Effect of Moderate Alcohol Intake on Nocturnal Sleep Respiratory Parameters in Healthy Middle-Aged Men

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Abstract

Purpose: It is known that a moderate to large volume of alcohol produces deterioration in obstructive sleep apnea (OSA), however, no consensus has been achieved with respect to the influence of a moderate volume of alcohol on mild to moderate OSA. In this study, we investigated the influence of alcohol on OSA-associated parameters in healthy middle-aged males drinking a moderate volume of alcohol (<1 g alcohol/kg bodyweight per day).

Methods: Subjects were 23 healthy males (mean age of 46.0) with a habitual ingestion of moderate amounts of alcohol. Respiratory sleep parameters were measured through the fitting of an Apnomonitor III (Chest Inc.) and portable sleep monitoring device (Actiwatch: AMI Inc.) to subjects on three nights; an alcohol-free night, a night on which they drank alcohol with dinner, and a night on which they drank alcohol within 30 minutes before retiring to bed. The measurements were categorized into the early and late halves of assumed sleep for analysis.

Results: The apnea-hypopnea index was significantly higher when drinking alcohol before retiring [mean (SD): 7.8 (8.2) events/hour] than the values on the alcohol-free day [2.9 (4.5) events/hour] and when drinking alcohol with dinner [3.8 (5.3) events/hour]. Furthermore, drinking alcohol before retiring resulted in lower arterial blood oxygen saturation (SpO²) during the early half of sleep [94.8 (1.4) %] when compared to the values on the alcohol-free day [95.7 (1.3) %] and drinking alcohol with dinner [95.4 (1.6) %]. In addition, the percentage of time with SpO² <92% (hypoxic event) during the early half of sleep [4.9 (9.3) %] was significantly higher than the values on the alcohol-free day [1.2 (1.8) %] and when drinking alcohol with dinner [1.4 (1.8) %].

Conclusion: These results suggest that moderate ingestion of alcohol within 30 minutes before retiring aggravates OSA-associated parameters in healthy males.

Key words: obstructive sleep apnea, alcohol intake, oxygen saturation

Introduction

The treatment of obstructive sleep apnea (OSA), a condition commonly associated with cardiovascular disease and autonomic disturbance, usually includes lifestyle modification such as avoidance or minimization of alcohol intake (1). However, health practitioners frequently tell patients that alcohol, taken in moderate quantities, has beneficial effects upon cardiovascular mortality (2, 3). In particular, published guidelines suggest a “safe upper level” of four standard (10 g alcohol) drinks of alcohol per day in males before the adverse effects of hypertension, heart and liver disease develop (4–7). For an 80 kg male, this would equate to 0.5 g alcohol/kg body weight (BW).

Alcohol, consumed in large quantities (>1.0 g alcohol/kg BW/day), sufficient to increase the blood alcohol concentrations (BAC) to >0.075 g/dl, increases apnea frequency, and duration and is associated with hypoxemia in patients with OSA (8–11). However, the effects of alcohol at lower doses (0.5–1.0 g alcohol/kg BW) on OSA are less clear. The consumption of 0.5 g alcohol/kg BW/day (with a corresponding mean BAC of 0.075 g/dl), was associated with a significant rise in the mean apnea-hypopnea index (AHI), from 10 to 20 events/h (12). In contrast, Block et al. (13) found no difference in the AHI (2.8 to 3.0 events/h) when subjects, with milder OSA, were given 1 g alcohol/kg BW (BAC 0.075 g/dl). Similarly, Teschler et al. (14)
found no difference in the AHI (44–51 events/h) when males with severe OSA were given 0.5 g alcohol/kg BW (BAC 0.05 g/dl). To further understand the effects of alcohol on sleep-disordered breathing, we undertook this study to determine the effects of moderate alcohol consumption on apnea-hypopnea frequency in healthy middle-aged male subjects.

Little is known about the differences in sleep respiratory parameters with regard to timing of alcohol ingestion. In this study and as the second outcome measure, we examined the timing of moderate alcohol intake on sleep breathing abnormalities.

Methods

Subjects

After explaining the protocol of the study, informed consent was obtained from 23 apparently healthy males with a habitual moderate ingestion of alcohol and without respiratory/cardiovascular/metabolic diseases requiring treatment. The means and standard deviations of age, height, body weight, and BMI were 46.0 (3.0) years, 170.1 (4.7) cm, 69.8 (11.1) kg, and 24.1 (3.3) kg/m², respectively. Eight of the 23 subjects were smokers, and none of the subjects had a regular exercise habit.

