

SLEEP – DISORDERS, APNOEAS, CARDIORESPIRATORY EFFECTS & OTHER EMERGING PROBLEMS

DR. COL (RETD) S. C. TEWARI

Introduction

We all know sleep as a very essential part of body circadian rhythm characterized by reduced awareness of environment, period of bodily rest. However, a number of problems of grave clinical significance and other important aspects of human health related to sleep disturbances are emerging and sleep studies have become a very important study world over^[1, 2, 3]

Keywords: SDB- Sleep Disordered Breathing, OSA- Obstructive Sleep Apnoea, RDI- Respiratory Disturbance Index, AHI- Apnoea Hypopnoea Index, UARS- Upper Airway Resistance Syndrome.

Importance of Sleep Studies

We all sleep some more than others. Most don't realize that sleep occupies over 1/3rd of human existence time and this period of life is regulated by fine tuned autonomic sympathetic and parasympathetic drives, homeostatic sleep- wakefulness drives and circadian inherent rhythm. Minor aberrations of sleep rhythms as depicted below are themselves quite disturbing for humans such as-

- a) Insomnia- Affects 30- 40% in West and industrialized nations.
- b) Narcolepsy- A neurologically based disorder also called as sleep paralysis.
- c) CSRD (Circadian Rhythm Sleep Disorders) - Consists of jetlag, shift wake sleep disorder, advanced sleep phase syndromes.

However, more devastating effects of sleep disturbances termed apnoea, both OSA and also central apnoea are proving to be intricately related to today's more dreaded lifestyle diseases like Hypertension, IHD, NIDDM^[4,5,6,7] Metabolic syndromes and not to forget the US data of

over 70 million Americans suffering from these and over 30% of Road and other accidents being related to these^[8,9].

Following data is illuminating about problem of sleep disturbances. *White et al* diagnosed OSA in 2% women and 4% men in middle age. *Wisconsin's cohort* study had 9 to 24% men and 4 to 9% women while studies in Israel and Australia estimated as high as 20 to 25% in the employed.

Amongst these people systemic hypertension is seen in 50 to 70% OSHAS; a factor which was independent of obesity, age, alcohol and smoking (Nieto, 2000)^[6]. Insulin resistance was seen in a very high percentage of these (15%). In a study by *Punjabi & others* by *Irwin et al* (2002 to 2004), oxidative stress was very high^[10].

Impact of Sleep on Breathing

Respiratory drive is decreased in NREM sleep and is irregular in REM sleep. Minute ventilation decreases by 1 to 2 lit/ min, arterial PCO₂ increases by 2 to 8 mm Hg, PO₂ decreases by 5 to 10 mm Hg and there is a general increase in upper airway resistance. These have negligible effect in health but have profound clinical consequences in cardio- respiratory disorders^[11].

Address for correspondence:

Dr. S.C.Tewari, Department of Medicine, Rural Medical College, Pravara Institute of Medical Sciences, Loni, Taluka - Rahata, Ahmednagar, Maharashtra-413 736, India.
E-mail: medicine@pmpims.org

Also sleep deficits result in prolonged health, safety^[12], economic consequences, intellectual and social performances, quality of life in social and sexual interactions too.

Sleep & Cardiovascular Changes

In NREM sleep there is decrease in metabolic rate, sympathetic activity and blood pressure and cardiac output. In REM sleep there is increased sympathetic flow and blood pressure. Disruptive sleep in OSA stresses the heart and circulation.

Definitions

Apnoea is cessation of airflow for at least 10 seconds. It is of 3 types - Central, Obstructive & Mixed. Hypopnoea is reduction in airflow more than 50% with 4% desaturation. Respiratory Disturbance Index (RDI)/ Apnoea Hypopnoea Index (AHI) is number of apnoeas/ hypopnoeas per hour of sleep. RDI more than 15 confirms OSA. Upper Airways Resistance Syndrome (UARS) where crescendo snoring leads to apnoea and arousal. Arterial oxygen saturation may or may not change.

