Influence of Patient Gender and Race on Obstructive Sleep Apnea in Perioperative Medicine

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KEYWORDS

• Obstructive sleep apnea • Perioperative medicine • Race • Gender

KEY POINTS

- Although obstructive sleep apnea (OSA) has long been recognized as a clinical condition (and an important risk factor in perioperative medicine), only recently have differences in race and gender been recognized.
- These differences have yet to make their way into the perioperative guidelines for the management of OSA.
- Disparities exist in the recognition, diagnosis, and management of OSA in women and non-White races.
- Further studies and advocacy are needed to ensure equitable outcomes in all patients with OSA in the perioperative period.

INTRODUCTION

Race, gender, and socioeconomic disparities have long plagued the diagnosis and treatment of obstructive sleep apnea (OSA). This is no different in the perioperative period, and likely has adversely affected those in marginalized groups. In order to understand how patient gender, race, and socioeconomic status may impact perioperative management of OSA, one must understand the history of OSA, the current tools available for diagnosis, the different standards for diagnosis based on health insurance provider, and the current treatment options, many of which are not covered by most insurance plans.

HISTORY

Snoring, witnessed apneas, and somnolence have long been associated. For example, the *Pickwick Papers* by Charles Dickens, published in the 1830s, depicts

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an obese boy named Joe who snores and is very sleepy during the day.[1] However, it was not until the 1950s that Pickwickian syndrome (now more commonly known as obesity hypoventilation syndrome, or OHS), a disorder of alveolar hypoventilation associated with OSA, was described.[2] This can be thought of as a very symptomatic extreme of sleep disordered breathing, as patients with OHS not only suffer from the symptoms associated with OSA (such as excessive daytime sleepiness), but also suffer from the symptoms of chronic hypercapnic respiratory failure (which can include facial plethora, dyspnea, chest pain, lower extremity edema, and other signs/symptoms of cor pulmonale). OHS was initially much more commonly recognized in obese men, although now the data suggest a greater than three-fold prevalence in women than men.[3]

It was not until the 1960s and 1970s that OSA was defined as its own clinical entity. Independent groups in Germany and France first described upper airway collapse during sleep in the mid-1960s using electroencephalography (EEG) and respiratory signals during sleep.[4,5] However, the term "obstructive sleep apnea" was not coined until the 1970s, and it was not until the late 1970s that the underlying pathophysiology of OSA was first described.[6,7] In 1978, a landmark paper by Remmers and colleagues was published, which described how in OSA the airway would close or narrow during sleep, leading to increased genioglossus activity, ultimately leading to an arousal from sleep to regain upper airway tone and adequately inspire.[7,8]

The 1980s brought a revolution in the treatment of OSA and OHS in the form of continuous positive airway pressure during sleep, or CPAP (aside from weight loss, treatment before the discovery of CPAP was limited to severe cases and often surgical in the form of a tracheostomy).[9] However, the disease was still poorly recognized (particularly in women and racial minorities), and diagnosis was limited to a small number of academic centers with the capability of performing an in-laboratory polysomnogram (which required patients to have the financial means to travel to and often pay for these studies). Furthermore, after being diagnosed with OSA, all patients would need to undergo an additional titration study in the sleep laboratory in order to find the optimum CPAP level to stent open the upper airway during sleep. CPAP machines were not commercially available until the 1990s (earlier devices were handmade), with masks often hand-molded to fit each individual patient's face (again, favoring those of affluence who were able to afford these interventions).[10]

During the late 1980s and early 1990s, further advancements came in the form of diagnosis and treatment of OSA. It was during this time that commercial CPAP devices with humidification (to prevent upper airway desiccation) became available. General practitioners became more aware of OSA; polysomnography became more widespread, and the first studies describing portable home sleep apnea testing were published in the early 1990s[11–13] (although the use of home sleep apnea testing was not approved by the Centers for Medicare and Medicaid Services [CMS] until 2008).[14] Alternative therapies for the treatment of OSA were also described during this time, such as the use of an oral appliance fitted by a dentist, positional therapy (ie, nonsupine sleep), and additional surgical options such as the uvulopalatopharyngoplasty (UPPP).[15,16] However, many of these alternative therapies for OSA were not (and still are not) covered by most health insurance plans, leading to treatment disparities based on who is able to afford often considerable medical costs.

