REVIEW ARTICLE

Home sleep testing (HST)

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Abstract

Obstructive sleep apnea (OSA) is the commonest variety of sleep apnea syndromes having a significant prevalence amongst the Indian population. But despite being a common disease, a large number of cases remain undiagnosed due to lack of diagnostic facilities. Though full polysomnography (PSG) is considered as the "gold standard" for the diagnosis of OSA, it is expensive, labour-intensive and has limited availability. Hence, the need for a strategy like Home sleep testing (HST), which is substantially less expensive and more readily available, thereby helping the physician in achieving a higher rate of diagnosis and treatment of OSA. HST may be used for diagnosis of OSA in patients with a high pretest probability of moderate to severe OSA, when PSG is not possible by virtue of immobility, safety or critical illness and for monitoring of non-continuous positive airway pressure (CPAP) based therapy. Various studies have shown that HST have a high degree of accuracy and is comparable to in-laboratory PSG with respect to improvement in sleep apnea-specific quality of life (SAQLI) and compliance to CPAP therapy. Though HST may not be as accurate as PSG, the modest reduction in its accuracy is counterbalanced by its timeliness, the greater patient access afforded and the substantially lower cost.

Keywords: Home sleep testing (HST), Polysomnography (PSG), Unattended limited channel testing (ULCT), Obstructive sleep apnea syndrome (OSAS)

Introduction

Sleep apnea syndromes (SAS) represent a group of conditions that are characterized by an abnormal respiration during sleep. There are three distinct forms of sleep apnea: central(CSA), obstructive(OSA), and complex(CompSAS). OSA, CompSAS and CSA constitute 84%, 15% and 0.4% of cases respectively,[1] making OSA the commonest variety of SAS. Nasal continuous positive airway pressure (CPAP) is the most effective treatment for patients with moderate to severe OSA.[2] The estimated prevalence of obstructive sleep apnea syndrome-OSAS (objective sleeping respiratory disturbance associated with daytime sleepiness) in the United States is 2% in women and 4% in men.[3] Epidemiological study from other countries also show that 1-5% of adult men suffer from OSAS.[4] The prevalence of OSAS in adult Indian population is approximately 3.5%.[5,6,7] This suggests that in India, up to about 34 million people may be suffering from OSAS. Despite being a common disease, a large number of OSAS cases, an estimated 82%, are not diagnosed due to lack of diagnostic facilities.[8] Hence the need for a strategy like home sleep testing (HST) which will help the physician to diagnose and treat patients with sleep

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Representative Case

A 48-year-old man with a BMI of 28 kg/m^2 with systemic hypertension came with complaints of loud snoring and excessive daytime sleepiness. His laboratory investigations were normal. He was found to have a high pre-test probability for OSAS. HST was done using Apnoea Link ™ (pulse oximetry, airflow and snoring sensor) as shown in figure 1. He was diagnosed to have severe OSAS and initiated on CPAP therapy of 8 cm of H_2O calculated by the BMI based formula. Subsequently an auto-PAP titration showed the 95th percentile pressure to be 9 cm of H_2O. Reassessment after 3 months of CPAP therapy showed improved sleep apnea-specific quality of life and improvement in OSAS symptoms.

apnea syndrome at a rate higher than what is currently prevalent.

Standard diagnosis and treatment for Obstructive Sleep Apnea Syndrome

Full polysomnography(PSG) is currently the "gold standard" for the diagnosis of OSAS and titration of effective continuous positive airway pressure(CPAP).[9,10,11,12,13] PSG provides detailed information on sleep state and respiratory and gas exchange abnormalities, in addition to a range of other variables including body position, heart rate and rhythm, and muscle tone and contraction.[10] PSG is performed on 2 nights for at least 6 hours in a sleep laboratory; baseline and with CPAP titration. Manual PSG scoring is done on both nights. Manual CPAP titration is done on 2nd night. Split-night studies may also be performed in which the initial part is devoted to diagnosis and the latter part involves the initiation of CPAP therapy. The following criteria are recommended for the diagnosis of OSAS:[10]

A. Excessive daytime sleepiness that is not better explained by other factors.

B. Two or more of the following that are not better explained by other factors:

   Choking or gasping during sleep, recurrent awakenings from sleep, unrefreshing sleep, daytime fatigue, impaired concentration.

