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Transthoracic Echocardiographic Findings in Patients With Chronic Kidney Disease Awaiting Kidney Transplantation

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ABSTRACT

Background. The high prevalence of classic cardiovascular risk factors in patients undergoing dialysis therapy or transplantation is associated with a 3.5- to 50-fold higher risk than in the general population. The primary cause of death in transplant recipients is cardiovascular disease.

Objective. To report echocardiographic findings using a screening protocol to detect heart disease in candidates for kidney transplantation.

Methods. Between November 2005 and December 2009, we examined 356 patients using 2-dimensional color Doppler echocardiography.

Results. A high prevalence of left ventricular hypertrophy, left ventricular diastolic dysfunction, valvulopathy, and valve calcification was observed. There was a positive correlation between valve calcification and female sex, age ($P < .001$), duration of renal replacement therapy ($P = .01$), peripheral arterial disease ($P = .02$), cerebrovascular disease ($P = .005$), and high concentration of lipoprotein(a) ($P = .02$).

Conclusion. An echocardiographic study should be part of the initial evaluation in candidates for renal transplantation.

CARDIOVASCULAR DISEASE is the leading cause of death (40%) in patients with chronic kidney disease, regardless of severity.[1] In patients receiving renal replacement therapy (RRT; dialysis or transplantation), the incidence is even greater. The risk of a cardiac event in patients receiving RRT is 3.5- to 50-fold higher than in the general population.[1] Annual mortality in patients with renal disease is 20% to 25%, with 45% of deaths due to cardiovascular disease.[1]

Epidemiologic studies have shown that classic cardiovascular risk factors including hypertension, dyslipidemia, diabetes mellitus, and smoking do not fully explain the high cardiovascular morbidity and mortality in this population. Thus, the scientific community is seeking other emerging risk factors such as lipoprotein(a), hyperhomocysteinemia, inflammation, and oxidative stress, which together with other factors such as uremic disorders including anemia, metabolic disorders, calcium- phosphorus disorders, and hypervolemia[2] may help to explain this high morbidity and mortality.

Echocardiography is the most useful imaging study for initial cardiac assessment, enabling detailed examination of the main cardiac structures including the pericardium, valvular apparatus, atria, and ventricles, and effective assessment of the left ventricular mass and changes in ventricular function.[3]

METHODS

Between November 2005 and December 2009, we studied 356 patients using 2-dimensional color Doppler echocardiography. Cardiac evaluation included clinical examination, electrocardiography, chest radiography, and baseline echocardiography. The echocardiographic study provided data about the dimensions of the ventricle and left atrium, valvular alterations, pericardium, and left ventricular systolic function. The color Doppler study was used to assess left ventricular diastolic function and valve flow. The initial screening for ischemic heart disease also included ergometry, dobutamine stress echocardiography, or myocardial perfusion study, depending on clinical findings and comcomitant disease.

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RESULTS

Mean (SD) patient age was 54.3 (11.9) years. Sixty-three percent of the patients were men, and 37% were women. Median (range) duration of RRT was 1 (0.2–1.2) years. The primary RRT was hemodialysis (91.2%), with peritoneal dialysis in 3.9% and no previous treatment in 4.8%. The primary causes of end-stage kidney disease were glomerulonephritis (25.6%), diabetic nephropathy (16.6%), vascular disease (13.2%), and tubulointerstitial nephropathy (11.2%). The primary cardiovascular risk factors were hypertension in 341 patients (95.8%), dyslipidemia in 201 (56.5%), diabetes mellitus in 97 (27.2%), and smoking in 190 (53.4%). The primary cardiovascular diseases were peripheral arterial disease in 53 patients (14.9%), cerebrovascular disease in 35 (9.8%), and ischemic heart disease in 43 (12.1%). Three hundred ten patients (87%) had no cardiac symptoms. The major echocardiographic findings are given in Table 1.

There was a high prevalence of valvular calcifications in this population (37.1%). Univariate analysis was performed to determine the association between calcifications and demographic features, risk factors, and analytical data. Qualitative variables were analyzed using the χ^2 test or the Fisher exact test, and quantitative variables were analyzed using the t test or a nonparametric test according to the number of cases or the normality of distribution. A positive correlation was observed between valve calcifications and female sex, age ($P < .001$), duration of RRT ($P = .01$), peripheral arterial disease ($P = .02$), cardiovascular disease ($P = .005$), and high concentration of lipoprotein(a) ($P = .02$).

