SLEEP DISORDERED BREATHING DIAGNOSIS & MANAGEMENT

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Sleep-disordered breathing (SDB)

- **Definition**- Sleep-disordered breathing (SDB) is present when there are repetitive episodes of apnea or hypopnea during sleep, associated with sleep fragmentation, arousals, and reductions in oxygen saturation.

- **Hypopnea** - Decrement in airflow of 50 percent or more associated with a 4 percent fall in oxygen saturation and/or electroencephalographic (EEG) arousal.

- **Apnea** – Obstructive / Central / Mixed.

- **RERA (Respiratory effort related arousal event)** - Sequence of breaths characterized by increasing effort leading to an arousal from sleep that does not fulfill criteria for apnea or hypopnea.

Sleep-disordered breathing (SDB) - Classification

- Obstructive Sleep Apnea/Hypopnea Syndrome
- Central Sleep Apnea Syndrome with Cheyne-Stokes Respiration (CSA-CSR)
- Central Sleep Apnea Syndrome
- Obesity Hypoventilation Syndrome

(AASM Task force report 1999)

- UARS – Patients with RERAs who do not have events that would meet definitions for apneas and hypopneas.
- ICSD II – UARS / RERA's be included as part of OSA and not considered as a separate entity. (Similar pathophysiology & Clinical consequences)

OSA Syndromes

- Primary snoring, upper airway resistance syndrome, and OSA.

- Common with all these entities is narrowing or complete obstruction of the upper airway.

- ***PRIMARY SNORING***
- Primary snoring is snoring that occurs regularly but does not result in significant daytime impairment or complaints or disruption of sleep.

- It has not been definitively shown that primary snorers will eventually develop OSA.

- Whether primary snoring results in harmful sequelae is currently unknown. (Epidemiological studies)

OSA / OSAS

- AHI—the number of apneas plus hypopneas per hour of sleep.
- AHI greater than 5 to 10 events per hour is indicative of OSA.
- For OSAS – A /B +C
- A. Excessive daytime sleepiness that is not explained by other factors
- B. Two or more of the following that are not explained by other factors:
- Choking or gasping during sleep
- Recurrent awakenings from sleep
- Unrefreshing sleep
- Daytime fatigue
- Impaired concentration
- C. Overnight monitoring demonstrates 5 to 10 or more obstructed breathing events per hour during sleep or greater than 30 events per 6 hours of sleep.

Obstructive sleep apnea

Mild sleep apnea, AHI: 5 to 15
events per hour

Moderate sleep apnea, AHI:15 to 30
events per hour

Severe sleep apnea, AHI greater
than 30 events per hour

AHI excludes the degree
of oxygen desaturation, degree of
hypoventilation, and
total number of arousals.

↑ AHI ----- ↑ Symptoms

Hypopneas – Same clinical
consequence as apneas

Diagnosis – History & Questionnares

- Severity of symptoms & anthropometric data predict with high sensitivity the probability of an increased AHI.

- Sleepiness – characterized by subjective ratings, including the Stanford Sleepiness Scale and Epworth Sleepiness Scale.

- The Epworth Sleepiness Scale is most often applied in clinical routines because of its practicability.

- QOL is significantly impaired in OSAS patients.

- Medical Outcomes Study Short Form 36 (SF-36) - multidimensional health components.
- Sleep Apnea Quality of Life Index and Quebec Sleep Questionnaire were developed to assess the specific effects of sleep apnea on QOL and within-subject changes after treatment.

- The choice of the instrument depends on whether sleepiness, impairment or treatment effects should be measured.

Epworth sleepiness scale

Advantages

Represents the
average sleep
propensity

Simplicity and
practicability
in routine especially
to describe
sleepiness in OSAS

Quality of life (QOL) in OSA

- SRBD considerably reduce the QOL
- AHI correlates poorly with these outcomes.
- QOL is what matters most to patients with sleep apnea.
- Recommended to apply to all patients at least one of the following instruments to measure QOL prior to and during therapy.
- **General Health Status Questionnaires**
- *Short Form 36 (SF-36), Nottingham Health Profile (NHP), Sickness Impact Profile (SIP), Munich Life Quality Dimension List (MLDL)*.
- **OSAS-Specific Questionnaires**
- *Calgary Sleep Apnea Quality of Life Index*
- *Quebec Sleep Questionnaire*

- SAQLI is time-consuming.
- The QSQ can be administered without supervision and even mailed to patients.
- The ease and convenience of standardized items of the QSQ exceeds the benefits of individualized items of the SAQLI.
- As an evaluative instrument to measure therapeutic effects, a disease-specific self-administered questionnaire like the QSQ is preferable because it is sensitive to treatment-induced changes.
- If there is no relevant improvement of QOL after several weeks on CPAP, a thorough check-up of the diagnosis and the treatment modality should be performed.