The 2000s and 2010s brought additional improvements. Home sleep apnea testing (HST) reduced overall diagnostic costs, decreased the burden on sleep laboratories, and provided increased convenience for many patients who were now able to undergo testing at home. Auto-adjusting CPAP devices also became commercially available, providing a further revolution in the management of OSA. Generally speaking, these

devices function by measuring airway vibration (snoring), airflow reduction/flow limitation, or airway impedance with the forced oscillation technique, and vary pressure delivery according to an internal algorithm (starting out at a lower pressure and increasing as needed in response to the previously described events, which are surrogate measures of upper airway events).[17] The development of auto CPAP (also known as APAP) not only improved CPAP tolerance (by allowing patients to start the night at a much lower pressure) but also further reduced the burden on sleep laboratories, by preventing patients from having to return for a CPAP titration study (to determine their optimal pharyngeal opening pressure).[18] Now, for the first time in history, patients could be diagnosed with OSA and treated without ever spending a night in the sleep laboratory.

Although these innovations significantly improved access to diagnosis and treatment, they did not benefit all groups equally. As most home sleep apnea tests do not measure EEG, they cannot show hypopneas associated with arousals (**Fig. 1**). Thus, home sleep apnea tests may not detect clinically significant OSA in lower-risk populations, such as women.[14,19] Home sleep apnea testing also requires a certain degree of health literacy, as the patient is required to put on the equipment at home (usually after instruction from a sleep technologist).[19]

During the mid-2010s to present, revolutions in sleep surgery added even more treatment options for OSA. In 2014, the results of the Stimulation Therapy for Apnea Reduction (STAR) trial were published in the *New England Journal of Medicine*, showing that hypoglossal nerve stimulation decreased median apnea-hypopnea index (AHI) by 68% at 12 months.[20] Notably, 83% of the participants in the trial were men, and 97% of participants were described as being "White race."[20] From 2011 onwards, otolaryngologists have been required to complete a fellowship in sleep medicine in order to be eligible to sit for the sleep medicine board examination; this fellowship usually includes training in sleep medicine and sleep surgery, including hypoglossal nerve stimulator implantation and advanced skeletal surgeries such as maxillomandibular advancement (MMA).[21] However, this has not improved access equally across different groups: non-White patients, patients of lower socioeconomic groups, and patients with Medicare compared to private insurance have been shown to have significantly lower odds of undergoing jaw surgery for OSA, despite having no significant difference in surgical complications, and the having similar effectiveness across different ethnicities.[22,23]

The early 2020s have brought additional challenges to the field of sleep medicine, which have not impacted all races and genders equally. One of these challenges has been the recall of certain Philips Respironics positive airway pressure devices in the setting of polyurethane foam degradation, which may cause airway irritation

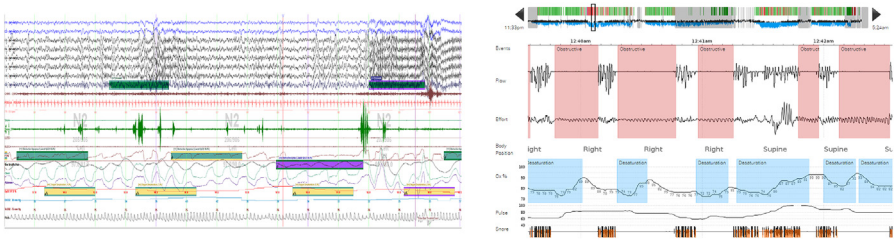

Fig. 1. In-laboratory polysomnogram (*right*) versus home sleep apnea test (*left*). This figure shows severe OSA as diagnosed with an in-lab polysomnogram versus a home sleep apnea test. Notice the ability to score arousals on the in-lab polysomnogram (due to the presence of EEG), while this is not possible on the home sleep apnea test.

