EDITORIAL

New Directions in the Diagnosis of Sleep Apnea-Hypopnea Syndrome

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Few areas of medicine have undergone such rapid development in recent years as the treatment of sleep disordered breathing and, in particular, sleep apnea-hypopnea syndrome. In 2004 alone, 1144 articles were published, and through them, knowledge has spread among physicians and in the general population. What we have learned is that SAHS is not a new clinical entity but rather one that has always been with us without receiving proper attention. Society now asks that those who suffer SAHS be attended quickly and that they receive a precise diagnosis and appropriate treatment.

SAHS is a highly prevalent disease that affects 4% to 6% of men and 2% to 4% of women among the population of middle aged adults.[1,2] Furthermore, it is evident that the prevalence increases with age,[3] and SAHS is clearly associated with deterioration in quality of life,[4] the onset of hypertension,[2,5,6] cardiovascular[7] and cerebrovascular diseases,[8] and traffic accidents.[9,10] Likewise, higher mortality has been observed in association with SAHS,[11-13] and treatment with continuous positive airway pressure (CPAP) has proven effective in studies throughout the world.[14] SAHS is an important health problem,[15] and recent studies have even demonstrated that failing to diagnose SAHS and therefore not treating it leads to a rate of use of health care services that is 2- to 3-fold higher than that of the general population without this disease.[16,17]

The Spanish Society of Pulmonology and Thoracic Surgery (SEPAR) has described a clinical picture for SAHS defined by sleepiness and neurological, psychiatric, and cardiorespiratory side effects of anatomical and functional changes in the upper airway that lead to repeated episodic obstruction during sleep. In turn, obstruction leads to decreased arterial oxygen saturation (SaO_2), arousals, and sleep that is not restorative.[18] The definition of SAHS centers on clinical consequences without specifying how many apneas and/or hypopneas are needed to arrive at a diagnosis. That approach clearly makes sense given that definitions of respiratory events are still evolving and will continue to do so. In this sense SEPAR itself has adapted to changes in the criteria that define respiratory events and their number as our understanding of the pathophysiology of SAHS and technological innovations has evolved. It is precisely the comparison of 2 sets of SEPAR guidelines that provided the aim of the interesting study by Aguirregomoscorta and colleagues[19] in this issue of ARCHIVOS DE BRONCONEUMOLOGÍA. In a study population of 118 evaluable patients, those authors compared the effect of applying the 1993 guidelines (in which data from thermistors were used to define apneas and hypopneas) and those of 2002 (in which nasal cannulas and thoracoabdominal bands were introduced) in terms of the effect on the indices for apneas and hypopneas individually, as well as on the apnea-hypopnea index (AHI). The authors found that 64% of patients who would have been classified as simple snorers under the 1993 criteria (AHI <10) would be considered to have SAHS under the 2002 guidelines. Likewise, nearly 48%, who would not have been prescribed treatment under the 1993 criteria (AHI <30), would have been treated with CPAP after 2002. Finally, the authors consider whether or not the AHI cutoff points used to diagnose SAHS should be changed. An added benefit of their work is that it offers us the chance to discuss the strengths and weaknesses of criteria used to establish a diagnosis of SAHS.

In 1976 Guilleminault et al[20] evaluated 40 healthy volunteers aged 18 to 60 years by polysomnography, observing that women had a mean 2.1 apneas per sleep hour and men had 6.7. Based on those results, they decided to establish the arbitrary cutoff of 5 apneas per sleep hour as being normal and fixed a time of 10 seconds or more to define an apnea. Those universally accepted criteria have many drawbacks. They do not consider the presence or absence of associated desaturations and/or encephalographic arousals and

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they therefore do not assess "damage" in terms of gas exchange or sleep fragmentation. It is also possible that a 10-second pause is not the same for a 30-year-old and an 80-year-old or even that it is the same for men and women. Moreover, those criteria fail to factor in associated comorbidity such as heart and respiratory diseases that reduce oxygen reserves or increase consumption. Such concurrent disease could mean that pauses of less than 10 seconds have clinical relevance. Nevertheless, the concept of apnea has held fast without changes, except that today's sensitive equipment does not usually detect a complete absence of flow and therefore an apneic event is scored when the flow falls more than 90%.

Block et al[21] introduced the concept of hypopnea to refer to the partially diminished respiratory signal that led to desaturation and they showed that the clinical impact of hypopneas and apneas are similar. The term "sleep hypopnea syndrome" was therefore coined.[22] Still, the definition of hypopnea has been disputed. The American Academy of Sleep Medicine (AASM) defines hypopnea as a discernible reduction in the airflow signal that is accompanied by a fall in SaO_2 of at least 3%[23] and/or arousals.[24] Those criteria are not unanimously accepted in all sleep laboratories, however, and the flow signal reductions applied vary from 30% to 90%, even as some observers accept any reduction judged "significant" or "discernible." Similarly, desaturation criteria range from 2% to 4%. Even the definition of arousal is heterogeneous and inter- and intra-observer variability is great. Furthermore, some groups do not include arousals in the definition of hypopnea. Additionally, the thermistor, which is an excellent method for detecting apneas, performs poorly in detecting hypopneas.[25] Therefore, in recent years semiquantitative signal processing systems have been introduced to measure airflow by way of a cannula connected to a pressure transducer.[26,27] These systems also help identify respiratory effort related arousals (RERAs), which pertain to the concept of increased upper airway resistance syndrome introduced by Guilleminault and colleagues.[28] RERAs served to describe the situation of individuals with neither apneas nor desaturations who had repeated arousals as a consequence of the progressive increase in intrapleural pressure as measured by an esophageal balloon.