Polysomnography

- The method for the definite diagnosis of disordered breathing during sleep is cardiorespiratory polysomnography.
- Includes the recording of sleep signals, respiratory effort, muscle movement and cardiovascular signals.
- Consists of a set of established signals recorded on a polygraph.
- Cardiorespiratory polysomnography requires a minimum of 12 physiological signals.
- Sleep scoring is performed for time episodes of either 20 or 30 s duration which are called ‘epochs’.
- An 8-hour sleep consists of 960 30-second epochs to be classified visually.
- An arousal is an increase in EEG frequencies for at least 3 s and less than 15 s.

Recording methods

- The most convenient way to record blood gases is pulse oximetry.
- The gold standard to record respiration is the quantitative recording of airflow using a pneumotachograph with a closed face mask.
- Inductive plethysmography is the best noninvasive method for respiratory effort because the principle is based on frequency changes in a coil around the body. (As compared to piezo elements).
- In a considerable number of patients, the interpretation of oxygen saturation is limited. (Oxygen binding curve, Other diseases).
- End tidal CO_2 - Capnography based on the ultra-red absorption spectroscopy (URAS).

Portable monitoring systems

- May be useful for the diagnosis of moderate to severe obstructive sleep-related respiratory disorders.

- Four levels are distinguishable in the diagnosis and differential diagnosis of sleep-related breathing disorders
  - Level 1, attended polysomnography.
  - Level 2, unattended polysomnography.
  - Level 3, polygraphy with the recording of at least 3 cardiorespiratory parameters and body posture.
  - Level 4, recording of oxygen saturation and one other parameter.

- Attended polysomnography (level 1) is considered to be the gold standard

- Level 2 - Not generally recommended either for the detection or the exclusion of sleep-related breathing disorders.

- Level 3 - Suitable for detecting sleep-related respiratory disorders with an apnea-hypopnea index (AHI) 15/h.

- All portable monitoring systems are not suitable for split-night studies.

- For the detection of central sleep-related respiratory disorders and hypoventilation syndromes there are no high-evidence studies available.

A typical diagnostic polysomnogram (PSG) entails a whole night of recording during sleep.

- Patients found to have sleep apnea return on a subsequent night for a second sleep study during which the level of CPAP necessary to abolish SDB events is determined by titration.

- A “split night” study combines the diagnostic and treatment studies into one night.

- Rationale - AHI in the first half of the night is indicative of the whole night of study; cost effective and efficient.

- An absence of REM sleep and/or less than 3 hours of sleep recorded during a split-night study can lead to significant underestimation of sleep apnea severity.

- ***GENERAL MEASURES***
- Maintaining a consistent bedtime and wake-up time as part of good sleep hygiene.
- Avoiding ingestion of stimulants (e.g., caffeine) and night exercise.

- WEIGHT LOSS
- 1 percent change in weight is associated with a 3 percent change in AHI.
- OSA severity is improved and in some patients abolished.
- Bariatric surgery.

- PHARMACOTHERAPY
- Antidepressants, respiratory stimulants, central nervous system stimulants, and hormones have been tried.
- Pharmacotherapy does not significantly improve apnea index.

- OXYGEN THERAPY
- Useful in patients who experience significant reductions in nocturnal oxyhemoglobin independent of apneas.

Specific Medical Therapies

- ***Position Therapy***
- Promoting sleep in the lateral decubitus position.
- Role of raising head end of the bed unclear.

- ***Pharyngeal Muscle Stimulation***

- **DEVICES**

CPAP (Continuous positive airway pressure)

- **Nasal CPAP**
- **Nasal BIPAP**
- **Auto CPAP**

- ***Intraoral Devices***

- Nasal CPAP is the treatment of choice for patients with moderate or severe OSA

- CPAP is indicated in all patients with an AHI greater than 30 events/hour and in those patients with an AHI of 5 to 30 events/hour with associated symptoms.

