

호흡 사건의 판독



임 희 진

한림의대 동탄성심병원 신경과

Respiratory rules

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- ▶ 1. Rules for Adults and Practice
- ▶ 2. Rules for Children and Practice

What we know from PSG?

- **Stage**
 - Sleep structure
 - EEG, EOG, Chin EMG (REM)
- **Event**
 - Respiratory event : **apnea, hypopnea, respiratory effort**
(thermister, nasal pressure cannula, finger pulse oximetry, snoring sensor, abdominal and thoracic plethysmography, body position sensor)
 - Movement disorder : propriospinal myoclonus at sleep onset, PLM, RBD (EMG-bilateral tibialis and chin)
 - Parasomnia
 - Epileptic event : EEG
 - Cardiac event : ECG

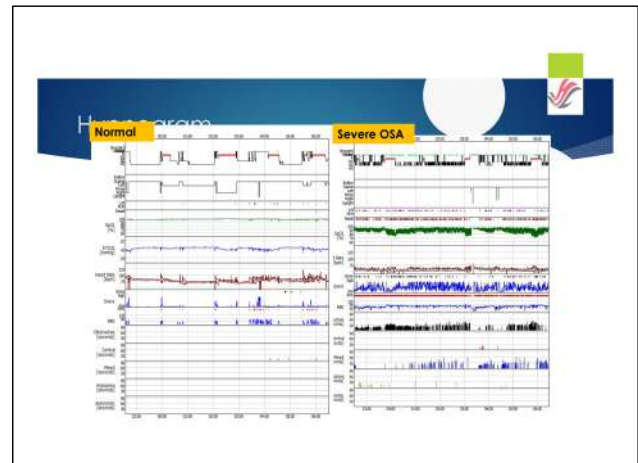
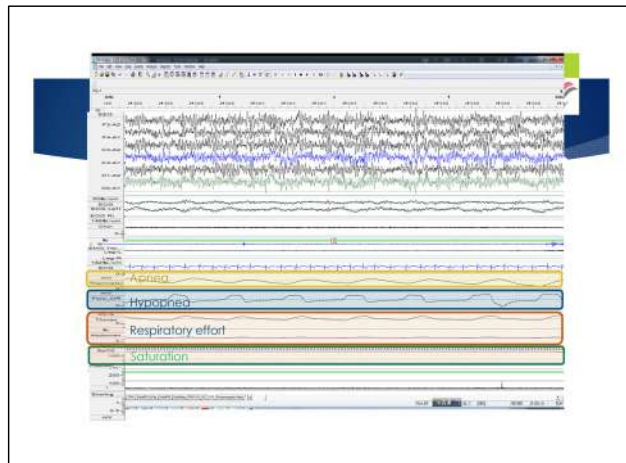
General Parameters must be reported

1. Electroencephalogram (EEG) derivations
2. Electrooculogram (EOG) derivations
3. Chin electromyogram (EMG)
4. Leg EMG derivations
5. Airflow signals
6. Respiratory effort signals
7. Oxygen saturation
8. Body position
9. Electrocardiogram (ECG)



Respiratory Events should be on PSG report

- | | |
|--|---|
| 1. Number of obstructive/mixed/central apneas | 10. Oxygen desaturations (S5, total number, index) |
| 2. Number of obstructive/central hypopneas | 11. Arterial oxygen saturation, mean value |
| 3. Number of apneas + hypopneas | 12. Minimum oxygen saturation during sleep |
| 4. Apnea Index (AI: # obstructive apneas + # central apneas ÷ # mixed apneas) × 60 / TST | 13. Occurrence of hypoventilation during diagnostic study (adult, children) |
| 5. Hypopnea Index (HI: # hypopneas ÷ 60 / TST) | 14. Occurrence of hypoventilation during PAF-Winton (adult, children) |
| 6. Apnea + Hypopnea Index (AHI: # of apneas and hypopneas ÷ 60 / TST) | 15. Occurrence of Cheyne-Stokes breathing in adults/children |
| 7. Obstructive/Central apnea hypopnea index | 16. Duration of Cheyne-Stokes breathing (absolute or as a percentage of total sleep time) or the number of Cheyne-Stokes breathing events |
| 8. Respiratory effort-related arousal (RERA): total number, index | 17. Occurrence of snoring |
| 9. Respiratory disturbance index (RDI: AHI + RERA index) | |