Table 1. Primary Echocardiographic Findings. LV (left Ventricular), LVEF (left ventricular ejection fraction), LVH (Left ventricular hypertrophy)

Echocardiographic Finding	Patients, No. (%)
LV hypertrophy	244 (68.5)
Myocardial contractility alterations	29 (8.1)
LV systolic dysfunction	27 (7.6)
Light, LVEF 55%–45%	11 (3.1)
Moderate, LVEF 45%–30%	10 (2.8)
Severe, LVEF ≤30%	6 (1.7)
LV diastolic dysfunction	151 (42.4)
Abnormal relaxation E < A	133 (37.4)
Pseudonormal pattern	15 (4.2)
Restrictive pattern	3 (0.8)
Mitral valve	
Prolapse	3 (0.8)
Calcification	81 (23.3)
Prosthesis	2 (0.5)
Insufficiency	100 (28.1)
Light	86 (24.2)
Moderate	13 (3.6)
Severe	1 (0.3)
Stenosis	5 (1.4)
Light	3 (0.8)
Moderate	2 (0.6)
Aortic valve	
Bicuspid	4 (1.1)
Calcification	103 (28.9)
Prosthesis	2 (0.6)
Insufficiency	61 (17.1)
Light	52 (14.6)
Moderate	9 (2.5)
Stenosis	21 (5.9)
Light	19 (5.3)
Moderate	1 (0.3)
Severe	1 (0.3)
Tricuspid insufficiency	53 (14.9)
Light	44 (12.3)
Moderate	8 (2.4)
Severe	1 (0.2)
Pericardial effusion	23 (6.5)

DISCUSSION

Left ventricular hypertrophy (LVH) is a common finding in patients receiving RRT, and usually is related to hypertension, although it may also be related to other factors such as age, race/ethnicity, anemia, and secondary hyperparathyroidism.[4] The prevalence of LVH is 70% to 80%.[3] Progression of LVH over time is associated with increased mortality.[5] Current guidelines recommend annual echocardiographic assessment, with early treatment, because reversibility of LVH is limited.[2]

The prevalence of congestive heart failure is increasing. In the general population, the incidence and prevalence are estimated to be between 1% and 5%, and in patients receiving dialysis therapy is 30%.[6] Alterations in ventricular filling during diastole have been observed in 60% of patients receiving dialysis therapy; in the present study, the prevalence was 42.4%.

The rate of left ventricular systolic changes in patients with chronic kidney disease is approximately 22%[3]; however, in our study population, the prevalence was significantly lower at 7.6%, which may be explained by the previous exclusion of patients having a diagnosis of dilated cardiomyopathy or severe left ventricular systolic dysfunction.

Valve calcification is a degenerative process in the general population. Its frequency increases with age, and it is rarely observed in persons younger than 60 years. In addition to age, other factors have been implicated including female sex, hypertension, dyslipidemia, diabetes mellitus, and hypercalcemia. In patients receiving dialysis therapy, other factors must also be included such as secondary hyperparathyroidism, elevation of the calcium-phosphorus product, and duration of dialysis.[7]

Computed tomography and echocardiography revealed valve calcification in 50% of patients receiving dialysis therapy compared with 5% to 10% of patients with normal renal function.[2] Aortic calcification affects 20% to 30% of the general population older than 65 years, with functionally relevant aortic stenosis in 2%. In patients receiving dialysis therapy, the prevalence is higher at 30% to 55%, as is calcification of the annulus at 10% to 52%. In the present

study, valve calcification was observed in 133 patients (37.1%).

In conclusion, in patients receiving dialysis therapy, the high prevalence of structural heart disease including LVH, valve calcification, and valvulopathy is associated with heart failure as the leading cause of death. Thus, echocardiography must be part of the initial evaluation of candidates for renal transplantation.

REFERENCES

1. Kundhal K, Lok CE: Clinical epidemiology of cardiovascular disease in chronic kidney disease. Nephron Clin Pract 101:c47, 2005

2. Goicoechea MA: Enfermedad cardiovascular en pacientes con estadios 4 y 5 de enfermedad renal crónica: pacientes en diálisis periódica de enfermedad renal crónica. Soc Esp Nefrol 24(Suppl 6):142, 2004

3. Zoccali C: How important is echocardiography for risk stratification in follow-up of patients with chronic kidney disease? Nature Clin Pract Nephrol 3:178, 2007

4. Jimeno F, Espinoza R: Diagnóstico y evolución ecocardiográfica en pacientes con insuficiencia renal crónica en hemodiálsis. Nefrología 16:237, 1996

5. Cases A: Otros factores de riesgo cardiovascular y renal: hipertrofia del ventrículo izquierdo, fibrilación auricular, tabaquismo, obesidad. Factores emergentes de riesgo cardiovascular: homocisteína, proteína C reactiva, fibrinógeno. Soc Esp Nefrol 24:62, 2004

6. Salguerira M, Millán JA: Insuficiencia cardiaca y disfunción diastólica en pacientes en hemodiálisis: factores asociados. Nefrología 25:669, 2005

7. Millán JA, Salguerira M: Calcificaciones valvulares cardíacas en pacientes en hemodiálisis: análisis de factores predisponentes. Nefrología 18:222, 1998