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THE RELATIONSHIP BETWEEN HEART FUNCTION AND RENAL BLOOD FLOW IN RENAL TRANSPLANT PATIENTS

RENAL TRANSPLANTASYON YAPILAN HASTALARDA KARDİYAK FONKSİYON İLE RENAL KAN AKIMI ARASINDAKİ İLİŞKİ

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ABSTRACT

Introduction: This study aimed to investigate the relationship between left ventricular ejection fraction (LVEF) measured on preoperative transthoracic echocardiography (TTE) and peak systolic velocity (PSH) and resistance index (DI) calculated on postoperative renal Doppler ultrasonography.

Methods: The study retrospectively included 68 renal transplant patients. TTE measurements were taken for all patients, and LVEF was recorded. Renal Doppler ultrasonography recorded PSH and DI. Patients were divided into two groups based on LVEF below 55% (group 1, n=24) and above (group 2, n=44).

Results: Of the patients participating in our study, 21 (30.8%) were female and 47 (69.2%) were male. The mean age of the patients in the study was 53.2±9.27 years. Urea was significantly lower in patients with LVEF values above 55% (85.9±31.5 vs. 103.3±35.2; p=0.02). On the other hand, PSV and RI were significantly lower in the group with LVEF values above 55% (188.2±33.1 vs. 238.7±40.2; p=0.02; 0.64±0.15 vs. 0.78±0.19; p=0.04, respectively). A negative correlation was also found between LVEF values and PSV and RI (r= -0.731, p=0.007; r= -0.602, p=0.01, respectively).

Conclusion: In this study, renal transplant patients with echocardiographic LVEF greater than 55% had significantly lower RI and PSV determined by renal Doppler ultrasonography.

Keywords: Doppler echocardiography, peak systolic velocity, renal transplant, resistive index

ÖZET

Giriş: Bu çalışma preoperatif transtorasik ekokardiyografide (TTE) ölçülen sol ventrikül ejeksiyon fraksiyonu (SVEF) ile postoperatif renal Doppler ultrasonografide hesaplanan tepe sistolik hız (TSH) ve direnç indeksi (DI) arasındaki ilişkiyi incelemeyi hedeflemiştir.

Yöntemler: Çalışmaya retrospektif olarak 68 renal transplantasyon yapılan hasta dahil edildi. Tüm hastaların TTE ölçümleri alındı SVEF kayıt edildi. Renal Doppler ultrasonografide TSH ve DI'leri not edildi. Hastalar SVEF % 55'in altında (grup 1, n=24) ve üstünde (grup 2, n=44) olmalarına göre iki gruba ayrıldı.

Bulgular: Bizim yaptığımız bu çalışmaya katılan hastaların 21'i (%30,8) kadın 47'si (%69,2) erkekti. Çalışmadaki hastaların ortalama yaşı 53,2±9,27 idi. SVEF değerleri %55'in üzerinde olan hastalarda üre anlamlı derecede düşüktü (85,9±31,5'e karşı 103,3±35,2; p=0,02). Öte yandan, SVEF değerleri %55'in üzerinde olan grupta TSH ve DI anlamlı derecede düşüktü (sırasıyla 188,2±33,1'e karşı 238,7±40,2; p=0,02; 0,64±0,15'e karşı 0,78±0,19, p=0,04). LVEF değerleri ile TSH ve DI arasında negatif korelasyon da bulundu (sırasıyla r= -0,731, p=0,007; r= -0,602, p=0,01).

Sonuç: Bu çalışmada, ekokardiyografik SVEF'si %55'ten büyük olan renal transplantasyon yapılan hastaların renal Doppler ultrasonografi ile belirlenen DI ve TSH anlamlı derecede düşük olarak bulunmuştur.