C. Overnight monitoring demonstrates five or more obstructed breathing events per hour during sleep. These events may include any combination of obstructive apneas/hypopneas or respiratory effort–related arousals (RERAs).

The patient suspected of OSAS must fulfill criterion A or B, plus criterion C. Further, OSAS severity, based on the frequency of abnormal respiratory events during sleep, is graded as a) mild: 5–15 events/hour of sleep, b) moderate: 15–30 events/hour of sleep and c) severe: more than 30 events/hour of sleep. CPAP therapy is then prescribed based on the results of the manual titration.

Home sleep testing (HST)

Polysomnography is performed using neuro (electroencephalography–EEG, electromyography-EMG and electro-oculography-EOG) and cardiorespiratory (heart rate, pulse oximetry, snoring airflow, and respiratory effort) channels. Some additional channels like body positioning may also be added. The 1994 review by American Sleep Disorders Association[14] classified PSG into 4 types/levels:

Type 1: ≥ 7 channel devices using both neuro and cardiorespiratory variables in a laboratory setting and fully attended

Type 2: ≥ 7 channel devices using both neuro and cardiorespiratory variables and unattended

Type 3: limited channel devices, usually using 4–7 cardiorespiratory channels

Type 4: 1 or 2 channels usually using oximetry as 1 of the parameters

Of these, level 3 and 4 can be performed in laboratory or at home, attended or unattended. Home sleep testing (HST) usually consists of unattended level 3 or 4 testing using portable monitors (PM) hence it is sometimes also called as unattended limited channel testing (ULCT). In-laboratory PSG i.e. the level 1 PSG is labour intensive and expensive with limited availability. On the other hand, untreated OSAS has severe adverse health consequences. This has resulted in an urgent need to use strategies that do not unduly rely on laboratory–based PSG.[12] Diagnostic-therapeutic approach such as overnight HST using level 3 or 4 PSG (cardiorespiratory variables only) with PM in conjunction with CPAP prescription, based on autotitration or using established formulae, are alternatives at least in the classic or the "garden variety" of OSAS.

