REVIEW ARTICLE

Obstructive Sleep Apnea in People and Dogs and an Equine Perspective

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Abstract

Sleep deprivation had been well documented in human, canine and equine species. However the medical causes and consequences of this affliction appeared to be more thoroughly investigated in human and canine species. In these a link between obstructive sleep apnea with its associated sleep deprivation, and gastrointestinal and thermoregulatory health had been established along with a bidirectional association between gastrointestinal reflux disease and obstructive sleep apnea. Surgeries to reduce the incidence of obstructive sleep apnea had also been developed. However this condition was yet to be formally recognised in horses and therefore the potential benefit of surgical approaches had not been explored.

In all three species the deleterious affects of sleep deprivation on emotional or psychological health had been established.

Key words: horse, upper oesophageal sphincter, sleep deprivation, sleep crashing.

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Introduction

In human medicine an association between a variety of upper airways abnormalities and obstructive sleep apnea (OSA) leading to sleep deprivation, which could on occasion trigger sleep terrors, had been established. It had also been reported that people who suffer from OSA had reduced maximal exercise capacity. In addition a bidirectional relationship between OSA and pulmonary conditions such as interstitial lung disease (ILD) and gastrointestinal reflux disease (GERD) had been investigated.

In canine studies OSA was recognised with a higher incidence being reported in brachycephalic breeds. OSA triggered by upper airways restrictions was shown to negatively impact exercise tolerance and could also lead to a progressive deterioration in pulmonary and gastrointestinal health. In addition the reduced capacity of these animals to thermoregulate during exercise had been documented as had incidences of sleep disorder behaviour.

In horses sleep deprivation was recognised as being more common than previously thought. Concurrently, but also quite independently, exercise intolerance and performance related pulmonary pathologies had been extensively researched, along with numerous upper airways abnormalities. The relationship between upper airways abnormalities and exercise intolerance or poor performance was also well established. There were numerous upper airways procedures performed in horses and both immediate clinical and longer term performance assessments were common. Unfortunately this form of assessment appeared to monopolise investigations whilst those into possible associations with longer term lower airways, gastrointestinal and emotional health were sparse.

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Treatments for OSA in humans and canines included surgical approaches that aimed to reduce the incidence of inappropriate pharyngeal and laryngeal narrowing or collapse. Following surgery measurable improvements in sleep quality and exercise tolerance had been demonstrated along with improvements in everyday function and wellbeing.

Research into sleep deprivation in horses centred around environmental and orthopaedic factors with little regard for the large number of upper airways dysfunctions that could potentially cause disruptions during paradoxical sleep.

Materials and Method

A search of the current available literature on canine, equine and human OSA prevalence and its potential to influence exercise tolerance, thermoregulation, pulmonary, cardiac and gastrointestinal health as well as psychological wellbeing. In addition a possible consequence of disturbed sleep in the form of sleep or night terrors was reviewed.

Surgical approaches utilised to manage OSA were also reviewed along with their impact on the post-operative health of patients.

Results

Prevalence

Human surveys suggest that OSA could be demonstrated in around 22% of men and 17% of women [1]. There was an increased incidence reported with ageing, obesity and smoking [2]. There also appeared to be an increasing population incidence in more recent studies [3].

In dogs OSA was mostly associated with brachycephalic breeds, brachycephalic obstructive airways syndrome (BOAS), but had also been reported in non-brachycephalic breeds [4,5,6].

In horses sleep deprivation of known and unknown cause had been the subject of numerous studies [10,11,12,13]. A serious consequence of this deprivation was referred to as 'sleep crashing' [10,11,13]. However OSA had neither been reported or researched in horses although clinical responses following palatoplasty procedures [7] had suggested a possible association between upper airways stability and sleep disturbance [8,9] .

Effects on exercise tolerance

In human patients with OSA it had been shown that their maximal exercise capacity was impaired [14,15].

Similarly with dogs several large studies with functional exercise testing had demonstrated reduced exercise capacity in OSA affected individuals [16,17,].

Exercise testing and performance assessments were commonly carried out in racehorses however a link between sleep deprivation and exercise tolerance had not been investigated.

Effects on thermoregulation

In people sleep quality influenced cardiovascular and thermoregulatory systems [18]. A compromised airway could also reduce the bodies capacity to deal with metabolic heat produced during exercise. Exertional heat stroke EHS could occur as a serious consequence of human athletic performance [19].

An increased risk of experiencing heat stress in brachycephalic dogs had been demonstrated particularly with increasing exercise demand [21,21].

Exertional heat illness EHI had been researched in horses [22,23,24]. However a possible relationship between sleep quality, upper airways dysfunction and EHI had not.

Associations with gastrointestinal disease:

An association between OSA and gastroesophageal reflux disease GERD had been long established in humans [25]. A bidirectional association had also been proposed such that OSA could exacerbate reflux and the reverse [26].

In dogs an increased incidence of gastrointestinal signs had also been reported [27] including gastroesophageal reflux [28].

