

Silent Upper Airway Resistance Syndrome*

Prevalence in a Mixed Military Population

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Study objectives: The upper airway resistance syndrome (UARS) is a recently described form of sleep-disordered breathing in which transient increases in upper airway resistance result in repetitive EEG arousals. UARS is not associated with apnea or diminished airflow, although snoring and excessive daytime somnolence (EDS) are common. This report describes a subset of patients with UARS diagnosed by polysomnography who do not manifest snoring, which we define as *silent upper airway resistance syndrome* (SUARS).

Design: A retrospective review of all polysomnographies performed at our sleep disorders center during 2000.

Setting: Sleep disorders center of a large, academic, military hospital.

Patients: Our center serves military personnel, military retirees, and their dependent families.

Interventions: Esophageal manometry during polysomnography was routinely performed on patients with hypersomnolence (Epworth sleepiness scale > 10) who demonstrated a total arousal index $\geq 10/h$ and a respiratory disturbance index of < 5/h on prior polysomnography. UARS was definitely diagnosed in patients who demonstrated repetitive increased upper airway resistance (IUAR) associated with brief EEG arousals followed by normalization of esophageal pressure (Pes). IUAR was defined by a pattern of crescendo negative inspiratory Pes of ≤ -12 cm H₂O.

Results: During calendar year 2000, we performed 724 polysomnographies in 527 patients. Obstructive sleep apnea was diagnosed in 383 patients (72.6%), and 44 patients (8.4%) were found to have UARS. In four patients with UARS (0.8% of total and 9.1% of UARS), snoring was not reported by history or observed during polysomnography, and SUARS was ultimately diagnosed.

Conclusions: UARS may occur in the absence of clinically significant snoring and may be an occult cause of EDS. We report a prevalence of SUARS of 9% among UARS patients and nearly 1% of all patients studied for hypersomnolence by polysomnography.

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Key words: esophageal manometry; excessive daytime sleepiness; hypersomnolence; increased upper airway resistance; obstructive sleep apnea; sleep-disordered breathing; upper airway resistance syndrome

Abbreviations: BMI = body mass index; EDS = excessive daytime sleepiness; ESS = Epworth sleepiness scale; OSAS = obstructive sleep apnea syndrome; Pes = esophageal pressure; RDI = respiratory disturbance index; RERA = respiratory effort-related arousal; SUARS = silent upper airway resistance syndrome; TAI = total arousal index; UARS = upper airway resistance syndrome

Upper airway resistance syndrome (UARS) is a recently described form of sleep-disordered breathing that may result in excessive daytime sleepiness (EDS).^{1–4} UARS is defined by repetitive increases in upper airway resistance (IUAR) associated with brief EEG arousals.^{1,5} The diagnosis requires

demonstration of IUAR in a crescendo pattern of negative inspiratory pressures on esophageal manometry.⁵ We used a negative inspiratory pressure of ≤ -12 cm H₂O in scoring these studies. The resulting arousals are followed by normalization of Pes.^{1,4–6} However, esophageal manometry is not

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commonly employed, making UARS difficult to diagnose definitively. Clinicians often make the diagnosis presumptively based on the presence of crescendo snoring associated with respiratory effort-related arousals (RERAs). Limited use of esophageal manometry may underdiagnose UARS and may lead to misclassification of a patient's hypersomnolence.⁴ This misdiagnosis may, in turn, result in the inappropriate use of stimulants as a potential treatment of EDS. These therapies may be ineffective or may mask the underlying sleep disorder.

Although difficult to diagnose, UARS is suggested by EDS associated with snoring in patients who do not demonstrate apneic or hypopneic respiratory events on polysomnography. However, patients may manifest sleep-disordered arousals consistent with UARS even in the absence of snoring, which we define as silent UARS (SUARS). The purpose of this article is to report the occurrence and prevalence of SUARS in our population.

