

Sleep Disorders in Patients with Bronchial Asthma

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SUMMARY

Respiratory disturbances during sleep are recognized as extremely common disorders with important clinical consequences. Breathing disorders during sleep can result in broad range of clinical manifestations, the most prevalent of which are unrefreshing sleep, daytime sleepiness and fatigue, and cognitive impairment. There is also evidence that respiratory-related sleep disturbances can contribute to several common cardiovascular and metabolic disorders, including systemic hypertension, cardiac dysfunction, and insulin-resistance. Correlations are found between asthma-related symptoms and sleep disturbances. Difficulties inducing sleep, sleep fragmentation on polysomnography, early morning awakenings and daytime sleepiness are more common in asthmatics compared with subjects without asthma. The "morning deep" in asthma is relevant for the characterization of asthma severity, and impact drugs' choices. Sleep and night control of asthma could be relevant to evaluate disease's control. Appropriate asthma control recovering is guarantor for better sleep quality in these patients and less clinical consequences of respiratory disturbances during sleep.

Key words: bronchial asthma, sleep disorders

1. INTRODUCTION

During last two decades respiratory disturbance during sleep are recognized as extremely common disorders with important clinical consequences (1, 2). In addition to affecting the quality of sleep respiratory-related sleep disturbances can interact closely with, and even contribute to, several common cardiovascular and metabolic disorders (1). The field of sleep medicine has now firmly entered the mainstream of clinical practice.

2. IMPACT OF SLEEP ON BREATHING

Sleep is not a homogenous phenomenon but consists of two distinct states, referred to as non-rapid eye movement (non-REM) or quiet sleep and rapid eye movement (REM) or active sleeping (1, 2, 3, 4). The two states are distinguished by combination of behavioral and electrographic criteria. Non-REM sleep consists of four stages that represent progressively deeper sleep, with the deepest stages (3, 4) being referred to as slow-wave sleep (4). REM sleep, during which dreaming occurs, is characterized by intense cerebral metabolic activity and central nervous system excitation, despite which incoming sensory information and outgoing motor activity are actively inhibited. In the normal adult, non-REM sleep and REM-sleep alternate cyclically, with periods of REM sleep lasting 10 to 20 minutes and occurring every 90 to 120 minutes (1, 2, 4).

Non-REM sleep and REM sleep have several important physiologic influences on breathing, particularly on respiratory drive, stability, and ventilatory mechanics (1, 2, 3). Overall respiratory drive is decreased during non-REM

sleep, owing to loss of the stimulatory effect of wakefulness on breathing and to a reduction in chemosensitivity. As a result, during stages 1 and 2 of non-REM sleep, as the central nervous system state fluctuates between awake and asleep, there is fluctuation in respiratory drive that predisposes to periodic breathing. Once slow-wave sleep is fully established, nonchemical respiratory inputs are minimized, and breathing is regulated by the metabolic respiratory control system. Under these conditions, overall respiratory drive is usually stable but less than during wakefulness. As a result, minute volume of ventilation is reduced by 1 to 2L/min compared with wakefulness, arterial PaCO₂ is increased by 2 to 8 mmHg and PaO₂ is decreased by 5 to 10 mmHg (1, 2, 3, 4).

During REM sleep, respiratory drive is often irregular, ventilatory responses to chemical and mechanical respiratory stimuli may be transiently reduced or abolished, and short periods of central apnoea lasting 10 to 20 seconds are relatively common (4, 5). In addition, intercostal and accessory muscle activity is reduced coincident with the generalized inhibition of skeletal muscle tone characteristic of this state. As a result, thoracoabdominal coupling may be diminished, resulting in further decreases in ventilation, and functional residual capacity may be reduced (2). The influences of non-REM and REM sleep on respiratory drive and muscle activity are exerted on the muscles of the upper airways in addition to those of the chest wall (2, 5). Therefore, upper airway resistance is increased during non-REM, and even more during REM sleep, compared with wakefulness.

The physiologic impact of sleep on breathing is of little consequences in healthy persons. In patients with disturbances of respiratory structure or function, however, the imposition of these sleep-related changes on the underlying disturbance may have the important clinical consequences (1, 2, 3, 4, 5, 6, 7).

3. PHYSIOLOGICAL AND CLINICAL CONSEQUENCES OF RESPIRATORY-RELATED SLEEP DISTURBANCES

Disorders of ventilation during sleep can result in several physiologic and clinical disturbances (Table 1). These complications arise either because of interference with the quality, quantity or structure of sleep or because of recurrent nocturnal hypoxaemia or asphyxia (3, 5, 6, 7). The disturbances in sleep structure result in neurophysiologic and behavioural manifestations rather than respiratory complaints (7), whereas the complications of nocturnal hypoxaemia or asphyxia are predominantly cardiovascular and respiratory in nature (1).

4. BRONCHIAL ASTHMA

| | Physiological disturbance | Clinical consequences |
|---|-------------------------------|------------------------------|
| I. Fragmentation of sleep by frequent arousals, | | |
| 1. | Recurrent awakenings | loss of slow-wave sleep |
| 2. | Restless sleep | |
| 3. | Unrefreshing sleep | |
| 4. | Morning headaches | |
| 5. | Daytime sleepiness | |
| 6. | Cognitive impairment | |
| 7. | Personality changes | |
| II. Recurrent nocturnal hypoxaemia or asphyxia; | | |
| 1. | Nocturnal cardiac arrhythmias | increased cardiac afterload |
| | 2. | Paroxysmal nocturnal dyspnea |
| 3. | Nocturnal angina pectoris | |
| 4. | Pulmonary hypertension | |
| 5. | Systemic hypertension | |
| 6. | Left ventricular dysfunction | |
| 7. | Chronic respiratory failure | |
| 8. | Insulin-resistance | |

Bradley D, Eliot A, Phillipson MD. Sleep disorders in breathing. In: Murray and Nadal Textbook of Respiratory Medicine, 4th ed. Philadelphia: Elsevier Saunders 2005; 107: 1671-1678

Table 1. Consequences of respiratory disturbances during sleep

Bronchial asthma is a chronic inflammatory disease of the airways. The chronic inflammation is associated with airway hyperresponsiveness that leads to recurrent episodes of wheezing, breathlessness, chest tightness, and coughing, particularly at night or in the early morning. These episodes are usually associated with widespread, but variable, airflow obstruction within the lung that is often reversible either spontaneously or with treatment (8).