In horses atrophy or aplasia of the upper oesophageal sphincter (UOS) or crico-pharynx had been reported as part of the 'laryngeal dysplasia' or 'fourth branchial arch› syndromes [29,30]. This had also been reported following laryngeal abductor prosthesis surgery [31]. Sphincter incompetence could permit oesophageal contents to reflux and in some instances trigger a dysphagia. UOS aplasia had also been reported as a sole entity [32].

Deleterious influences on the cardio-pulmonary systems

A common comorbidity existed between human OSA and interstitial lung disease ILD [33,34]. This relationship was thought to be complex and possibly bidirectional[35]. People suffering with OSA had a well recognised increased risk of coronary artery disease, congestive heart failure and stroke [36]. OSA was considered to be a risk factor for several cardiovascular conditions including cardiovascular mortality [37].

Brachycephalic obstructive airway syndrome BOAS was a known cause of pulmonary hypertension (PH) in dogs [38,39]. The longer term effects on cardiac health of PH had not as yet been studied however the significance of certain circulating biomarkers had [40].

As much as a number of different forms of upper airways collapse were documented and researched in horses, there were no studies to investigate their potential short or longer term impact on cardio-pulmonary health.

Effects on welfare and wellbeing

OSA in people with resultant insomnia had a significant effect on psychological well-being and daily function [41,42]. OSA with GERD was found to be associated with daytime sleepiness and depression [43].

In dogs it was recognised that disturbances in sleep, affected physiological functions such as cognition and physical performance [44] however potential psychological issues had not yet been researched.

In equids as much as cases of sleep deprivation were being more frequently recognised[10,11,12,13], research into their implications for longer term health and welfare were sparse [45].

Sleep terrors (night terrors)

In people these were a serious but also uncommon consequence of disturbed sleep. These occurred when the atonia associated with REM sleep was absent. Sleep terrors were well recognised in both children and adults [46,47]. In some cases a link better OSA and sleep terrors had been established [48].

REM sleep disorder behaviour recorded in dogs was the equivalent of sleep terror behaviour seen in people [49]. This had been observed as a consequence of OSA or BOAS in some canine cases [49].

Sleep terrors in horses were first described by Joseph J Bertone DVM[10,50]. A single case study had also been published [9].

Surgical approaches to manage OSA

Early human procedures addressed a perceived elongation of the soft palate with a surgery referred to as an uvulopalatopharyngoplasty (UPPP) [51]. Later an intrapalatine resection (IPR) looked to address general palatine flaccidity[52]. More recent procedures addressed both palatine and generalised pharyngeal flaccidity.Two examples were an anterolateral advancement pharyngoplasty [53] and a barbed reposition pharyngoplasty [54]. Maxillomandibular advancement surgery had also been shown to reduced airway turbulence in patients with OSA [55].

Surgical procedures used to address pharyngeal airways collapse in dogs mostly aimed to shorten and in some cases thin the soft palate. A staphylectomy [56], a folded flap palatoplasty FFP [57] or a H-pharyngoplasty [58] were amongst the more common approaches.

In horses, surgical approaches to treat pharyngeal dysfunction during exercise fell broadly into three categories. (i) Surgery to alter or advance the laryngeal position [59,60], (ii) Surgery to reduce palatal length [61] (iii) Surgery to reduce palatal and or associated pharyngeal flaccidity [7, 62,63,64,65,].

In horses the only reference to a possible association between pharyngeal instability and sleep deprivation, was in those cases that presented with concurrent UOS aplasia [8.9,66].

Discussion

Associated more commonly with the practice of alternative medicines is the term 'holistic'. The philosophy of considering the body as a whole rather than as a series of individual compartments or systems. Holistic practice also gives consideration to the mind and its association with the physical body. This holistic approach had certainly become more common in human and veterinary medicine however there was still a tendency for researchers and practitioners to look only at their particular areas of interest for answers. The pressure placed on a sole practitioner or researcher to provide a satisfactory service by both clients and employers could promote this attitude and practice.

A more holistic approach was evident in the rapidly evolving process in human medicine when dealing with sleep deprivation, to consider a variety of possible causes, influencing factors, along with physical and psychological consequences and additionally potential surgical and management treatments. Considering factors such as OSA's potential to influence gastrointestinal disease, pulmonary health, thermoregulation and its association with gastrointestinal reflux, along with direct and indirect affects of reduced sleep quality on psychological health and well-being.

A demonstration of that basic philosophy that was introduced to us as children, 'and the knee bone is connected to the thigh bone'.

In canine veterinary medicine a more holistic approach was evident in studies on the impact of OSA or BOAS, not only on sleep quality but also respiratory health, thermoregulation, exercise tolerance and psychological parameters. As were investigations into surgical treatments and their outcomes.

In equine veterinary medicine we recognised upper airways dysfunctions, associated exercise intolerance and then independently researched lower airways pathology, oesophageal reflux, thermoregulatory disorders, unwanted behaviours and sleep deprivation.

Conclussion

A more holistic approach that encouraged both practitioners and researchers to be more 'inclusive' would greatly improve the likelihood of achieving advancement in both human and veterinary medicine and surgery.

It was therefore recommended that when investigating sleep deprivation, unexplained unwanted behaviours and heat exhaustion in horses, that both upper and lower airways assessments along with ultrasonography to determine UOS competence should be carried out. And the reverse!

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