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Evaluation of the Relationship between Diuresis and Kidney Function in Transplant Patients at Tabriz Imam Reza Hospital

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Abstract

Introduction
Kidney transplantation is the method of choice and a cost-effective treatment for ESRD patients, which has significantly reduced mortality and complications of the disease. In this study, we aim to investigate the effects of diuresis on renal function in transplant patients. The aim of this cross-sectional analysis is to find out the effects of diuresis on renal function in patients undergoing renal transplantation.

Methods
This cross-sectional study was conducted on kidney transplant patients at Tabriz Imam Reza Medical Education Center. During the study, patients were examined based on specific inclusion and exclusion criteria. Demographic information, including age, sex, morning weight the day before surgery, underlying disease, and duration of dialysis in years, was recorded. The study also included calculating the patients' GFR using the CKD-EPI equation and determining its relationship with both recovery urinary output and 24-hour urinary output.

Results
This study included 49 patients who underwent kidney transplantation. The right and the left kidney was transplanted in 42 and 7 patients respectively. Present study showed that there was no significant relationship between the laboratory parameters of patients, including preoperative sodium, preoperative potassium, preoperative urea, preoperative creatinine, postoperative sodium, postoperative potassium, postoperative urea, postoperative creatinine, preoperative GFR, postoperative GFR, and diuresis of patients in the recovery room and 24 hours after surgery. Additionally, there was no significant relationship between indicators such as age and weight and the amount of diuresis of patients in the recovery room and 24 hours after the operation. Furthermore, this study did not find a significant difference in preoperative GFR, postoperative GFR, recovery output, and 24-hour output between patients with hypertension and the non-hypertensive group.

Conclusion
There was no significant relationship between demographic indicators and laboratory parameters and the amount of diuresis in patients. Additionally, the study found no significant difference in GFR and output between patients with hypertension and those without hypertension.

Keywords: diuresis, kidney, kidney function, kidney transplantation.

Introduction

Kidney transplantation is a selective and cost-effective method for treating end-stage renal disease (ESRD). It is considered one of the most important and successful transplants of the current century, as it significantly improves the quality of life and reduces the complications and mortality associated with ESRD (1, 2). Over the past 40 years, kidney transplantation has evolved from a hopeless procedure to a beneficial treatment for those with chronic kidney disease (3). Despite these advances, complications such as rejection, immunosuppressive drug-related complications, recurrence of the primary disease, cardiovascular disease, infection, neoplasms, and surgical complications still play a key role in the survival of the recipient and the transplanted kidney (4). Allograft dysfunction remains a critical issue for these patients (5). One of the major weaknesses of kidney transplantation is allograft rejection, which is the main cause of chronic allograft dysfunction (6). On the other hand, one of the most important challenges in organ transplantation, which poses ethical issues worldwide, is the limited availability of transplantable organs, including kidneys (7). Although kidney transplantation offers better quality of life for most patients compared to dialysis, long-term patient survival is still uncertain. With advancements in surgical techniques, preoperative care, and the use of immunosuppressive drugs, short-term (one-year) patient survival has improved significantly (8). For instance, in adults who received a transplant from a non-living donor, the one-year survival rate increased from 75.7% in 1988 to 87.7% in 1996. In living donor recipients, these rates were reported as 88.8% and 93.9%, respectively, indicating an improvement in short-term survival. However, long-term graft survival remains a challenge (9, 10).

The renal medulla produces concentrated urine by generating an osmotic gradient that increases gradually from the corticomedullary border to the inner medullary tip. This concentration of sodium chloride (NaCl) enhances both the adaptive and innate immune response (11, 12). Myeloid mononuclear phagocytes (MMPs) contain myeloid cells with macrophage function. They are classified into M1 inflammatory and M2 repair or profibrotic cells. High concentrations of NaCl have been shown to impair M2 function and enhance M1 function, including the host's antibacterial response, in several disease models in vivo. However, in animal models, they have succeeded in polarizing MMPs towards the M2 phenotype (13).

MMPs are present in both the renal cortex and medulla. Following kidney transplantation, cortical MMPs (macrophages) are a negative predictor of graft survival. The prognostic role of medullary macrophages in early biopsies with low-grade inflammation is currently unknown (14). Both immunological and non-immunological factors contribute to the development of chronic allograft nephropathy. Early identification of patients who are at the highest risk of graft rejection and timely therapeutic intervention are critical for improving kidney transplant outcomes. As discussed in this article, GFR is a valuable indicator of long-term outcomes. Given the increasing prevalence of kidney transplants, improving kidney function is of utmost importance. The purpose of this study is to investigate the relationship between diuresis and kidney function in transplant patients at Imam Reza Hospital in Tabriz.

