Sleep: Identifying and Diagnosing Adults With Sleep Apnea, continued

questionnaire as having at least 2 of these risk factors, were deemed high risk for sleep apnea.

RESULTS: Between April 2003 and May 2007, 485 patients with a mean age of 68.3 were studied. Four hundred and twelve (84%) of the patients were overweight with a BMI of ≥25, 257 (53%) experienced daytime somnolence, and 204 (42%) snored. Two hundred and four patients were identified as high risk; of these 184 patients (90%) had significant sleep apnea diagnosed by polysomnogrophy. The questionnaire demonstrated a sensitivity of 0.87, specificity of 0.90, and a positive predictive value of 0.89 for the diagnosis of significant sleep apnea. High-risk patients were 8 times more likely to have significant sleep apnea as compared to the low risk patients.

CONCLUSION: The Berlin questionnaire accurately identifies elderly patients at high risk for significant sleep apnea.

CLINICAL IMPLICATIONS: Obesity, snoring, and daytime somnolence are risk factors that can identify patients with sleep apnea.

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NOVEL QUANTIFICATION OF AIRWAY OBSTRUCTION IN ADULT OBSTRUCTIVE SLEEP APNEA

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PURPOSE: Obstructive sleep apnea (OSA) is comprised of dynamic airway events that occur during natural sleep. Current airway measures are static (cephalometry) or involve invasive techniques which interfere with natural sleep (sleep endoscopy). We propose that real-time magnetic resonance imaging (RT-MRI) with simultaneous non-invasive physiologic measures of sleep can elucidate site of obstruction.

METHODS: A prospective series of 7 OSA subjects diagnosed by attended polysomnography, Fujita classification, Functional Outcomes of Sleep Questionnaire (FOSQ) and Epworth Sleepiness Score (ESS) underwent continuous RT-MRI during a 90 minute nap without sedation utilizing actigraphy. The upper airway at the mid-saggittal plane was visualized in real time (33 frames per second) using a sliding window algorithm (RTHawk system). Respiratory events, pulse arterial tone amplitude (zzzPAT algorithm), oxygen saturation, and pulse rate were simultaneously monitored (Watch-PAT, Itamar Inc, Israel).

RESULTS: OSA subjects displayed a mean BMI of 27 and the apnea-hypopnea index was 48.3 events per hour with a Fujita class that varied from palate only (type I) to palate and tongue obstruction (type II). The mean FOSQ and ESS scores were 3.18 and 9.1, respectively. Airway obstructions visualized on the RT-MRI during sleep included palate only, tongue only, combined upper airway narrowing and obstruction, and epiglottis obstruction and were predictive of the Fujita class. Respiratory events during sleep (mean rate of 27.1/hr/subject) and desaturations (mean rate of 14.7/hr/subject) coincided with the obstructive events observed during the RT-MRI. Respiratory events were associated with PAT signal attenuation, PAT amplitude reduction, pulse rate acceleration, and desaturation events. The specific location of airway obstruction was characterized with a high degree of precision.

CONCLUSION: Our study shows a novel approach to simultaneously evaluate airway obstructions with respiratory and desaturation events in real time during natural sleep.

CLINICAL IMPLICATIONS: By simultaneously observing site of obstruction dynamically as detailed by RT-MRI and quantifying respiratory events, this approach can target the actual site of obstruction preoperatively and has the potential of improving predictions of successful surgical outcome in patients with OSA.

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REMOTE INFRARED IMAGING: A NOVEL NONCONTACT METHOD TO MONITOR AIRFLOW DURING POLYSOMNOGRAPHY

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PURPOSE: The use of nasal pressure as the sole monitor for airflow during polysomnography may overestimate disease, especially in mouth breathers. Remote infra-red imaging (IR-I) provides a non-contact method to monitor airflow. Using an infra-red camera placed eight feet from subjects and mathematical modeling, the heat signal from expired air is converted to a signal constituting an airflow channel and is integrated into the existing polysomnographic software as a separate channel. We evaluated the efficacy of IR-I as an alternative airflow channel during polysomnography in comparison with the conventional methods of nasal pressure, nasal-oral thermistors and capnography.

