

Changes of Left Ventricular Mass Index Among End-Stage Renal Disease Patients After Renal Transplantation

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Purpose: The aim of this study was to determine left ventricular (LV) mass index via echocardiography in end-stage renal disease patients (ESRD) before and after renal transplantation, and its association with one-year survival.

Materials and Methods: Forty-seven patients with ESRD who were candidate for renal transplantation were evaluated with echocardiography before and 4 months after the operation. Left ventricular ejection fraction (EF), LV mass, and LV mass index were determined. All of the patients were followed up for 1 year.

Results: Mean LVEF was 51.6% which increased to 53.7% after renal transplantation ($P = .001$). Mean LV mass was 209 gr before the operation which decreased to 189 gr after the operation ($P = .001$). Mean LV mass index before the operation was 120 gr/m² which decreased to 110 gr/m² following the operation ($P = .002$). All of the patients survived during 1-year follow-up, and no death was reported.

Conclusion: Renal transplantation had beneficial effects in terms of LV function in young patients with ESRD.

Keywords: end-stage renal disease, left ventricular hypertrophy, kidney transplantation, echocardiography

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INTRODUCTION

End-stage renal disease (ESRD) is considered as one of the most important diseases with a great burden on health care systems. Complications of ESRD on various organs, especially cardiovascular system, are noticeable.

Cardiovascular diseases are the major cause of morbidity and mortality in all stages of ESRD, in both adults and children.^(1,2) Coronary artery disease and left ventricular hypertrophy (LVH) are the two most common cardiac complications in patients with ESRD.^(3,4) Left ventricular hypertrophy is a risk factor for

cardiovascular morbidity, including sudden death, congestive heart failure, etc among patients with ESRD.^(1,5) Some of the variables which contribute to progression of LVH in patients with ESRD include hypertension, volume overload, an increase in left ventricular afterload, uremia, and anemia.⁽⁶⁾

Renal transplant is the most acceptable treatment modality for the patients with ESRD, which improves some complications of renal failure such as chronic uremia and volume overload.⁽⁷⁾ In previous studies, the effect of successful renal transplantation on the carotid

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artery indices and ventricular hypertrophy has been showed.^(8,9) Correction of the uremic state by renal transplantation has lead to regression of LVH during a 12-month follow-up.⁽⁷⁾ On the contrary, other studies did not show a significant impact of renal transplantation on cardiovascular status. In a study by De Lima and colleagues⁽⁸⁾ on patients without obvious cardiovascular diseases who underwent renal transplantation due to ESRD, it was noted that renal transplantation improved the ESRD-induced cardiovascular morbidities, especially ventricular distensibility and LV mass index (LVMI), but did not cause complete regression.

The aim of this study was to determine echocardiography parameters such as LVMI in ESRD patients who underwent renal transplantation.

MATERIALS AND METHODS

This cross-sectional study lasted for one year in 2 university hospitals, and 47 patients with diagnosis of ESRD who were candidates for renal transplantation and were older than 18 years were included using convenient sampling method. Patients with history of cardiovascular diseases, cardiac valvular diseases, congenital cardiovascular diseases, or usage of cardiotoxic medications were excluded.

Data collected by a questionnaire consisted of demographic information, risk factors of a cardiovascular disease (including diabetes mellitus, hypertension, hyperlipidemia, and cigarette smoking), etiology of ESRD, systolic blood pressure (SBP), diastolic blood pressure (DBP), need to dialysis and its type, and laboratory parameters such as hemoglobin, creatinine, sodium, and potassium.

All of the patients underwent echocardiography prior to operation by a cardiologist and LV mass (LVM), LV mass index (LVMI), and LV ejection fraction (EF) were determined. For determination of LVM, the Devereux formula was used:⁽¹⁰⁾

$$\text{LV mass (gr): } 1.04 [(LVID + PWT + IVST)^3 - LVID^3] - 14$$

LVID = LV internal dimension

PWT = posterior wall thickness

IVST = interventricular septal thickness

Left ventricular mass was divided by body surface area to measure LVMI.