Part I . Rules for Adults

A. Technical Specifications

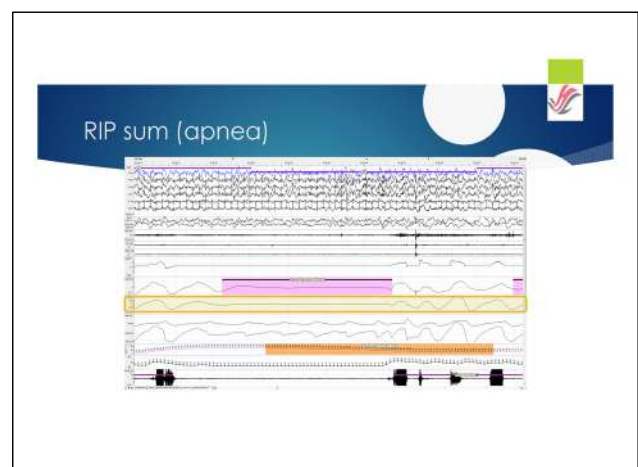
- For identification of an **apnea** during a diagnostic study, use an **oronasal thermal airflow** sensor to monitor airflow. **RECOMMENDED**
- For identification of an apnea during a diagnostic study when the oronasal thermal airflow sensor is not functioning or the signal is not reliable, use one of the following (alternative apnea sensors) **RECOMMENDED**
 - a. nasal pressure transducer (with or without square root transformation)
 - b. RIPsum (calibrated or uncalibrated) **RECOMMENDED**
 - c. RIPflow (calibrated or uncalibrated) **RECOMMENDED**
 - d. PVDFsum (polyvinylidene fluoride) **ACCEPTABLE**

Technical Specifications

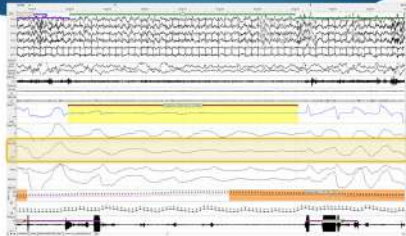
- For identification of a **hypopnea** during a diagnostic study, use a **nasal pressure transducer** (with or without square root transformation of the signal) to monitor **RECOMMENDED**
- For identification of a hypopnea during a diagnostic study when the nasal pressure transducer is not functioning or the signal is not reliable, use one of the following (alternative hypopnea sensors) **RECOMMENDED**
 - a. oronasal thermal airflow **RECOMMENDED**
 - b. RIPsum (calibrated or uncalibrated) -optional
 - c. RIPflow (calibrated or uncalibrated) **RECOMMENDED**
 - d. dual thoracoabdominal RIP belts (calibrated or uncalibrated) **RECOMMENDED**
 - e. PVDFsum **ACCEPTABLE**

RIP (respiratory inductance plethysmography)

- The **RIPsum** is the sum of the signals from thoracic and abdominal RIP sensors (belts) and excursions in the signal are an estimate of tidal volume.
- The **RIPflow** is the time derivative of the RIPsum and excursions in the signal are an estimate of airflow.
- The **PVDFsum** is the sum of signals from thoracic and abdominal PVDF sensors (belts).
- Reco: PVDF (polyvinylidene fluoride) **VDFsum is optional.**



RIPsum (hypopnea)

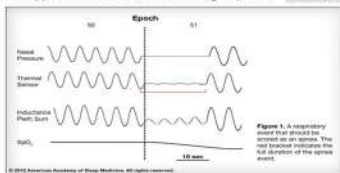


Technical Specifications

- ▶ During positive airway pressure (PAP) titration, use the **PAP device flow signal** to identify apneas or hypopneas. **RECOMMENDED**
- ▶ For monitoring **respiratory effort**, use one of the following:
 - a. esophageal manometry **RECOMMENDED**
 - b. dual thoracoabdominal RIP belts (calibrated or uncalibrated) **RECOMMENDED**
 - c. dual thoracoabdominal PVDF belts **ACCEPTABLE**
- ▶ For monitoring oxygen saturation, use pulse oximetry with a maximum acceptable signal averaging time of ≤ 3 seconds at a heart rate of 80 beats per minute. **RECOMMENDED**
- ▶ For monitoring **snoring**, use an acoustic sensor (e.g. microphone), piezoelectric sensor or nasal pressure. - optional **RECOMMENDED**
- ▶ For detection of hypoventilation during a diagnostic study, use arterial PCO₂, transcutaneous PCO₂ or end-tidal PCO₂ transducer - optional **RECOMMENDED**
- ▶ For detection of hypoventilation during PAP titration, use arterial PCO₂, or use transcutaneous PCO₂ **RECOMMENDED**

