REMOVAL EFFICIENCY OF PROTEIN BOUND SOLUTES AND ANTIOXIDANTS BY ONLINE HEMODIAFILTRATION COMPARED WITH HIGH-FLUX HEMODIALYSIS

Kazuhiro Okano[1, 2], Ken Tsuchiya[1, 2], Kosaku Nitta[1]

[1]Dep. of Medicine & [2]Dep. of Blood Purification, Kidney Center, Tokyo Women's Medical University, Tokyo, Japan.

INTRODUCTION

Recent evolution of blood purification therapy to chronic kidney disease includes online hemodiafiltration (OL-HDF). However, two recent controlled trials compared OL-HDF with either low-flux (J Am Soc Nephrol 2012; 23: 1087) or high-flux (Nephrol Dial Transplant 2013; 28: 192) hemodialysis (HD) showed no significant difference in primary analysis, while one trial reported a reduction in all-cause mortality (J Am Soc Nephrol 2013; 24: 487). In the present study, we investigated difference of removal efficiency in protein-bound solutes, antioxidants, and oxidative stress markers between high-efficiency, predilution OL-HDF and high-flux HD.

MATERIALS & METHODS

We enrolled stable 27 HD and 7 OL-HDF patients at our dialysis center. High performance polysulfone membranes were used in both groups. OL-HDF was performed in predilution mode with 600 mL/min of total dialysate flow, which consists of 200 mL/min of infusion flux and 400 mL/min of convection flow. High-flux HD was performed using the same dialysate. The protein-bound solutes include homocystine, indoxyl sulfate, hippurate, and leptin. We measured serum levels of vitamin A, vitamin C, and vitamin E as representative antioxidants. We selected two oxidative stress markers, advanced oxidation protein products (AOPP) and oxidized low-density lipoprotein (OxLDL), which are known as useful oxidation markers of protein and lipid, respectively. We estimated serum volume before (Vpre) and after (Vpost) treatment, quantity of removal (QR), and removal rate (RR) as follows:

Vpost = measured weight after the treatment x 0.05

Vpre = Vpost + water-removal volume by the treatment

$$\text{QR} = \frac{\text{serum concentration before the treatment (Cpre) x Vpre - serum concentration after the treatment (Cpost) x Vpost}}{\text{measured weight after the treatment}}$$

$$\text{RR (\%)} = \frac{(\text{Cpre x Vpre} - \text{Cpost x Vpost}) \text{ x } 100}{\text{Cpre x Vpre}}$$

RESULTS

Table 1. Baseline characteristics of the participants

	HD (n = 27)	OL-HDF (n = 7)	P
Demographics			
Age (years)	59.7±11.3	59.3±10.7	0.924
Male gender	11 (40.7)	2 (28.5)	0.569
Dialysis characteristics			
Time on diaysis (years)	12.8±11.3	17.4±9.7	0.335
Kt/V	1.23±0.31	1.17±0.22	0.091
Cause of kidney disease			
Glomerulonephritis	19	5	0.966
Diabetic nephropathy	4	1	0.983
Polycystic kidney disease	2	1	0.782
Nephrosclerosis	2	0	0.766
Clinical characteristics			
Systolic blood pressure (mmHg)	136.6±19.7	135.2±20.4	0.806
Diastolic blood pressure (mmHg)	77.2±13.6	80.1±13.7	0.244
Previous cardiovascular disease	8	1	0.536
BMI (kg/m^2)	21.3±4.6	24.5±4.6	0.109
Laboratory data			
Hemoglobin (g/dL)	10.9±1.2	10.7±0.9	0.648
Albumin (g/dl)	3.7±0.3	3.5±0.3	0.681
Blood urea nitrogen (mg/dL)	63.6±11.5	67.7±14.1	0.434
Creatinine (mg/dL)	11.4±2.7	12.7±1.3	0.205
Calcium (mg/dL)	9.1±0.8	8.6±0.9	0.249
Phosphate (mg/dL)	5.7±1.6	7.0±2.4	0.672
HDL cholesterol (mg/dL)	56.9±20.0	55.1±17.8	0.832
LDL cholesterol (mg/dL)	95.8±25.6	104.1±18.8	0.428
Triglyceride (mg/dL)	91.6±55.4	82.7±32.2	0.835
TSAT (%)	17.3±8.0	15.9±9.7	0.527
Ferritin (ng/mL)	81.9±86.0	35.2±36.9	0.174
CRP (mg/dL)	0.37±0.63	0.14±0.14	0.345
Medications			
ACE-I/ARB	26	7	0.453
Calcium channel blocker	12	2	0.610
β-blocker	9	1	0.331
Phosphate binders	25	7	0.464
Vitamin D	15	5	0.453
Cinacalcet	9	3	0.643

Values expressed as mean ± SD or number (percent). Kt/V denotes fractional urea clearance. BMI, body mass index; HDL, high density lipoprotein; LDL, low density lipoprotein; TSAT, transferrin saturation; CRP, C-reactive protein; ACE-I/ARB, angiotensin-converting enzyme inhibitor/angiotensin Ⅱ receptor blocker. Significance at P value < 0.05

Table 1

There were no significant difference in clinical and laboratory parameters between the two groups. Various medications were used for the participants without any significant difference. The dialysis efficiency, such as Kt/V, also showed no significant difference between the two groups.