Several PM have been proposed that range in

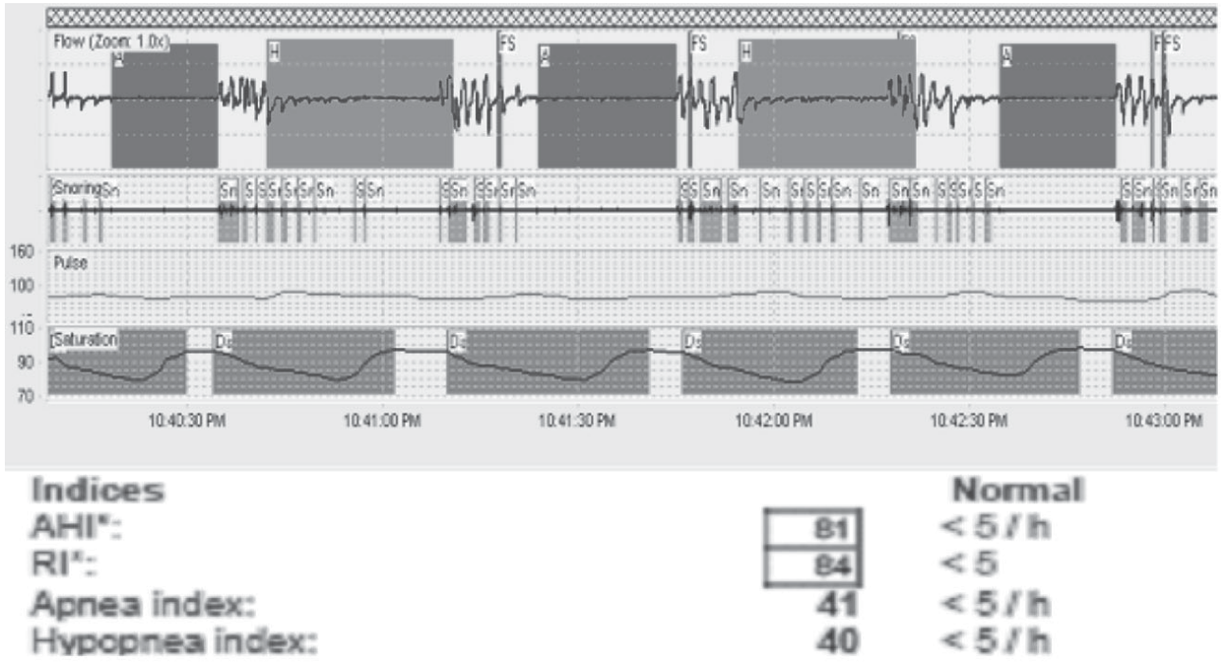

Figure 1: Sleep study using limited variables- pulse oximetry and airflow and snoring sensors

complexity from full PSG to oximetry alone.[15] Monitors that record respiratory variables together with oximetry but without electroencephalography (EEG) and electromyography (EMG) are particularly attractive because the same definition of OSAS, as in standard PSG, can be employed.[16]

Use of HSTs: When and how

HST may be used for diagnosis of OSA in patients with a high pretest probability of moderate to severe OSA, when PSG is not possible by virtue of immobility, safety or critical illness and for monitoring non-CPAP based therapy. Airflow, effort, and oximetric biosensors conventionally used for in-laboratory PSG should be used in HST as these can be manually scored, if required, using AASM guidelines.[17] This is the reason why pulse artery tonometry (PAT) and actigraphy based studies have not been approved so far.

Interpretation of unattended limited channel testing (ULCT) or portable monitor (PM)

Machine auto-score is sufficient if the results match clinical assessment. If any discrepancy exists, manual scoring is recommended. AASM has developed scoring criteria that they recommend for use with both PSG and HST.[17]

Advantages of HSTs

Level 3 and 4 monitoring can be performed both attended and unattended. Testing can be at the patient's home with simple monitors, providing a natural sleeping environment. HSTs are substantially less expensive and more widely available than in-laboratory PSGs[18] They can be used for the diagnosis as well as for titration of CPAP. Sensitivities for the HSTs range from 86-100% while specificities range from 64-100%. Most importantly, patients have similar treatment outcomes whether OSA is diagnosed by PSG or HST.[16]

Evidence to support Home sleep testing (HST)

Overnight oximetry and portable sleep monitoring at home can identify OSA with a high degree of accuracy.[19,20,21] In a study by Tonelli de Oliveira et al,[22] after being validated at the laboratory against full PSG, the diagnostic performance of a type 3 PM for detecting OSAS at home was found to be within acceptable limits for diagnostic tests. There is no difference between

laboratory-based testing versus HST with respect to compliance or improvement in sleep apnea–specific quality of life (SAQLI), one of the only verified outcomes of sleep apnea therapy.[16] Randomized, controlled, open-label trials [23] have found that PSG confers no advantage over HST in terms of diagnosis and CPAP titration in the initial management of OSA.

Approval for HST

AASM task force recommends that HSTs can be used with a comprehensive sleep evaluation supervised by a trained sleep specialist in an accredited sleep center utilizing quality control.[17] US Centers for Medicare and Medicaid Services (CMS) now cover CPAP treatment for positive tests from Type II, III and IV (at least 3 channels) devices.[24]

Contraindications to HST

Exclusion criteria for HST include significant comorbid medical conditions like heart disease, congestive cardiac failure (CCF), cor pulmonale, hypoventilation, stroke, seizures, psychosis and other serious conditions like asthma, hepatic or renal failure. Also patients suspected of having comorbid sleep disorders like cen-tral sleep apnea, periodic limb movement disorder (PLMD), insom-nia, parasomnias, circadian rhythm disorders, or narcolepsy must be excluded.[17]

Pretest probability before Home sleep testing (HST)

