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*Original article*

## The Relationship between Cardiac Valve Calcification and Abdominal Aortic Calcification in Peritoneal Dialysis Patients

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### Abstract

**Introduction.** Vascular and valvular calcifications are important and prevalent complications in ESRD patients including those receiving PD therapy. The aim of this study was to evaluate the relationship of aortic and mitral valve calcification with abdominal aortic calcification in CAPD patients.

**Methods.** We studied 38 stable patients (58.8 % males; mean age 55.5±13.6 years; 23.6% diabetics and average duration of dialysis 28.36±16.97 months) treated with CAPD for more than 6 months. Calcification of the aortic and mitral valves assessed by echocardiography was graded as 0-2 for absence or presence of calcification. Plain X-ray images of lateral lumbar spine from all subjects with abdomen empty from dialysis fluid were studied for calculation of semi-quantitative vascular calcification scores as described by Kauppila (range 0-24).

**Results.** Calcification of the mitral valve was present in 14 patients (36.8%) and calcification of the aortic valve in 11 patients (28.9%). 8 patients had calcification of the both valves and 17 (44.7%) had a valve calcification (Vc) score ≥1. Kauppila scores revealed 21 patients (55.2%) with abdominal aortic calcifications (AAC) and 14 patients (36.8%) with scores higher than 7. The mean AAC score of the study population was 5.03±3.85. We found that AAC score increased significantly in patients with Vc score ≥1 comparing with patients without valve calcification Vc score=0 ( $P<0.001$ ). To study further this association we excluded from analysis patients with AAC score=0, and we found that Vc score increased significantly in patients with AAC score ≥7 comparing with those with AAC score 1-6 ( $P<0.001$ ).

**Conclusions.** Our study demonstrates that CV calcifications are highly prevalent in CAPD patients and cardiac valve calcifications are strongly associated with abdominal aortic calcification these patients.

**Keywords:** peritoneal dialysis, aortic calcification, plan X-ray, valvular calcification

### Introduction

Vascular and valvular calcifications are important and pre-

valent complications in ESRD patients including those receiving PD therapy and very much contributed to the exceedingly high cardiovascular mortality in this population. Using plain radiographs to estimate number of arterial sites with calcification including carotid artery, abdominal aorta, and iliofemoral axis, both the presence and extent of vascular calcifications are strong predictors of cardiovascular and all-cause mortality in the ESRD patients. Abdominal aortic calcification detected nonquantitatively using plain lateral abdominal radiographs has also been shown to be an independent predictor of all-cause mortality and cardiovascular death in hemodialysis patients [1]. Cardiac valvular calcification, detected using echocardiography, also predicts all-cause mortality and cardiovascular death in chronic PD patients [2]. Notably, patients with both aortic and mitral valvular calcification showed the highest risk of mortality and cardiovascular death compared to those with either heart valve calcification or no valve calcification [3]. These data suggest that the presence of vascular or valvular calcification, irrespective of the sites involved, is indicative of a poor prognosis in the dialysis population including patients on PD. There are very little data about the prevalence of valvular and vascular calcification in PD patients. The use of simple and inexpensive methods to evaluate cardiovascular calcifications is preferred. The aim of this study was to evaluate the relationship of aortic and mitral valve calcification with abdominal aortic calcification in PD patients.

### Material and Methods

We conducted an observational cross-sectional study in the Dialysis Center of University Hospital Center "Mother Teresa" during January-March 2012, enrolling all stable patients on peritoneal dialysis, who agreed to participate in this study and had been treated with peritoneal dialysis for more than 6 months. Patients were on continuous ambulatory PD (4-5 exchanges/day with 2000 ml) dialyzed using conventional lactate-buffered glucose-based PD solutions (Dianeal PD4; 40 mmol/L lactate, pH 5.3 to 5.5 containing 1.36, 2.27, or 3.86% dextrose as appropriate; Baxter Healthcare). Vascular calcifications were evaluated by plain X-ray using semi-quantitative scores as described by Kauppila *et al.*

