CHEST Topics in Practice Management

Split-Night Polysomnography*

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Obstructive sleep apnea (OSA) is a common disorder associated with serious health consequences, increased health-care utilization, and economic burden. With greater public and medical attention to sleep disorders, the volume of referrals for sleep studies over the last decade has increased by approximately 12-fold. Despite the steep growth of infrastructure to diagnose and treat OSA, access to such services remains a sizeable problem, and demand overwhelms capacity. To expedite diagnosis of sleep apnea and prescription of treatment, one strategy adopted by sleep specialists is to employ split-night polysomnography, a strategy that encompasses both diagnosis of OSA and initiation of positive pressure therapy in a single night. This article reviews the literature examining this combined diagnostic/therapeutic strategy and discusses the applicable third-party issues of procedural coding and reimbursement.

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Abbreviations: AASM = American Academy of Sleep Medicine; AHI = apnea-hypopnea index; CMS = Centers for Medicare and Medicaid Services; CPAP = continuous positive airway pressure; CPT = current procedural terminology; ICD-9-CM = International Classification of Diseases, Ninth Revision, Clinical Modification; OSA = obstructive sleep apnea; RDI = respiratory disturbance index; REM = rapid eye movement

Obstructive sleep apnea (OSA), a common condition,[1] is associated with serious health consequences,[2] increased health-care utilization,[3,4] and economic burden.[5] With greater public and medical attention to sleep disorders, the volume of referrals in the United States for sleep studies over the last decade has increased by 12-fold, while the number of sleep laboratories during the same time period has merely doubled.[6] Despite the steep growth of infrastructure to diagnose and treat OSA, access to such services remains a sizeable problem, and demand overwhelms capacity.[7] Although cost-effective analysis reports that diagnosis and treatment of sleep apnea is economically attractive,[8,9] a combination of limited numbers of accredited facilities, staff, and reimbursement issues have led to a "bottle-neck" effect.

The current reference standard for evaluating sleep-disordered breathing is polysomnography.

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However, it is by no means the ultimate "gold standard." Polysomnography is subject to error involved with data measurement, artifact, and interpretation. Additionally, polysomnographic testing may misclassify patients based on night-to-night variability, a well-recognized phenomenon.

Ultimately, a majority of patients with OSA receive a prescription for continuous positive airway pressure (CPAP), as this remains the primary therapy for OSA. To expedite the process of diagnosing OSA and initiating CPAP treatment, many have turned to strategies other than the "gold standard" of in-laboratory polysomnography followed by a subsequent night of CPAP titration. Examples of report-

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edly more efficient alternatives include home-based sleep studies,[10,11] autotitrating CPAP machines,[12,13] daytime office-based titration,[14] and CPAP titration using a prediction equation.[13,15] Other more recent paradigms include using arbitrary CPAP pressures[16] or patient-titrated CPAP[17] in an effort to decrease time to therapy. Split-night diagnostic-titration evaluation, or split-night polysomnography, is another such option that many sleep centers have adopted. In the split-night paradigm, a patient undergoes routine in-laboratory polysomnography; if a diagnosis of OSA is established, CPAP titration commences thereafter. Both diagnosis and optimal levels of CPAP therapy are theoretically achieved in 1 night, obviating the need for an additional night of study and its associated burden on resources. Naturally, this has appeared an attractive option for many centers and patients in reducing waiting times, time to prescription of CPAP therapy, and resources expended.[18] Indeed, Elshaug et al[18] estimated that by employing a split-night protocol, the waiting time for CPAP therapy decreased by 7 months. In the retrospective analysis by McArdle and colleagues,[19] patients studied using a split-night protocol had a lower median time from referral to initiation of CPAP than those undergoing full-night evaluations (13 months vs 22 months, respectively; $p = 0.003$). In light of these data, the American Academy of Sleep Medicine (AASM) report considers the use of split-night polysomnography acceptable if prespecified conditions are met (Table 1). The indications for CPAP titration when employing full-night polysomnography are also shown in the table for comparison.

Nonetheless, the use of split-night studies has not been received with unanimous support.[20] Firstly, use of this abbreviated version veers from the benchmark full night of diagnostic study. Secondly, there is concern that split-night polysomnography hinders the accurate assessment of sleep architecture and severity of sleep disorders, especially since even full-night polysomnography is subject to significant diagnostic variability from night to night. Therefore, the data collected on any given night may not be representative of the patient's typical sleep. Additionally, there is concern that rapid eye movement (REM) sleep, a sleep stage associated with more severe disturbances of upper-airway function, may not be observed in a split-night protocol. This may lead to an underestimation of the severity of apnea burden. Finally, there is a belief that performing CPAP titration on the same night may not be the optimal method to achieve patient acceptance and adherence to CPAP therapy. Rather, providing them with a devoted night is believed to promote acceptance and perseverance. Despite these seemingly appropriate concerns, as many as 20% of sleep practitioners regard split-night study of sleep as a routine default[21] when full-night studies are unavailable and/or impractical, and 16% believe that all patients with complaints of excessive daytime somnolence should be routinely investigated with a split-night strategy.[21]

To address this issue, many investigators have studied the efficacy and cost-effectiveness of employing split-night polysomnography as a diagnostic and treatment strategy. The studies undertaken can be grouped into three categories: (1) those that test the accuracy of the split-night study to diagnose OSA; (2) effectiveness of CPAP titration; and (3) patient acceptance and adherence to therapy following a split-night study. Studies available within each of these categories are summarized in Table 2. Based on two retrospective investigations[22,23] of the accuracy of the split-night study vs the full-night diagnostic study, failure to document OSA during the first portion of the night cannot reliably exclude the disease. As such, in circumstances in which the first portion of the night in a split-night study is inconsistent with OSA, it should be converted to a full-night study, especially for patients in whom REM sleep is absent.

Evaluating the adequacy of split-night studies also includes examining the effectiveness of CPAP titration within the abbreviated period of sleep permit-

Table 1—*Indications for CPAP Titration Depending on the Type of Polysomnogram

Split-Night Diagnostic-Titration Evaluation Criteria	Full-Night Evaluation Criteria
1. Patient with AHI > 40/h of sleep during a ≥ 2-h baseline portion of the sleep study.	1. Patient with apnea index > 20/h of sleep.
2. A patient with AHI > 20 to < 40/h during the first 2 h of sleep who is assessed clinically to require CPAP based on other risk factors: sleepy, heart disease, hypertension, and lung disease.	2. Patient with RDI > 15/h of sleep.
3. CPAP titration > 3 h.	3. Sleepy patient with RDI > 5/h of sleep.
4. Polysomnography demonstrates that CPAP abolishes respiratory events during REM and non-REM sleep.	
5. Second full-night polysomnography for CPAP titration is performed if diagnosis of sleep-disordered breathing is confirmed but criteria 2 and 3 are not met.	

*From Kushida et al.[32]