Chapter: 9

SLEEP in COPD

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COPD affects 24 million people in the USA and is projected to be the 3rd leading cause of death worldwide by the year 2020. COPD is the 7th leading cause of disability in the USA resulting in significant morbidity and impaired quality of life (QOL). Little is known regarding the sleep patterns in patients with COPD or how altered sleep may impact clinical outcomes. I will review the data on sleep quality in COPD patients, factors that disturb sleep, the effect of normal sleep on respiratory function and how this can impact the patient with COPD, and suggest sleep improving strategies.

Sleep Quality in COPD

Approximately 40% of patients with severe COPD complain of difficulty initiating and maintaining sleep or other sleep disturbance. Additionally, polysomnography (PSG) has demonstrated increased sleep latency, decreased total sleep time (TST), poor sleep efficiency, decreased slow wave sleep (SWS) and REM sleep, as well as an increase in the number of arousals and early morning awakenings causing fragmented sleep (NETT trial). COPD patients are also shown to have more nocturnal wakefulness (30%) than control subjects.

Factors that Contribute to Sleep Disruption

Insomnia and daytime sleepiness is more prevalent in COPD patients with nighttime cough, dyspnea, or wheezing. Other factors that may cause sleep fragmentation include pain, frequent urination, inability to lie flat, or other co-morbid condition. Co-existent sleep disorders are present in 10-20% of individuals with COPD, such as snoring, periodic leg movement (PLMD) and restless leg syndrome (RLS) that are often un-diagnosed or un-treated.

Medications used to treat COPD can affect sleep quality. Beta-adrenergics if taken in higher dosage may cause insomnia. However, if bronchoconstriction is present, then a beta-agonist improves sleep. Long-acting anticholinergic, tiotropium, improves sleep quality, but the effect may diminish over time. Oxygen therapy can have a positive effect on sleep quality.

All these abnormalities contribute to COPD patient's complaints of excessive daytime sleepiness (72%), impaired daytime concentration (32%) and fatigue, which can interfere with performing daily activities, QOL, and are associated with more pronounced depression.

Normal Respiratory Changes during Sleep

Normal sleep is associated with the loss of voluntary respiratory control and breathing becomes dependent on metabolic or gas exchange components. Ventilatory responses to both hypercapnia and hypoxemia are decreased due to decreased medullary chemo-

responsiveness. This becomes more pronounced during REM sleep when there is a loss of intercostal and accessory muscles activity leaving the diaphragm to maintain adequate work of breathing and minute ventilation. Minute ventilation decreases by ~10% in healthy subjects during NREM and Pa02 may decrease by 2-8mm Hg with an increase in PaC02 by 3-10mm Hg. Additionally there is increased upper airway resistance due to decreased pharyngeal dilator muscle activity. Airflow obstruction and hypoventilation result in ventilation/perfusion abnormalities that do not impact overall respiratory function or gas exchange in healthy individuals.

Effect of Respiratory Function during Sleep in COPD Patients

Nocturnal hypoxemia and impaired gas exchange are known to cause significant morbidity and mortality in COPD. Indeed, to date, only oxygen therapy has been shown to improve mortality and exercise tolerance (NOTT trial). Hypoventilation, altered neuromuscular function, and changes in breathing patterns that are expected during normal sleep can cause profound respiratory impairment in patients with COPD (1).

Normal alterations in respiratory mechanics and gas exchange that occur during sleep can result in substantial nocturnal oxygen desaturation in patients with COPD. Koo et al studied 15 patients with severe COPD (FEV1 0.96 liters) and found a mean decrease in nocturnal Pa02 of 13.5mm Hg, **despite** a lack of daytime hypoxemia (Pa02 >60mm Hg) reflecting the potential deleterious effects that can occur during sleep. Forced expiratory volume in one second (FEV1) correlates poorly with the degree of oxygen desaturation that may occur during sleep. Daytime oxygen saturation is the best predictor of sleep desaturation. Individuals with lower baseline daytime oxygenation are more susceptible to developing sustained nocturnal oxygen desaturation. Those with impaired diaphragmatic function (emphysema) are especially vulnerable during REM sleep where minute ventilation has been shown to drop by 32% resulting in hypoxemia and hypercapnia. These factors may lead to the same sequelae that occur in patients with obstructive sleep apnea (OSA): impaired sleep quality, arrhythmias, vascular endothelial injury, myocardial ischemia, pulmonary hypertension and cor pulmonale with possible decreased survival.

The Overlap Syndrome

Obstructive sleep apnea (OSA) is present in 10-15% of COPD patients and is known as the “Overlap Syndrome”. Patients with Overlap Syndrome (COPD + OSA) have a compounded affect on respiratory mechanics and oxygenation that can result in profound intermittent oxygen desaturation and/or sustained hypoxemia that would not be as severe with each disease process alone. Patients with only OSA may have severe oxygen desaturation with apneic episodes, but usually are able to restore oxygenation in between the apneas. Patients with Overlap Syndrome, even if the OSA component is milder, are often incapable of regaining oxygenation in between apneas due to pre-existing lung disease.

Alternatively, patients with chronic daytime hypoxemia and/or hypercapnia may have a less sensitive arousal threshold to oxygen desaturation associated with snoring or apneic

episodes and sleep through these more severe oxygen desaturations. This can create greater daytime gas exchange abnormalities.

Management

Medical management with long-acting bronchodilators is the mainstay of therapy for COPD. Tiotropium has been shown to improve sleep duration and decrease awakenings, and patients have fewer excerbations. Oxygen therapy is indicated for daytime hypoxemia following the ATS/ERS recommendations. The potential benefit of nocturnal oxygen is to reduce the profound decrease in oxygenation that occurs during sleep that create arousals and sleep fragmentation. Continuous positive airway pressure (CPAP/BIAPAP™) may improve daytime function in patients who have daytime carbon dioxide retention, Overlap Syndrome, and sleep respiratory failure that is not corrected by oxygen therapy, congestive heart failure, and patients with nocturnal asthma. Studies have been small with inconsistent results in measuring sleep quality. No controlled studies have been conducted on the effect of positive pressure in patients with Overlap syndrome.

Additional strategies to improve sleep include promoting sleep hygiene by advising patients to go to bed and get up at the same time each day in order to facilitate a circadian rhythm. Exercise should be in the morning. The bedroom should be only for sleep and sex, not eating or watching television. Medications, such as diuretics, should be taken early in the daytime. More frequent, light meals should be eaten instead of heavier evening meals. Avoid alcohol and sedatives if possible. Underlying sleep disorders described above should be treatment. Lastly, short term use of a non-GABA agent, such as melatonin agonist may be tried and has been shown to improve sleep initiation and does not suppress respiration in COPD patients.

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