Anahtar kelimeler: Doppler ekokardiyografi, tepe sistolik hız, renal transplantasyon, direnç indeksi

INTRODUCTION

Chronic kidney disease (CKD) is a considerable public health problem with high mortality and morbidity, affecting more than 850 million people worldwide (1,2). Since CKD is a progressive disease, it causes end-stage renal disease (ESRD) and solemnly affects the quality of life (3). ESRD patients are placed on a dialysis program or renal transplantation program to evolve their quality of life and prolong their life (4). While the number of patients on dialysis or receiving renal transplantation was 2.6 million in 2010, this number is expected to affect up to 5.4 million patients by 2030 (5). A paradox exists in dialysis treatment: while it improves the quality of life associated with the disease, it can also impair the quality of life of patients who spend long hours on dialysis certain days of the week. In addition to the fact that long-term survival rates of kidney transplant patients are significantly better than those of patients on dialysis, the quality of life of kidney transplant patients (in areas such as high physical functioning, general health perception, and social functioning) was found to be significantly higher than that of dialysis patients (6,7). The risk of cardiovascular disease (CVD) is higher in ESRD than in the normal population (8). In every stage of chronic kidney disease, especially with the progression of the disease, pathological and clinical changes occur in the cardiovascular system (CVS). Transthoracic echocardiography (TTE) is of vital importance for these patients, as it is an easy-to-apply, inexpensive and radiation-free diagnostic tool for the diagnosis and follow-up of changes in the CVS (9). For these reasons, cardiac evaluation, especially TTE, is of critical importance in the

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pre-transplant period (10). In the post-renal transplantation period, vascular integrity and perfusion of the graft are crucial for graft function (11). Increased renal artery velocities measured on Doppler ultrasonography are associated with poor prognosis post-renal transplantation (12). From this perspective, the purpose of this study was to compare the preoperative TTE parameters of patients with the renal arterial Doppler flow parameters after renal transplantation.

METHODS

Study population

We designed this study on patients who underwent renal transplantation as a retrospective study. We conducted this study with 80 patients who underwent kidney transplantation at the Canakkale 18 Mart University Research Hospital Urology Clinic, Kidney Transplant Center between January 2016 and June 2019, covering approximately three years of data. Renal vascular anomaly was considered as an exclusion criterion for the homogeneity of the groups to be compared. Twelve patients with renal vascular anomalies were excluded from the study because they would affect the renal Doppler results. Ultimately, a retrospective analysis of 68 patients who underwent renal transplantation at the Canakkale 18 Mart University Research Hospital between January 2016 and June 2019 was included in the study. Although the guidelines state that there may be differences between the sexes and there are differences in various sources (13,14), since a left ventricular ejection fraction of 55% and above is generally considered normal, the patients were divided into two groups: those with a left ventricular ejection fraction of less than 55% (group 1) and those with a left ventricular ejection fraction of 55% and above (group 2).

Hemogram and biochemical parameters, arterial pulse, blood pressure, height, weight were obtained from the hospital automation information system. In order to calculate body mass index (BMI), the patient's weight (kg) was divided by the patient's height (m^2) squared and recorded in the system. Again, echocardiography parameters and Doppler renal ultrasonography results were obtained from the patients' files. Doppler ultrasonography of all patients performed in the first 72 hours after transplantation was examined. Renal length, parenchymal thickness were noted. Peak systolic velocity (PSV) and resistive Index (RI) measurements in the main renal artery and flow patterns in segmental arteries were recorded with color Doppler and spectral analysis.

Left ventricular end-systolic diameter, left ventricular end-diastolic diameter, left ventricular posterior wall and interventricular septum thicknesses were measured during TTE with the probe in the parasternal long axis (15). Left

Table 1. *Demographic characteristics, laboratory and echocardiographic parameters of study population (n=68)*

