Relationship of Calcified Plaques of Carotid and Femoral Arteries with Left ventricular Hypertrophy in Maintenance Hemodialysis Patients

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Citation

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Abstract

Objectives: Two Principle findings of cardiovascular disease in end-stage renal disease patients undergoing regular hemodialysis are left ventricular hypertrophy (LVH) and arterial disease due to rapidly progressive atherosclerotic vascular disease that can be characterized by arterial plaques. In this study we aimed to study the relationship of left ventricular hypertrophy with plaques of carotid-femoral artery in end-stage renal disease patients undergoing regular hemodialysis.

Patients and Methods: 61 patients with end-stage renal disease (ESRD), undergoing regular and maintenance hemodialysis treatment (F=23 M=38), consisting of 50 non-diabetic hemodialysis patients (F=20 M=30) and 11 diabetic hemodialysis patients (F=3 M=8) were selected for this study. In all subjects echocardiography and B-mode ultrsonographic assessment of carotid-femoral arteries for plaque occurrence were performed.

Results: In this study there was a positive correlation between stages of LVH and duration of hemodialysis treatment, a positive correlation between stages of LVH and stages of hypertension, significant association between stages of LVH with plaque score, and also a positive correlation between stages of LVH and presence of chest pain, as well as association of diabetes mellitus with the presence of chest pain and positive correlation between stages of HTN and plaque score. In addition, plaque score and percent of LV ejection fraction correlations were observed. Also, the association of plaque score with diabetes mellitus was demonstrated.

Conclusions: The present study documents parallel cardiac and vascular adaptation in ESRD patients and demonstrates the potential contribution of structural and functional large artery alteration to the pathogenesis of left ventricular hypertrophy.

INTRODUCTION

In patients with renal failure, cardiovascular complications are a major clinical problem. The most important is left ventricular hypertrophy (LVH) and the main cause of death in these patients is due to cardiac involvement ([1,2]). Cardiac risk is increased by a factor of 20 in uremic patients compared with matched segments of general population ([1,2,3]). It had been known for a long time that atherosclerosis plaques in arteries are more frequent in patients with chronic renal failure ([1]). In fact, patients with end- stage renal disease (ESRD) under hemodialysis suffer from excessive mortality due to atherosclerotic cardiovascular disease (ACVD) compared with the general population ([4]).

This is frequently attributed to a process of accelerated atherosclerosis (rapidly progressive atherosclerosis) especially as the risk factors of ACVD in the general population such as hypertension, lipid abnormalities, glucose intolerance and left ventricular hypertrophy are more commonly observed in these groups ([4,5]). Ultrasonic assessment of plaques in the carotid and femoral arteries are widely used as surrogate marker of atherosclerosis in coronary arteries ([3]) but prospective evaluations about the association of arterial plaque with hypertrophy of left ventricle or cardiac ejection fraction are not well researched and appear to be lacking in patients with ESRD under hemodialysis. Therefore, we sought to examine whether any association exists between carotid-femoral artery plaques with LVH and chest pain of hemodialysis patients.

PATIENTS AND METHODS

This is a cross-sectional study done on 61 patients with end-stage renal disease (ESRD), undergoing regular hemodialysis treatment between September 2002 and December 2003. Patient selection exclusion criteria were cigarette smoking, body mass index (BMI) more than 25, anti lipid drugs taking, recent MI and vascular diseases as well as pericarditis and pericardial effusion in echocardiography as well as active and chronic infection. For stratification of hypertensive patients, according to the sixth and seventh report of the joint national committee on prevention, detection, evaluation and treatment of high blood pressure, we stratified hypertensive patients from stage one to three ([6,7]) (stage of zero equal to no HTN). Stages of the hypertension of HD patients were considered before treatment and at the first start of hemodialysis treatment. Carotid sonography was done by a single sonologist unaware of history or lab data of patients using a Honda-Hs-2000 Sonograph and 7.5 MHZ linear probe. The procedure was done at the end of diastolic phase and the sites of measurements were at the distal common carotid artery, area of bifurcation and at the first proximal internal carotid artery. The subjects were in supine position with neck hyperextension and rotation of head for facilitation of procedure performing.