Obstructive Sleep Apnoea (OSA)

OSA causes daytime sleepiness, accidents^[12], and a much higher incidence of sudden deaths due to being superimposed on IHD, Asthma and COPD. Its incidence is 2% of middle aged females & 4% of males with progressive increases with age. A large study has shown following figures^[13]

RDI >5: 7 - 18 million in USA affected

RDI >15: 1.8 - 4 million

In one of the few Indian studies^[14] Udwardia *et al* reported prevalence of SDB in 19.5% of the city population and OSA was in 7.5%.

Pathogenesis of OSA

During part of sleep, posterior movement of tongue occurs and gets apposed with posterior pharyngeal wall. There is occlusion of nasopharynx and oropharynx leading to hypoxia and arousal. Once the

patient is aroused, the airway is restored and patient goes back to sleep. This cycle repeats itself indefinitely. These are beautifully captured in following MRI scans taken from a patient. (Figure1-4)

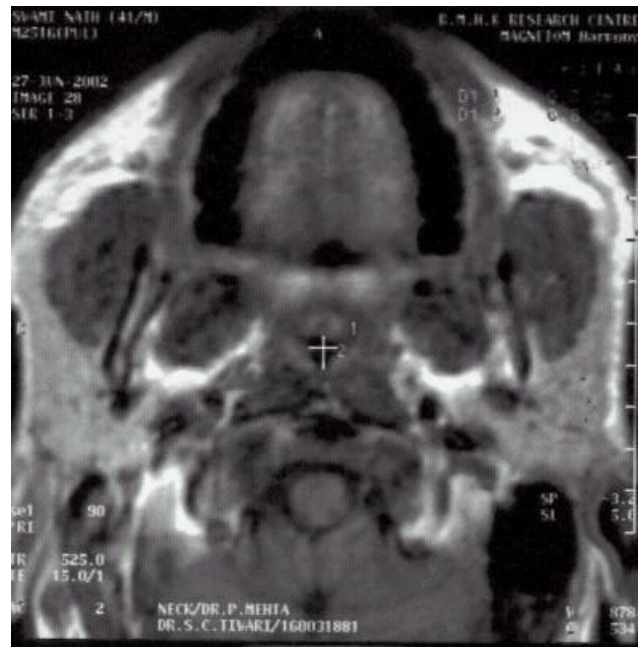


Figure 1: Narrowed oropharyngeal airways in a classical case (Horizontal Section)