METHODS: Mean thermal measurements were performed continuously in real time at the nostrils or the mouth of subjects during one hour of polysomnography with simultaneous recording of nasal pressure, nasal-oral thermistor, expired CO2, IR-I, abdominal and thoracic excursion via piezocrystals and/or impedance plethysmography. To minimize bias, single airflow channel was scored separately without visualization of the other flow channels.

RESULTS: Thirteen subjects (9 men, 4 women) without known sleep apnea were studied. The range for age was 24 to 61 years, BMI:19.7 to 40.5 kg/m2, and Epworth Score: 1 to 19. 10.5 hours of sleep was recorded from 13 subjects. Flow-time trace generated by IR-I closely resembled that of the other airflow channels during sleep and wakefulness (figure 1). 22 sleep-disordered breathing events by thermistor, 19 by nasal pressure and 20 by IR-I were detected. One "false positive" event was detected by IR-I. The kappa statistic for thermistor versus IR-I was 0.90, nasal pressure versus IR-I was 0.76, thermistor versus nasal pressure was 0.87 (figure 2).

CONCLUSION: This is the first report of remote thermal imaging as a method to monitor airflow and detect airflow abnormalities during sleep. There was a near perfect agreement between remote IR-I and standard thermistors.

CLINICAL IMPLICATIONS: This novel "virtual thermistor" provides a non-contact method to aid in the diagnosis of sleep apnea and represents an alternative to standard nasal-oral thermistors and as an adjunct to nasal pressure.

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DIAGNOSTIC IMPLICATIONS OF APNEA/HYPOPNEA INDEX VS RESPIRATORY DISTURBANCE INDEX IN PATIENTS WITH SLEEP BREATHING DISORDERS

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PURPOSE: The International Classification of Sleep Disorders 2nd Edition (ICSD-2) defines obstructive sleep apnea (OSA) based on scoreable respiratory events which included apneas, hypopneas, and respiratory effort related arousals (RERAS) while Center for Medicare and Medicaid (CMS) uses apneas plus hypopneas. We hypothesize that CMS criteria may underdiagnose OSA because of exclusion of RERAS. We compared the impact of ICSD-2 versus CMS criteria on the diagnosis of OSA.

METHODS: We retrospectively compared the effect of using the ICSD-2 (RDI ≥ 15, AHI < 10) vs. CMS criteria (AHI between 15-30) to diagnose significant OSA on polysomnography (PSG) parameters, Epworth Sleepiness Scales (ESS), Pittsburgh Sleep Quality Index (PSQI), Fatigue Severity Scale (FSS) and prevalence of co-morbidities (hypertension, diabetes mellitus and depression) using Mann-Whitney U statistical method.

RESULTS: 100 consecutive patients with suspected OSA undergoing PSG, were analyzed. Comparison of patient groups (ICSD-2 vs. CMS group) did not reveal any significant difference in associated sleep efficiency, Stages I &II, Stage Delta, Stage REM or spontaneous arousals, suggesting comparable sleep disruption. The use of AHI was associated with a significantly lower mean SaO2 (83% AHI vs. 87% RDI). No significant difference was noted in the subjective measures of daytime functioning. Prevalence of hypertension was higher using the RDI (54% RDI vs. 27% in the AHI).

CONCLUSION: Inclusion of RERAs in the ICSD-2 criteria impacts classification of the severity of SDB. The AHI criteria, which exclude RERAS, tend to select patients with significantly worse nocturnal hypoxemia.

CLINICAL IMPLICATIONS: The CMS criteria for the diagnosis of OSA may underdiagnose patients with SDB and related co-morbidities, i.e., hypertension.

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