MATERIALS AND METHODS

We retrospectively reviewed all patients who underwent polysomnography for the evaluation of EDS at our sleep disorders center during 2000. Our center serves active duty military personnel, military retirees, and their dependent family members.

All patients were studied by attended overnight polysomnography in our sleep laboratory using a 16-channel montage (SensorMedics α Somnostar System; SensorMedics; Yorba Linda, CA). Polysomnography consisted of continuous recordings of central and occipital EEGs, bilateral electro-oculograms, submental and bilateral tibial electromyograms, and ECG. Nasal and oral airflow was measured by thermistor or pressure transducer. Tracheal sounds were monitored using an acoustic microphone. Thoracic and abdominal excursions were measured using inductance plethysmography. Continuous oxygen saturation was assessed using noninvasive pulse oximetry. Body positioning was verified by infrared video recording. The study lasted 6 to 8 h and terminated following final awakening. Polysomnographies were scored in 30-s epochs following Rechtschaffen and Kales⁷ criteria for sleep staging. Arousals were defined as a change in EEG activity from a slower background frequency for ≥ 1 s.⁵⁻⁸

Hypersomnolent patients with a respiratory disturbance index (RDI) [apnea/hypopnea] $< 5/h$ and a total arousal index (TAI) $\geq 10/h$ were routinely reevaluated by polysomnography with esophageal manometry in an attempt to diagnose UARS. Hypersomnolence was defined as a score > 10 on an Epworth sleepiness scale (ESS).⁹ Esophageal manometry utilized a multiport

Gaeltec catheter (Gaeltec Ltd; Hackensack, NJ). RERAs were scored when IUAR was followed by an EEG arousal.^{1,5} IUAR was established by the development of a negative inspiratory pressure of ≤ -12 cm H₂O preceding an arousal.^{1,5} Episodes of IUAR were followed by normalization of esophageal pressure (Pes).^{1,4,5} The diagnosis of UARS required a RERA index $\geq 5/h$ and an RDI $\leq 5/h$.⁵

Data were analyzed using repeated measures with analysis of variance for the crossover design. The two groups, SUARS and UARS, were compared and analyzed using independent-sample *t* test, and the level of significance was set at $p < 0.05$. Statistical analysis was carried out using software (SPSS for Windows version 11.0; SPSS; Chicago, IL).

RESULTS

During calendar year 2000, 527 patients underwent a total of 724 polysomnographies. Of those studied, obstructive sleep apnea was diagnosed in 383 patients (72.6%), and 44 patients (8.4%) were found to have UARS.

Among those with a diagnosis of UARS, snoring was not reported by history or observed during polysomnography in four patients. SUARS was ultimately diagnosed in these individuals. Among those with SUARS, three were men and the average age was 34.8 ± 6 years. None met criteria for obesity by body mass index (BMI), and all four patients reported EDS. Further patient demographics and polysomnography results are depicted in Tables 1, 2. These demographics and clinical variables were compared to 20 consecutive patients with UARS diagnosed using polysomnography (Table 2). No significant differences between these two groups were identified.

The overall prevalence of UARS was 8.4% of those patients studied in our center in calendar year 2000. SUARS was seen in 9.1% of UARS patients and 0.8% of all patients studied using polysomnography for EDS.

DISCUSSION

UARS can occur in the absence of snoring and may be an occult etiology for EDS. Sleep-disordered breathing without clinically apparent snoring has been previously reported in the literature.^{2,10} In a

Table 1—Patient Demographics and Polysomnography Results

Age, yr	Gender	BMI	ESS	TAI	RDI	RERA Index	Pes Nadir, cm H ₂ O
41	Male	24.5	11	29.3	0.6	40.5	- 31
28	Male	27.7	18	26.4	3.8	23.8	- 45
40	Female	26.4	23	27.2	0.2	21.3	- 32
30	Male	22.0	13	34.2	2.4	29.5	- 25

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