Pretest probability of OSAS helps select an ideal candidate and improves the results of HST. This can be done by various evidence based clinical prediction tools to accurately assess the pretest probability of OSAS. The Sleep Apnea Clinical Score (SACS)[25] is one such screening tool based on snoring, witnessed episodes of apnea, neck circumference and systemic hypertension. A score of 15 or greater gives a likelihood ratio of 4.45 of having moderate to severe OSA.[25] A simple way of using SACS is calculation of adjusted neck circumference i.e. measured neck circumference in cm and adding 3 cm for snoring, 3 cm for witnessed apneas and 4 cm for systemic hypertension. Adjusted neck circumference of <43 cm, between 43-47.9 cm and ≥48 cm indicate low risk, intermediate risk and high risk for OSAS.[26] Other clinical prediction tools include the Epworth Sleepiness Scale,[27] Berlin Questionnaire which assesses snoring, daytime sleepiness, history of hypertension, age and body mass index (BMI),[28] Mallampati scoring [29] and STOP-BANG questionnaire.[30]

Prescribing Continuous positive airway pressure (CPAP) with HST

It has traditionally been recommended that technicians should titrate CPAP overnight in patients with OSA until most of the apneas and arousals are abolished, as monitored by PSG.[13] The required pressure is then delivered by a fixed CPAP machine. Autoadjusting CPAP (auto-CPAP), on the other hand, adjusts pressure according to inspiratory flow limitation, snoring and apneas and may be used in overnight CPAP titration.[31,32,33] The 95th percentile overnight airway pressure determines the effective level of CPAP required. This pressure may be delivered using a fixed CPAP or patients may use the auto-CPAP machines for long term. The auto titration method can be used to initiate CPAP treatment at home or in hospital.[34,35,36] Home titration can deliver the same benefits as in-laboratory titration at about two thirds the cost.[37] Another method is to start CPAP by using various formulae[38] instead of a formal titration in a sleep laboratory. These formulae predict the required CPAP based on neck circumference/ body mass index and oxygen desaturation/ AHI.[39,40,41] West et al[32] randomised prospectively patients diagnosed recently with OSA to one of three different methods of CPAP therapy i.e. (1) long term autotitration, (2) autotitration for 1 week with long term fixed pressure thereafter and (3) an algorithm method of pressure determination and showed that the method of determining CPAP for treatment of moderate to severe OSA makes no significant difference to clinical outcome measures.This study showed that although the formula based group pressure (8 cmH_2O) was lower than the split-night titration group pressure (9.5 cmH_2O), the patients improved equally with respect to sleepiness and adverse effects in both groups. However, the formula is complicated and difficult to use in practice. Another simple method is to put patients on a CPAP based on the body mass index (BMI).[42] The recommended pressures are 8cm H_2O for BMI<30/Kg/m^2, 10cm H_2O for BMI between 30-35/Kg/m^2 and 12 cm H_2O for BMI>35/Kg/m^2. Both the algorithm based pressure or arbitrary-pressure approach to determine CPAP pressures for treatment of OSA are simple and equally

effective alternatives to the labour intensive overnight PSG-based titration or the expensive auto- CPAP titration. Another study by Skomro et al[43] showed that in-laboratory diagnosis and therapy for OSA, using primarily a splitnight PSG, does not lead to superior 4-week outcomes (subjective somnolence, arterial BP, sleep quality and quality of life) when compared with home-based diagnosis and treatment. Furthermore, there was no difference in CPAP adherence between both groups at 4 weeks.

Bypassing the sleep study altogether

Another ambulatory approach is the response to empirical auto-CPAP therapy during 2 weeks in sleepy snorers with clinically suspected OSAS shown by a study by Senn et al.[44] In this study, the CPAP trial predicted the OSAS (AHI 10 events per hour) with positive and negative predictive values of 97% and 78%, respectively. Furthermore, the trial identified patients using CPAP for more than 4 months who experienced persistent symptomatic improvement with positive and negative predictive values of 92% and 100%, respectively. Therefore, a CPAP trial may help to diagnose OSAS, identify patients who benefit from CPAP, and reduce the need for PSG.