Alcohol intake was calculated based on the daily recall of consumption. The alcohol concentration for beer, Japanese Sake, wine, and whisky were taken as 5%, 15.6%, 14%, and 43%, respectively. Alcohol intake [mean (standard deviation)] was 36.4 (25.6) g/day [0.5 (0.4) g alcohol/kg BW/day] when the subjects drank alcohol with dinner and 48.5 (30.5) g/day [0.7 (0.5) g alcohol/kg BW/day] when they drank alcohol before retiring, with no significant difference.

We asked subjects to adhere to the following schedule for three nights: no alcohol drinking during the day, drinking alcohol with dinner (around 7:00 pm) and drinking alcohol within 30 minutes before retiring to bed (11:00–12:00 pm). The order of measurements on the three nights was randomized.

Data acquisition

Sleep respiratory parameters were investigated using an Apnomonitor device (Apnomonitor III: Chest Inc. Tokyo, Japan). The Apnomonitor device consists of a monitoring recorder for lending to the subjects for home measurement. In the recorder, ventilation flow was monitored via a thermistor fixed in the thyroid cartilage.

Apnea-hypopnea was monitored by the flow sensor and tracheal sounds. Subjects also underwent monitoring of oxygen saturation using a digital SpO₂ (pulse oximetry) transducer. The recorded signals were processed in a computer with analytic software, and the development of apnea (more than a 10 second pause in ventilation) and hypopnea (defined as a ≥30% reduction in airflow) incidence with respect to duration, and heart rate were indicated in figures. Apnea-hypopnea index (the average number of apneas plus hypopneas per hour of sleep) was used as an outcome measure. Percentage of time with SpO₂ below 92% (hypoxic event) (15) was also calculated as a quantitative evaluation of the rate of decrease in arterial blood oxygen saturation. Takishima et al. (16) developed the Apnomonitor device in 1986 as a portable sleep apnea monitoring device for home measurement. Okada et al. (17) confirmed the reliability of the Apnomonitor device for the detection of apnea.

Measurements were performed on weekdays, and the subjects were provided with adequate explanation of the uses of the equipment (mouth/nose flow rate, tracheal sounds, arterial blood oxygen saturation, and heart rate). On the day of measurement, the subjects connected each sensor while watching the instructions for using the Apnomonitor on a videotape. To limit the influence of installation on sleep, the Apnomonitor III was used once during sleep, prior to the day of measurement.

In order to record sleep time, we used actigraphy (Actiwatch: Mini Mitter Company Inc. Bend, Oregon, USA), a method used to estimate sleep-wake rhythms by measurement of gross motor activity. Actigraphy has been established as a valid method in the assessment of sleep-wake patterns (18, 19).

The Actiwatch measures the three parameters of sleep duration, assumed sleep and actual sleep. The duration of assumed sleep was calculated by subtracting the duration of sleep latency and arousal from the duration of sleep calculated from the bedtime and wake-up time. The duration of actual sleep was calculated by subtracting the duration that was considered arousal time during sleep from the duration of assumed sleep. In this study, we used assumed sleep as the duration of sleep. Assumed sleep was also divided into early and late halves to examine to which extent alcohol may affect respiratory parameters during sleep.

Statistical analysis

Since the variables we measured in the sample were not normally distributed we used nonparametric Friedman's test to compare differences among the three experimental states. When there was a significant difference, multiple comparison analysis was performed using Wilcoxon’s test. The significance level was adjusted for multiple comparison analysis. For separate analysis, we classified measured assumed sleep into early and late halves and repeated the tests. By considering a standard deviation (SD) of 4.5 events/hour for AHI, with 23 subjects there is a power of 0.65 to detect differences of 3.4 events/hour (0.75 SD) between the three nights. The data was analyzed with SPSS.

Results

The comparison of the sleep parameters measured by the Actiwatch for the three experimental states is shown in Table 1. There were no significant differences in the duration of assumed sleep (min), actual sleep percent (%), sleep efficiency (%), or sleep latency (min) between the three experimental nights.

Table 2 shows the mean (SD) of the respiratory sleep parameters for the three nights. Heart rate was higher when drinking alcohol before retiring than that on the alcohol-free day and when drinking alcohol with dinner; however, there were no significant differences. When drinking alcohol before retiring, the frequency of AHI, was highest [7.8 (8.2) events/h], with significant differences in comparison to the values on the alcohol-free day [2.9 (4.5) events/h] and when drinking alcohol with dinner [3.8 (6.2) events/h]. Percentage of time with SpO₂