Sleep Disorders in Patients on a Kidney Transplant Waiting List

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ORIGINAL ARTICLES

OBJECTIVE: To evaluate the prevalence of sleep disorders in patients awaiting kidney transplants compared to a control group.

PATIENTS AND METHODS: We carried out an observational study of 23 patients on a kidney transplant waiting list in comparison with 20 healthy volunteers matched for age, sex, and body mass index (BMI). Overnight polysomnography was performed and a diagnosis of sleep apnea-hypopnea syndrome (SAHS) established when the apnea-hypopnea index (AHI) was 10 or higher.

RESULTS: Eighty-two percent of the patients awaiting kidney transplants (16 men and 7 women with a mean [SD] age of 51 [15] years and a mean BMI of 25 [3.8] kg/m²) had some type of sleep disorder. The most frequent disorders were SAHS (48%) and insomnia and periodic limb movement disorder (31.5% compared to 8.2%)
P=0.001) and oxygen desaturation index (31.5 compared to 8.2; P=0.001). Those with sleep-disordered breathing had a higher AHI (17.7 vs 3.6; P=0.001) and oxygen desaturation index (24.5% vs 40%; P=0.001). Those with sleep-disordered breathing had a higher AHI (17.7 vs 3.6; P=0.001) and oxygen desaturation index (24.5% vs 40%; P=0.001). Those with sleep-disordered breathing had a higher AHI (17.7 vs 3.6; P=0.001).

CONCLUSIONS: Sleep disorders are common in patients awaiting kidney transplants. Such patients show reduced quantity and quality of sleep compared to controls and a significantly elevated number of respiratory events that may affect morbidity and mortality.


Introduction

Sleep apnea-hypopnea syndrome (SAHS) is associated in the general population with increased cardiovascular morbidity and mortality. As cardiovascular disease is the most frequent cause of death among patients in hemodialysis, SAHS may play a role in the continued high mortality rate among such patients.

Recent studies have described the importance of nocturnal hypoxemia associated with SAHS and the severity of coronary arteriopathy in patients with chronic renal failure (CRF) on hemodialysis. Several studies have been conducted to determine a possible association between CRF and SAHS. While its mechanism has not been clearly determined, it has been suggested that...
uremic toxins may be involved in the appearance of SAHS. This hypothesis has been supported by several reports of improvement in sleep-disordered breathing once kidney function has been successfully restored following transplantation. Such observations have increased interest in sleep disorders in patients with CRF.

Studies show considerable disparity concerning the prevalence of SAHS in patients with CRF, with rates ranging from 14.5% to 86%. This is probably due to differences in research designs, as many of the studies were carried out in selected populations with small samples and with diagnostic techniques other than polysomnography (PSG), the gold-standard diagnostic test for sleep disorders. There have been even fewer studies of populations with distinct clinical characteristics, such as patients awaiting kidney transplants, in whom quality of sleep and possible sleep-disordered breathing have not been adequately evaluated. The aim of our study, then, was to evaluate quality of sleep and respiratory disorders using overnight PSG in a group of patients on a kidney transplant waiting list compared to sleep quality in a control group of healthy subjects.

**Study Subjects**

The study was carried out in the Sleep-Disordered Breathing Unit of the Hospital Universitario Reina Sofia in Cordoba, Spain. All patients on a hemodialysis program in a satellite unit of our hospital’s nephrology department who were on a kidney transplant waiting list were considered eligible. All had hemoglobin levels higher than 11 g/L and hemodialysis was adequate (equilibrated Kt/V>1.3). Hemodialysis using a bicarbonate dialysis fluid was started when the patient presented insomnia or daytime sleepiness and had a periodic limb movement index of 15 or more per hour in PSG, provided the movements were not associated with respiratory events. A diagnosis of insomnia was established when the patient reported insomnia (poor quality or insufficient quantity of sleep perceived by the patient) and a PSG result showing sleep latency longer than 30 minutes and sleep efficiency less than 60%. A diagnosis of primary snoring was made if snoring was the main symptom and if PSG did not show 5 or more respiratory events.

**Statistical Analysis**

Qualitative variables were expressed as absolute numbers and percentages, and quantitative variables as means (SD). Qualitative variables were analyzed using the chi-square test. Means were compared using the nonparametric Mann-Whitney U test. 95% confidence intervals were calculated, and statistical significance was set at \( P<0.05 \). The statistical analysis was carried out using SPSS software, version 11.1 (SPSS Inc, Chicago, Illinois, USA).

**Results**

At the time of the study, 25 of the 60 patients (41%) enrolled in the hemodialysis program were on a kidney transplant waiting list. Of those, one refused to undergo PSG and another could not discontinue sleeping pills. The remaining 23 patients (92%) agreed to participate in the study.

Table 1 shows the characteristics of the 2 groups studied (patient and control). No between-group differences in...
age, sex, body mass index, smoking habit, or waking SpO₂ can be seen. The comparison of the sleep study variables between the 2 groups are shown in Table 2. Significant differences were found in all the values related to quality of sleep, except in the percentage of stage IV sleep. Sleep latency in the group of patients awaiting kidney transplants was 32 minutes and the percentage of time in bed corresponding to nocturnal awakenings was 19%. Significant differences were found for both of these variables, and sleep efficiency was significantly poorer in patients with CRF (P<.010). The sum of the percentages of deep sleep and REM sleep was also less in patients than in controls (24% compared to 40%; P=.0001). Finally, the arousal and periodic limb movement indexes (P=.0001) were significantly higher in the group with CRF.

