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Review Article

Sleep Related Breathing Disorders in an Intensive Care Setting

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Abstract

Sleep related breathing disorders (SRBD) are common in critically ill as well as in postoperative patients. Because of anatomical reasons the risk of difficulties of endotracheal intubation is increased in these patients. Furthermore, awareness of SRBD might influence management of weaning and reduce the risk of post-extubation failure. The use of sedatives and analgetics should be minimized to prevent overlap and aggravation of apneas which might have detrimental effects. If possible, non-invasive ventilation should be used immediately after extubation. There are no data on long term outcome of critically ill patients who are diagnosed with SRBD.

ABBREVIATIONS

AHI: Apnea Hypopnea Index; CPAP: Continuous Positive Airway Pressure; CSAS: Central Sleep Apnea Syndrome; NIV: Non Invasive Ventilation; OSAS: Obstructive Sleep Apnea Syndrome; SRBD: Sleep Related Breathing Disorders; ICU: Intensive Care Unit

INTRODUCTION

Although sleep related breathing disorders (SRBD) have a high prevalence in the general population less is known about their impact on the clinical course of intensive care treatment,

notably concerning the use of non-invasive ventilation and weaning. This is remarkable, since SRBD are associated with acute cardiovascular and respiratory problems, e.g. congestive heart failure, arterial hypertension, arrhythmia [1] and increased work of breathing.

Prevalence and pathophysiology of SRBD

An apnea is defined as a complete cessation of airflow for at least 10 seconds whereas hypopnea is determined by a 50% reduction of oro-nasal airflow. SRBD are further classified as obstructive due to collapse of the pharyngeal airway or central, which is characterized by absent breathing efforts [2,3]. Despite

the fact that central sleep apnea syndrome (CSAS) and obstructive sleep apnea syndrome (OSAS) might appear in the same patient ("mixed apnea"), there are variable related complications for intensive care (Table 1). Generally, clinically relevant sleep apnea might be considered if there is an apnea-hypopnea index of at least 5 events/h. Respiratory disturbances trigger complex pathophysiological responses, e.g. hypoxemia, arterial hypertension, arrhythmia, intrathoracic pressure changes with the result of increased work of breathing, sleep fragmentation due to repetitive arousal and last but not least, ventilator control instability. However, the meaning of this threshold in intensive care is unknown. Furthermore, appropriate diagnostic tools to diagnose SRBD in critically ill and ventilated patients are not defined. Polysomnography, the gold standard in diagnosis of SRBD, is feasible among critically ill patients as recently demonstrated by Knauert et al [4]. However, these measurements allow analysis of sleep efficacy, sleep stages or sleep architecture, but cannot give any information on respiratory variables in mechanically ventilated patients. Nevertheless, central apnea detection can be assessed in mechanically ventilated patients. If the patient is on non-invasive ventilation, then obstructive events could be assessed.

In the general population SRBD are diagnosed in 2-4% [5] with a 10-fold higher prevalence in heart failure patients or in patients with coronary artery disease. In acute care, Goring et al. estimated a frequency of 77% of SRBD [6]. Other authors, diagnosed SRBD in all of the patients who suffered acute respiratory failure and required mechanical ventilation [7,8]. Nevertheless, these data are based on small case series, some of them based on clinical suspicion for SRBD. Unexpectedly, Bolona et al. found OSA to be associated with a reduction of ICU length of stay as well as ICU and hospital mortality [9]. Furthermore, it is unknown if definitions of sleep related breathing disorders are appropriate in intensive care settings.

Sleep related breathing disorders and airway management

Although the pathophysiology of OSAS is not understood in detail, anatomical problems should be emphasized. Typical features of OSAS include obesity, increased neck circumference as well as enlargement of pharyngeal airway tissue. Therefore, OSAS patients have to be considered as high risk patients in case of intubation [10] or tracheostomy. Indeed, OSAS patients have a nearly 10-fold higher incidence of difficult airways (21.9%) than the control population (2.6%) [11]. Intubation over a fiberoptic scope with or without mild sedation should be considered if there is any doubt about the ability to intubate the patient.

Table 1: Characteristics of patients with SRBD in terms of mechanical ventilation and weaning.

Potential risk	OSAS	CSA
Related cardiovascular disorders	+	+
Difficult airway	++	-
Ventilator instability during mechanical ventilation	-	+
Sleep fragmentation with risk of delirium in weaning	+	+
Aggravation due to sedatives and analgetics	+	+

Influence of SRBD on peri-and postoperative management

Sleep apnea patients who undergo surgery are at increased risk of postoperative complication, e.g. pneumonia, hypoxemia, cardiac, pulmonary embolism or neurological complications [12, 13]. Therefore, it is not surprising, that there is a higher rate of postoperative transfer to ICU and increased length of hospital stay in OSAS patients [14].