Criticism against and disadvantages of HST

It may be difficult for a physician, who has not received training in sleep medicine, to determine which patient should be subjected to HST as it requires an understanding of the risk factors for OSA and the diagnostic criteria for other sleep disorders. Disadvantages of HST include limited capability to immediately identify and resolve technical issues since an attendant may not be present, inability to diagnose other types of sleep disorders, and an increased role for the patient in terms of the application and use of the device, which may make some patients uncomfortable. Though there are a number of studies[20,23,43] which validate the equivalency of home-based limited-channel diagnostic testing for obstructive sleep apnea compared with in-laboratory polysomnography, an editorial[45] suggested that these studies were done on patients who were adequately screened for the signs and symptoms of sleep apnea, who did not have confounding sleep or medical disorders that may reduce the sensitivity and specificity of the HST and were done by physicians who are familiar with the care of patients with obstructive sleep apnea. This editorial concluded that HST can work in selected patients cared for by sleep specialists and recommended the use of HST through accredited sleep centers with trained physicians. However, the opinion that a sleep specialist was required for HST was countered by another study [46] which compared a simplified package of care (incorporating nurse-led home diagnosis and CPAP therapy) for patients with moderate–severe OSA with physician-led current best practice in OSA management and found that the outcome of the simplified model of care was not inferior to the usual specialist sleep physician–led, hospital-based model. Hence HST can be carried out even by a primary care physician in patients with high pretest probability of moderate to severe OSA. However there should be a timely referral to a sleep specialist when in doubt.

Conclusion

Specialist guidelines favour laboratory-based testing for diagnosis and treatment of sleep apnea; however, this facility is not available to many patients.[26] The high prevalence of OSAS and the failure of access to PSG to keep up pace with the rising OSA rates makes it necessary to consider simplified approaches to the diagnosis at least in selected cases.[47] HSTs strengthened with pretest probability scores such as the SACS followed by use of long term auto-adjusting CPAP or fixed CPAP based on adjusted CPAP home titration or even formula-based CPAP pressures have an equivalent clinical outcome compared with the conventional laboratory-based approach.[26] Though HST may not be as accurate as PSG, the modest reduction in its accuracy is counterbalanced by its timeliness, the greater patient access afforded and the substantially lower cost.

References

1. **Morgenthaler TI**, Kagramanov V, Hanak V, Decker PA. Complex sleep apnea syndrome: is it a unique clinical syndrome? *Sleep 2006;29(9):1203-9*.
2. **Loube DI**, Gay PC, Strohl KP, Pack AI, White DP, Collop NA. Indications for positive airway pressure treatment for adult obstructive sleep apnea patients: a consensus statement. *Chest 1999;115:863-6*.
3. **Young T,** Palta M, Dempsey J, Skatrud J, Weber S, Badr S. The occurrence of sleep disordered breathing among middle-aged adults. *N Engl J Med 1993;328:1230-5*.

4. **Davies RJ**, Stradling JR. The epidemiology of sleep apnoea. *Thorax 1996;51(Suppl 2):565-570.*

5. **Saxena S,** Gothi D, Joshi JM. Prevalence of Symptoms and Risk of Sleep Disordered Breathing in Mumbai (India). *Indian J Sleep Med 2006;1.1: 27-31.*

6. **Sharma SK**, Kumpawat S, Banga A, Goel A. Prevalence and risk factors of obstructive sleep apnea syndrome in a population of Delhi, India. *Chest 2006;130:149-56*

7. **Vijayan VK**, Patial K. Prevalence of Obstructive Sleep Apnea Syndrome (OSAS) In Delhi, India. *Chest 2006;130: 92S.*

8. **Young T,** Evans L, Finn L, Palta M. Estimation of the clinically diagnosed proportion of sleep apnea syndrome in middle-aged men and women. *Sleep 1997;20:705-6.*

9. Indications and standards for use of nasal continuous positive airway pressure (CPAP) in sleep apnea syndromes. American Thoracic Society. Official statement adopted March 1944. *Am J Respir Crit Care Med 1994;150:1738-45.*