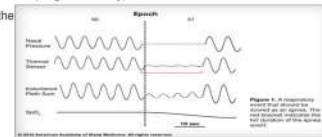
Measuring Event Duration

- ▶ For scoring either an apnea or a hypopnea, the event duration is measured from the nadir preceding the first breath that is clearly reduced to the beginning of the first breath that approximates the baseline breathing amplitude. **RECOMMENDED**



Scoring of Apneas

- ▶ Score a respiratory event as an apnea when **BOTH** of the following criteria are met **RECOMMENDED**
 - a. There is a drop in the peak signal excursion by $\geq 90\%$ of pre-event baseline using an **oronasal thermal sensor** (diagnostic study), PAP device flow (titration study) or an **alternative apnea sensor** (diagnostic study).
 - b. The duration of the

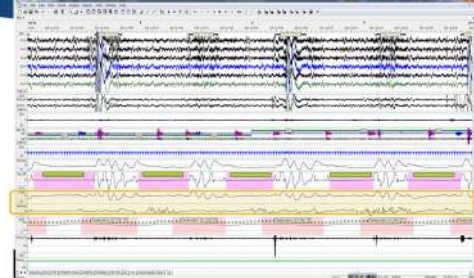
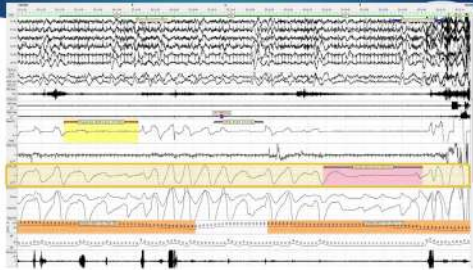


Scoring of Apneas

- ▶ Score an apnea as **obstructive** if it meets apnea criteria and is associated with **continued or increased** inspiratory effort throughout the **entire** period of absent airflow. **RECOMMENDED**
- ▶ Score an apnea as **central** if it meets apnea criteria and is associated with **absent** inspiratory effort throughout the entire period of absent airflow. **RECOMMENDED**
- ▶ Score an apnea as **mixed** if it meets apnea criteria and is associated with **absent** inspiratory effort in the initial portion of the event, **followed by resumption** of inspiratory effort in the second portion of the event **RECOMMENDED**

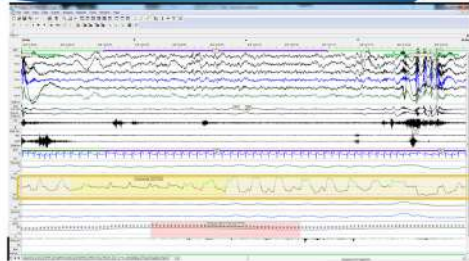
Obstructive Apnea



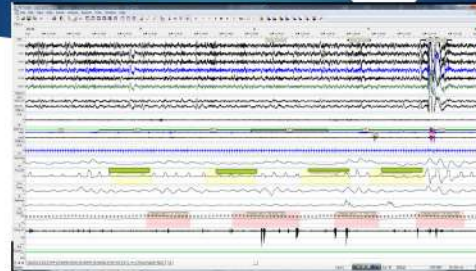


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Hypopnea (obstructive)



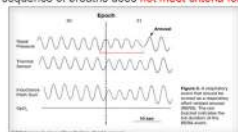
Hypopnea (obstructive)



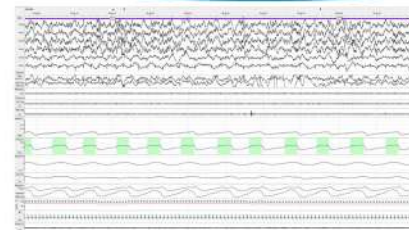
Scoring Respiratory Effort-Related Arousal (RERA)

- ▶ Scoring respiratory effort-related arousals is *optional*.
- ▶ Score a respiratory event as a respiratory effort-related arousal (RERA) if there is a sequence of breaths lasting **≥10 seconds** characterized by increasing respiratory effort or by flattening of the inspiratory portion of the nasal pressure (diagnostic study) or PAP device flow (titration study) waveform **leading to arousal** from sleep when the sequence of breaths does **not meet criteria for an apnea or hypopnea**.