Methods

This cross-sectional study included all patients aged 15-60 years with end-stage renal disease (ESRD) who underwent kidney transplantation and visited Imam Reza Hospital in Tabriz from March 2019 to Feb 2021. Patients with congestive and symptomatic heart diseases, pericarditis, myocardial dysfunction, a history of treatment for ischemic heart disease, hypernatremia, hyperglycemia, or a history of diabetes were excluded from the study. This research involved a comprehensive evaluation of demographic information, including age, gender, morning weight the day before surgery, underlying disease, and duration of dialysis, as well as the GFR of patients and its relationship with the recovery of urinary output and 24-hour urinary output. Renal function indices, including the volume of urine output in the operating room after ureteral anastomosis until recovery, the volume of urine output in the recovery room until transfer to the ward, the volume of urine in the ward up to 24 hours after entering the ward, and 24-hour urine samples to determine the concentration of sodium, potassium, urea, and creatinine, were monitored from the time of drug administration to 24 hours after surgery. The amount of creatinine in the patients' blood was measured twice, and the average of the obtained numbers was used to calculate their clearance, which was then compared to their diuresis and urea concentration. Additionally, before the transplant operation, all patients underwent hemodialysis to prevent fluid retention and electrolyte imbalances. This study was approved by a regional ethic committee of research under the code IR.TBZMED.REC.1400.620.

Statistical Analysis

All statistical calculations were performed using SPSS software (version 16.0 for Windows, SPSS, Inc., Chicago, IL). Data were reported as mean ± standard deviation (SD) for parametric variables, and percentages and numbers for categorical variables. Normality of continuous variables was confirmed with Kolmogorov-Smirnov tests. Chi-square and one-way ANOVA methods were used to examine differences between the study groups, and Pearson correlation was used to examine the relationship between the variables. For all conducted tests, a significance level of 5% and a confidence interval of 95% were considered for the p-value. Confounding factors were also investigated in order to examine the relationship between the studied variables.

Results

This study included 49 kidney transplant recipients, of whom 33 were male and 16 were female (a male to female ratio of 33% to 67%). The mean age of the participants was 42.02 ± 12.80 years, ranging from 15 to 60 years. On average, the patients weighed 69.13±13.43 kg, and 57.1% of them had hypertension. Among the patients, 42 received a kidney transplant on the right side, while the remaining 7 received a transplant on the left side.

Table 1 presents the demographic information, clinical and laboratory parameters of the patients. Table 2 provides information on the Lasix dosages that were given to the patients during the study period.

Variables	Mean ± SD or Numbers
Gender (Female: Male)	16:33
Age	12.80±42.02
Side of kidney transplantation (right: left)	42:7
Weight	69.13±13.43
Hypertension	(57.1%) 28
Dialysis duration	16.53±19.76
Preop Na	139.55±3.32
Preop K	4.31±0.79
Preop Urea	81.85±49.33
Preop Cr	5.86±2.78
Preop GFR	221.78±187.56
Postop Na	139.51±4.71
Postop K	4.17±0.54
Postop Urea	61.75±29.06
Postop Cr	3.50±1.87
Postop GFR	356.07±216.27
Recovery output	1437.75±904.82
24-hour output	9774.08±5738.88

Table 1: The demographic information, clinical and laboratory parameters

Lasix dosages	40	60	80	100	110	120	130	140	150	180
Number of patients	(2.0%) 1	(6.1%) 3	(8.2%) 4	(32.7%) 16	(2.0%) 1	(26.5%) 13	(4.1%) 2	(14.3%) 7	(2.0%) 1	(2.0%) 1

Table 2: Information of Lasix dosages

As shown in Table 3, there was no significant relationship between the laboratory parameters of the patients, including preoperative sodium, preoperative potassium, preoperative urea, preoperative creatinine, postoperative sodium, postoperative potassium, postoperative urea, postoperative creatinine, preoperative GFR, and postoperative GFR, and the amount of diuresis in the recovery room and during the 24 hours after surgery. Additionally, there was no significant relationship between variables such as age and weight and the amount of diuresis for the patients in the recovery room and during the 24 hours after the operation.