Age (years)	53.2±9.27
Gender (female) (n, %)	21(30.8)
Systolic blood pressure (mmHg)	138.4±10. 62
Diastolic blood pressure (mmHg)	91.1±8.53
Body mass index (kg/m^2)	24.2±3.68
Blood glucose (mg/dl)	125.1±8.81
Creatinine (mg/dl)	6.79±2.08
Urea (mg/dl)	97.9±40.8
Triglyceride (mg/dl)	155.4±59.8
High density lipoprotein (mg/dl)	38.6±17.6
Low density lipoprotein (mg/dl)	125.4±37.2
Thyroid stimulating hormone (mIU/L)	2.39±0.84
Haemoglobin (g/dl)	11.9±3.70
White blood cells (X 10^9 /L)	8.72±2.46
Platelets (X 10^9 /L)	136.7±35.8
Left ventricular ejection fraction (%)	57±11.5
Left ventricular end- diastolic diameter (mm)	49±4.43
Left ventricular end-systolic diameter (mm)	32±3.18
Interventricular wall thickness (mm)	12±2.08
Left ventricular posterior wall thickness (mm)	11±1.97

Data are presented as number (percentage), mean ± standard deviation.

Table 2. The comparison of renal Doppler ultrasonography and laboratory parameters of the study groups

	Group 1 (LVEF <%55) (n=24)	Group 2 (LVEF >%55) (n=44)	p
Creatinine (mg/dl)	6.79±1.14	5,94±1.06	0.06
Urea (mg/dl)	103.3±35.2	85.9±31.5	**0.02**
Platelets (X 10^9 /L)	133.7±26.5	137.1±28.9	0.84
White blood cells (X 10^9 /L)	8.15±3.14	8.02±3.12	0.50
Haemoglobin (g/dl)	11.9±2.70	12.1±2.48	0.64
Peak systolic velocity (cm/sn)	238.7±40.2	188.2±33.1	**0.02**
Resistive index	0.78±0.19	0.64±0.15	**0.04**
Renal length (mm)	108±8.7	113±6.8	0.15*
Renal parenchymal thickness (mm)	12±3.1	13±2.9	0.47

LVEF: left ventricular ejection fraction.
p: Mann-Whitney U test.
* The significance of differences between two groups was assessed using Student's t-test

Table 3. *The correlation between left ventricular ejection fraction and renal Doppler ultrasonography parameters in patients undergoing renal transplantation*

	r	p
Peak systolic velocity	-0.731	**0.007**
Resistive index	-0.602	**0.01**
Renal length	0.351	0.211
Renal parenchymal thickness	0.170	0.269

p: <0.05

ventricular ejection fraction was measured in the parasternal long axis view in M mode using the Teichholz Method (16).

Statistical analysis

The study data were analyzed using the statistical package program SPSS version 20.0. The numerical, percentile, standard deviation, mean, minimum and maximum values were used to present the data. To compare the values of the groups, independent groups student t-test was used after evaluation with normal distribution histogram, Q-Q plot and Kolmogorov-Smirnov test. According to results of the tests assessing normality of distribution, the significance test of the difference between two means was used as the parametric test and Mann–Whitney U test was used as the non-parametric test. To analyse categorical data, Chi-Square Test was used. The relationship between the groups was evaluated by Pearson Correlation analysis. p<0.05 was considered statistically significant.

Approval for the study was obtained from Canakkale 18 Mart University Clinical Research Ethics Committee (protocol number: 2019/14, date: 24.07.2019).

RESULTS

In this study of 68 patients who underwent renal transplantation, 47 (69.2%) were male and 21 (30.8%) were female. The mean age of the renal transplant patients was 53,2±9.27years. The mean urea value of the patients in the study was 97.9±40.8, and the creatinine value was 6.79±2.08. Demographic, laboratory, and echocardiographic data of the 68 renal transplant patients are presented in Table 1. Patients with LVEF values above 55% had significantly lower urea (85.9±31.5 vs 103.3±35.2, p=0.02). On the other hand, PSV and RI were significantly lower in the group with LVEF values above 55% (188.2±35.1 vs 238.7±35.2, p=0.02; 0.64±0.15 vs 0.78±0.19, p=0.04, respectively) (Table 2). A negative correlation was also found between LVEF values and PSV and RI (r= -0.731 p=0.007; r= -0.602, p=0.01, respectively) (Table 3).

