Clinical associations of prolonged intradialytic hypoxemia in hemodialysis patients: results from a population-based study

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Background and Aims

Hypoxemia is the common terminal pathway of multiple structural and functional pathologies. Intradialytic hypoxemia is well-documented, but its clinical associations are ill-defined. Notwithstanding etiology, hypoxemia and hypoxia are associated with acute and chronic sequelae affecting multiple organ systems, including the cardiovascular system, and activation of pro-inflammatory pathways. Some of these pathologies are highly prevalent in HD patients, for example impairment of cardiac function, as well as inflammation. In patients with congestive heart failure (CHF) and sleep apnea it was observed that not only the frequency, but also the time spent with oxygen saturation below 90%, the hypoxic "burden", is a predictor for hemodynamic stress.

Here we **aim** to explore the associations between prolonged intradialytic hypoxemia and clinically relevant markers.

Methods

We analyzed intradialytic arterial oxygen saturation (SaO2) in chronic non-catheter hemodialysis (HD) patients treated between January 2012 and September 2014 in 17 facilities. SaO2 was reported every minute by the Crit-Line™ monitor. Treatments in which the undocumented use of a central-venous catheter as vascular access was suspected (i.e., mean SaO2 below 80%) were excluded. Data were averaged across all treatments on a per-patient level. Prolonged hypoxemia was defined as SaO2 below 90% for more than 1/3 of treatment time. Patients were stratified into 2 groups based on the presence or absence of prolonged intradialytic hypoxemia. Demographical and clinical data were extracted from electronic medical records.

Results

We studied 1608 patients (59% males; 50% whites) during 70330 HD treatments. 199 patients (12.4%) had prolonged intradialytic hypoxemia (Table 1). Prolonged intradialytic hypoxemia was associated with longer dialysis vintage, higher interdialytic weight gain (IDWG) and a higher prevalence of CHF and chronic obstructive pulmonary disease (COPD). Additionally, patients with prolonged intradialytic hypoxemia had lower serum albumin, a higher neutrophil-to-lymphocyte ratio (NLR), lower hemoglobin levels and required more erythropoetin.

Table 1: Comparison of patients with and without prolonged intradialytic hypoxemia

Variable	Prolonged intradialytic hypoxemia		Difference	p-value
	yes (n=199) Mean±SD	no (n=1409) Mean±SD	Mean (CI)	
Gender (% male)	52.3	59.9	-7.6	0.040[1]
Race (% white)	47.7	49.8	-2	0.595[1]
Age (years)	63.6±12.5	62.1±15.4	1.5 (3.4; -0.4)	0.126[2]
Diabetic (%)	48.7	47.8	0.9	0.810[1]
CHF (%)	26.6	19.5	7.1	0.020[1]
COPD (%)	13.6	6.2	7.4	<0.001[1]
Vintage (years)	4.7±4.2	3.7±4.0	1.0 (1.7; 0.3)	0.003[2]
BMI (kg/m^2)	29.5±8.3	28.7±7.8	0.8 (2.1; -0.5)	0.236[2]
preSBP (mmHg)	145.3±21.7	145.8±19.8	-0.5 (2.5; -3.5)	0.728[2]
postSBP (mmHg)	139.3±22.0	136.2±18.8	3.1 (6.3; -0.2)	0.062[2]
IDWG (kg)	2.6±1.3	2.3±1.0	0.3 (0.5; 0.2)	<0.001[2]
Albumin (g/dl)	3.8±0.4	4.0±0.3	-0.2 (0.1; 0.2)	<0.001[2]
NLR	4.7±3.3	3.7±2.2	1.0 (1.5; 0.5)	<0.001[2]
Hgb (g/dl)	10.5±1.1	10.8±0.9	-0.4 (-0.2; -0.5)	<0.001[2]
Epo Dose (Units per treatment)	4460±5357	2587±3133	1874 (1107; 2640)	<0.001[2]

[1]Chi-square test; [2]t-test; CHF: congestive heart failure; COPD: chronic obstructive disease; BMI: body mass index; preSBP: predialysis systolic blood pressure; postSBP: postdialysis systolic blood pressure; IDWG: interdialytic weight gain; NLR: neutrophil-to-lymphocyte ratio; Hgb: Hemoglobin; Epo: erythropoetin

Conclusion

Our data indicate that patients with prolonged intradialytic hypoxemia are characterized by an inflammatory phenotype, as evidenced by lower albumin and higher NLR. The observational nature of our study prevents conclusions concerning causality; prospective studies are required to further explore the underlying pathophysiology of prolonged intradialytic hypoxemia and the effectiveness of interventions.

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L7) Dialysis. Epidemiology, outcome research, health services research.

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DOI: 10.3252/pso.eu.52era.2015

ePosters supported by F. Hoffmann- La Roche Ltd.