10. Practice Committee of the American Sleep Disorders Association. Practice parameters for the indications for polysomnography and related procedures. Polysomnography Task Force, American Sleep Disorders Association Standards of Practice Committee. *Sleep 1997;20:406-22.*

11. American Academy of Sleep Medicine Task Force. Sleep-related breathing disorders in adults: recommendations for syndrome definition and measurement techniques in clinical research. *Sleep 1999;22:667–689.*

12. **McNicholas WT**. Diagnosis of Obstructive Sleep Apnea in Adults. *Proc Am Thorac Soc 2008;5:154–160.*

13. Positive Airway Pressure Titration Task Force of the American Academy of Sleep Medicine. Clinical Guidelines for the Manual Titration of Positive Airway Pressure in Patients with Obstructive Sleep Apnea. *J Clin Sleep Med 2008;4:157-171.*

14. Standards of Practice Committee of the American Sleep Disorders Association. Practice parameters for the use of portable recording in the assessment of obstructive sleep apnea. *Sleep 1994;17:372-7.*

15. **Ferber R,** Millman R, Coppola M, et al. ASDA standards of practice: portable recording in the assessment of obstructive sleep apnea.*Sleep 1994;17:378–92.*

16. **Jobin V**, Mayer P, Bellemare F. Predictive value of automated oxygen saturation analysis for the diagnosis and treatment of obstructive sleep apnoea in a home-based setting. *Thorax 2007;62:422.*

17. **Collop NA,** Anderson WM, Boehlecke B, Claman D, Goldberg R, Gottlieb DJ, et al. Clinical guidelines for the use of unattended portable monitors in the diagnosis of obstructive sleep apnea in adult patients. Portable Monitoring Task Force of the American Academy of Sleep Medicine. *J Clin Sleep Med 2007;3(7):737-47.*

18. **Ghegan MD**, Angelos PC, Stonebraker AC, Gillespie MB. Laboratory versus portable sleep studies: a meta-analysis. *Laryngoscope 2006;116(6):859-64.*

19. **Coppola MP,** Lawee M. Management of obstructive sleep apnea syndrome in the home:The role of portable sleep apnea recording. *Chest 1993;104:19-25.*

20. **Whitelaw WA**, Brant R, Flemons WW. Clinical usefulness of home oximetry compared with polysomnography for assessment of sleep apnea. *Am J Respir Crit Care Med 2005;171:188-193.*

21. **Golpe R,** Jime´nez A, Carpizo R. Home sleep studies in the assessment of sleep apnea/hypopnea syndrome. *Chest 2002;122:1156-61.*

22. **Tonelli de Oliveira AC,** Martinez D, Vasconcelos LF, Gonçalves SC, Lenz MC, Fuchs SC, et al.Diagnosis of obstructive sleep apnea syndrome and its outcomes with home portable monitoring.*Chest 2009;135(2):330-336.*

23. **Mulgrew AT**, Fox N, Ayas NT, Ryan CF. Diagnosis and initial management of obstructive sleep apnea without polysomnography: a randomized validation study. *Ann Intern Med 2007;146:157-66.*

24. Department of Health and Human Services, Center for Medicare and Medicaid Services. Decision Memo for Continuous Positive Airway Pressure (CPAP) Therapy for Obstructive Sleep Apnea (OSA). CAG#0093R. March 13, 2008.

25. **Flemons WW,** Whitelaw WA, Brant R, Remmers JE. Likelihood ratios for a sleep apnea clinical prediction rule. *Am J Respir Crit Care Med 1994;150:1279-85.*

26. **Skjodt NM**. Approach to outpatient management of adult sleep apnea. *Can Fam Physician 2008;54:1408-1412.*

27. **Johns MW**. A new method for measuring daytime sleepiness: the Epworth Sleepiness Scale. *Sleep 1991;14(6):540-545.*

28. **Netzer NC**, Stoohs RA, Netzer CM, Clark K, Strohl KP. Using the Berlin Questionnaire to identify patients at risk for the sleep apnoea syndrome. *Ann Intern Med 1999;131(7): 485-91.*

