Sleep apnea ABCs

(AUGUST 2014)

TO THE EDITOR: We read with interest the paper by Dr. Reena Mehra, "Sleep apnea ABCs: Airway, breathing, circulation."[1] It was very consistent and informative. However, we feel that some considerations on the pathogenesis warrant more discussion.

The pathophysiologic heterogeneity of sympathetic nervous system activity enhancement is complex and involves both intermittent hypoxia and arousal. We agree with Dr. Mehra about the importance of intermittent hypoxia in sympathetic activation, and we would like to point out the importance of effects of arousal from sleep on autonomic outflow. In some patients with obstructive sleep apnea (OSA) in whom respiratory events are not followed by oxygen desaturation, sympathetic activation cannot be explained by intermittent hypoxia. Arousal has been reported to be associated with an acute increase in sympathetic activity in the absence of hypercapnia or hypoxia.[2] Cortical arousals from sleep have been historically assumed to be important in restoring airflow at the end of OSA breathing events.[3] Furthermore, arousals often precede upper-airway opening in patients with OSA.[4]

In **Figure 1** of Dr. Mehra's paper, all the respiratory events were associated with microarousals. According to the conventional definition, cortical arousal is an abrupt shift in the electroencephalogram lasting more than 3 seconds. In **Figure 1**, the beginning of arousals must be scored a few seconds before breathing recovery, just at the beginning of electroencephalogram acceleration. The second respiratory event was scored as obstructive apnea, or the apnea started out as central apnea, where all respiratory channels are flat and then the chest and abdominal belts start moving, making it look like typical mixed apnea.

In the title of the paper, the "A" of ABCs referred to airway and, more specifically, to the collapse of the upper airway in sleep, which is the cause of OSA. We think that the "A" can be attributed to arousal, which is specific to sleep and contributes to the pathogenesis of OSA.

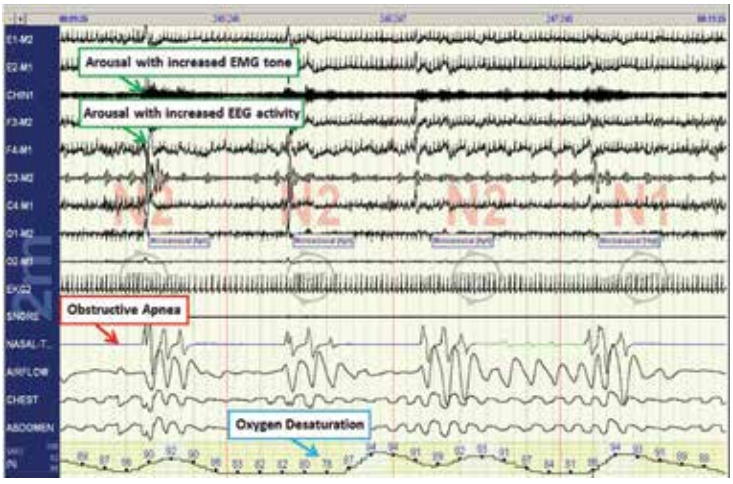

FIGURE 1. This polysomnogram of a 2-minute compressed window of time shows repetitive obstructive apneic events and a hypopneic event accompanied by severe oxygen desaturation (nadir, 78%) and arousals detected by encephalography that occur at the termination of the respiratory events. The patient is lying on his right side and is in N2 and N1 stages of sleep. The red arrow points to the obstructive apnea, the green arrow to the arousal, and the blue arrow to the accompanying oxygen desaturation episode. There is a delay of desaturation due to circulation time. The patient is a 47-year-old man with hypertension, asthma, excessive daytime sleepiness, snoring, witnessed apneic events, and multiple awakenings from sleep caused by cough and shortness of breath. The overall apnea-hypopnea index observed on this polysomnogram was 86 events per hour of sleep. This, along with the severe degree of hypoxia and accompanying symptoms, is consistent with the diagnosis of severe obstructive sleep apnea syndrome. (EEG = electroencephalography; EMG = electromyography)

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IN REPLY: We thank Dr. Abouda for underscoring the role of arousals in the pathophysiology of obstructive sleep apnea (OSA). Although the focus of the referenced article was to provide a general overview of the epidemiology, diagnostic testing, and cardiovascular ramifications of untreated OSA and not a detailed summary of the underlying pathophysiology, we welcome the comments from Dr. Abouda to highlight the importance of cortical or microarousals in OSA.

