END-USERS

- Interaction between system designers and end-users is paramount to understand requirements and difficulties of design.

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