Asthma is a serious global health problem with an estimated 300 million affected individuals. People of all ages in countries throughout the world are affected by this chronic airway disorder that, when uncontrolled, can place severe limits on daily life and is sometimes fatal.

The prevalence of asthma is increasing in most countries, especially among children. Asthma is a significant burden, not only in terms of health care costs but also of lost of productivity and reduced participation in family and social life (8).

There is now good evidence that the clinical manifestations of asthma-symptoms, sleep disturbance, limitations of daily activity, impairment of lung function and use of rescue medications- can be controlled with appropriate treatment. When asthma is controlled, there should be no more than occasional recurrence of symptoms and severe exacerbations should be rare (8).

4.1. NOCTURNAL BRONCHIAL ASTHMA

The mechanisms accounting for the worsening of asthma at night are not completely understood but may be driven by circadian rhythms of circulating hormones such as epinephrine, cortisol, and melatonin and neural mechanisms such as cholinergic tone (9). An increase in airway inflammation at night has been reported (9). This may reflected a reduction in endogenous anti-inflammatory mechanisms.

5. SLEEP DEPRIVATIONS IN BRONCHIAL ASTHMA

Patients with persistent asthma should be controlled with appropriate therapy e.g. inhaled corticosteroids and beta agonists (8). However, a considerable proportion of patients remain symptomatic especially at night despite the use of inhaled corticosteroids (ICS) (8, 9). These nocturnal dyspnoea and wakefulness induce sleep deprivation, anxiety and poor quality of life in patients suffering from bronchial diseases. Sleep and night control of asthma could be relevant to evaluate disease's control (10).

Correlations are found between asthma-related symptoms and sleep disturbances. Difficulties inducing sleep, sleep fragmentation on polysomnography, early morning awakenings and daytime sleepiness are more common in asthmatics compared with subjects without bronchial diseases (11, 12). More than 40% of asthmatic children report clinically significant daytime sleepiness (13). Up to 50% of adult asthmatic patients did experience excessive daytime sleepiness. Napping appears a necessity in children and adults with asthma versus non asthmatics (12). Reasons are multiple: sleep deprivation induced by poor disease control, abnormal bedtime behaviours and drug-induced insomnia (14). Despite a higher compliance to therapy and a higher inhaled corticosteroids use than men, women report more often anxiety and insomnia (15). Theophylline, high dosage of long-acting beta-agonist and oral corticosteroids, allocated to poor disease control, are responsive of sleep disruption. These strategies can be eliminated by ICS optimization (8, 14). The "morning deep" in asthma is relevant for the characterization of asthma severity, and impact drugs' choices (8).

Disturbed sleep is common in asthma. Melatonin which has sleep-inducing activity could interact with bronchial muscle tone and mucosal inflammation and changes in the drugs' pharmacokinetics are evoked (16).

Obstructive Sleep Apnoea – Hypopnoea Syndrome

(OSAHS) seem significantly more prevalent among patients with severe asthma compared with moderate, and OSA is more prevalent for both asthma groups than obese controls (17, 18). Probably sleep disruptions, fat-related throat inflammation are responsive of instability (18). The symptoms of sleep apnoea are related to the severity of asthma independent of other “classical” conditions e.g. allergen challenges or exposures, infections, tobacco use etc. (17, 18).

For asthmatic patients, treatment of OSAHS is CPAP (Continuous positive airway pressure) and weight loss (19), but also rhinitis control because of its attributable –airway obstruction (20). Asthma night-time symptoms scores are improved by CPAP treatment without amelioration in airway abnormalities. If auto CRAP are relevant for pressure titration in general population, efficient pressure lab’s determination seems more relevant for asthmatics, but for how many nights?

Asthma is associated with decreased subjective quality of sleep and increased daytime sleepiness. Concurrent allergic rhinitis is an underlying cause of sleep impairment in asthmatic patients (20). Obesity and sleep apnoea are more frequent, and non invasive ventilation (CPAP/NIV) could be difficult to set. Auto PEEP (positive end-expiratory pressure) phenomenon could interact with intrinsic pressure, for a good or worse gradient (19).

6. CONCLUSION

Breathing disorders during sleep can result in a broad range of clinical manifestations. Respiratory-related sleep disturbances can interact closely with, and even contribute to a several common cardiovascular and metabolic disorders. Asthma is associated with a decreased subjective quality of sleep, difficulties inducing sleep, sleep fragmentation, early morning awakenings and increased daytime sleepiness. Poor disease control induces elevated corticosteroid dosages and systemic treatment requirement achieving sleep deprivation. Evaluating asthma through a 24-hour cycle provides valuable information on variations in the sleep/wake cycle associated with asthma control, use of rescue medications and asthma symptoms. Sleep and night control of asthma could be relevant to evaluate disease’s control. Appropriate asthma control recovering is guarantor for better sleep quality in these patients and less clinical consequences of respiratory disturbances during sleep.

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