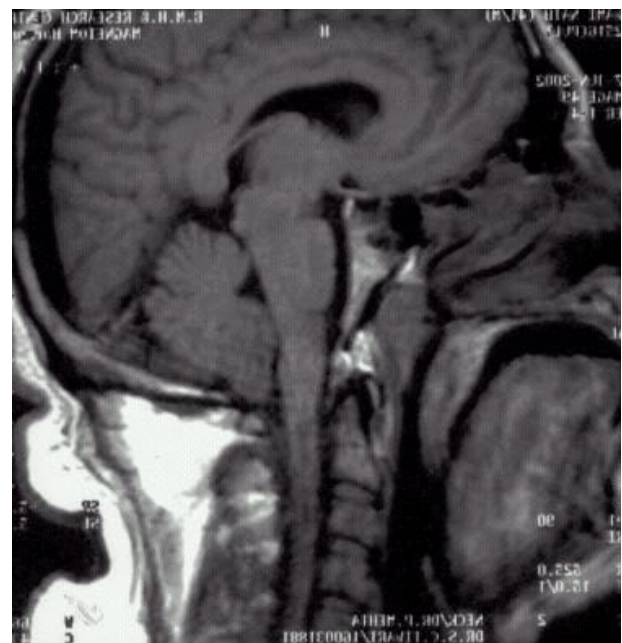


Figure 2: Same view as in Figure 1 in Sagittal Cut



Figure 3: Nasopharynx closure with palate relaxation in early sleep

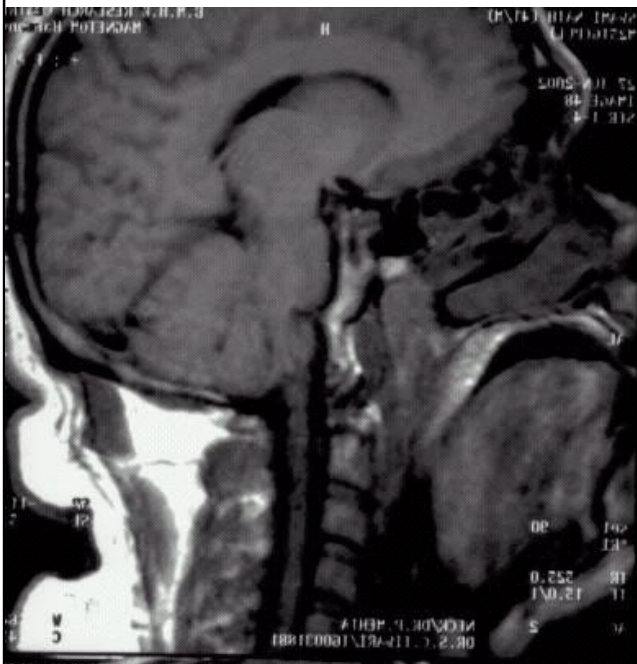


Figure 4: Complete oropharynx closure with tongue falling back

Risk Factors for OSA

Males are more predisposed than females in the ratio of 2:1. Incidence is more in obese people. Males with a neck collar size of more than 17" and females more

than 15" are at a higher risk. However, strongest risk factor is obesity, particularly central obesity by influence of this on upper respiratory fat deposition, affects airway size and compliance and abdominal loading causing hypoxia, and males have androgenic central fat deposition also on neck^[15,16]. Patients with retrognathia, micrognathia, tonsillar hypertrophy and deviated nasal septum are also more predisposed. Alcoholics and sedative users are at increased risk apart from patients of Down's syndrome, Achondroplasia, Hypothyroidism and Acromegaly.

Clinical Features

History is usually provided by the bed- partner and complaints include loud habitual snoring, witnessed episodes of apnoea, nocturnal awakening, gasping/ choking sensations in sleep, nocturia, unrefreshing sleep and morning heavy head. Other tell- tale symptoms are daytime sleepiness, automobile and work related accidents, irritability and memory loss apart from decreased libido of individual.

Cardiovascular Consequences

Increased sympathetic flow with a further increase at the end of apnoea and arousal time sympathetic surge leads to rise in blood pressure which increases the risk of acute coronary events. There is an increased incidence of tachy- and bradyarrhythmias and heart blocks. There is also a two- fold increase in the risk of stroke and nocturnal angina in all these patients^[15,16,17]. A combination of COPD plus OSA would result in rapid development of cor pulmonale and right heart failure^[17, 18, 19].

Sleep and Bronchial Asthma

Nocturnal exacerbations of asthma are common, estimated in upto 74% of patients with a large number of factors being implicated. The independent effect of sleep on bronchial hyper- responsiveness is still under study. There is a two- fold increase in lower airway resistance, all other factors being same^[21]. Paradoxically, the highest airway resistance is seen in stage 3 & 4 of NREM, rather than REM sleep.

Sleep In Congestive Heart Failure

There is a considerable overlap amongst the two entities, with 40 to 50% of CHF patients having OSA or CSR- CSA. There is a higher mortality in this subgroup of patients which can be significantly reduced by CPAP. A third of the sudden deaths in patients of CHF are due to acute cardiac events occurring during sleep^[22, 23].

Sleep Apnoea and Atrial Fibrillation

Sleep apnoea and atrial fibrillation and other nocturnal arrhythmias are also known to be frequently co- existing^[24, 25].

Diagnosis and Management Options

Last 20 years have seen a significant increase in awareness among Physicians about this disorder but still a large section of General Physicians need is to inculcate more knowledge about these.

An institutional or better a home- based polysomnographic study is now a standard method of diagnosing the disease^[26].

Treatment Options in OSA

Medical treatment includes general measures like weight loss, cutting down on alcohol intake and sedatives. Pharmacologic agents like Acetazolamide, Protryptiline and oxygen therapy are less effective. Specific measures include position therapy. Most effective therapy is Positive Airway Pressure (CPAP, auto CPAP or BiPAP) in addition to intra- oral devices to reposition the mandible and maintain the tongue in forward position. Though tolerance to these also requires long time persuasion of patients^[27, 28].

