Effects of hemodialysis combined with hemodiafiltration and calcium supplements on cardiac structure and function in maintenance hemodialysis patients with diabetic nephropathy

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Abstract

Objective: To investigate the effect of hemodialysis (HD) combined with hemodiafiltration (HDF) and oral calcium supplements on cardiac structure and function in maintenance hemodialysis (MHD) patients with diabetic nephropathy.

Methods: 47 MHD patients with diabetic nephropathy were recruited, allocated to either HD (n=17) or HD+HDF(n=30) and followed for 4 or more years. Clinical characteristics and general biochemical indicators were monitored. The patients were evaluated by echocardiography before, and after 4 years of treatment.

Results: 1) Pro-BNP, P, and hs-CRP levels, and Ca×P were significantly higher after treatment than before treatment and were positively correlated with LVMI (*P*<0.05). 2) P, hs-CRP, and pro-BNP levels, and Ca×P were significantly higher after treatment than before treatment in the HD group but all had significantly decreased in the HD+HDF group . After treatment, P, hs-CRP, and pro-BNP levels, and Ca×P, were significantly lower in HD+HDF group than in the HD group .3) During treatment, LVEDd and LVMI decreased significantly,and LVEF increased significantly,in the HD+HDF group compared with the HD group after 4 years treatment This result is differ from other researcher' s data.4) Patients had significantly decreased LVEDd and LVMI in HD+HDF+ calcium acetate group compared with those inHD+HDF+ calcium carbonate group (P<0.05).5) High-flux dialysis combined with HDF significantly decreased the FGF23 concentration.

Conclusion: HD combined with HDF and oral calcium acetate improved left ventricular hypertrophy (LVH) and cardiac function in MHD patients with diabetic nephropathy during treatment.LVEDd and LVMI decreased and LVEF increased significantly. High-flux dialysis combined with HDF can decrease the FGF23 concentration.

Materials and methods

Patients

47 MHD patients with diabetic nephropathy were recruited between January 2011 and January 2017 at the Hemodialysis Center, Sixth People's Hospital of Shanghai,China. Eligible patients were diagnosed with DN by pathological examination of a renal biopsy, or had a medical history, clinical manifestations, and recent examination consistent with DN.All participants were ESRD patients indicated for renal replacement therapy, and received HD therapy at the Blood Purifying Center of our hospital.

Study protocol

Blood samples were drawn in the morning, before HD and after fasting for 8–12 h, The samples were centrifuged at 700 *g* for20 min at 4°C to pellet the cells; the serum was then removed and stored at −20°C until analysis. The age, gender, height, dry weight, present and past illnesses, family history, and medical history of the patients were recorded.

Serum biochemistry

Fibroblast growth factor 23 (FGF23)was measured by ELISA according to the kit manufacturer's instructions

Statistical analyses

SPSS 19.0 software (IBM Corp., USA)was used for statistical analysis.

Result

Table 1. Serum levels of biochemical indexes in MHD patients with diabetic nephropathy before and after treatment

	Pretreatment	Posttreatment	*t*	*P*
Pro-BNP (ng/L)	6244.34±4136.58	8338.57±5899.17**	3.30	<0.01
Ca (mmol/L)	2.06±0.12	2.09±0.19	1.47	0.15
P (mmol/L)	1.86±0.33	2.04±0.64 *	2.35	0.02
Ca×P (mmol^2/L^2)	3.81±0.67	4.29±1.56 *	2.53	0.02
hs-CRP (mg/L)	13.25±24.91	27.69±32.02**	3.37	<0.01
PTH (pg/mL)	319.44±185.37	360.10±133.42	1.90	0.06
FGF23(ng/L)	281.8±196.7	202.1±183.4	1.98	0.06
Log FGF23	2.45±0.39	2.31±0.36	1.82	0.05

*P<0.05,**P<0.01compared with Pretreatment

Table 3. Effects ofcalcium supplements on cardiac structure in HD+HDF group of MHD patients

	Calcium carbonate (*n*=13)	Calcium acetate (*n*=16)	*t*	*P*
	47.95±2.32	45.48±3.53*	3.573	0.041
LVEDs (mm)	37.89±4.16	35.53±3.83*	3.624	0.045
LAD(mm)	38.28±5.42	38.59±7.48	1.239	0.362
IVST(mm)	10.58±1.50	11.13±1.83	1.903	0.371
LVPWT(mm)	10.50±1.21	10.37±1.50	1.201	0.104
LVMI (g/m^2)	126.45±40.15	144.56±48.53	3.458	0.182
FS(%)	30.66±6.42	30.50±5.52	–0.047	0.543