Variables		Recovery output	-hour output
Preop Na	correlation coefficient	-.176	.449
	P-value	.445	.801
Preop K	correlation coefficient	.138	.464
	P-value	.300	.683
Preop urea	correlation coefficient	.158	.401
	P-value	.477	.779
Preop Cr	correlation coefficient	.144	.188
	P-value	.013	.196
Postop Na	correlation coefficient	-.164	-.144
	P-value	.467	.011

Postop K	correlation coefficient	.436	.405
	P-value	.840	.761
Postop urea	correlation coefficient	.100	.155
	P-value	.340	.489
Postop Cr	correlation coefficient	-.469	.414
	P-value	.636	.935
Preop GFR	correlation coefficient	-.168	-.404
	P-value	.408	.493
Postop GFR	correlation coefficient	.405	-.448
	P-value	.759	.957
Age	correlation coefficient	.169	.479
	P-value	.405	.591
Weight	correlation coefficient	.409	-.446
	P-value	.739	.968

Table 3: The relationship between output and studied variables based on Spearman correlation

Table 4 shows the relationship between GFR and the output of patients with hypertension and the group without hypertension. This study found no significant difference in the preoperative GFR, postoperative GFR, recovery output, and 24-hour output between patients with hypertension and those without hypertension.

Variables	Mean ± SD or Numbers		P-value
	With hypertension	Without hypertension	
Preop GFR	194.39±140.95	258.29±234.86	0.05
Postop GFR	309.00±157.45	418.82±267.50	0.17
Recovery Output	1508.92±1009.82	1342.85±756.18	0.79
24-hour Output	10932.14±5972.00	8230.00±5149.28	0.16

Table 4: The comparison of GFR and output of patients based on blood pressure

Discussion

The study involved 49 patients who underwent kidney transplant surgery. The results showed that there was no significant relationship between the laboratory parameters of the patients, including sodium, potassium, urea, creatinine, GFR before and after surgery, and the diuresis rate of patients in the recovery room and during the 24 hours after surgery. Additionally, there was no significant relationship between variables such as age and weight and the amount of diuresis of the patients in the recovery room and during the 24 hours after the operation. The study also found no significant difference in the preoperative GFR, postoperative GFR, recovery output, and 24-hour output between patients with hypertension and those without hypertension.

Kidney transplant is the preferred treatment for end-stage renal disease. A successful kidney transplant improves patients' quality of life, reduces their risk of death, and is less expensive than maintenance dialysis. However, this method places a significant burden on the healthcare budget of countries (15). While short-term results, such as one-year graft and patient survival rates of over 90% and one-year acute rejection rates of less than 15%, are promising, the question remains whether further improvement is possible or necessary (16). These excellent short-term outcomes are not always predictive of long-term survival, highlighting the necessity to identify new short-term endpoints that can correlate with long-term graft outcomes and ideally lead to longer graft survival (17).

Kidney allograft function is an attractive candidate as a surrogate marker for transplantation research studies and for evaluating new drugs, although its use as an outcome marker for transplant rejection is controversial (18). In the last 25 years, a significant decrease in mortality after kidney transplantation has been observed, especially in the early post-transplant period. This improvement is largely due to safer surgeries and anesthesia, and fewer deaths from infections. Cardiovascular and malignant diseases are currently the leading cause of death in transplant recipients. A medium-term goal is to progressively reduce cardiovascular deaths, while progress in preventing malignancies is a more distant goal (19). In general, GFR is considered the most reliable indicator of overall renal function, as well as a predictor of long-term graft survival and an independent risk factor for cardiovascular mortality, the leading cause of death in renal transplant recipients (20). It is worth noting that in non-grafted chronic kidney disease, a decrease in GFR is associated with a significant increase in complications related to the loss of kidney function, such as high blood pressure, anemia, and abnormal mineral metabolism. Another crucial point is that the decrease in GFR is also linked to an increase in healthcare costs. Therefore, an accurate assessment of kidney allograft performance is essential in the clinical management of kidney transplant recipients (21). The measurement methods of GFR using exogenous markers, such as inulin clearance, which is considered the gold standard, as well as other methods like radiolabeled isotopes and non-radioactive contrast agents (such as Iothalamate or Iohexol), are laborious and expensive. As a result, they are rarely used in clinical practice. Therefore, endogenous markers like serum creatinine (SCr) or cystatin C (CyC) are used to estimate kidney function. However, there are concerns about the accuracy of existing eGFR equations in kidney transplant recipients, and guidelines still provide conflicting recommendations regarding the methods of estimating GFR in this population (22).

SCr concentration is the most common marker used to estimate GFR. SCr was first described as a marker of GFR in 1937, and its analysis is inexpensive and generally available. Creatinine is a breakdown product of creatine phosphate in muscle tissue, produced at a relatively constant rate depending on muscle mass, and filtered in the glomerulus. However, it is also actively secreted in the proximal tubule. Tubular secretion normally contributes to 10% of renal chromium removal, but increases as GFR decreases, causing SCr to remain within the normal range until GFR decrease below 60-70 mL/min. Some chromium is also available from the diet. Meat consumption significantly contributes to urinary chromium excretion, both as a result of expanding total creatine and as a result of chromium absorption through digestion. Therefore, several factors, such as sex, age, race, muscle mass, and dietary protein intake, can reduce the accuracy of SCr as an index of GFR. In particular, there are other determinants in kidney transplant recipients that may interfere with chromium metabolism, such as corticosteroids, which have a direct catabolic effect and cause a change in the ratio of muscle mass to total body weight. Catabolic diseases, such as infection, acute rejection, and long-term dialysis, can also be partially responsible for decreasing GFR (23-25). Since chromium excretion is unpredictable, GFR can decrease to half of the normal value before SCr increases. However, several studies in kidney transplantation have shown a weak correlation between SCr and GFR. Additionally, the most common method for measuring SCr (Jaffé) is susceptible to interference from chromogens, such as bilirubin, glucose, and uric acid, while the enzymatic method is susceptible to interference from bilirubin and some antibiotics. Significant changes between SCr measurement calibrations may also cause inaccuracies in its determination. Recently, an attempt has been made to standardize the measurement of SCr by adopting a common calibration standard, the isotope dilution mass spectrometry (IDMS) standard, resulting in significant improvements and traceability of SCr measurements. Nonetheless, SCr is recommended as a screening test for changes in allograft function and for regulating immunosuppressive drugs. Furthermore, it has been shown that SCr itself may be a predictor of long-term graft and patient survival (26).

Creatinine clearance (CCr), which is measured from 24-hour urine collection, is often used in clinical practice to calculate GFR. However, due to chromium secretion by renal tubules and limitations of SCr as a kidney marker, CCr overestimates GFR. Additionally, this calculation does not correct for tubular secretion and may overestimate GFR in transplant populations, with additional errors in urine collection. CCr measurement using this method becomes more reliable after administration of cimetidine, which inhibits tubular secretion, but still does not provide more information about kidney function than other chromium-based methods. To validate graft function as a reliable surrogate marker, we must use an accurate measure of kidney function. The eGFR equation was developed as an alternative method to estimate GFR in the clinical setting because it allowed us to overcome some of the limitations of SCr.

Previous studies, such as the study conducted by Koning et al., found the administration of diuretics to be effective in reducing the incidence of delayed graft function (DGF) in transplant patients. However, more recent studies, such as the study conducted by Baar et al., found a significant relationship between the use of diuretics during kidney transplantation and the incidence of DGF. Therefore, the use or non-use of diuretics in kidney transplantation remains a controversial issue (27, 28). Studies that have attempted to predict GFR in transplanted kidneys by using the amount of diuresis have shown that only measuring the amount of diuresis is not enough to predict the one-year performance of the transplanted kidney (29). Consistent with previous studies, this study could not find a significant relationship between demographic parameters, such as age and weight, and laboratory parameters, including sodium, potassium, urea, creatinine, GFR before and after surgery, and the amount of diuresis of patients in the recovery room and during the 24-hour period.

Conclusion

The findings of this study suggest that demographic parameters, such as age and weight, and laboratory parameters, including sodium, potassium, urea, creatinine, GFR before and after surgery are not significantly associated with the amount of diuresis of patients in the recovery room and during the 24-hour period after surgery. Furthermore, the study did not reveal any significant difference in GFR and output between patients with hypertension and those without hypertension. These results imply that other factors may play a more significant role in predicting kidney function, and further research is necessary to identify these factors.

References

1. Mahdavi R, Khammar A. (1999). Cause of destroyed transplanted kidney and recipient kidney after transplantation and investigation at 328 recipient. *The Iranian Journal of Urology, 6*(23):27-32.
2. Jalalzadeh M, Mousavinasab N, Peyrovi S, Ghadiani MH. (2015). The impact of acute rejection in kidney transplantation on long-term allograft and patient outcome. *Nephro-urology monthly, 7*(1).
3. Bakr MA, Ghoneim MA. (2005). Living donor renal

transplantation, 1976-2003: the mansoura experience. *Saudi Journal of Kidney Diseases and Transplantation, 16*(4):573-83.

4. Hasanzadeh F, Aghaei N, Sahebkar Moeini M. (2015). The Association between Disease–related Characteristics and Kidney Transplant Complications. *Journal of Mazandaran University of Medical Sciences,25*(126):82-94.
5. Matas AJ, Payne WD, Sutherland DE, Humar A, Gruessner RW, Kandaswamy R, et al. (2001). 2,500 living donor kidney transplants: a single-center experience. *Annals of surgery, 234*(2):149.
6. Nazemeian F, Naghibi M, Naghibi A. (2007). Effective Factors in reducing the length of hospitalization in renal transplant recipients. *Medical journal of Mashad University of Medical Sciences, 50*(95):11-6.
7. Farzaneh Z, Bagher L. Iranian model of kidney transplantation and approaches to ethical reinforcement. 2007.
8. McLaren AJ, Fuggle SV, Welsh KI, Gray DW, Morris PJ. (2000). Chronic allograft failure in human renal transplantation: a multivariate risk factor analysis. *Annals of surgery, 232*(1):98.
9. Golestan B, HOSSEINI MS, Nafar M, Rennolls K, Mohammad K. AN ESTIMATION OF THE CHRONIC REJECTION OF KIDNEY TRANSPLANT USING AN ETERNAL WEIBULL REGRESSION: A HIS-TORICAL COHORT STUDY. 2009.
10. Kälble T, Lucan M, Nicita G, Sells R, Revilla FB, Wiesel M. (2005). EAU guidelines on renal transplantation. *European urology, 47*(2):156-66.
11. Sands JM, Layton HE. (2014). Advances in understanding the urine-concentrating mechanism. *Annual review of physiology*, 76:387-409.
12. Schatz V, Neubert P, Schröder A, Binger K, Gebhard M, Müller DN, et al. (2017). Elementary immunology: Na+ as a regulator of immunity. *Pediatric Nephrology*, 32:201-10.
13. Nelson PJ, Rees AJ, Griffin MD, Hughes J, Kurts C, Duffield J. (2012). The renal mononuclear phagocytic system. *Journal of the American Society of Nephrology: JASN, 23*(2):194.
14. Jantsch J, Schatz V, Friedrich D, Schröder A, Kopp C, Siegert I, et al. (2015). Cutaneous Na+ storage strengthens the antimicrobial barrier function of the skin and boosts macrophage-driven host defense. *Cell metabolism, 21*(3):493-501.
15. Rocha MJ, Ferreira S, Martins LS, Almeida M, Dias L, Pedroso S, et al. (2012). Cost analysis of renal replacement therapy by transplant in a system of bundled payment of dialysis. *Clinical transplantation, 26*(4):529-31.
16. 16. Lamb K, Lodhi S, Meier-Kriesche HU. (2011). Long-term renal allograft survival in the United States: a critical reappraisal. *American journal of transplantation, 11*(3):450-62.
17. Hariharan S, McBride MA, Cohen EP. (2003). Evolution of endpoints for renal transplant outcome. *American Journal of Transplantation, 3*(8):933-41.
18. Mariat C, Maillard N, Phayphet M, Thibaudin L, Laporte S, Alamartine E, et al. (2008). Estimated glomerular filtration rate as an end point in kidney transplant trial: where do we stand? *Nephrology Dialysis Transplantation, 23*(1):33-8.
19. Briggs JD. (2001). Causes of death after renal transplantation. *Nephrology Dialysis Transplantation, 16*(8):1545-9.
20. Levey AS, Coresh J, Bolton K, Culleton B, Harvey KS, Ikizler TA, et al. (2002). K/DOQI clinical practice guidelines for chronic kidney disease: evaluation, classification, and stratification. *American Journal of Kidney Diseases, 39*(2 SUPPL. 1):i-ii+ S1-S266.
21. Karthikeyan V, Karpinski J, Nair RC, Knoll G. (2004). The burden of chronic kidney disease in renal transplant recipients. *American Journal of Transplantation, 4*(2):262-9.
22. Eckardt K-U, Kasiske BL, Zeier MG. (2009). KDIGO clinical practice guideline for the care of kidney transplant recipients. *American Journal of Transplantation*, 9:S1-S155.
23. Perrone RD, Madias NE, Levey AS. (1992). Serum creatinine as an index of renal function: new insights into old concepts. *Clinical chemistry, 38*(10):1933-53.
24. El Haggan W, De Ligny BH, Partiu A, Sabatier J, