

INTERPETATION OF SLEEP DISORDER BREATHING IN LEVEL I PSG

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Sleep related breathing disorder

- Central sleep apnea due to drug or substance
- Primary sleep apnea of infancy
- Obstructive sleep apnea
- Sleep-related nonobstructive alveolar hypoventilation, idiopathic
- Primary central sleep apnea
- Central sleep apnea due to Cheyne Stokes breathing pattern
- Central sleep apnea due to medical condition not Cheyne Stokes

Spectrum of sleep disorder breathing

- Obesity-hypoventilation syndrome
- Severe obstructive sleep apnea
- Moderate obstructive sleep apnea
- Mild obstructive sleep apnea
- Upper airways resistance syndrome
- Chronic, heavy snoring
- Intermittent snoring
- Quiet breathing

Types of PSG

EEG

- potentials generated by the cerebral cortex
- reflection of large apical dendrites of the pyramidal cell neurons (does not reflect the action potentials of the neurons)
- 10-20 electrode placement

Sleep staging

- Rechtschaffen and Kales (R and K) 1967 → stage W, N1-4 & R
- AASM 2007 → stage W, N1-3 & R
- Epoch
- Paper speed of 30 sec
- Predominant Stage > 50 %

Awake

Alpha rhythm-trains of sinusoidal **8-13** activity over **occipital** region ; attenuating with eye opening

Eye blinks- conjugate vertical eye movements at a frequency of .5-2hz

REM may be seen with initial deflection lasting < 500msec

Submental EMG - relatively high tone

Stage Wake

Eyes Closed vs. Eyes Open

NREM 1

slow eye movements: conjugate, regular ,
sinusoidal eye movement with initial deflection
>500 msec

vertex sharp waves

low amplitude 4-7 Hz/ mixed frequency activity

Stage N1 onset

- Sleep Onset: The start of first epoch scored as any stage other than Stage W

Rules

- **In subjects who generate alpha rhythm**, score stage N1 if alpha rhythm is attenuated and replaced by low amplitude, mixed frequency activity for more than 50% of the epoch
- **In subjects which do not generate alpha rhythm**, score stage N1 commencing with earliest of any of the following phenomena:
 - Activity in the range of 4-7 Hz with slowing of background frequencies by > 1 Hz from those of stage W
 - Vertex sharp waves
 - Slow eye movements

Sleep Spindles

- Sleep Spindle – 11-16 Hz
- .5 second spindles - 6-7 cycles
- Central - vertex region
- ≥.5 second in duration

K Complexes

- Sharp, slow waves, with a negative then positive deflection
- No amplitude criteria
- $\geq .5$ second in duration
- Central in origin

Start of N2 stage

Begin scoring stage N2 if one or both of the following occur during the first half of that epoch or the last half of the previous epoch

- a) One or more K Complexes unassociated with arousals
- b) One or more trains of sleep spindles

Continue as stage N2

Epochs with low amplitude, mixed frequency EEG activity without K complex or sleep spindles if they are preceded by

- a) K complex unassociated with arousals or
- b) Sleep spindle

End of Stage N2

- Transition to stage W,N3 or R
- An arousal (change to N1)

NREM 3

- >20% Delta Activity (.5-2 Hz with amplitude >75 uV) is seen over frontal region
- no eye movements
- EOG leads will only pick up the EEG activity
- about thirty to forty five minutes after sleep onset
- far more difficult to awaken

Stage R

- Brain suddenly becomes much more active.
- REM-conjugate, irregular, sharply peaked eye movements with initial deflection < 500 msec
- Low chin EMG activity
- Sawtooth waves- low amplitude sharply contoured or triangular (2-6hz); over central head regions

Stage REM: Phasic Twitching

- Very short muscle twitches that normally occur in REM Sleep
- May occur in the inner ear, genioglossal, limb, and facial muscles
- Another form of phasic activity is Penile Tumescence

The arrows are pointing to Phasic Twitching

AROUSAL RULE

- If there is an abrupt shift of EEG frequency including alpha, theta and /or frequencies greater than 16 Hz (but not spindles) that last more than 3 seconds, with at least 10 seconds of stable sleep preceding the change.
- Concurrent increase in submental EMG lasting at least 1 sec.

Arousal

- People are unlikely to be aware of the arousal.
- Arousals are relevant as they may prevent progression into deeper stages of sleep, thereby affecting sleep quality.
- An arousal is, therefore, not the same as being awake.

Filter setting

- The higher the LFF setting ,the greater is the attenuation of the signal.
- The lower the HFF setting ,the greater is the attenuation of the signal.

EOG and EMG Placements

- Corneoretinal potential
- Conjugate eye movements
- Out of phase pen movements
- Leg EMG
- Position sensor

- Thoraco-abdominal movements
- Position sensor
- Flow tracing

Respiratory Rules Technical Considerations

- The sensor to detect absence of airflow for identification of an **apnea** is an **oronasal thermal sensor**.
- The sensor for the detection of airflow for the identification of a **hyopnea** is a **nasal air pressure transducer**.
- The sensor for detection of respiratory effort is either esophageal manometry, or calibrated or uncalibrated inductance plethysmography.

Scoring of Apnea

- There is a drop in the peak thermal sensor excursion by $\geq 90\%$ of baseline
- The duration of event lasts at least 10 seconds
- At least 90% of the event's duration meets the amplitude reduction criteria for Apnea.

Hypopnea Rules – Alternative

- Duration > 10 secs
- The Nasal pressure signal drop by $\geq 50\%$
- There is $\geq 3\%$ desaturation from pre-event base line
- At least 90% of the event's duration must meet the amplitude reduction of criteria for hypopnea.

RERA

- If there is a sequence of breaths lasting at least 10 seconds characterized by increasing respiratory effort or flattening of the nasal pressure waveform leading to an arousal from sleep when the sequence of breaths does not meet criteria for an hypopnea or an apnea.
- Prefer the use of esophageal pressure for assessing change in respiratory effort, however nasal pressure and inductance plethysmography can be used.

Scoring SDB

Severity	Mild	Moderate	Severe
AHI	5-15	15-30	>30
RDI	15-20	20-40	>40

CSR

- If there is at least 3 consecutive cycles of cyclical crescendo and decrescendo change in breathing amplitude
- + atleast one of the below :
 1. 5 or more central apnea / hypopnea per hr of sleep.
 2. The cyclic crescendo and decrescendo change in breathing amplitude has a duration of atleast 10 consecutive mins.

CSR has variable cycle length that is most commonly in the range of 60 seconds.

Movement Time

- Amplifier blocking or excessive EMG
- Obscured tracing
- Sleep must occur before and after
- ≥ 15 seconds \leq than one minute
- Scorable stage of sleep

Major body movement

- >15 sec; sleep stage can't be determined
- If alpha present → W
- If W precedes or follows → W
- Otherwise score same as epoch that follows it

EEG Arousal

Very short
duration
(< 15 seconds)
activity with no
EEG obscuring

MVT Time

Over 15
seconds of
amplifier
blocking, etc.,
that obscures
record

Hypoventilation Rule

- Score a hypoventilation during sleep as present if there is a ≥ 10 mm Hg increase in PaCo₂ during sleep in comparison to an awake supine value.
- An increased PaCo₂ value obtained immediately upon awakening from sleep is suggestive of sleep hypoventilation
- (not specified) but ETCO₂ or TcCO₂ are the sensors that can be used.

Cardiac Rules

- A single modified ECG lead II using torso electrode placement is recommended
- Sinus Tachycardia > 90 beats
- Sinus bradycardia < 40 /minute

Rules to define a significant leg movement

- The minimum duration of leg movement event is 0.5 seconds
- The maximum duration of leg movement is 10 seconds
- The minimum amplitude of LM event is an 8 micro volt increase in EMG voltage above resting EMG
- The timing of onset of LM event is defined as the point at which there is an 8 micro volt increase in EMG voltage above resting EMG
- The timing of the ending of the LM event is defined as the start of the period lasting at least 0.5 seconds during which the EMG does not exceed 2 micro volt above the resting EMG

Artifacts

- POPPING ARTIFACT
- MOISTURE ARTIFACT
- Equipment malfunction
- Oximetry probe malfunction
- Bruxism artifact
- ECG artifact
- Eye movement artifact

Respiration movement artifact

EEG wires are not lying close to the patient and moving with the patient's breathing movements.

LACES approach

- Location
- Application
- Connection
- Equipment
- Settings(filters, sensitivity, gain, polarity)

Follow up of patient

Movement disorder

MOVEMENT RULES

- PLM – periodic leg movement
- ALMA – alternating leg muscle activity
- HFT – hypnagogic foot tremor
- EFM – excessive fragmentary myoclonous
- BRUXISIM -
- RBD – Rem Sleep behaviour disorder
- Rhythmic movement disorder

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Rules to define PLM

- The min number of consecutive LM events needed to define PLM series is 4 LMs
- The min period length between LMs is 5 seconds
- The max period between LMs is 90 seconds
- Leg movement on two different legs separated by less than 5 seconds is counted as single leg movement.

Rules to define ALMA

- The min number of discrete and alternating burst of a leg muscle activity needed to score ALMS series is 4 ALMAs
- The min frequency of the alternating EMG bursts in ALMA is 0.5 Hz
- The max frequency of the alternating EMG bursts in ALMA is 3 Hz

SCORING HFT

- The min number of bursts needed to make a train of bursts in hypnagogic foot tremor is 4 bursts
- The min frequency of the EMG bursts in hypnagogic foot tremor is 0.3 Hz
- The max frequency of the EMG bursts in hypnagogic foot tremor is 4 Hz

Rules to define EFM

- The usual maximum EMG burst duration seen in fragmentary myoclonus is 15 msec
- At least 20 minutes of NREM sleep with EFM must be recorded
- At least 5 EMG potentials per minute must be recorded

Scoring Bruxism

- Bruxism may consist of brief or sustained elevation of chin EMG activity that are at least twice the amplitude of background EMG
- Brief elevation of chin EMG activity are scored as bruxism if they are .25-2 Seconds in duration and if at least 3 such elevation occurs in regular sequence.
- Sustained elevation of chin EMG activity are scored as bruxism is more than 2 seconds
- A period of at least 3 seconds of stable background chin EMG must occur before a new episode of bruxism can be scored
- Bruxism can be scored reliability by audio in combination with polysomnography by a minimum 2 audible tooth grinding episodes/night of polysomnography in the absence of epilepsy

Rules to score RBD

- The polysomnographic characteristics of RBD are characterised by either or both of the following features:
 - Sustained muscle activity in REM sleep in the chin EMG
 - Excessive transient muscle activity during REM in the chin or limb EMG

Rules to score RMD

- The minimum frequency for scoring rhythmic movements is 0.5 Hz
- The maximum frequency for scoring rhythmic movements is 2 Hz
- The minimum number of individual movements required to make a cluster of rhythmic movements is 4 movements
- The minimum amplitude of an individual rhythmic burst is 2 times the background EMG activity