For all of those reasons, it is evident that the AHI can vary a great deal depending on what definition of hypopnea is chosen.[29,30] In spite of these limitations, hypopnea is generally accepted to be a reduction in airflow between 30% and 90% measured by cannulas and/or effort detected by thoracoabdominal bands, in the presence of a fall in SaO_2 of more than 3% and/or arousals. In fact, with current systems for detecting hypopneas, the consideration of upper airway resistance syndrome to be unrelated to SAHS has become a matter of dispute[31,32] and for that reason the most recent AASM recommendations classify RERAs to be hypopneas falling within the scope of SAHS. Thus, an AHI over 5 in the presence of suggestive symptoms that are not attributable to other causes is considered diagnostic of SAHS.[23] Applying that cutoff with all patients when we still do not know if it should vary by age or sex[2] seems overconfident, however. Meanwhile, the most important symptom for defining SAHS along with an abnormal AHI—namely excessive daytime sleepiness—is extraordinarily prevalent in the general population.[1,2] Researchers have even failed to find an association between the AHI and daytime sleepiness,[2] and it is therefore evident that other factors as yet unknown are interacting in the process.

Another limitation that bears scrutiny is that the epidemiological information available for SAHS and its consequences is based on studies that were carried out with thermistors and using technical methods that are now considered inadequate.[1-7] The 2002 SEPAR guidelines were evidence-based and peer reviewed, but it is important to remember that in addition to inherent difficulties related to the identification of respiratory events there is also the fact that no real AHI threshold has been established. That means that the situation for this parameter is different from that of blood sugar levels, at least for the time being. An AHI greater than 5 to 10 must be considered abnormal, but the index probably differs in accordance with age and sex and normal thresholds in different groups are not known. Likewise, excessive daytime sleepiness should only be attributed to SAHS when there is no other explanation. A related issue that must still be discussed is whether CPAP can be prescribed based solely on a specific AHI value, in function of its cardiovascular implications, or if we should continue insisting on the presence of other symptoms like daytime sleepiness or on the development of complications[18] before taking that step.

All the aforementioned limitations, though they are many, are still not the entire list of difficulties to be coped with. In Spain there are between 1 200 000 and 2 150 000 individuals with significant SAHS who are therefore candidates for CPAP treatment,[33] yet only 5% to 9% have been diagnosed and treated.[33] In addition, while the number of sleep laboratories has tripled in the last 9 years, there are still too few of them to meet the growing demand, leading to unacceptable waiting periods of up to a year or longer.[34] Conventional polysomnography is the gold standard test,[35,36] but it is not problem-free or cheap—it consumes resources that put it beyond the reach of most hospitals. Performing conventional polysomnography on all patients suspected of having SAHS is neither possible nor cost-effective and simpler diagnostic approaches are needed. Simplified diagnostic systems such as respiratory polygraphy are now accepted,[35-37] lowering the cost of either hospital or home testing. Most importantly, however, diagnosis has been decentralized—it is no longer tied to the referral hospitals that tend to be saturated. Diagnosis at smaller hospitals working in concert with a referral hospital is now possible. Nevertheless, better validation studies of polygraphy are

still needed, particularly in the home setting.[38] Such studies would need to reach beyond looking at the correlation between AHIs obtained by polysomnography and polygraphy, in order to also validate the therapeutic decisions based on each system.

Finally, if the newest single channel devices that measure respiratory events directly (with thermistors and nasal pressure cannulas) prove useful, they will lead to substantial change in the diagnostic process for SAHS, though only a few validation studies have been appeared.[39,40] Designed to work as expert systems when managed by nonexperts, these devices mean that primary care physicians can become involved in the diagnosis, treatment, and monitoring of patients with SAHS. It will become commonplace to see multidirectional coordination of the tasks of referral hospitals (sleep laboratories), collaborating centers (sleep units without polysomnography but with respiratory polygraphic devices), and primary care physicians to facilitate diagnosis and treatment. Finally, it is very possible that genetic and biological markers related to SAHS will not only serve as risk factors but also as diagnostic tools.

It is very clear that the reality of SAHS is changing the world over—sleep will no longer belong to dreamers alone. Many researchers have directed their efforts, their hopes and a large portion of their dreams so that we will be able to reap the benefits in a future that is not far off. We hope to make good use of the fruits of their work.

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