The carotid was evaluated in axial longitude sonography and the right and left carotid and femoral arteries were scored from 0 (no plaque) to 4 (plaque presence at all four sites) regardless of the number and size of the plaques in each site. Plaque occurrence in each site scored one point. The plaques were divided into 3 groups: soft, calcified and mixed. The plaques were visualized as a echogen or hypoecho protrusion into the vessel lumen. Soft plaques are hypoecho, calcified are echogen and had a shadow. Mixed plaques have heterogen echo. Plaques were considered as a local intimal thickness of more than 1 mm. For plaque measurement the largest longitude was considered. One single cardiologist who was unaware of the patients` data performed all echocardiophies (B-mobe) for left ventricular hypertrophy and percent of LV ejection fraction. On the base of sepal thickness ,we stratified the patients into no LVH (septal thickness between 6-11 mm), mild (septal thickness between 11-15 mm), moderate (septal thickness between 15-18 mm), and severe LVH (septal thickness >18 mm). LVH measurements were done at the end diastolic phase.

Cardiac ejection fraction between 55 to 75% were considered normal. For statistical analysis descriptive data were expressed as Mean± SD. Comparison between groups were performed by chi-square test (x^2 test), Mann Whitney, as well as Kruskal & Wallis and Fisher's exact tests. For correlations we used Spearman`s Rho test and partial correlation with adjustment for age. Phi & Cramer's V and Eta tests were used too. All statistical analysis were performed by using the statistically analysis system (SPSS version 11.00). Statistical significance was inferred at a p value< 0.05.

RESULTS

Total patients were 61 (F=23 M=38), consisting of 50 non diabetic hemodialysis patients (F=20 M=30) and 11 diabetic hemodialysis patients (F=3 M=8). Table 1 shows the mean± SD of data of patients. Tables 2, 3, and 4 show the frequency distribution of chest pain, stages of HTN, and stages of LVH of patients. Table 5 shows the frequency distribution of plaque score in total patients as well as diabetic and non-diabetic groups.

Figure 1

Table 1: Mean ± SD, Minimum and Maximum of data.

		Age years	D.H.T* months	EF** percent
total patients n=61	Mean±SD	46.5±16	32±31	51±8.9
	Min	15	2	25
	Max	78	108	70
diabetic group n=11	Mean±SD	57±16	22.6±22.4	47.7±7
	Min	27	3	30
	Max	78	60	55
non-diabetic group n=50	Mean±SD	47.8±16	34±33	51±9
	Min	15	2	25
	Max	78	108	70

*duration of hemodialysis treatment.

**LV ejection fraction.

Figure 2

Table 2: Frequency distribution of stages of hypertension (HTN)

Stages of HTN	Total patients n=61		DM group* n=11		Non-DM group n=50	
	Number	Percent	Number	Percent	Number	Percent
0	4	6.6	0	0	4	8
1	5	8.2	0	0	5	10
2	33	54.1	8	72.7	25	50
3	19	31.1	3	27.3	16	32

*DM=Diabetes Mellitus.

Figure 3

Table 3: Frequency distribution of chest pain in hemodialysis patients

Chest pain	Total patients n=61		Diabetic patients n=11		Non diabetic patients n=50	
	Number	Percent	Number	Percent	Number	Percent
Yes	24	39.3	9	81.8	15	30
No	34	60.7	2	18.2	35	70

Figure 4

Table 4: Frequency distribution of Left ventricular hypertrophy (LVH) in hemodialysis patients.

	Total patients n=61		Diabetic patients n=11		Non diabetic patients n=50	
	Number	Percent	Number	Percent	Number	Percent
No LVH	9	14.8	1	9	8	16
Mild LVH	25	41	4	36.4	21	42
Modrate LVH	20	32.8	4	36.4	16	32
Severe LVH	7	11.5	2	18.2	5	10

Figure 5

Table5: Frequency distribution of plaque scores of Carotid and Femoral arteries

	plaque score	Frequency	Percent
Total patients N=61	0	33	54.1
	1	5	802
	2	12	19.7
	3	2	3.3
	4	9	14.8
Group 2 N=11	0	1	9.1
	1	1	9.1
	2	6	54.5
	3	0	0.0
	4	3	27.3
Group 3 N=50	0	32	64.0
	1	4	8.0
	2	6	12.0
	3	2	4.0
	4	6	12.0

Group2=Diabetic HD patients

Group3=Nondiabetic HD patients

Mean ± SD of ages of subjects was 46.5±16 years. Mean ± SD of length of the time patients had been on hemodialysis was 32 ± 31 months. Mean ± SD of LV ejection fraction was 51±8.9 percent and 39.3% of patients had chest pain. All of the plaques were calcified. In this study there were no significant difference in age, percent of cardiac ejection fraction, and duration of hemodialysis between males and females (P>0.05) (Mann-Whitney U test). There was also no significant different of LVH between the two sexes (x^2 test) (P>0.05). There was no significant difference in the presence of chest pain and also no significant difference of DM between the two sexes (Fisher's exact test)(p>0.05). No significant difference between sex of the subjects and stages of hypertension (P>0.05) (x^2 test) was found. In this study, there was a positive association between stages of LVH and duration of hemodialysis treatment (p<0.01) and no significant difference between stages of LVH and ages of the patients (p>0.005)(Kruskal-Wallis statistical analytic test).