Especially in elective surgery, OSAS should be identified preoperatively in order to optimize therapy and minimize risk. In contrast to emergency patients admitted to the ICU some studies and reviews focus on anesthetic management of OSAS. An interesting study examined the impact of general surgery on severity of postoperative breathing disorders. The authors found negative effects on sleep architecture in the first postoperative night whereas sleep related breathing disorders were greatest on the third postoperative night [15]. Based on several studies, Vasu et al. recommend following strategies: intra operative management should include minimization of surgical stress. Furthermore, as far as possible regional anesthesia should be considered. Extubation should be done in semi-upright position. Minimal use of sedatives and opioids as well as the use of CPAP in patients with known OSAS are recommended, and high risk patients without diagnosis of OSAS so far could have a benefit using Auto - CPAP [13]. Unfortunately, there is no evidence concerning patient selection for ICU transferal and recommended length of ICU stay. However, in times of restricted ICU capacities this question is important.

Effect of medical treatment on sleep disordered breathing in intensive care medicine

Especially in the early post extubation phase there is a high probability for the development of breathing disorders due to an overlap of anesthetics or sedatives and disturbed sleep architecture [10]. In this context, Diaz-Abdad and co-workers found SRBD in nearly all (94.7%) patients who were admitted to a specialized weaning unit owing to prolonged mechanical ventilation [16]. Its presence could deteriorate successful weaning from mechanical ventilation. Furthermore, sleep fragmentation might lead to a kind of delirium. In this case, additional application of sedatives could trigger a vicious circle [17] with the result of further ventilator instability, hypoxemia and finally the need of re-intubation.

Impact of sleep disordered breathing on weaning and extubation failure

Intubation as well as tracheal cannulation will eliminate obstructive apnea completely during mechanical ventilation. Nevertheless, clinical problems are shifted into weaning and post extubation (see below).

The respiratory system is regulated by feedback loops, mainly determined by chemoreceptors (PaO₂, PaCO₂). Mechanical ventilation directly influences oxygenation and particularly determines PaCO₂. Therefore, hyperventilation with excessive high minute ventilation leads to ventilator control instability because of a decrease of PaCO₂ below the so called apneic threshold resulting in Cheyne-Stokes characteristic crescendo-decrescendo pattern of breathing. These effects are further aggravated in patients with heart failure or stroke presumably

Table 2: Strategies to prevent weaning and respiratory failure in sleep apnea.

Extubate in lateral position
Avoid overlap of sedatives/analgetics
Early use of CPAP/NIV
Consider regional anesthesia in surgery

because of an extended circulation time [12]. This should be considered with reference to spontaneous breathing trials and weaning.

Certainly, CSAS might complicate spontaneous breathing trials because of an associated periodic breathing pattern. In clinical practice, it might be helpful to lengthen time to apnea alarm at the ventilator settings. Since CSA are deteriorated by sedatives, it seems mandatory to minimize their use. Intensive care physicians should be aware of OSA-associated complications. The latter include hemodynamic changes which could be summarized as cardiac stress, and disturbed breathing leading to hypoxia, and last but not least, to an increased work of breathing. It is quite obvious that this has negative impact on weaning success particularly after long-term ventilation and in patients with critical illness polyneuropathy.

Respiratory failure after extubation is characterized by the following features: increase of respiratory rate more than 50% from baseline, pH less than 7.35 with PaCO₂ >45 mmHg, and pulse oxymetric saturation below 90% [18]. Obviously, some of these problems are to be expected in sleep apnea, even in stable condition. Therefore, critical care physicians should be aware of sleep related breathing disorders with a view not to take desaturation and apnea as parts of respiratory failure and to avoid re-intubation in these patients. Early initiation of positive airway pressure could be used to prevent reintubation. Extubation should be performed in lateral or semi-upright position, without an overlap of sedatives (Table 2).

On the other hand, intermittent airway obstruction is associated with an increase of respiratory work in OSAS patients (breathing against resistance). It is clear, that this might have detrimental effects, for example in weaning of OSAS patients who develop critical illness neuropathy. Furthermore, hemodynamic problems, for example an increase of left ventricular afterload or apnea/hypoxia triggered supraventricular/ ventricular arrhythmia might be harmful.

Nevertheless, treatment of sleep apnea after extubation in patients who are known to have SRBD seems to be reasonable. The early use of CPAP immediately after extubation is thought to be safe and might allow an unrestricted use of analgesic drugs [19].

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