Pak Heart J

SLEEP DISORDERED BREATHING (SDB) AND CARDIOVASCULAR HEALTH

Mohammad Hafizullah

Khyber Medical University, Peshawar, Pakistan

Address for Correspondence:

Dr. Mohammad Hafizullah,

Vice Chancellor,
Khyber Medical University, Peshawar, Pakistan

Email: mhu5555@gmail.com

This article may be cited as: Hafizullah M. Sleep disordered breathing (sdb) and cardiovascular health. Pak Heart J 2016;49(03): 91-4.

Sleep is important for health and breathing is essential for life. Disturbances in breathing during sleep - sleep disordered breathing (SDB) has been recognized as of paramount importance having immense effects on human health and health care system. Sleep apnea is a potentially life-threatening chronic disease that affects more than 12% U.S. adults.[1] Two recent white papers commissioned by the American Academy of Sleep Medicine (AASM) provide a detailed analysis of the huge economic burden associated with undiagnosed and untreated obstructive sleep apnea among adults in the United States.[2] The white paper, "Hidden Health Crisis Costing America Billions," based on longitudinal data suggests that the estimated prevalence of OSA has increased substantially over the last two decades, and utilizing Frost & Sullivan's modeling and forecasting expertise, the paper estimates that OSA afflicts 29.4 million adults in the U.S.[3] The estimated cost of diagnosing and treating OSA in the U.S. in 2015 was approximately $12.4 billion where as the estimated cost burden of undiagnosed OSA among U.S. adults was an astounding $149.6 billion in 2015. The paper estimates that an additional $49.5 billion were required by the health care system to diagnose and treat every American adult with OSA. However, this expenditure would produce a projected savings of $100.1 billion.[2] For the companion white paper, "In an age of constant activity, the solution to improve the nation's health may lie in helping it sleep better," Frost & Sullivan surveyed more than 500 U.S. adults currently being treated for OSA.[3] After treatment, patients reported longer average nightly sleep duration with improved sleep quality, and greater productivity. Treatment resulted in numerous health benefits like 56% of patients reported improvement in risk for heart disease and 41% of respondents reported slightly or significantly fall in blood pressure. Positive behavioral changes were reduction in average cigarettes smoked and those who stated that their quality of life was "good or very good" nearly tripled from 26% to 76% following treatment.[4]

Sleep apnea is of two types Obstructive Sleep Apnea (OSA) and Central Sleep Apnea (CSA). OSA is characterized by repetitive interruption of ventilation during sleep caused by collapse of the pharyngeal airway. An obstructive apnea is equal to more than 10-second pause in respiration associated with ongoing ventilatory effort. Obstructive hypopneas are decrease in, but not complete cessation of, ventilation, with an associated fall in oxygen saturation or arousal. OSA syndrome is diagnosed when a patient has an apnea-hypopnea index (AHI; number of apneas and hypopneas per hour of sleep) more than five and symptoms of excessive daytime sleepiness.[6,7] Central Sleep Apnea (CSA) has repetitive

cessation of ventilation during sleep resulting from loss of ventilatory drive. A central apnea is a 10-second or longer pause in ventilation with no associated respiratory effort. CSA syndrome is diagnosed when a patient has more than 5 central apneas per hour of sleep and the associated symptoms of disrupted sleep (frequent arousals) and/or hypersomnolence during the day.[7,8]

Screening and diagnosis of patients for SDB employs multiple tools, though the sensitivity and specificity of these have not been well documented. These options include the Epworth Sleepiness Scale, the Berlin questionnaire, overnight oximetry, and devices combining respiratory assessment, ECG, and oximetry.[9-11] Holter recording has been proposed as a possible screening tool.[12] A definitive diagnosis in patients with suspected OSA or CSA requires evaluation for a night in a sleep laboratory with recording of multiple physiological variables (polysomnography). These variables generally include sleep staging using the electroencephalogram, electromyogram, electrooculogram, respiration (flow, effort, oxygen saturation), and snoring. With these parameters disordered breathing with its effect on sleep and oxygenation are precisely quantified. The importance of the cardiovascular response to sleep has been recognized in the recently revised Sleep Scoring Manual from the American Association of Sleep Medicine (AASM), and this now includes ECG monitoring as one of the parameters of polysomnography.[9-14]

SDB is of great importance in the world of cardiology as this has been implied in causation and acceleration of coronary heart disease, systemic hypertension, pulmonary hypertension and arrhythmias. Prevalence of OSA in cardiovascular patients is 2 to 3 times higher than in reference populations without CVD.[15,16] Population-based epidemiology studies and observations of OSA patients show that prevalence of hypertension, type II diabetes, cardiovascular disease, and stroke to be higher in people with OSA.[16-21] The prevalence of SDB in CAD patients is up to 2-fold higher.[22,23]