Patients requiring surgical interventions need evaluation for accurate site and cause of obstruction prior to surgical intervention. Nasal surgeries like Septoplasty and sinus surgery, Tonsillectomy with or without Adenoidectomy, Uvulopalatopharyngeoplasty (UPPP), Laser Assisted Uvulopalatoplasty (LAUP), Genioglossus Advancement with Hyoid Myotomy (GAHM) and Maxillomandibular Advancement

Osteotomy are amongst the commonly performed interventions for patients suffering from OSA. These are required to be done in very selective cases and under expert hands.

Conclusion

We have come a long way in understanding and analyzing the clinical and metabolic consequences of sleep related disorders from the time first report of these by in early seventies. The intricate relationship of these OSA's with serious cardiovascular and other consequences including hypertension, metabolic syndromes, sudden death, relationships with road and air accidents are quite apparent and deterioration in intellectual, social and sexual relationships of sufferers have become major health hazards.

These needs are now being addressed all over the world and in future the management strategy is changing from primary attention to treat these to prevention with special emphasis of relation of these disorders with obesity and other lifestyle modifications. This is now also true for countries like India where we are also seeing the epidemic proportional rise of obesity, etc. related problems.

The indications for treatment of OSA in future will need to be changed from symptomatic to prognostic reasons because obesity relation with addition of OSA, metabolic syndrome and serious impact on cardiovascular morbidity and mortality is likely to pose a great challenge for specialists in these studies even in countries like ours.

References

1. He J, Kryger M, Zorick F et al. Mortality & Apnoea Index in Obstructive Sleep Apnoea- Experience in 385 male patients. Chest. 1988; 94: 9- 14
2. Nieto FJ, Young TB, Lind BK et al. Association of Sleep- Disordered Breathing , Sleep Apnoea & Hypertension in a Large Community- Based Study- Sleep Heart Health Study. JAMA 2000. 283: 1829- 36

3. Shilna K, Tomiyama H, Takata Y et al. Concurrent Presence of Metabolic Syndrome in Obstructive Sleep Apnoea Syndrome Exacerbates the Cardiovascular Risk- A Sleep Clinic Cohort Study. *Hypertens Res.* 2006; Jun 29 (6): 433- 41
4. Shahar E, Whitney C, Redline S et al. Sleep-Disordered Breathing & Cardiovascular Disease- Cross- sectional Results of the Sleep Heart Health Study. *Am J Resp Crit Care Med.* 2001; 163(1): 19- 25
5. Young T, Peppard P, Palta M et al. Population-Based Study of Sleep- Disordered Breathing as a Risk Factor for Hypertension. *Arch Intern Med.* 1997; 157: 1746- 52
6. Ip M, Lam B, Ng M et al. Obstructive Sleep Apnoea is Independently Associated with Insulin Resistance. *Am J Resp Crit Care Med.* 2002; 165: 670- 6
7. Punjabi N, Sorkin J, Katznel L et al. Sleep-Disordered Breathing & Insulin Resistance in Middle- Aged & Overweight Men. *Am J Resp Crit Care Med.* 2002; 165 (5): 677- 82
8. Kim H, Young T, Matthew C et al. Sleep disordered Breathing & Neuropsychological Deficits- A Population Based Study. *Am J Resp Crit Care Med.* 1997; 156: 1813- 19
9. Horstmann S, Hess CW, Bassetti C et al. Sleep Related Accidents in Sleep Apnoea Patients. *Sleep.* 2000; 23: 383- 389
10. Irwin MR, Wang M, Campomayor CO et al. Sleep Deprivation & Activation of Morning Levels of Cellular & Genomic Markers of Inflammation. *Arch Intern Med.* 2006; 166: 1756- 62
11. Hedner J, Ejnell H, Sellgren J et al. Is High & Fluctuating Muscle Nerve Sympathetic Activity in the Sleep Apnoea Syndrome of Pathogenetic Importance for the Development of Hypertension? *J Hypertens Suppl.* 1988; 6: S529- S531
12. Teran- Santos J, Jimenez- Gomes A, Cordero- Guevara J. The Cooperative Group Burgos Santander. The Association between Sleep Apnoea & the Risk of Traffic Accidents. *N Engl J Med.* 1999; 340: 847- 51
13. Young T, Palta M, Dempsey J et al. The Occurrence of Sleep- Disordered Breathing among Middle- Aged Adults. *N Engl J Med.* 1993; 328: 1230- 35
14. Udawadia ZF, Doshi AV, Lonkar SG & Singh E. Prevalence of Sleep Disturbed Breathing & Sleep Apnoea in Middle- Aged Urban Indian Male. *Am J Resp Crit Care Med* 2004; 169: 168- 73
15. Dealberto MJ, Ferber C, Gavma L et al. Factors Related to Sleep Apnoea Syndrome in Sleep Clinic Patients. *Chest.* 1994; 105: 1753- 58
16. Grunstein R, Wilcox I, Yang T et al. Snoring & Sleep Apnoea in Men- Association with Central Obesity & Hypertension. *Int J Obes.* 1993; 17: 533- 540
17. Andreas S, Schulz R, Werner G et al. Prevalence of Sleep Apnoea in Patients with Coronary Artery Disease. *Cor Art Dis.* 1996; 7: 541- 45
18. Koskenvuo M, Kaprio J, Televakivi T et al. Snoring & Obstructive Sleep Apnoea as a risk factor for Ischaemic Heart Disease & Stroke in Men. *BMJ* 1987; 294: 16- 19
19. Dyken ME, Somers VK, Yameda T et al. Investigating the Relationship between Stroke & Obstructive Sleep Apnoea. *Stroke.* 1996; 27: 401- 407
20. White KF, Douglas NJ. Peripheral Oedema in the Sleep Apnoea- Hypopnoea Syndrome. *Sleep.* 1991; 14: 354- 356
21. Asthma at Night. *Clin Chest Med.* 1985; 6: 663- 75
22. Bradley TD, Logan AG, Kimoff RJ. Canadian Positive Airway Pressure for Central Sleep Apnoea & Heart Failure. *New Engl J Med.* 2005; 353: 2025- 33

