

Journal search and commentary

Article reviewed:

Improvement of sleep apnea in patients with chronic renal failure who undergo nocturnal hemodialysis[☆]

Thomas C. Wetter, Gwendolyn B. Böhm

Max Planck Institute of Psychiatry, Munich, Germany

Objectives

To investigate whether or not nocturnal hemodialysis is associated with a lower prevalence of sleep apnea than conventional hemodialysis in patients with chronic renal failure.

Study design

Prospective study including polysomnography and biochemical measures before and after conversion from conventional to nocturnal hemodialysis.

Study population

Fourteen patients (10 men, 4 women; mean (\pm SD) age 45 ± 9 years) with chronic renal failure (chronic glomerulonephritis: three patients; diabetes mellitus: two; polycystic kidney disease: two; hypertensive nephrosclerosis: one; reflux nephropathy: one; unknown cause: five patients) that had been treated by conventional hemodialysis for 1–15 years. Patients were not assessed for the presence of sleep apnea before enrolment.

Methods

All patients were investigated while they were being treated with conventional hemodialysis for 4 h on each of 3 days per week. Baseline measures (serum creatinine, bicarbonate and polysomnography including airflow, respiratory effort, arterial oxygen saturation, transcutaneous partial pressure of carbon oxide and anterior tibialis electromyography for evaluation of periodic leg movements) were performed on two different nights during 1 week in a random order: on one occasion after the patient had undergone conventional hemodialysis during the day and on the other occasion after a two-day interval during which the patient had not undergone conventional daytime hemodialysis. After obtaining the baseline-measurements, the treatment was changed to nocturnal hemodialysis for eight hours during each of six or seven nights a week. After a 6-week conversion period and stabilization of the condition for 6–15 months, the same baseline measurements were performed for follow-up on two different nights: on and off nocturnal hemodialysis in random order. Comparisons of mean values for groups were made with Students *t*-tests for two groups or analysis of variance for repeated measures with a Bonferroni correction.

[☆] Hanly PJ, Pierratos A, N Engl J Med 2001;344:102–107.

Results

Eight of the 14 patients (57%) undergoing conventional daytime hemodialysis had sleep apnea (defined as an apnea-hypopnea index higher than 15 per hour) including one patient who had Cheyenne–Stokes respiration. Central, obstructive and mixed apneas were distributed equally among the patients. Nocturnal compared to conventional daytime hemodialysis showed a significant reduction of the apnea-hypopnea index from an average of 25–8 episodes per hour of sleep ($P = 0.03$) with a slightly less decrease during the single night when the patient was not undergoing nocturnal hemodialysis (average = 13 ± 13 per hour). This reduction occurred predominantly in seven patients with sleep apnea, in whom the average sleep disordered breathing frequency fell from 46 ± 19 to 9 ± 9 per hour ($P = 0.006$). In parallel, significant increases occurred for mean oxygen saturation (averages: 89.2 ± 1.8 to 94.1 ± 1.6 %, $P = 0.005$), transcutaneous partial pressure of carbon dioxide (averages: 38.5 – 48.3 mm Hg, $P = 0.006$) and serum bicarbonate concentration (averages from 23.2 ± 1.8 to 27.8 ± 0.8 mmol/l, $P < 0.001$). All 14 patients showed significant decreases in mean serum creatinine concentration during the period of nocturnal hemodialysis (averages: 3.9 ± 1.1 vs. 12.8 ± 3.2 mg/dl 2 days after conventional hemodialysis) but the average was slightly increased on the single night when the patients were not undergoing nocturnal hemodialysis (5.7 ± 1.7 mg/dl). Sleep patterns did not differ substantially between all groups. Sleep efficiency ranged between $80 \pm 8\%$ during nocturnal hemodialysis and $87 \pm 10\%$ on the day of conventional hemodialysis. The percentage of slow wave sleep was high with a range between $24 \pm 10\%$ during conventional hemodialysis and $30 \pm 7\%$ when the patient was not undergoing nocturnal hemodialysis. The number of arousals per hour, defined as an awakening from sleep for 3 to 15 s (range from 23 ± 20 to 25 ± 24) and the number of periodic leg movements per hour of sleep (PLMS) did not differ between treatment groups (range from 37 ± 33 to 40 ± 52).

Conclusion

The authors concluded that nocturnal hemodialysis

corrects sleep apnea in patients with chronic renal failure.

Comment

It has long been recognized that a significant number of patients with chronic renal failure suffer from sleep disorders and daytime sleepiness; however, sleep studies using polysomnography have been performed only in recent years. Both these studies and the article being reviewed showed a high prevalence of sleep apnea syndrome in patients with end-stage renal disease [1]. In addition, prior studies have shown that conventional hemodialysis did not reduce the prevalence or severity of sleep apnea in patients with chronic renal failure [2]. The present report is important because it showed for the first time that a conversion from conventional hemodialysis to nocturnal hemodialysis is associated with a significant improvement of sleep apnea. This may reduce morbidity for these patients. Interestingly, a single patient who had obstructive sleep apnea (and treatment with continuous positive airway pressure) before chronic renal failure developed continued to have severe obstructive sleep apnea despite successful conversion to nocturnal hemodialysis.

The pathogenesis of sleep apnea in patients with chronic renal failure remains unknown. The authors speculated that the improvement with nocturnal administration might be due to a better control of metabolic acidosis and hypocapnia, resulting in a stabilization of ventilatory control during sleep.

However, a mechanism mediated primarily through the effect of nocturnal hemodialysis on the upper airway by decreasing the volume of extracellular fluid was not excluded.

Another major finding of the study was, that sleep efficiency did not improve with nocturnal hemodialysis. In addition, the number of total arousals and the number of PLMS remained high despite the significant reduction of the apnea-hypopnea index. This finding suggests that a significant proportion of the arousals were associated with PLMS, however, a PLMS arousal index was not reported. Unfortunately, the authors did not report whether or not the patients suffered from periodic leg movements while awake (PLMW) or symptoms of the restless legs syndrome

(RLS), although both disorders are common in patients with chronic renal failure [3,4]. The RLS, reported to occur for 17–57% in uremic patients, is one of the most unpleasant complaints of patients undergoing chronic hemodialysis [4] and is associated with severe sleep disturbances and substantial morbidity [5]. Therefore it would have been of great interest to determine whether or not symptoms of the RLS have changed in patients undergoing nocturnal hemodialysis. In view of the unaffected sleep efficiency and high number of PLMS, one may speculate that nocturnal hemodialysis is not associated with a significant improvement of RLS. However, this question remains open and should be investigated in future studies.

References

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