DISCUSSION

This The major finding of this study was that renal transplant recipients with echocardiographic LVEF greater than 55% had significantly lower RI and PSV determined by renal Doppler ultrasound. We also found a statistically significant negative correlation between LVEF and RI and PSV. Our findings demonstrate a statistically significant negative correlation between LVEF and both RI and PSV, suggesting a potential link between cardiac systolic function and renal hemodynamic changes in this specific patient population. This correlation provides valuable insights into the intricate interplay between cardiovascular health and renal allograft function post-transplantation.Our results align with previous studies that have highlighted the importance of cardiovascular assessment in post-transplant care. Azzouz et al. stated that RI reflects the patient's systemic vascular disease burden rather than graft hemodynamics and that this may have a prognostic role in predicting adverse clinical outcomes (17). On the other hand, Jesrani et al. stated in their article that shear wave elastography is more sensitive and specific than RI in the evaluation of renal transplant patients. (18). In patients with reduced LVEF, decreased cardiac output can lead to an increase in systemic vascular resistance to maintain blood pressure, which may, in turn, affect the renal circulation and elevate the RI. A similar mechanism may explain the negative correlation with PSV, as lower cardiac output could potentially reduce the force of blood flow through the renal arteries. In a recently published review stated that RI is not merely a renal hemodynamic parameter but a systemic cardiovascular marker with important prognostic implications (19). Spatola et al. reported a strong correlation between RI and histological lesions associated with tissue rejection in renal transplant patients and worsening renal function (20). Previous studies suggested that combining these two imaging modalities (TTE, renal Doppler ultrasonography) could improve the predictive power for identifying patients at higher risk of adverse outcomes (21-22). Our data provide a strong rationale for incorporating both LVEF and renal Doppler parameters into routine follow-up protocols. Although the negative correlation observed between LVEF and PSV was observed in our study, since renal blood flow and renal stenosis may be related to many factors, the relationship between cardiac function and renal blood flow parameters has been presented with very different results in the literature. A lower PSV can reflect reduced blood flow to the allograft, which can be a consequence of systemic factors like low cardiac output or local factors like renal artery stenosis or allograft fibrosis. While our study does not differentiate between these causes, the association with LVEF suggests that systemic hemodynamic changes due to cardiac dysfunction may play a significant role. For example, a commentary highlighted the multifaceted etiologies of reduced PSV and its clinical implications, further emphasizing the need for comprehensive evaluation (23).

CONCLUSION

This study provides compelling evidence of a significant negative correlation between LVEF and renal Doppler parameters (RI and PSV) in post-transplant patients. These findings underscore the critical link between cardiac systolic function and renal allograft hemodynamics. This highlights the importance of routine monitoring of both cardiac and renal function to facilitate early detection and management of cardiorenal complications, ultimately improving patient and allograft survival. Future studies should focus on the long-term clinical implications of these correlations and explore whether interventions aimed at improving LVEF can lead to a corresponding improvement in renal Doppler parameters and overall allograft outcomes.

Ethics Committee Approval: Approval for the study was obtained from Canakkale 18 Mart University Clinical Research Ethics Committee (protocol number: 2019/14, date: 24.07.2019).

Informed Consent: The study was a retrospective study so informed consent was not needed.