Table 2. Targeted molecules and their circulating levels before dialysis session

	Molecule	MW (D)	HD (n = 27)	OL-HDF (n = 7)	P
Protein-bound solutes	Homocystine (nmol/mL)	268	29.9±13.8	32.3±15.4	0.675
	Indoxyl sulfate (μg/mL)	251	28.7±10.8	36.0±4.6	0.144
	hippurate (μg/mL)	179	91.6±55.4	82.7±32.2	0.835
	Leptin (ng/mL)	16,000	5.7±1.6	7.0±2.4	0.672
Antioxidants and oxidative stress markers	Vitamin A (IU/dL)	287	221.9±81.1	193.4±100.3	0.418
	Vitamin C (μg/mL)	176	22.4±38.4	9.3±2.8	0.382
	Vitamin E (mg/mL)	417	1.1±0.3	1.1±0.2	0.608
	OxLDL (U/L)	540,000	77.4±25.9	86.6±26.3	0.390
	AOPP (U/L)	80,000 - 600,000	43.5±6.4	41.1±5.8	0.437

Values expressed as mean ± SD. MW, molecular weight; D, dalton; HD, hemodialysis; OL-HDF, on-line hemodiafiltration; OxLDL, oxidized low-density lipoprotein; AOPP, advanced oxidation protein products. Significance at P value < 0.05.

Table 2

the serum levels of protein-bound solutes, antioxidants, and oxidative stress markers before the session in the two groups. There was no significant difference between the two groups in the protein-bound solutes. Antioxidants and oxidative stress markers also showed no significant difference between the two groups, suggesting that OL-HDF may have little effect on exacerbation of oxidative stress balance compared to HD.

Table 3. Reduction of protein-bound solutes by HD or OL-HDF

Molecule (MW)	HD (n = 27)	OL-HDF (n = 7)	P
Homocystine (135)			
QR (nmol/mL)	2.16 ± 1.04	2.48 ± 1.65	0.507
RR (%)	70.7 ± 4.9	70.9 ± 5.5	0.926
Indoxyl sulfate (251)			
QR (μg/mL)	2.07 ± 1.01	2.67 ± 0.85	0.215
RR (%)	68.1 ± 6.5	70.6 ± 8.7	0.400
hippurate (179)			
QR (μg/mL)	2.35 ± 1.51	3.75 ± 1.49	0.048
RR (%)	83.1 ± 3.8	86.1 ± 4.5	0.064
Leptin (16,000)			
QR (ng/mL)	1.99 ± 4.78	4.28 ± 8.88	0.308
RR (%)	57.7 ± 16.7	67.3 ± 27.3	0.207

Values expressed as mean ± SD or number (percent). MW, molecular weight; HD, hemodialysis; OL-HDF, on-line hemodiafiltration. Significance at P value < 0.05.

Table 3

Reduction of protein-bound solutes by OL-HDF or HD. The QR and the RR of the protein-bound solutes showed higher in OL-HDF than in HD but there were no significant difference observed, except for the QR in hippurate. These suggest that pre-dilution OL-HDF is effective in removing protein-bound solutes even though reduction efficiency of these solutes is not statistically significant between the two groups.

Table 4. Reduction of antioxidants and oxidative stress markers

Molecule (MW)	HD (n = 27)	OL-HDF (n = 7)	P
Vitamin A (287)			
QR (IU/kg)	12.16 ± 5.78	14.60 ± 12.60	0.167
RR (%)	52.8 ± 7.0	68.0 ± 15.4	<0.001
Vitamin C (176)			
QR (mg/kg)	1.04 ± 0.68	0.82 ± 0.24	0.696
RR (%)	81.8 ± 5.6	79.9 ± 9.2	0.484
Vitamin E (417)			
QR (μg/kg)	47.2 ± 26.6	48.7 ± 25.5	0.893
RR (%)	41.5 ± 11.5	41.3 ± 14.7	0.974
OxLDL (540,000)			
QR (U/kg)	2.81 ± 1.77	3.08 ± 1.41	0.713
RR (%)	35.4 ± 17.4	33.3 ± 7.0	0.767
AOPP (80,000 - 600,000)			
QR (U/kg)	2.46 ± 0.89	2.50 ± 1.02	0.931
RR (%)	53.8 ± 6.8	57.5 ± 5.1	0.338

Values expressed as mean ± SD or number (percent). MW, molecular weight; HD, hemodialysis; OL-HDF, on-line hemodiafiltration; OxLDL, oxidized low-density lipoprotein; AOPP, advanced oxidation protein products. Significance at P value < 0.05.

Table 4

All vitamins are small-sized molecules but two of them, vitamin A and E, are not water-soluble and bind with carrying proteins in circulation. OL-HDF had significantly better RR in vitamin A than HD (p = 0.017), while both OL-HDF and HD showed lower reduction of serum vitamin E than that of vitamin A. Water-soluble vitamin C showed almost 80% of the RR and no significant difference between the two groups. The QR and the RR of these two oxidative stress markers showed no significant difference between the two groups.

RESULTS

Most protein-bound solutes were removed insignificantly but better by OL-HDF compared with high-flux HD. The OL-HDF group had significant better removal of vitamin A but did not affect imbalance of oxidative stress compared with the HD group.

53 ERA 421-SP

Dialysis. Extracorporeal dialysis: techniques and adequacy.

Kazuhiro Okano

DOI: 10.3252/pso.eu.53era.2016

ePosters supported by F. Hoffmann- La Roche Ltd.