**P*<0.05 compared with control

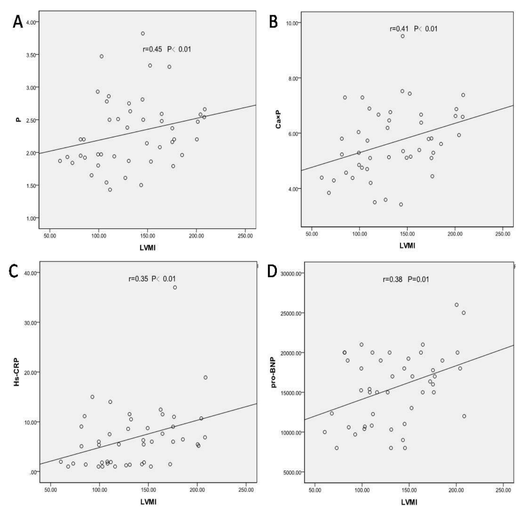

Fig.1. Analysis of the correlations between LVMI and serum P, hs-CRP, and pro-BNP levels, and Ca×P. A) LVMI was positively correlated with the serum P level (*r*=0.45, *P* <0.01, R^2=0.064). B) LVMI was positively correlated with the serum Ca×P (*r*=0.41, *P* <0.01, R^2=0.118). C) LVMI was positively correlated with the serum hs-CRP levels (*r*=0.35, *P* <0.01, R^2=0.122). D) LVMI was positively correlated with the serum pro-BNP levels (*r*=0.38, *P*=0.01, R^2=0.145).

Table 2.Correlation analysis between serum levels of P, Ca×P, hs-CRP, pro-BNP and cardiac structure and function in MHD patients with diabetic nephropathy

	P		Ca×P		Hs-CRP		Pro-BNP	
	r	*P*	*r*	*P*	*r*	*P*	*r*	*P*
LVEDd	0.45**	<0.01	0.39*	0.01	0.45*	0.01	0.68**	<0.01
LVEDs	0.31*	0.04	0.28*	0.04	0.46**	<0.01	0.43*	0.01
LAD	0.32*	0.03	0.26*	0.04	0.57**	<0.01	0.36*	0.04
LVPWT	0.34*	0.02	0.32*	0.03	0.38*	0.01	0.39*	0.04
IVST	0.36*	0.01	0.33*	0.03	0.46**	<0.01	0.32*	0.04
LVMI	0.45*	<0.01	0.41**	<0.01	0.35**	<0.01	0.38*	0.01
LVEF	–0.31*	0.04	–0.28*	0.04	–0.65**	<0.01	–0.77**	<0.01
E/A	0.04	0.81	-0.30*	0.04	-0.4**1	<0.01	-0.38	0.42

Table 4. Comparison of serum P, hs-CRP, and pro-BNP levels, and Ca×Pbefore and after treatment in the HD and HD+HDF groups

Group		P (mmol/L)	Ca×P (mmol^2/L^2)	hs-CRP (mg/L)	Pro-BNP (ng/L)
HD	Pre-treatment	1.84±0.19	3.84±0.37	12.74±2.46	5963.31±1330.04
(*n*=16)	Post-treatment	2.30±0.37*	5.05±1.03*	47.14±22.72*	11472.47±4229.01*
	t_1	6.57	5.75	7.88	7.97
	P_1	<0.01	<0.01	<0.01	<0.01
HD+HDF	Pretreatment	1.88±0.17	3.78±0.44	13.76±2.88	6525.37±1535.89
(*n*=30)	Post-treatment	1.78±0.20*△	3.53±0.62*△	8.24±7.45*△	5304.67±2571.44*△
	t_1	–2.50	–2.22	–2.33	–2.36
	P_1	0.02	0.04	0.04	0.03
	t_2	–3.36	–3.79	–5.19	–2.61
	P_2	<0.01	<0.01	<0.01	0.01

*P_1<0.05 compared with Pretreatment in the same group; △P_2<0.05compared with Post-treatment in the HD group.

Summary

In conclusion, this study found that HD combined with HDF was a safe and effective blood purification measure, and that this combined treatment improved LVH and cardiac function in MHD patients with diabetic nephropathy. HD+HDF combined with oral calcium acetateis more beneficial to cardiac structure than calcium carbonate for MHD patients with diabetic nephropathy and renal failure.

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