

Complex Sleep-Disordered Breathing

Recognition and Management

Complex Sleep-Disordered Breathing

- Complex sleep apnea (CompSA) is a form of central apnea specifically identified by the persistence or emergence of central apneas or hypopneas upon exposure to CPAP or an E0470 device when obstructive events have disappeared. These patients have predominantly obstructive or mixed apneas during the diagnostic sleep study occurring at greater or equal to 5 times per hour. With use of CPAP or E0470, they show a pattern of apneas and hypopneas that meets the definition of CSA.

Central Sleep Apnea Definition

- An apnea/hypopnea index of greater than 5
- Central apneas/hypopneas greater than 50% of the total apneas/hypopneas
- Central apneas/hypopneas greater than or equal to 5 times per hour
- Symptoms of either excessive sleepiness or disrupted sleep

Polysomnographic Phenotypes of Sleep-Disordered Breathing

- Three fundamental physiologic derangements
 - Airflow obstruction - OSA
 - Dysregulation of respiratory control - CSA
 - Hypoventilation or ventilation/perfusion mismatch – COPD REM related desaturation

Categories of Sleep Apnea

- Obstructive apnea - effort + glottic collapse
- Central apnea - no effort
- Mixed apnea - no effort followed by effort + glottic collapse
- Complex apnea – variably central and mixed events on treatment with PAP

Pathophysiology of Complex Apnea

- Dysregulation of CO₂ homeostasis
- Hypocapnea is induced by CPAP/Bilevel PAP
- Patients have a relative hypersensitivity to the hypocapnea and become apneic
- Test has the appearance of a “CPAP/Bilevel PAP tolerance test”

Pathophysiology of Complex Apnea

- Two clinical types of patients - hypercapnic and hypocapnic
- Hypercapnic – central congenital hypoventilation, advanced chronic obstructive lung disease, obesity hypoventilation
- Hypocapnic - respiratory instability related to highly sensitive hypocapnia-induced apneic threshold

Pathophysiology of Complex Apnea

- NonREM sleep occurs in “stable” and “unstable” forms – microstructure of sleep
- Recognition of “complexity” by time series analysis of sleep stability states
- “Unstable” nonREM can be recognized as cyclic alternating pattern (CAP)

Simple vs. Complex Apnea

- NonREM sleep
 - Obstructive apnea – usually non-CAP nonREM with relatively stable arousal threshold
 - Complex apnea – usually CAP nonREM with arousal instability
- REM
 - Obstructive apnea – worse
 - Complex – better

Complex Sleep Apnea

- Pressure support (CPAP/Bilevel PAP) of airway can eliminate flow limitation and improve breathing, but control dysfunction persists or becomes apparent
- Complex apnea is induced or increases before flow limitation can be completely eliminated
- Patients with complex disease cannot be adequately treated with PAP

Complex Sleep Apnea

- CPAP/Bilevel PAP relatively more biologically uncomfortable
- Arousals cannot be eliminated
- Patients have residual symptoms (fatigue, sleepiness, depressed mood)

Complex Sleep Apnea

- Bilevel PAP can induce worsening instability, presumably by worsening hypocapnea, especially without a backup rate
- Oxygen treatment can be tried but is rarely fully effective
- Remarkable stability of breathing during REM

Management of Complex Sleep Apnea

- Accurate disease phenotyping is necessary to establish the diagnosis
- Visual polysomnographic analysis often shows CAP/nonREM dominant disease
- Often short symmetric cycles of respiratory abnormality in nonREM sleep

Management of Complex Sleep Apnea

- Avoid pressure toxicity – most important point
- PAP therapy – CPAP/Bilevel PAP are inducing hypocapnea and causing the problem
- Oxygen supplementation can be helpful if there is desaturation

Management of Complex Sleep Apnea

- Bilevel PAP with a backup rate across the central portion of the events can occasionally work – goal is to prevent hypercapnea but not induce hypocapnea
- Variable positive airway pressure (VPAP) or so called adaptive servo ventilation may be the treatment of choice – less hypocapnea is produced with this mode of treatment

Management of Complex Sleep Apnea

- Avoid drugs that induce complex disease – high-dose opiates including methadone and baclofen
- Pharmacotherapy – theophylline and acetazolamide

Management of Complex Sleep Apnea

- Drugs that induce stable nonREM sleep – classic benzodiazepines, ω -1-agonists, selective GABA-A receptor agonist gaboxodol, the neurosteroids, and GABA transporter blocker, tiagabine
- Non-GABA mechanisms – mirtazapine and sodium oxybate

Management of Complex Sleep Apnea

- Consider nonvented mask and/or enhanced expiratory rebreathing space
- Controlled increase of CO₂ concentrations in the inspired air

Management of Complex Sleep Apnea

- If at all possible, prevent it in the first place
- Minimize hypocapnea by using the lowest PAP pressure that allows reasonable control of OSA