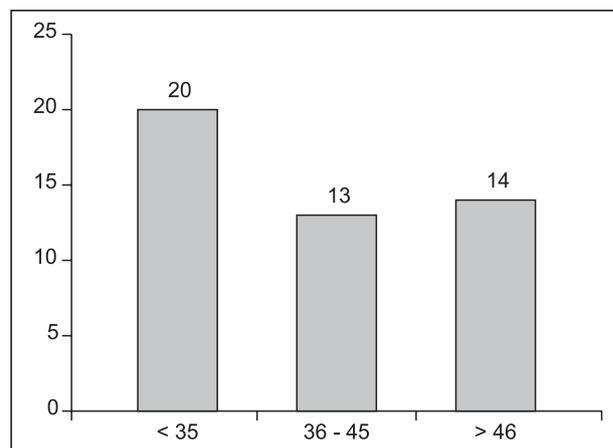
Four months after the operation, echocardiography was performed again. All of the patients were followed up for one year in outpatient clinics.

Descriptive indices, including frequency (percentage) and mean were calculated. For comparison of hemoglobin and hematocrit levels as well as echocardiography variables and blood pressure before and 4 months after the operation, the paired student *t* test was used. *P* values less than .05 were considered statistically significant. All statistical analysis was performed using SPSS (Statistical Package for the Social Science, version 13.0, SPSS Inc, Chicago, Illinois, USA) software.

Informed consents were obtained from all participants prior to enrollment. The study protocol was in accordance with Declaration of Helsinki.

RESULTS

The patients population consisted of 27 men (57.4%) and 20 women (42.6%) with age range of 23 to 56 years. Of patients, 14(29.8%) were \geq 46 years old (Figure). Twenty patients received dialysis (42.6%), of whom 4 patients underwent peritoneal dialysis (20%) and the remaining 16 subjects (80%) underwent hemodialysis. Five



Frequency of 47 patients who underwent renal transplantation in different age groups.

patients (25%) received dialysis 3 times a week while 15 patients (75%) received dialysis 2 times per week.

Table 1 demonstrates the etiologies of ESRD in the study participants. Forty-five patients had only one diagnosed etiology for ESRD, whereas 2 patients (4.3%) had two diagnosed etiologies for ESRD. Diabetes mellitus was the most common cause of ESRD with the prevalence of 21.3% (10 patients).

Table 2 presents the frequency of cardiovascular disease risk factors in the studied patients. Twenty-three patients (48.9%) had SBP more than 140 mmHg and 15 subjects (31.9%) had DBP greater than 90 mmHg.

Mean (\pm SD) serum hemoglobin level before renal transplantation was 10.14 (\pm 2.87) mg/dL which increased to 12.5 (\pm 2.18) mg/dL ($P = .001$, 95% confidence interval (CI), - 3.63 to - 1.07) afterward. Mean (\pm SD) serum hematocrit

level before the operation was 30.86% (\pm 8.68) which significantly increased to 37.57% (\pm 7.56) ($P = 0.003$, 95% CI, - 10.94 to - 2.46) after the operation.

Mean (\pm SD) systolic blood pressure was 136.09 (\pm 17.7) mmHg before the surgery, which decreased to 127.39 (\pm 12.95) mmHg ($P = .07$, 95% CI, - 1.11 to 18.5). There was no significant decrease in diastolic blood pressure before and after transplantation; 79.22 (\pm 9.6) mmHg vs. 76.09 (\pm 7.68) mmHg, $P = .25$, 95% CI, - 2.45 to 8.71). Comparison of blood pressure and laboratory findings before and after the operation are summarized in Table 3.

Mean LVEF of patients before renal transplantation was 51.6%, which increased to 53.7% after the operation ($P = .001$). Mean LVM before the operation was 209 gr, which decreased to 189 gr after the operation ($P = .001$). Mean LVMI was 120 gr/m² before the operation which decreased to 110 gr/m² following operation ($P = .002$).

All of the patients survived during 1-year follow-up, and no death was observed.

Table 1. Etiologies of ESRD in 47 patients who underwent renal transplantation.

Etiology	Frequency	Percentage (%)
Diabetes mellitus	10	21.3
Hypertension	6	12.8
Glomerulonephritis	9	19.1
Urologic diseases	7	14.9
Others	7	14.9
Unknown	10	21.3

Table 2. Frequency of cardiovascular risk factors in 47 ESRD patients who underwent renal transplantation.