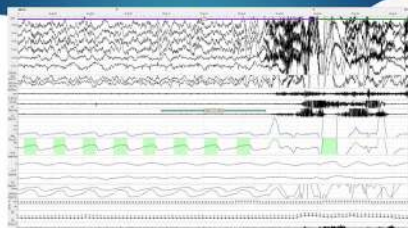
RECOMMENDED



Before RERA



RERA



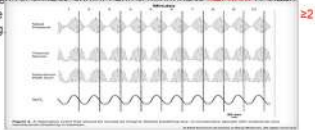
Scoring Hypoventilation

- ▶ Monitoring hypoventilation is *optional*.
- ▶ If electing to score hypoventilation, score a respiratory event as hypoventilation during sleep if **EITHER** of the below occur
 - There is an increase in the arterial PCO_2 (or surrogate) to a value **>55 mmHg** for **≥10 minutes**.
 - There is a **≥10 mmHg** increase in arterial PCO_2 (or surrogate) during sleep (in comparison to an awake supine value) to a value **> 50 mmHg** for **≥10 minutes**.

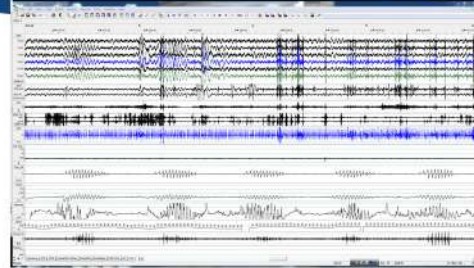
Scoring Cheyne-Stokes Breathing

► Score a respiratory event as Cheyne-Stokes breathing if **BOTH** of the following are met

- There are episodes of ≥ 3 consecutive central apneas and/or central hypopneas separated by a crescendo and decrescendo change in breathing amplitude with a cycle length of ≥ 40 seconds.
- There are ≥ 5 central apneas and/or central hypopneas per hour of sleep associated with the hours of monitoring.



Cheyne-Stokes Respiration



Part 2 : Rules for Children

• Ages for Which Pediatric Respiratory Scoring Rules Apply

: Criteria for respiratory events during sleep for infants and children can be used for children **<18 years**, but an individual sleep specialist can choose to score children ≥ 13 years using adult criteria.

Part 1 : Rules for Children : same as adults

A. Technical Specifications

- For identification of an **apnea** during a diagnostic study, use an **oronasal thermal airflow** sensor to monitor airflow. **RECOMMENDED**
- For identification of an apnea during a diagnostic study when the oronasal thermal airflow sensor is **not** functioning or the signal is not reliable, use one of the following (alternative apnea sensors) **RECOMMENDED**
 - a. nasal pressure transducer (with or without square root transformation) **RECOMMENDED**
 - b. RIPsum (calibrated or uncalibrated) **RECOMMENDED**
 - c. RIPflow (calibrated or uncalibrated) **ACCEPTABLE**
 - d. end-tidal PCO_2

Technical Specifications : same as adults

- For identification of a **hypopnea** during a diagnostic study, use a **nasal pressure transducer** (with or without square root transformation of the signal) to monitor **RECOMMENDED**
- For identification of a hypopnea during a diagnostic study when the nasal pressure transducer is **not** functioning or the signal is not reliable, use one of the following (alternative hypopnea sensors)
 - a. oronasal thermal airflow **RECOMMENDED**
 - b. RIPsum (calibrated or uncalibrated) -optional
 - c. RIPflow (calibrated or uncalibrated) **RECOMMENDED**
 - d. dual thoracoabdominal RIP belts (calibrated or uncalibrated) **RECOMMENDED**

Scoring of Apneas

► Score a respiratory event as an apnea when **ALL** of the following criteria are met: **RECOMMENDED**