- Titration polysomnography - Typically, 5 to 20 cm H_2O is the pressure needed to abolish apneas, snoring, and oxyhemoglobin desaturation in all positions and during REM sleep.

- CPAP titration should not be considered complete unless the patient has been supine.

- The biggest drawback to nasal CPAP use – Adherence to nightly use.

Factors affecting adherence

Symptomatic relief
Initial experience with CPAP
Side effects – nasal congestion, airleaks
Recent life events
Social support system

Methods to improve adherence

Intensive educational/psychological support
Humidification
Auto-titrating CPAP
Bi-level PAP
Cflex

Regular use in the first 3 months of CPAP therapy appears to be strongly indicative of long-term use.

Patients use the treatment, on average, for 4 to 5 hours per night.

Auto CPAP

- Adjusts CPAP throughout the night by detection of airway flow, snoring, apneas, inspiratory flow limitation, and airway vibration (snoring).
- Less pressure delivered throughout the night - more tolerable.
- No significant improvement in adherence.

- ***BIPAP***
- Reduced expiratory positive airway pressure.
- Subjects may feel more comfortable , use it more often.
- Cost is a concern , No significant improvement in adherence.

- ***Others***
- ***C- Flex (Respironics) & EPR (ResMed)***
- ***Ramp***

- ***Mask Clinics***

Intraoral Devices

- Tongue retaining device
- Palatal lifting devices
- Mandibular advancing devices

- Indications - Patients with primary snoring, or mild-to-moderate OSA where weight loss and CPAP have not been viable options, and for those who are not surgical candidates.

- Severe OSA patients - Trial of CPAP first.

- Recommended to have follow-up polysomnography and dental visits.

- Do not reduce the AHI as much as nasal CPAP.

- The higher the AHI, the less benefit obtained with intraoral devices

- Side effects - Excessive salivation, transient discomfort after awakening, temporomandibular joint discomfort, and changes in occlusive alignment.

- Tracheotomy - Only surgery that is consistently effective in OSA.
- Indications - Life-threatening OSA with cor pulmonale, arrhythmias, or severe hypoxemia that cannot be controlled with nasal CPAP.
- Level of obstructive site influences the type of surgical procedure to be performed.
- Fiberoptic laryngoscopy or imaging can be used to classify the obstruction .
- Oropharyngeal (type I), oropharyngeal and hypopharyngeal (type II), and hypopharyngeal (type III) levels.
- The surgical outcomes are better in patients with retropalatal obstruction compared with retroglossal obstruction.

Upper airway resistance syndrome (UARS)

- Essential diagnostic features
- ➢ Excessive daytime sleepiness/daytime fatigue
- ➢ Polysomnographic findings of an AHI of less than 5 per hour of sleep.
- ➢ Elevated electroencephalographic (EEG) arousal index (>10 EEG arousals/hour) associated with increased respiratory efforts

- Supportive features
- History of snoring, crescendo snoring before EEG arousal, and improvement with nasal CPAP therapy.

- Nasal cannula–pressure transducer system and esophageal pressure monitoring - Recognition of increasing negative intrathoracic pressure associated with upper airway flow limitation, resulting in arousals from sleep.

- Younger age groups, male predominance noted in OSA is not seen in UARS.
- UARS also is seen in patients who have a lower body mass index (BMI).
- No apneas, hypopneas, or changes in arterial oxygen saturation are seen.
- The standard for the measurement of respiratory effort is esophageal pressure (Pes) monitoring.
- No data regarding the benefit of weight loss in the treatment of UARS.
- CPAP is still the most frequently recommended treatment option.
- Oral appliances and surgery have been used with variable success.

Central sleep apnea

- Episodes of apnea or hypopnea related to loss of ventilatory output from the central respiratory generator in the brainstem to the respiratory pump.

- 2 classes based upon the presence or absence of hypercapnia during wakefulness.

- Hypercapnic – Association with a variety of neurologic diseases, including Shy-Drager syndrome, CVA, myasthenia gravis, neuromuscular disease, bulbar poliomyelitis, brain stem infarction, and encephalitis.

- Normocapnic / Hypocapnic –
- Primary CSA syndrome.
- Central sleep apnea-Cheyne-Stokes breathing (CSA-CSR).
- High altitude periodic breathing (HAPB).