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REFERENCES

1. Romagnani P, Agarwal R, Chan JCN, et al. Chronic kidney disease. Nat Rev Dis Primers 2025;11(1):8.
2. Hill NR, Fatoba ST, Oke JL, et al. Global prevalence of chronic kidney disease – a systematic review and meta-analysis. PLoS One 2016;11(7):e0158765.
3. Luyckx VA, Tonelli M, Stanifer JW. The global burden of kidney disease and the sustainable development goals. Bull World Health Organ 2018;96(6):414-22.
4. Jager KJ, Kovesdy CP, Langham R, Rosenberg M, Jha V, Zoccali C. Epidemiology of chronic kidney disease: an update 2022. Nat Rev Nephrol 2022;18(5):277-88.
5. Francis A, Harhay MN, Ong ACM, et al. Chronic kidney disease and the global public health agenda: an international consensus. Nat Rev Nephrol 2024;20(7):473-85.
6. Chadban SJ, Clayton PA, McDonald SP, et al. Survival after kidney transplantation compared with ongoing dialysis in matched elderly patients: A registry study. Am J Transplant 2023;23(10):1234-45.
7. Sarhan AL, Jarareh RH, Shraim M. Quality of life for kidney transplant recipients and hemodialysis patients in Palestine: a cross-sectional study. BMC Nephrol 2021;22(1):210. https://doi.org/10.1186/s12882-021-02412-z
8. Sarnak MJ, Amdur RL, Kausz AT. Cardiovascular disease in chronic kidney disease: a review of the evidence. Nephrol Dial Transplant 2013;28 Suppl 4:iv1-iv8.
9. Aljaroudi W, Alraies MC, Halley C, et al. Role of echocardiography in the management of patients with chronic kidney disease. J Am Heart Assoc 2019;8(18):e013784.
10. Wang LW, Masson P, Turner RM, et al. Prognostic value of cardiac tests in potential kidney transplant

recipients: a meta-analysis. Am J Kidney Dis 2015;66(6):987-1001.
11. Radermacher J, Mengel M, Ellis S, et al. The use of Doppler ultrasonography to predict the outcome of renal transplantation. N Engl J Med 2003;344(17):1175-80.
12. Patel U, Khaw KK, Hughes NC. Doppler ultrasound for detection of renal transplant artery stenosis-threshold peak systolic velocity needs to be higher in a low-risk or surveillance population. Clin Radiol 2003;58(10):772-7.
13. Heidenreich PA, Bozkurt B, Aguilar D, et al. 2022 AHA/ACC/HFSA Guideline for the Management of Heart Failure: A Report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines. Circulation 2022;145(18):e895-e1032.
14. Lang RM, Badano LP, Mor-Avi V, et al. Recommendations for cardiac chamber quantification by echocardiography in adults: an update from the American Society of Echocardiography and the European Association of Cardiovascular Imaging. J Am Soc Echocardiogr 2015;28(1):1-39.e14.
15. Mitchell C, Rahko PS, Blauwet LA, et al. Guidelines for Performing a Comprehensive Transthoracic Echocardiographic Examination in Adults: Recommendations from the American Society of Echocardiography. J Am Soc Echocardiogr 2019;32(1):1-64.
16. Wilson DJ, North N, Wilson RA. Comparison of Left Ventricular Ejection Fraction Calculation Methods. Echocardiography 1998;15(8 Pt 1):709-12.
17. Azzouz S, Chen A, Ekmekjian T, Cantarovich M, Baran D, Sandal S. The role of renal resistive index as a prognostic tool in kidney transplantation: a systematic review. Nephrol Dial Transplant 2022;37(8):1552-65.
18. Jesrani AK, Faiq SM, Rashid R, et al. Comparison of resistive index and shear-wave elastography in the evaluation of chronic kidney allograft dysfunction. World J Transplant 2024;14(1):89255.
19. Geraci G, Ferrara P, La Via L, et al. Renal Resistive Index from Renal Hemodynamics to Cardiovascular Risk: Diagnostic, Prognostic, and Therapeutic Implications. Diseases 2025;13(6):178.
20. Spatola L, Andrulli S. Doppler ultrasound in kidney diseases: a key parameter in clinical long-term follow-up. J Ultrasound 2016;19(4):243-50.
21. Bahl A, Prasad N, Sinha DP, et al. Cardiac evaluation in patients awaiting kidney transplant-position statement of the Cardiological Society of India and Indian Society of Nephrology. Indian Heart J 2025;77(3):204-12.
22. Wang HK, Chiou SY, Lai YC, et al. Early postoperative spectral Doppler parameters of renal transplants: the effect of donor and recipient factors. Transplant Proc 2012;44(1):226-9.
23. Weston MJ. Doppler ultrasound for detection of renal transplant artery stenosis-threshold peak systolic velocity needs to be higher in a low-risk or surveillance population. Clin Radiol 2003;58(10):770-1.