and cytotoxic/genotoxic effects.[24,25] Vulnerable populations, such as those of lower socioeconomic backgrounds and non-White races, are projected to be impacted to a greater degree. Often, these patients have lower access to news/may be unaware of the recall and the potential health effects, and are unable to afford to pay out of pocket for a new CPAP machine while waiting for Philips Respironics to replace their current device (most insurers placed the responsibility of replacing the recalled devices with Philips Respironics, and did not reimburse for a new device if patients had received their current CPAP within the last 5 years).[25,26]

Finally, the recent US Food and Drug Administration (FDA) approval of GLP-1 agonists for the treatment of obesity could have a profound impact on the management of OSA, as obesity is generally considered the greatest risk factor for OSA.[27] However, studies have demonstrated racial and socioeconomic inequities and disparities in prescribing practices and ability to obtain these medications.[28,29] This adds yet another therapy option for OSA that is more readily available to White patients of higher socioeconomic status.

DEFINITIONS

OSA is currently defined in adults as complete or partial obstructions to airflow during sleep, occurring at least 5 times per hour on average during the course of the sleep period (which must be at least 2 hours).[30,31] According to the American Academy of Sleep Medicine (AASM), an apnea, or complete obstruction to airflow, is defined as a drop in the peak signal excursion of an oronasal thermal sensor by at least 90% of baseline that lasts for 10 seconds or longer.[32] A hypopnea, or partial obstruction to airflow, has 2 different definitions, largely because of differing health insurance guidelines. The AASM recommended definition of a hypopnea is an airflow reduction of at least 30% for greater than or equal to 10 seconds, associated with either a 3% oxyhemoglobin desaturation or an arousal from sleep.[32] Most private health insurers accept this recommended definition. However, CMS payors mandate that the hypopnea be associated with at least a 4% oxyhemoglobin desaturation, and do not recognize respiratory events as hypopneas if they are only associated with arousals from sleep.[33]

This has created inequities in the diagnosis of OSA – patients who rely on CMS payors, such as those of lower socioeconomic status, the disabled, and older adults may meet the definition of OSA as per a private health insurer (and the AASM), but not by CMS.[34] These patients are then left with a choice – either forgo treatment or pay expensive out-of-pocket costs. For example, current out-of-pocket costs for a new CPAP setup range from about $700 to $1200, including necessary supplies such as tubing, mask, and headgear.[35] Most manufacturers recommend that the CPAP mask and tubing be replaced every 3 months, and the headgear and humidification water chamber be replaced every 6 months, adding additional significant costs over the life of the device.[36]

Other treatments are similarly or more expensive than CPAP, and often not covered by health insurance. Oral appliances, when fitted by a dentist, often cost over $2000; positional devices can cost anywhere from $30 to hundreds of dollars. Hypoglossal nerve stimulator insertion can cost $30,000 or more, while longer surgeries such as MMA may cost $100,000 or more.[37] These costs do not include the follow-up costs with a sleep medicine specialist, to ensure that therapy remains adequate and no changes are necessary. Often, CPAP alternatives require follow-up sleep studies, which adds additional cost that may not be covered, particularly if insurance did not approve the aforementioned treatment (this can vary from $150 on the low end for a

home sleep apnea test, to over $10,000 on the high end for an in-laboratory sleep study).[38] The diagnosis and treatment of OSA can be quite expensive, which can place a significant burden on lower socioeconomic groups.

INFLUENCE OF GENDER AND RACE ON OBSTRUCTIVE SLEEP APNEA IN THE PERIOPERATIVE PERIOD – A DISCUSSION

Over the past decade, anesthesiologists have become more aware of OSA and its implications in perioperative care. Francis Chung, an anesthesiologist at the University of Toronto, developed the STOP questionnaire to quickly screen patients for OSA (with more screening questions added later to become the widely-used STOP-BANG questionnaire).[39,40] In its more modern form, the STOP-BANG questionnaire consists of eight yes or no questions.