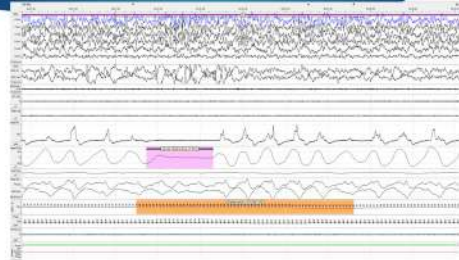
- There is a drop in the peak signal excursion by $\geq 90\%$ of pre-event baseline using an **oronasal thermal sensor** (diagnostic study), PAP device flow (titration study) or an **alternative apnea sensor** (diagnostic study).
- The duration of the $\geq 90\%$ drop at **least the minimum duration** as specified by obstructive, mixed, or central apnea duration criteria.
- The event meets respiratory effort criteria for obstructive, central or mixed apnea.

two breaths

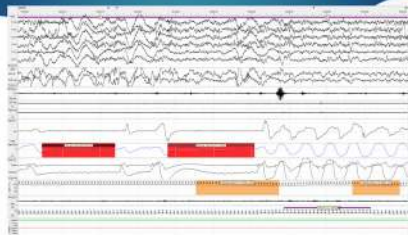
Scoring of Apneas

- ▶ Score an apnea as **obstructive** RECOMMENDED
: at least the duration of 2 breaths during baseline breathing AND is associated with the presence of respiratory effort throughout the entire period of absent airflow.
- ▶ Score an apnea as **central** RECOMMENDED
: absent inspiratory effort throughout the entire duration of the event AND at least one of the following is met:
a. The event lasts ≥ 20 seconds.
b. The event lasts at least the duration of two breaths during baseline breathing and is associated with an arousal or a $\geq 3\%$ arterial oxygen desaturation.
c. The event lasts two breaths and with a decrease in heart rate to less than 50 beats per minute for at least 5 seconds or less than 60 beats per minute for 15 seconds (infants under 1 year of age only).
- ▶ Score an apnea as **mixed** if it meets apnea criteria for at least the duration of 2 breaths during baseline breathing AND is associated with absent respiratory effort during one portion of the event AND the presence of inspiratory effort in another portion, regardless of which portion comes first. RECOMMENDED

Obstructive Apnea (Children)



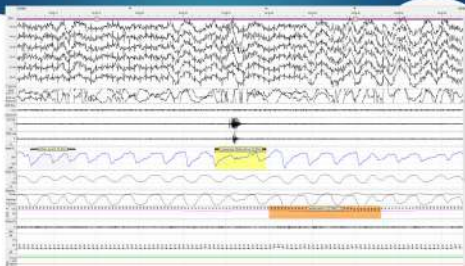
Central apnea (children)



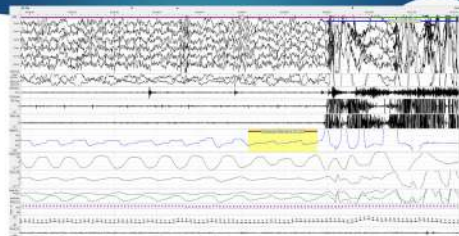
Scoring of Hypopneas

- ▶ Score a respiratory event as a hypopnea if **ALL** of the following criteria are met:
a. The peak signal excursions drop by $\geq 30\%$ of pre-event baseline using nasal pressure (diagnostic study), PAP device flow (titration study) or an alternative hypopnea sensor (diagnostic study).
b. The duration of the $\geq 30\%$ drop in signal excursion lasts for ≥ 2 breaths.
c. There is a $\geq 3\%$ oxygen desaturation from pre-event baseline or the event is associated with an arousal.
- ▶ score a hypopnea as obstructive or central : optional

Hypopnea (children)



Hypopnea (children)



Scoring Respiratory Effort-Related Arousal (RERA)

- ▶ Scoring respiratory effort-related arousals is optional.
- ▶ Score a respiratory event as a respiratory effort-related arousal (RERA) if there is a sequence of breaths lasting **lasting ≥ 2 breaths** (or the duration of two breaths during baseline breathing) when the breathing sequence is characterized by increasing respiratory effort or by flattening of the inspiratory portion of the nasal pressure (diagnostic study) or PAP device flow (titration study) waveform **leading to arousal** from sleep when the sequence of breaths RECOMMENDED **does not meet criteria for an apnea or hypopnea**.

Scoring Hypoventilation

- ▶ Monitoring hypoventilation is optional.
- ▶ Score a respiratory event as hypoventilation during sleep when **>25%** of the total sleep time as measured by either the arterial PCO_2 or surrogate is spent with a **$\text{PCO}_2 > 50$ mm Hg**.