

## ORIGINAL RESEARCH—ERECTILE FUNCTION

# Impaired Vigilance Is Associated with Erectile Dysfunction in Patients with Sleep Apnea

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### ABSTRACT

**Introduction.** Erectile dysfunction (ED) is frequent in patients with obstructive sleep apnea (OSA) and may act as a surrogate of endothelial dysfunction. Furthermore, impairments of vigilance and sustained attention are also commonly associated with OSA.

**Aim.** The purpose of this study was to evaluate whether there is an association between ED and sustained attention deficits.

**Methods.** A prospective cross-sectional cohort of 401 male in-patients undergoing diagnostic polysomnography for suspected OSA and a 25-minute sustained attention test was analyzed. ED was assessed using the 15-item International Index of Erectile Function (IIEF-15) questionnaire. The Epworth Sleepiness Scale (ESS) served as a measure of daytime sleepiness.

**Main Outcome Measure.** Severity of impaired erectile function (EF) assessed by the IIEF-15, core task parameters of the sustained attention test (i.e., CR: correct reactions; V-CR: variation of correct reactions, CE: commission errors, RT: reaction time; V-RT: variation of reaction times).

**Results.** Three hundred eighty-one consecutive patients presenting for in-lab polysomnography were included in the analysis. Impaired EF was diagnosed in 246 patients (65%). With increasing impairment of EF, patients scored significantly worse in all vigilance test parameters and demonstrated more severely diminished vigilance (normal EF: 11.9%, moderately impaired EF: 24.1%, and severely impaired EF: 34.9%). Multivariate regression analyses including established risk factors for ED, OSA, or sleepiness revealed a significant independent association between lower scores for EF and impairments on the following vigilance test variables: odds ratio (95% confidence interval) for V-CR: 0.52 (0.34–0.81), CE: 0.87 (0.80–0.95), and V-RT: 0.91 (0.87–0.96). The ESS was independently associated with both measures of performance instability: odds ratio for V-CR: 6.94 (2.97–16.23) and V-RT: 1.28 (1.14–1.44).

**Conclusions.** In OSA patients, the severity of impaired EF was associated with impaired vigilance performance, independent of other known risk factors for ED or OSA and not mediated by sleepiness. Potentially, the findings suggest a direct relationship between vascular or endothelial dysfunction and impairments in both EF and neurobehavioral cognitive function. **Popp R, Kleemann Y, Burger M, Pfeifer M, Arzt M, and Budweiser S. Impaired vigilance is associated with erectile dysfunction in patients with sleep apnea. J Sex Med 2015;12:405–415.**

**Key Words.** Erectile Function; Erectile Dysfunction, Sexual Dysfunction; Endothelial Dysfunction; Vigilance Performance; Sustained Attention; Daytime Sleepiness

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## Introduction

Erectile dysfunction (ED) is a frequent symptom affecting about 20% of the male population [1]. ED is also a particularly common condition in men with obstructive sleep apnea (OSA). The incidence of ED among this population is in a range between 40% and 64% [2–4], and male patients with OSA experience more sexual dissatisfaction and sexual dysfunction compared with age-matched controls [5]. However, decreased libido or sexual dysfunction may be under-recognized in these patients, as not all of them address these problems voluntarily.

While there appears to be a direct link between OSA and the development of ED, the common overlapping risk factors (i.e., age, hypertension, diabetes, and psychological factors such as depression) make it somewhat difficult to confirm a clear causal relationship [6]. However, a few studies could detect that OSA and the related intermittent nocturnal hypoxemia were an independent risk factor and correlate with ED and overall sexual function [3,7].

ED is a surrogate of endothelial and vascular dysfunction. Due to altered vasodilating and vasoconstricting processes, endothelial dysfunction can cause both ED and cardiovascular diseases [8,9]. ED may even be an initial symptom of an early stage of endothelial dysfunction leading to arteriosclerosis and cardiovascular disease [10,11].

There is converging evidence that OSA produces (cerebro)vascular microlesions as well as sympathetic activation and enhances endothelial dysfunction [6]. These dysfunctions evoke changes in microvascular perfusion that favor the rise of ED. Specifically, repetitive nocturnal hypoxemia due to OSA induces oxidative stress, hormonal alterations, and increased inflammatory stimuli. Finally, OSA-related intermittent hypoxia can result in an amplified risk of hypertension and cardio- and cerebrovascular disease (e.g., myocardial infarction and strokes) [12,13]. Sleepiness may further augment the risk for vascular events. Thus, in patients with OSA, sleepiness is an independent risk factor for vascular events [14,15]. In addition, OSA can produce psychological alterations and neural dysfunction such as impaired vigilance or alertness [16]. Remarkably, an early finding of Bédard and colleagues specifically related nocturnal hypoxemia to vigilance impairments in OSA [17]. As a basic pathophysiological mechanism, the authors assumed a hypoxia-induced vascular damage of the brain.

In contrast to sexual dysfunction, vigilance problems are much more apparent neurobehavioral complaints in OSA patients seeking treatment in a sleep laboratory. These patients frequently report difficulties staying awake and alert especially in boring or tedious situations, which results in increased daytime sleepiness, vigilance impairments, and unintended lapses of sustained attention. In general, vigilance or sustained attention (most researchers use both terms synonymously [18,19]) refers to the basic ability of the organisms to maintain their attention and remain alert to stimuli over prolonged periods of time, even if the monitoring task is monotonous [20]. On vigilance tasks, patients with severe OSA demonstrated impaired performance compared with healthy controls [21,22]. Recently, a meta-review underscored the negative effects of OSA on cognition, most likely in the domain of attention/vigilance [23].

To date, no study has evaluated the association of impaired vigilance performance with sexual dysfunction in patients with OSA. Based on these considerations and on the assumption that ED and vigilance in these patients may be due to a common underlying mechanism of endothelial or vascular dysfunction, we would expect a statistical association between those different domains of performance. Thus, the aim of this analysis was to examine a possible link between ED and neurobehavioral impairments of sustained attention in the presence of other risk factors for ED and OSA. Specifically, since sustained attention deficits are sensitive to sleepiness, we considered subjective daytime sleepiness as a possible confounding or mediating factor of vigilance performance in patients with OSA.

## Methods

### Study Population

A subgroup from a prospective study sample comprising 401 consecutive male in-patients with supposed OSA who were referred to diagnostic in-lab polysomnography between June 2006 and June 2007 entered the present analysis [7,24]. As described previously, only patients with neurological or psychiatric dysfunctions (e.g., depression), hypogonadism, current treatment with phosphodiesterase-5-inhibitors, or severe lung diseases had not been included into the study [7].

For the present analysis, we only included patients who underwent a full record of valid data in a 25-minute sustained attention task (N = 381). Nineteen patients refused to perform the complete

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