29. **Nuckton TJ**, Glidden DV, Browner WS, et al. Physical examination: Mallampati score as an independent predictor of obstructive sleep apnea. *Sleep 2006;29:903–908.*

30. **Vasu TS,** Doghramji K, Cavallazzi R, Grewal R, Hirani A, Leiby B, et al. Obstructive sleep apnea syndrome and postoperative complications:clinical use of the STOP-BANG questionnaire. *Arch Otolaryngol Head Neck Surg 2010;136(10):1020-4.*

31. **Ayas NT,** Patel SR, Malhotra A, Schulzer M, Malhotra M Jung D, et al. Auto-titrating versus standard continuous positive airway pressure for the treatment of obstructive sleep apnea: results of a meta-analysis. *Sleep 2004;27:249-253.*

32. **West SD,** Jone DR, Stradling JR. Comparison of three ways to determine and deliver pressure during nasal CPAP therapy for obstructive sleep apnea. *Thorax 2006;61:226-231.*

33. **Masa JF,** Jiménez A, Duran J, Capote F, Monasterio C, Mayos M, et al. Alternative methods of titrating continuous positive airway pressure. *Am J Respir Crit Care Med 2004;170:1218-1224.*

34. **Planes C**, D'Ortho MP, Foucher A, Berkani M, Leroux K, Essalhi M, et al. Efficacy and cost of home-initiated Auto-nCPAP versus conventional CPAP. *Sleep 2003;26:156–60.*

35. **Stradling JR**, Barbour C, Pitson DJ, Davies RJ. Automatic nasal continuous positive airway pressure titration in the laboratory, patient outcomes. *Thorax 1997;52:72–5.*

36. **Berry RB**, Parish JM, Hartse KM. The use of auto-titrating continuous positive airway pressure for treatment of adult obstructive sleep apnea. An American Academy of Sleep Medicine review. *Sleep 2002;25:148–73.*

37. **Stradling JR**. Reducing the Cost of Treating Obstructive Sleep Apnea Good News for Patients. *Am J Respir Crit Care Med 2004;170:1143-4.*

38. **Lopez-Campos JL**, Garcia Polo C, Leon Jimenez A, Gonzalez-Moya E, Arnedillo A, Fernandez Berni JJ. CPAP titration: Different methods for similar clinical results. *Eur J Intern Med 2007;18:230-4.*

39. **Miljeteig H**, Hoffstein V. Determinants of continuous positive airway pressure level for treatment of obstructive sleep apnea. *Am Rev Respir Dis. 1993;147:1526-1530.*

40. **Hoffstein V**, Mateika S. Predicting nasal continuous positive airway pressure. *Am J Respir Crit Care Med 1994;150:486–8.*

41. **Stradling JR,** Hardinge M, Smith DM. A novel, simplified approach to starting nasal CPAP therapy in OSA. *Respir Med 2004;98:155–8.*

42. **Hukins CA**. Arbitrary-pressure continuous positive airway pressure for obstructive sleep apnea syndrome. *Am J Respir Crit Care Med 2005;171:500-505.*

43. **Skomro RP** , Gjevre J , Reid J , et al . Outcomes of home-based diagnosis and treatment of obstructive sleep apnea . *Chest 2010;138(2):257-263.*

44. **Senn O**, Brack T, Russi EW, Bloch KE. A continuous positive airway pressure trial as a novel approach to the diagnosis of the obstructive sleep apnea syndrome. *Chest 2006;129:67-75.*

45. **Collop NA.**Home Sleep Testing:It Is Not About the Test.*Chest 2010;138:245-246.*

46. **Antic N**, Buchan C, Esterman A, et al. A Randomised Controlled Trial of Nurse-led Care for Symptomatic Moderate-Severe OSA. *Am J Respir Crit Care Med 2009;179:501-508.*

47. ATS/ACCP/AASM Taskforce Steering Committee. Executive summary on the systematic review and practice parameters for portable monitoring in the investigation of suspected sleep apnea in adults. *Am J Respir Crit Care Med 2004;169:1160–1163.*