Whether cortical arousal during sleep is bad or good is controversial. During the development of the American Academy of Sleep Medicine respiratory event guidelines, the assignment of detriment or benefit to the arousal when considering defining and scoring of a hypopnea event was a topic of much discussion.[1,2] Supporters of including arousal in the hypopnea definition cite data that sleep fragmentation without attendant hypoxia is associated with symptoms such as excessive daytime somnolence, which is recognized to be effectively addressed with OSA treatment.[3,4] Moreover, experimental data indicate that arousals lead to activation of the sympathetic nervous system.[5] On the other hand, those who question the inclusion of cortical arousal in the hypopnea definition cite large-scale epidemiologic studies that have failed to find a significantly increased cardiovascular risk in relation to increasing arousal index, as well as the enhanced potential to introduce measurement variability.[1]

The effects of cortical arousals as a purported source of sympathetic activation may operate in concert with hypoxic influences, the latter resulting in sustained increases in blood pressure in both animal models and human studies.[6,7] Gottlieb et al[8] examined the effect of supplemental oxygen vs continuous positive airway pressure (CPAP) on 24-hour mean arterial pressure in a multicenter randomized controlled trial. Although CPAP reduced blood pressure, as expected, the somewhat unanticipated finding that supplemental oxygen did not suggests that other factors such as hypercapnia and cortical arousals with attendant sympathetic activation may represent potential culprits. Along these lines, in patients with OSA and increased loop gain, benefit in response to sedative hypnotics has been shown to reduce ventilatory instability through an increase in arousal threshold.[9] A genetic predisposition may influence the intensity of cortical arousals and accompanying cardiovascular influences that appear to be consistent within individuals but that are heterogeneous within populations.[10]

Few studies have identified increased cortical arousals as a cardiovascular risk factor. In the Cleveland Family Study, an elevated arousal index was associated with hypertension, but respiratory event-specific arousals was not specifically examined.[11] Not only have large-scale epidemiologic studies failed to identify an association between arousal index and cardiovascular outcomes, existing data appear to support the contrary. For example, the extent of incident white matter disease identified on brain magnetic resonance imaging was inversely related to the arousal index in a subset of participants of the Sleep Heart Health Study, a large population-based study focused on sleep and cardiovascular outcomes.[12] Furthermore, elevated arousal indices in women were associated with reduced incidence of stroke in the Sleep Heart Health Study.[13] These data suggest that arousals may represent beneficial, protective biomarkers reflecting truncation of respiratory events translating into reduced duration of hypoxic exposure and decreased work of breathing.

Needed is further investigation dedicated to understanding the impact of cortical arousals on health outcomes in population-based studies and elucidating the mechanistic role of cortical arousals in the autonomic nervous system physiology in various subtypes of sleep-disordered breathing (eg, obstructive vs central sleep apnea) as well as periodic limb movements.

As the upper **A**irway is central to the pathophysiology of OSA leading to compromise in **B**reathing and **C**irculatory or **C**ardiovascular ramifications, we think it logical that the "A" in ABCs should stand for "airway." Hopefully, future research will allow us to better understand the associated benefit vs detriment of cortical arousals as they pertain

CONTINUED ON PAGE 562

CONTINUED FROM PAGE 556

to subgroup susceptibilities and enhance our ability to tailor a personalized medicine approach to the treatment of sleep disorders.

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EMR notes should communicate and educate

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TO THE EDITOR: Dr. Venkat[1] was spot on when he identified the need for electronic medical records to communicate and educate, rather than document. Short and actionable notes are best. But with the focus on billing and compliance, annotated, informative assessments are actually discouraged. Our billing and coding department performs periodic chart audits and considers the note "out of compliance" if there is a difference between the list of free text assessments and the International Classification of Diseases, Ninth Revision (ICD-9) codes chosen. Therefore, many physicians just use the billing codes as their assessment and skip the free text assessment section of a SOAP (subjective-objective-assessment-plan) note, which means the notes convey even less of what the physician is thinking. A classic example is the note of a patient whom I knew had pernio, yet the assessment blandly reported "circulatory disorder." The plan likewise is often reduced to the imported structured text of the tests and medications ordered rather than a rich discussion of the differential diagnosis and medical reasoning.

Imagine the notes we might write if their primary purpose was communication to ourselves and the others involved in our patients' care. Imagine if the notes made us more knowledgeable about the uniqueness of this particular patient and also contributed to a continuous learning environment. More meaning, less filler. The notes would be shorter and sweeter, as Dr. Venkat suggested.

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