Number of Risk Factor*	Frequency	Percentage, %
One	11	23.4
Two	11	23.4
Three	9	19.1
Four	2	4.3
No risk factor	14	29.8
Total	47	100

*Risk factors evaluated were diabetes mellitus, hypertension, hyperlipidemia, and cigarette smoking.

DISCUSSION

According to previous studies, the most prevalent echocardiographic abnormalities seen in ESRD patients are LVH and systolic dysfunction. Left ventricular hypertrophy is a strong predictor of poor prognosis and determinant of survival in ESRD patients.^(8,9) It has been shown that LVH initiates along with renal failure, increases with renal failure progression, and it will not be even improved by renal transplantation.^(11,12)

The high rate of cardiovascular diseases following renal transplantation is mainly due to a high incidence of conventional risk factors both before and after the operation.⁽¹³⁾

Table 3. Frequency distribution of systolic blood pressure, diastolic blood pressure, and laboratory results in 47 ESRD patients before renal transplantation.

	Before	After	Sig.
Systolic blood pressure, mmHg	136.09 (\pm 17.77)	127.39 (\pm 12.95)	0.07
Diastolic blood pressure, mmHg	79.22 (\pm 9.6)	76.09 (\pm 7.68)	0.25
Hemoglobin, mg/dL	10.14 (\pm 2.87)	12.5 (\pm 2.18)	0.001
Hematocrit, %	30.86 (\pm 8.68)	37.57 (\pm 7.56)	0.003

Factors, which contribute to decreased LVMI after the operation, are treatment of hypertension and reduction in intravascular volume. On the other hand, there are some variables that result in increased LVM such as treatment with immunosuppressive agents.^(11,12)

Based on our findings, renal transplantation significantly improved LVEF, and decreased both LVM and LVMI. In most studies on renal transplant recipients, LVM and LVMI have decreased significantly. In the study by Montanaro and colleagues⁽⁹⁾ on 23 adult renal transplant recipients, a significant reduction in the mean LVM (246.2 to 202.7 gr) and mean LVMI (161.4 to 122.1 gr/m²) was observed at 2-year follow-up. The incidence of LV hypertrophy also decreased from 76 to 35 subjects. However, the underlying cause has not been understood well.⁽¹⁴⁾ In another study performed on 22 ESRD patients who underwent renal transplantation, it was shown that after 40 months, the survival rate was 100% without any major cardiovascular complication. In spite of a significant reduction in LV end-diastolic diameter, the mean LVMI remained above normal limits, and only one-third of subjects had normal LVMI.⁽⁸⁾ In a recent study, echocardiography performed within 1 year after renal transplantation revealed a decrease of LVH from 67% to 37%.⁽¹⁵⁾

The survival rate of our subjects was 100%, therefore, we were not able to determine any statistical correlations between LVMI changes and survival. The reported survival rate in another study was 95%.⁽¹⁶⁾ The high survival in this study may be due to the younger age; 42.6% were younger than 35 years old.

Based on previous studies, patients who did not receive dialysis before renal transplantation had less mortality than those who underwent dialysis.⁽¹⁷⁾ Only 57% of the patients had undergone dialysis before operation, and this could be another reason for a better survival rate. It has been reported that persistent LVH may be associated with a high rate of infection and chronic rejection, which in turn worsens the prognosis of renal transplant recipients.⁽¹⁸⁾

Contrary to the literature indicating beneficial

impact of renal transplantation on LVMI, a recent study performed cardiac magnetic resonance imaging, which showed no significant change in LVMI in subjects who received renal transplantation (2.75%/yr, \pm 9.1) compared to patients who remained on dialysis (-3.6%/yr \pm 16.7). The authors concluded that renal transplantation is not associated with significant regression of LVMI, which may be due to overestimation of LVMI by echocardiography.⁽¹⁹⁾

CONCLUSION

In conclusion, renal transplantation had a beneficial effect on LV function, improved LVEF, and decreased both LVM and LVMI in young patients with ESRD. Concomitant treatment of risk factors with renal transplantation is recommended.

Further studies with long-term follow-ups as well as larger sample sizes are required to better clarify the impact of renal transplantation on echocardiographic variables.

CONFLICT OF INTEREST

None declared.

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