To calculate the Kauppila index, a lateral lumbar spine X-ray image was taken for each patient. A semiquantitative scoring system was used to assess the calcifications in the anterior and posterior aortic walls as observed in the four image segments corresponding to the areas in front of each of the first four lumbar vertebrae. Each segment was assigned a score for anterior wall calcifications and a score for posterior wall calcifications. Scores ranged between 0 and 3 (0=no calcification, 1=irregular punctate calcifications, 2=localized linear calcifications, 3=linear calcifications spanning the length of the vertebra). The total score of a patient was calculated as the addition of the partial scores and ranged from 0 to 24 [4]. Kauppila scores  $\geq 7$  have been associated with higher coronary calcification as evaluated by electron beam computed tomography-a technique with high sensitivity and specificity [5]. Cardiac valve calcifications were evaluated by two-dimensional echocardiography with a HDI 5000 Sono CT echocardiographic machine with a 3.3-MHz multiphase array probe in subjects lying in the left decubitus position. Two-dimensional assessment of the aortic valve and mitral valve was performed on the basis of the parasternal long-axis and short-axis views. All echocardiograms were analyzed by a single experienced echocardiographer who was blinded to all clinical details. Cardiac valve calcification was defined as bright echoes of more than 1 mm on one or more cusps of the aortic valve or mitral valve or mitral annulus. Echocardiograms were graded as 0-2 for absence or presence of calcification of the mitral and aortic valve.

### Statistical analysis

Results of the continuous variables were expressed as mean  $\pm$ SD. Dichotomous variables are expressed as numbers and percentages. Categorical variables were expressed as numbers and frequencies. For univariate analysis, we used the unpaired Student's t-test, Fisher's Exact test or Chi-squared test depending on the characteristics of the variables. Statistical Package for Social Sciences (SPSS for windows, version 15.0) was used for all the analyses.

### Results

In this study, it were enrolled 38 stable patients (58.8 % males; mean age  $55.5 \pm 13.6$  years; 9 (23.6%) diabetics and average duration of dialysis  $28.36 \pm 16.97$  months) that had been treated with peritoneal dialysis for more than 6 months. It was noted that seventeen of the 38 peritoneal study patients (44.7%) had echocardiographic evidence of valvular calcification (Vc) score  $\geq 1$ . Calcification of the mitral valve was present in 14 patients (36.8%) and calcification of the aortic valve was present in 11 patients (28.9%). 8 patients had calcification of the both valves. Kauppila scores revealed 21 patients (55.2%) with presence abdominal aortic calcifications (AAC) and 14 patients (36.8%) with scores higher than 7. The mean ( $\pm$ sd) AAC score of the study population was  $5.03 \pm 3.85$ . By utilizing the t-test for independent samples, it was not found a statistical difference between groups with valvular calcification and without valvular calcification, related to age, time on dialysis,

**Table 1.** Clinical and laboratory parameters of groups without valve calcification and with valve calcification

Variables	Groups with (Y) and without (No) valve calcification	Nr of patients	Mean	Std. Deviation	P value
Age (years)	No	21	50.74	13.11	NS
	Y	17	57.50	18.82	
Dialysis time (months)	No	21	26.42	16.88	NS
	Y	17	29.17	17.78	
Serum Phosphorus (mg/dl)	No	21	4.07	.85	NS
	Y	17	4.79	1.51	
Serum Calcium (mg/dl)	No	21	8.41	.96	NS
	Y	17	8.53	.93	
PTH level (pg/ml)	No	21	454.21	402.59	NS
	Y	17	530.21	565.99	
Alkaline phosphatase (U/l)	No	21	170.84	243.64	NS
	Y	17	102.25	76.91	
C Reactive Protein (mg/dl)	No	21	10.55	11.98	NS
	Y	17	12.05	13.82	
Residual Renal Function (ml/min)	No	21	4.58	2.22	NS
	Y	17	4.29	2.66	
Albuminemia (g/dl)	No	21	3.26	.36	NS
	Y	17	3.30	.44	
Cholesterol (mg/dl)	No	21	189.84	51.95	NS
	Y	17	175.72	49.97	
Triglyceride (mg/dl)	No	21	162.58	92.35	NS
	Y	17	159.72	92.40	
Pulse pressure (mmHg)	No	21	46.32	12.12	NS
	Y	17	53.61	18.61	

phosphorus level, calcium level, PTH, alkaline phosphatase, CRP, GFR, seric albumin level, cholesterol level, triglycerides, and pulse pressure (Table 1). We found that

