

Effect of Nocturnal Hemodialysis on sleep apnea: A Meta-analysis

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OBJECTIVES

Recently, a small but growing literature depicted the beneficial effects of nocturnal hemodialysis (NHD) over conventional hemodialysis (CHD) and had put forward some meta-analyses in the fields of cardiovascular and long-term survival. Sleep disorders such as sleep apnea (SA), a risk factor for cardiovascular diseases, are the common morbidities in hemodialysis (HD) patients. The Impact of various dialysis models on SA, however, has not been determined. The objective of our meta-analysis is to examine the potential effects of NHD, compared with CHD, on sleep disorders in HD patients.

METHODS

Several electronic databases were searched using the search terms “nocturnal” (or “nightly”) and “dialysis” (or “hemodialysis” or “renal dialysis”). Two authors independently extracted data, evaluated the study quality and conducted random-effects model meta-analysis using STATA 12.0.

CONCLUSION

There was an increase of SaO₂ accompanied with a decrease of AHI and TST after conversion from CHD to NHD in our meta-analysis, but the improvement of sleep apnea by NHD required more large randomized controlled trials with long term follow up in this high risk population using these alternative dialysis regimens.

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RESULTS

Of 1566 potentially relevant citations searched, 7 studies fulfilled eligibility criteria, representing 6 single-arm studies and 1 observational study (a total of 112 participants). In an analysis of 5 studies that assessed AHI (86 analyzable patients), conversion from CHD to NHD resulted in a significant reduction in the AHI (-14.07; 95% CI, -19.09 to -9.05). For patients on dialysis or not, the reduction was -18.25 (95% CI, -22.72 to -13.78) and -11.45 (95% CI, -19.57 to -3.32), respectively. In addition, for patients with sleep disorder, there was a relatively more noteworthy descent in the AHI after alteration from CHD to NHD (-18.53; 95% CI, -26.88 to -10.18). For patients on dialysis or not, the decrease was -28.46 (95% CI, -42.15 to -14.77) and -14.41 (95% CI, -22.49 to -6.33), separately, both of which seemed more evident than that of all patients. AHI decreased substantially after conversion from CHD to NHD, and it tended to increase during the non-dialysis night for all patients and sleep-disorder patients.

In an analysis of 3 studies that reported on SaO₂ (40 analyzable patients), NHD resulted in a significant increase in the SaO₂ of 1.27% (95% CI, 0.58% to 1.96%) after conversion from CHD to NHD, and the SaO₂ was below normal value before conversion. Especially on dialysis day, it showed a significant increase of 2.7% (95% CI, 1.34% to 4.06%), whereas for the non-dialysis day, SaO₂ increased moderately by 0.97% (95% CI, 0.44% to 1.51%). Comparing with all patients, there was a similar and rather noteworthy trend for patients with sleep disorder.

Although there were 5 studies reporting about TST, 3 studies reporting data in mean \pm standard deviation were finally included in the meta-analysis (38 analyzable patients). The change of the TST after conversion from CHD to NHD was -0.31h (95% CI, -0.47 to -0.15). For patients on dialysis or not, the alteration was -0.44h (95% CI, -0.65 to -0.23) and -0.14h (95% CI, -0.26 to -0.03), respectively. For patients with sleep disorder, it presented a similar trend of reduction in the TST after conversion and the reduction of TST was relatively significantly on non-dialysis day (-0.36, 95% CI, -0.67 to -0.04). For the 2 studies not included in the analysis, however, it showed a trend that there was an increase of TST after conversion from CHD to NHD, but there was no statistically significant.

Table Summary effects of nocturnal hemodialysis on AHI, SaO₂ and TST

Outcome variables	Group	No. studies	No. patients	Baseline mean value (95% CI)	Mean change ^a (95% CI)	P value	Assessment of heterogeneity		
							I ² index ^b	P value	
Apnea-hypopnea index (n./h)	overall	5	86	25.29 (13.44 to 37.14)	-14.07 (-19.09 to -9.05)	0.000	60.7%	0.013	
	all patients	on	3	25.44 (-35.11 to 85.98)	-18.25 (-22.72 to -13.78)	0.000	0.0%	0.405	
	off	5	86	28.98 (15.44 to 42.51)	-11.45 (-19.57 to -3.32)	0.006	72.6%	0.006	
	patients with sleep disorder	overall	4	48	37.29 (16.66 to 57.92)	-18.53 (-26.88 to -10.18)	0.000	65.6%	0.012
	on	2	15	36.00 (-65.65 to 137.65)	-28.46 (-42.15 to -14.77)	0.000	39.9%	0.197	
	off	4	48	38.99 (27.87 to 50.10)	-14.41 (-22.49 to -6.33)	0.000	54.7%	0.085	
Oxyhemoglobin saturation (%)	overall	3	62	93.39 (92.80 to 93.97)	1.27 (0.58 to 1.96)	0.000	45.7%	0.137	
	all patients	on	1	93.2	—	0.000	—	—	
	off	3	62	93.48 (91.31 to 95.65)	0.97 (0.44 to 1.51)	0.000	0.0%	0.908	
	patients with sleep disorder	overall	3	50	92.53 (90.42 to 94.65)	1.93 (0.56 to 3.30)	0.006	75.6%	0.001
	on	1	7	91.7	—	0.000	—	—	
	off	3	50	92.95 (87.23 to 98.67)	1.59 (0.20 to 2.98)	0.025	73.3%	0.005	
Total sleep time (h)	overall	3	38	5.54 (5.42 to 5.67)	-0.31 (-0.47 to -0.15)	0.000	59.2%	0.031	
	all patients	on	3	5.52 (5.32 to 5.71)	-0.44 (-0.65 to -0.23)	0.000	41.3%	0.182	
	off	3	38	5.51 (4.17 to 6.84)	-0.14 (-0.26 to -0.03)	0.014	0.0%	0.410	
	patients with sleep disorder	overall	2	15	5.60 (4.94 to 6.26)	-0.36 (-0.59 to -0.13)	0.002	0.0%	0.523
	on	2	15	5.55 (2.37 to 8.73)	-0.36 (-0.85 to 0.13)	0.154	53.5%	0.142	
	off	2	15	5.65 (5.01 to 6.29)	-0.36 (-0.67 to -0.04)	0.027	0.0%	0.760	

a By random effects model meta-analysis

b A measure of statistical heterogeneity across study results an I² index $\geq 50\%$ indicates medium-to-high heterogeneity.

Abbreviations: AHI, apnea-hypopnea index; SaO₂, Oxyhemoglobin saturation; TST, total sleep time.

Note: “on” means that the measurements were performed after the patient had undergone conventional hemodialysis during the day and a night when the patient was being treated with nocturnal hemodialysis. “off” means that the measurements were performed during which the patient had not undergone conventional hemodialysis and a night when the patient was not undergoing nocturnal hemodialysis. “overall” means that the data were collected both on dialysis day and non-dialysis day.