- Snoring?
- Tiredness?
- Observed apneas?
- Pressure (ie, history of hypertension)?
- Body mass index (BMI) greater than 35?
- Age greater than 50?
- Neck circumference greater than 40 cm?
- Male gender?

These screening questions have been used to assess pretest probability of moderate or severe OSA with a score of 0 to 2 being low risk, 3 to 4 intermediate risk, and greater than 4 high risk.[40] STOP-BANG is now the most widely used screening tool for OSA in preoperative, primary care, and sleep clinics.[41]

Although a meta-analysis has confirmed the high performance of STOP-BANG for OSA screening in surgical populations overall, it may underperform in certain groups.[42] For example, it has long been known that the prevalence of OSA in postmenopausal women approaches that in men.[43–47] Furthermore, screening tools such as STOP-BANG may underperform in special populations such as pregnant women.[48] However, no question in the STOP-BANG questionnaire directly accounts for these additional risk factors.

It is also known that OSA tends to be more prevalent and more severe in certain non-White races. Again, this is not accounted for in STOP-BANG. For example, Black patients (particularly Black men) tend to have more severe OSA upon clinical presentation compared with White patients (suggesting a possible delay in diagnosis in Black patients).[49,50] Furthermore, the most patients of Chinese descent with OSA are nonobese and tend to present with more severe illness; this is thought to be caused by craniofacial anatomic differences between races.[51] Other studies have found significant craniofacial and upper airway differences between Black and White patients, as well as between women and men.[52,53] Again, common perioperative screening tools for OSA such as STOP-BANG likely do not account for these important clinical considerations.

Transgender patients may also be at increased risk of OSA, in ways that are not currently accounted for in the widely used screening tools. A recent study showed a higher risk of snoring in testosterone-treated transgender men, a phenomenon previously described in multiple case reports, although the pathophysiology is somewhat controversial.[54–56] All authors in the aforementioned studies are in broad agreement, however, that further studies need to be done, as the current literature regarding OSA in transgender communities is lacking.[56]

Other under-represented populations might not be immediately obvious. For example, a recent study suggests that the STOP-BANG questionnaire missed the diagnosis of OSA in a large number of young veterans with PTSD.[57]

Pathophysiology of OSA may also differ in these underrepresented populations, as much of what is understood of OSA comes from trials using primarily White men. Thus, the current 1 size fits all approach to treating OSA may not be best for certain groups.[58] The perioperative guidelines that are currently available for the management of OSA do not take this into account, and overall have been found to have low applicability and poor methodological quality.[59,60] Guidelines mostly focus on the preoperative period, and are often vague, based on expert opinion, and with low levels of evidence in the intraoperative and postoperative periods.[60] Many of these guidelines are older and out of date, and do not account for different factors such as different phenotypes (also known as endotypes) of OSA that may be found more commonly in certain gender and racial groups.[61–66] In fact, certain endotypes of OSA may actually benefit from practices that the previously mentioned guidelines recommend against. For example, sedatives (such as benzodiazepines and opioids) may actually improve OSA when the primary pathophysiologic mechanism is a low arousal threshold from sleep, a phenotype more commonly seen in women.[67–69] In sum, additional studies are needed to understand how best to screen for OSA in underrepresented groups, as well as best perioperative practices for these patients.

SUMMARY

OSA is a disease that has traditionally been studied in White men, although important differences likely exist between various races and genders.[70,71] These differences may be magnified in the perioperative period, and new guidelines are needed that address these factors. Diagnostic criteria, adherence to, and availability of treatment options may also differ significantly depending on socioeconomic status and health insurance provider. Additional advocacy is needed to address these inequities and improve outcomes across races and genders.

CLINICS CARE POINTS

- Disparities exist in the diagnosis and treatment of OSA in women, minority groups, and those of lower socioeconomic status.
- Most of the recommendations regarding the perioperative management of OSA do not account for gender or racial differences.
- Further studies are needed to determine how gender and racial differences impact OSA in the perioperative period.
- Additional advocacy is needed in order to ensure adequate treatment options are available for all patients with OSA.

DISCLOSURE

The author has nothing to disclose.

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