Table 3 shows the comparison of respiratory sleep disorders between the 2 groups. Patients awaiting kidney transplants had a higher AHI than controls (P=.001), as well as higher percentages of time in apnea (P=.006) and time in apnea or hypopnea (P=.007). The patient group had a significantly higher percentage of decreases in SpO₂ of 3% or more per hour of sleep (P=.001). A higher percentage of sleep time with SpO₂ less than 90% was also recorded for patients than control subjects, although the difference was not significant (P=.076).

The Figure shows the diagnoses established according to the results of PSG and symptoms. Significant differences were observed in the frequency of SAHS, insomnia, and periodic limb movement disorder. It must be emphasized that some participants presented more than a single sleep disorder and that 82% of the patients awaiting kidney transplants had some such disorder, most frequently SAHS (n=11; 48%), insomnia (n=7; 30%), periodic limb movement disorder (n=7; 30%), restless legs syndrome (n=3; 13%), and primary snoring (n=4; 21%).

**Discussion**

Our study, using the gold standard technique for sleep studies and with a high level of participation, showed a high prevalence of sleep disorders in patients on a kidney transplant waiting list. The most frequent disorders were SAHS, insomnia, and periodic limb movement disorder.
The prevalence of sleep disorders in patients with CRF is high. In our study, 82% of such patients presented at least 1 sleep disorder. This high percentage is similar to that obtained in a cohort of patients in a hemodialysis program. There were differences, however, compared to other groups, probably due to differences in study design. Patients on a kidney transplant waiting list tend to be younger than those excluded from the list and also tend not to present severe comorbidity, such as liver disease, respiratory failure, or cardiovascular disease. This may have affected the results of our study.

Sleep-disordered breathing has been associated, as in our study, with CRF. Patients on a kidney transplant waiting list had a mean AHI of 17.7 and a significantly elevated percentage of sleep time in apnea and in apnea or hypopnea. These data confirm the severity of sleep-disordered breathing in this population. Other findings also point to disease severity. Respiratory events had considerable repercussions on $SpO_2$, as 31 significant decreases in $SpO_2$ were observed per hour of sleep in our patients. This point is of great interest. Firstly, such episodes of hypoxemia-reoxygenation favor the production of free radicals, and this has been suggested as a possible mechanism of atherogenesis. Furthermore, sudden decreases in nocturnal $SpO_2$ have been associated in the general population with increased morbidity and mortality due to vascular disease.

The effect that such desaturations may have on patients awaiting kidney transplants is unknown. We do know, however, that despite advances in hemodialysis and improved control of some cardiovascular risk factors, mortality due to vascular disease remains high. There must therefore be other risk factors that are not yet adequately accounted for. It is reasonable to hypothesize that the presence of sleep-disordered breathing may be one of these. Although this has not yet been fully elucidated, several recent studies support such a hypothesis.

One of the mechanisms most frequently involved in the appearance of sleep-disordered breathing in patients with CRF is an increase in levels of uremic toxins. Daily nocturnal hemodialysis has been seen to improve sleep-disordered breathing compared to conventional hemodialysis. Another mechanism that has been proposed to explain sleep-disordered breathing in these patients is inadequate central respiratory control due to altered chemoresponsiveness.

In any event, while these aspects are being studied, special attention should be paid to symptoms such as snoring and apneas noticed by someone living with the patient. Such symptoms are frequently associated with SAHS both in the general population and in patients with CRF. Obviously, clinical suspicion will facilitate early diagnosis and adequate control of SAHS through the use of continuous positive airway pressure (CPAP) treatment. However, while there is consensus regarding the indication of CPAP in the general population, there is no such consensus regarding its use in patients with CRF, in whom adaptation to therapy is poor. While this question is being settled, CPAP therapy should be considered for patients with cardiovascular comorbidity.

It has been suggested that kidney transplantation can improve breathing during sleep. In the 4 patients in our series studied before and after successful kidney transplants, we observed a decrease in the number of respiratory events and an improvement in parameters related to nocturnal $SpO_2$. In addition to offering overall improvement, measured in terms of the patient's health and quality of life, kidney transplantation can correct sleep-related breathing disorders.

The present study, carried out on the total population of patients on a kidney transplant waiting list, provides further evidence of the prevalence and potential seriousness of sleep-disordered breathing. However, some limitations of the study should be borne in mind. Firstly, although 92% of the eligible population was included in the study, the number of patients was small. Nevertheless, it was sufficient to establish comparisons and obtain conclusive results. Secondly, the sensation of nonrestorative sleep in such patients may be due to multiple factors, and physical fatigue may be attributable to CRF itself. For this reason, we chose to use an AHI of 10 or higher to establish a diagnosis of SAHS, so as to avoid overdiagnosing SAHS by using the currently recommended cutoff point of 5. Thirdly, the control group consisted of volunteers, although as these were selected from among health care workers and relatives of the patients studied and were people who showed a high level of collaboration and reliability, selection bias was unlikely.

In conclusion, sleep disorders, of which SAHS is the most common, are frequent in patients with CRF awaiting kidney transplants. Such patients show reduced quality and quantity of sleep and this in turn affects their quality of life. Furthermore, respiratory events and sudden episodes of nocturnal hypoxemia, which are numerous in such patients, may lead to increased morbidity and mortality. However, more studies are needed to show that proper diagnosis and treatment of SAHS can modify morbidity and mortality due to cardiovascular disease in this population.

REFERENCES