There was a positive close relationship between stages of LVH and stages of HTN (r= 0.580 p<0.001) as well as no significant correlation between DM and LVH (P>0.05) (Phi & Cramer's V test) . Significant positive correlation between presence of chest pain and DM (P<0.001) was found and association between the presence of DM with stages of HTN as well as DM with sex were negative (p>0.005)(Phi & Cramer's V test). No correlation between DM and percent of heart ejection fraction was found (P>0.005)(Eta test). No significant difference of duration of hemodialysis, age and percent of heart ejection fraction between diabetic and non-diabetic group was found (P> 0.05)(Mann-Whitney test).

No significant correlation of percent of heart ejection fraction (EF%) with duration of hemodialysis treatment (P>0.05) (Spearman's rho test) was found. A significant correlation between presence of chest pain and stages of LVH (P<0.001))(Phi & Cramer's V test) was observed. About HTN, there was not any association between stages of HTN with chest pain (P> 0.05) (x^2 test) In regard to plaque score a positive correlation of plaque scores with ages of the patients (p=0.003) and a positive correlation of plaque scores with percent of heart ejection fraction(p=0.019) was demonstrated (Kruskal-Wallis statistical analytic test). Significant positive correlation between plaque scores and diabetes mellitus was observed (p=0.004) (x^2 test). Significant positive correlation between plaque scores with LVH (r= 0.259 p=0.023) and significant positive correlation between plaque scores with length of the time patients had been on hemodialysis (r= 0.239 p=0.033) as well as significant positive correlation between plaque scores with stages of HTN(r= 0.240 p=0.032) (partial correlation test after adjustment for age) were found. Finally, after dividing

the patients into diabetic and non diabetic for analysis of the correlations mentioned above, no other important data were found.

DISCUSSION

In this study there were positive correlations between stages of LVH and duration of hemodialysis treatment, positive correlationss between stages of LVH and stages of hypertension, and also positive correlations between stages of LVH and presence of chest pain. Association of diabetes mellitus with the presence of chest pain as well as plaque score with ages and DM of patients and plaque score with LV EF%, LVH, duration of hemodialysis treatment, and stages of HTN had significant positive correlations. Strauman et al. in a study on 62 patients on maintenance hemodialysis observed 65% prevalence of LV hypertrophy. He showed age, body mass index, and duration of HTN was associated with LV hypertrophy and asymmetric septal hypertrophy ($_{8}$). Greaves et al. in the evaluation of 30 HD patients and 54 patients under peritoneal dialysis compared with 38 ESRD patients not yet on dialysis demonstrated that left ventricular wall thickness was greater in dialysis group ($_{9}$). De Lima et al. in the study of 103 HD patients showed that systolic blood pressure was significantly associated with LV mass and was significantly and independently correlated with LVH and posterior wall hypertrophy ($_{10}$).

Hojs in a study on 28 HD patients showed age was the only significant determinant of number of plaques. He concluded that hemodialysis patients had advanced atherosclerosis in the carotid arteries compared with normal subjects ($_{11}$). More over in his recent study, he showed no difference in plaque occurrence between 28 HD patients with 28 ESRD patients prior to hemodialysis ($_{11}$). Pascasio et al. observed a large number of vascular plaques in uremia patients that was statistically significant in all the vessels except on the carotid sites. He concluded that the process of advance atherosclerosis might be started with the beginning of renal failure. He suggested that hemodialysis treatment may not a potential factor to accelerate arthrosclerosis and finally he concluded that the progression of atherosclerosis might be related to atherogenic factors operative before regular dialysis ($_{11}$).

Savage et al. in a study on 24 dialysis patients notedan increased prevalence of plaques in carotid and femoral arteries. This study also showed the relationship between femoral artery plaque and age ($_{4}$). The present study documents parallel cardiac and vascular adaptation in ESRD and demonstrates the potential contribution of structural and functional large artery alteration to the pathogenesis of LVH and functional alterations. We propose to more work on the association of vascular changes with cardiac involvement and their interactions.

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