23. Naughton M, Bernard D, Tam A et al. Role of Hyperventilation in the Pathogenesis of Central Sleep Apnoea in Patients with Congestive Heart Failure. *Am Rev Resp Diseases*. 1993; 148: 330- 338
24. Gami AS, Pressman G, Caples SM et al. Association of Atrial Fibrillation with Obstructive Sleep Apnoea. *Circulation*. 2004; 110: 364- 67
25. Mehra R, Benzamin EJ, Shahor E et al. Association of Nocturnal Arrhythmias with Sleep Disordered Breathing- The Sleep Heart Health Study. *Am J Resp Crit Care Med* 2006; 173: 910- 16
26. Fiemons W, Littner M, Rowley J et al. Home Diagnosis of Sleep Apnoea- A Systematic Review of Literature & Evidence Review Co-sponsored by the American Academy of Sleep Medicine, The American College of Chest Physicians & The American thoracic Society. *Chest*. 2003; 124: 1543- 79
27. Standards of Practice Committee of the American Academy of Sleep Medicine. Practice Parameters for the use of Auto-titrating Continuous Positive Airway Pressure Devices for Titrating Pressures & Treating Adult Patients with Obstructive Sleep Apnoea Syndrome- An American Academy of Sleep Medicine Report. *Sleep*. 2007; 25: 143- 47
28. Gay PC, Herold DL, Olson EJ. A Randomized Double Blind Clinical Trial Comparing Continuous Positive Airway Pressure with a Novel Bi- level Pressure System for the treatment of Obstructive Sleep Apnoea Syndrome. *Sleep*. 2003; 26: 864- 69



Medical Quote

The doctor who can no longer find time in his day for prayer and the inner life, time to prepare for his consultations in the presence of God and to seek his will for his patients, cannot bring to them the spiritual climate that is necessary if they are to open their hearts to him. Driven on by his devotion to the needs of his practice, he leads a fatiguing and unsatisfying life in which only more and more rarely does he find those peaceful moments on intimacy when he can provide what the patient most expects of him.

- Dr. Paul Tournier-