- ***Primary CSA***
- Uncommon disorder and the pathophysiology and natural history are not well understood.

- Exaggerated ventilatory response to $PaCO_2$ during both wakefulness and sleep.

- Arousals and ventilatory pattern in CSA are not cyclical waxing and waning.

- Dominant clinical features of CSA include fragmented sleep with frequent awakenings which may lead to daytime hypersomnolence.

- More than 5 central events per hour of sleep are required to make a diagnosis of CSA.

- Treatment – CPAP , Oxygen , Acetazolamide.

Cheyne-Stokes respiration (CSA-CSR),

- Common form of SDB most often encountered in the setting of HF.
- Breathing pattern characterized by crescendo-decrescendo tidal volumes with intervening central apneas - Periodic breathing.
- In contrast to OSA, where arousals typically occur with apnea termination, arousals from sleep in CSA-CSR tend to occur at the height of the hyperpneic phase following apnea.
- CSA-CSR in HF has been associated with increased mortality.
- PSG - Characteristic waxing and waning pattern of alternating apneas and hyperpneas.
- 5 or more central apneas or hypopneas per hour of sleep as well as at least 10 consecutive minutes of cyclic crescendo and decrescendo changes in breathing amplitude.

Treatment of CSA-CSR

Directed treatment of underlying heart failure
CPAP
Oxygen
Inhaled CO2
Theophylline
Acetazolamide

High altitude periodic breathing

- All individuals ascending to elevations greater than 7,500 meters will experience HAPB.
- Cyclic central apneas and hyperpneas associated with repetitive arousals, fragmented sleep of poor quality and occasional dyspnea.
- Significant symptoms can also occur at lesser elevations, as low as 3,500 meters.
- HAPB is a normal response to altitude. Usually on first night.
- Mechanism - Heightened sensitivity to hypoxia with an exaggerated ventilatory response to reduced ambient oxygen levels leading to hypocapnia.
- Treatment - Supplemental oxygen is effective at reversing HAPB, while inhaled CO_2 may reduce apneas but appears to have no effect on the periodicity of ventilation

Obesity hypoventilation syndrome (OHS)

- Syndrome of central hypoventilation during wakefulness that is seen in obese patients with sleep disordered breathing.

- Pathogenesis is not completely understood.

- Diagnostic features
- Obesity

- Sleep-disordered breathing (SDB) in the form of OSAHS with AHI greater than 5 per hour and/or sleep hypoventilation syndrome (SHVS) (a 10–mm Hg increase in arterial PCO_2 or persistent oxygen desaturation not explained by obstructive apneas or hypopneas)

- Stable daytime hypoventilation (arterial PCO_2 > 45 mm Hg)

- Associated with a higher morbidity and mortality rate compared with eucapnic OSAHS patients matched for age, body mass index, and lung function.

- SDB → intermittent hypercapnia with respiratory acidosis → increased serum bicarbonate, levels in the daytime → Persistent metabolic alkalosis blunts the central ventilatory response to carbon dioxide → Reducing the change in hydrogen ions for a given change in carbon dioxide → Hypoventilation.

- Primarily in middle age ,with an estimated prevalence of 10% to 20% of OSAHS patients.

- Increases with degree of obesity.

- Patients more likely to have dyspnea, daytime desaturation, and edema.

- Evaluation of lung functions is important to identify obstructive and restrictive lung disease.

- Serum bicarbonate is a useful screening test, and ABG testing usually reveals compensated respiratory acidosis with a normal pH

Treatment of OHS

- CPAP therapy may not achieve the required goals in OHS patients due to a failure of airway patency, inadequate inspiratory pressures, patient intolerance, and most importantly an absence of necessary ventilatory support.

- Nocturnal NIV – Treatment of choice.

- Supplemental oxygen if BIPAP does not correct oxygen desaturation.

- Monitoring compliance → Adherence to therapy is associated with improved outcomes.

- Patients who do not tolerate noninvasive positive airway pressure should be considered for tracheostomy.

- Bariatric surgery for selected patients.

Summary

- Recognition that sleep medicine is a unique discipline.
- Enormous impact of sleep disturbance on many aspects of our life.
- Sleep related breathing disorders are increasingly common.
- Need to educate the community regarding the symptoms of SDB and informing that specific treatments exist.