AAC score increased significantly in patients with Vc score  $\geq 1$  comparing with patients without valve calcification Vc score=0 (Chi-square test  $P < 0.001$ ). To study further

this association we excluded from analysis patients with AAC score=0, and we found that Vc score increased significantly in patients with AAC score  $\geq 7$  comparing with those with AAC score 1-6 (Fisher's Exact Test,  $P < 0.001$ ).

## Discussion

In CKD patients, the presence of vascular calcifications is a marker of increased cardiovascular risk and this association, based on observational studies, is classified as grade B evidence by the recent KDIGO recommendations. Simpler evaluations of vascular calcifications, assessing only the presence or absence of vascular calcifications have also been associated with mortality, such as the identification by plain X-ray of vascular calcifications in the abdominal aorta [6]. Plain X-Ray and echocardiography are less expensive and, for that reason, more convenient for screening vascular calcifications. But cardiovascular calcifications are not very well studied in the peritoneal dialysis population. Based on these data we analyzed stable patients who had been for more than 6 months in peritoneal dialysis treatment with the intention of verifying whether there is a correlation between the presence of valvular calcifications and aortic abdominal calcification in peritoneal dialysis patients. The results of the present study underline that valvular calcifications are highly frequent in peritoneal dialysis patients. The prevalence of cardiac valvular calcification ranges from 32% to 47% in PD patients [7]. In our group study, 44.7% of the patients had valvular calcification. Also, the prevalence of aortic abdominal calcification was very high (55.2%). In two small surveys, at least 60% to 80% of the PD patients, were complicated with coronary artery calcification [8,9].

Wang and colleagues reported that cardiac valvular calcification is a marker reflecting generalized calcification in the PD patients [10]. In the present study, it was found that AAC score increased significantly in patients with valve calcification Vc score  $\geq 1$  comparing with patients without valve calcification Vc score=0 (Chi-square test  $P < 0.001$ ). On the other hand, Bellasi and colleagues found a strong association between abdominal aorta calcification on plain X-ray films and coronary artery calcium score (CACS) obtained using electron beam tomography [5] with cut-off values that allow the identification of patients with a higher CV risk. We studied further the relationship between cardiac valve calcification and AAC by excluding from analysis patients with AAC score=0 in order to observe the power of this correlation. We found that Vc score increased significantly in patients with AAC score  $\geq 7$  comparing with those with AAC score 1-6 (Fisher's Exact Test,  $P < 0.001$ ). It was not aim of our study to analyze the impact of peritoneal dialytic regimen or optimizing the dialytic regimen prescription on valvular/vascular calcification. All patients in PD treatment, independently of the PD modality used, may benefit from increased convective peritoneal phosphorus clearance, although no detailed studies on the effect of increased ultrafiltration rates on peritoneal

phosphorus clearance are available. Peritoneal phosphorus clearance much more resembles the removal of middle molecules which need long dwell times to diffuse and do not depend on the number of exchanges of PD fluid.

## Conclusion

Results of our study show that CV calcification evaluated either with plan X-ray or echocardiograms are highly prevalent in CAPD patients and cardiac valve calcifications are strongly associated with abdominal aortic calcification these patients. Simpler and inexpensive techniques such as echocardiograms or plan X-ray are widely available and can be used to provide important information about CV calcifications that may be relevant for guiding therapeutic intervention in CAPD patients.

*Conflict of interest statement.* None declared.

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