In a study recruiting more than 200 patients without history of CAD who underwent CT angiography within 3 years of polysomnography, the median coronary artery calcification score (Agatston units) was 9 in OSA patients and 0 in non-OSA patients ($p<0.001$).[24] In patients with nocturnal angina pectoris sleep apnea was considered to be one of the important causes. Nocturnal angina and ST depression reduce with treatment of sleep apnea by CPAP.[25] A study on more than 500 subjects reported that people with OSA are more likely to have a family history of premature death from CAD. This was independent of gender, BMI, and personal history of CAD (OR, 2.13; 95% CI, 1.04 to 4.66; $p=0.046$).[26] In a longer-term study, SDB in patients with CAD was associated with a significant increase in the composite end point of death, myocardial infarction, and cerebrovascular events during 5-year median follow-up, occurring in 28% and 16% of men with and without SDB respectively.[27]

Does treatment of OSA help in reducing CAD events? An observational study showed that in patients of CAD with OSA, treatment was associated with reduction in the occurrence of new cardiovascular events.[28] A prospective study evaluated incidence of fatal and nonfatal cardiovascular events in healthy men, snorers, and patients with treated and untreated OSA. In men with severe untreated OSA (AHI >30), both fatal and nonfatal cardiovascular events were markedly increased, whereas, fatal and nonfatal cardiovascular events in treated OSA patients approached levels seen in simple snorers.[29] However, there are no randomized trials of the effects of treatment of OSA and CSA on risk of developing coronary artery disease, risk of myocardial infarction, or risk of cardiovascular death.

The updated and expanded National Sleep Disorders Research Plan identified gaps in our knowledge regarding SDB and cardiovascular disease and highlighted the following areas for further research.

1. The interaction between cardiac dysfunction and the ventilatory control system in the pathogenesis of CSR. The need to conduct adequately powered clinical trials, particularly in high-risk populations, to assess the impact of therapy of SDB on hypertension, cardiovascular disease, metabolic syndrome, cardiac dysfunction, quality of life and survival.
2. To study longitudinal normative data on sleep and cardiorespiratory patterning in children.
3. To investigate genes and gene products that may contribute to the cardiovascular pathophysiology of SDB.

Conducting these studies in pediatric populations may have distinct advantages because they are less likely to be "contaminated" by age-associated comorbidities present in adult populations. Need to have longitudinal studies to assess the long-term impact of SDB during childhood and into adulthood, especially considering the increasing prevalence of obesity in children. And to study novel noninvasive screening/diagnostic methodologies for SDB that are less expensive and more widely applicable than standard full polysomnography.[30]

We as cardiologists have to recognize that this area is in need of dedicated research to broaden the knowledge base. Specific questions that need answers include whether sleep apnea can initiate development of cardiac and vascular disease, whether sleep apnea in established cardiovascular disease patients accelerates disease progression, and whether treatment of sleep apnea will result in clinical improvement, fewer cardiovascular events and reduced mortality.

REFERENCES:

1. U.S. Census Bureau Population Division. Annual estimates of the resident population: April 1, 2010 to July 1, 2015 [Online]. 2016 [cited on July 8, 2016]. Available from URL: https://www.census.gov/popest/data/datasets.html
2. Watson NF. Health care savings: the economic value of diagnostic and therapeutic care for obstructive sleep apnea. J Clin Sleep Med 2016;12(8):1075-7.
3. American Academy of Sleep Medicine. Hidden health crisis costing America billions. Underdiagnosing and undertreating obstructive sleep apnea draining healthcare system. Mountain View, CA: Frost & Sullivan; 2016.
4. Peppard PE, Young T, Barnet JH, Palta M, Hagen EW, Hla KM. Increased prevalence of sleep-disordered breathing in adults. Am J Epidemiol 2013;177:1006-14.
5. American Academy of Sleep Medicine. In an age of constant activity, the solution to improving the nation's health may lie in helping it sleep better. What benefits do patients experience in treating their obstructive sleep apnea? Mountain View, CA: Frost & Sullivan; 2016.
6. Sleep-related breathing disorders in adults: recommendations for syndrome definition and measurement techniques in clinical research. The Report of an American Academy of Sleep Medicine Task Force. Sleep 1999;22(5):667-89.
7. Fogel RB, Trinder J, Malhotra A, Stanchina M, Edwards JK, Schory KE, White DP. Within-breath control of genioglossal muscle activation in humans: effect of sleep-wake state. J Physiol 2003;550:899-910.
8. White DP. Pathogenesis of obstructive and central sleep apnea. Am J Respir Crit Care Med 2005;172:1363-70.
9. Miletin MS, Hanly PJ. Measurement properties of the Epworth sleepiness scale. Sleep Med 2003;4:195-9.
10. Netzer NC, Stoohs RA, Netzer CM, Clark K, Strohl KP. Using the Berlin Questionnaire to identify patients at risk for the sleep apnea syndrome. Ann Intern Med 1999;131:485-91.
11. Abraham WT, Trupp RJ, Phillips B, Bourge RC, Bailey B, Harding SM, et al. Validation and clinical utility of a simple in-home testing tool for sleep-disordered breathing and arrhythmias in heart failure: results of the Sleep Events, Arrhythmias, and Respiratory Analysis in Congestive Heart Failure (SEARCH) study. Congest Heart Fail 2006;12:241-7.
12. Roche F, Gaspoz JM, Court-Fortune I, Minini P, Pichot V, Duverney D, et al. Screening of obstructive sleep apnea syndrome by heart rate variability analysis. Circulation 1999;100:1411-5.
13. Iber C. The AASM manual for the scoring of sleep and associated events: rules, terminology and technical specification. Westchester: The American Academy of Sleep Medicine; 2007.
14. Caples SM, Somers VK, Rosen CL, Shen WK, Gami AS, Cotts W, et al. The scoring of cardiac events during sleep. J Clin Sleep Med 2007;3:147-54.
15. Wolk R, Kara T, Somers VK. Sleep-disordered breathing and cardiovascular disease. Circulation 2003;108:9-12.
16. Ancoli-Israel S, Du Hamel ER, Stepnowsky C, Engler R, Cohen-Zion M, Marler M. The relationship between congestive heart failure, sleep apnea, and mortality in older men. Chest 2003;124:1400-5.
17. Al-Delaimy WK, Manson JE, Willett WC, Stampfer MJ, Hu FB. Snoring as a risk factor for type II diabetes mellitus: a prospective study. Am J Epidemiol 2002;155:387-93.
18. Elmasry A, Lindberg E, Berne C, Janson C, Gislason T, Awad Tageldin M, et al. Sleep-disordered breathing and glucose metabolism in hypertensive men: a population-based study. J Intern Med 2001;249:153-61.
19. Hu FB, Willett WC, Colditz GA, Ascherio A, Speizer FE, Rosner B, et al. Prospective study of snoring and risk of hypertension in women. Am J Epidemiol 1999;150:806-16.
20. Hu FB, Willett WC, Manson JE, Colditz GA, Rimm EB, Speizer FE, et al. Snoring and risk of cardiovascular disease in women. J Am Coll Cardiol 2000;35:308-13.
21. Nieto FJ, Young TB, Lind BK, Shahar E, Samet JM, Redline S, et al. Association of sleep-disordered breathing, sleep apnea, and hypertension in a large community-based study. Sleep Heart Health Study. JAMA 2000;283:1829-36.
22. Mooe T, Rabben T, Wiklund U, Franklin KA, Eriksson P. Sleep-disordered breathing in men with coronary artery disease. Chest 1996;109:659-63.
23. Peker Y, Kraiczi H, Hedner J, Loth S, Johansson A, Bende M. An independent association between obstructive sleep

apnoea and coronary artery disease. Eur Respir J 1999;14:179-84.

24. Sorajja D, Gami AS, Somers VK, Behrenbeck TR, Garcia-Touchard A, Lopez-Jimenez F. Independent association between obstructive sleep apnea and subclinical coronary artery disease. Chest 2008;133:927-33.
25. Peled N, Abinader EG, Pillar G, Sharif D, Lavie P. Nocturnal ischemic events in patients with obstructive sleep apnea syndrome and ischemic heart disease: effects of continuous positive air pressure treatment. J Am Coll Cardiol 1999;34:1744-9.
26. Gami AS, Rader S, Svatikova A, Wolk R, Herold DL, Huyber C, et al. Familial premature coronary artery disease mortality and obstructive sleep apnea. Chest 2007;131:118-21.
27. Mooe T, Franklin KA, Holmström K, Rabben T, Wiklund U. Sleep-disordered breathing and coronary artery disease: long-term prognosis. Am J Respir Crit Care Med 2001;164:1910-3.
28. Milleron O, Pillière R, Foucher A, de Roquefeuil F, Aegerter P, Jondeau G, et al. Benefits of obstructive sleep apnoea treatment in coronary artery disease: a long-term follow-up study. Eur Heart J 2004;25:728-34.
29. Marin JM, Carrizo SJ, Vicente E, Agusti AG. Long-term cardiovascular outcomes in men with obstructive sleep apnoea-hypopnoea with or without treatment with continuous positive airway pressure: an observational study. Lancet 2005;365:1046-53.
30. Somers VK, White DP, Amin R, Abraham WT, Costa F, Culebras A, et al. Sleep apnea and cardiovascular disease an American Heart Association/American College of Cardiology Foundation Scientific Statement from the American Heart Association Council for High Blood Pressure Research Professional Education Committee, Council on Clinical Cardiology, Stroke Council, and Council on Cardiovascular Nursing. Circulation 2008;118(10):1080-111.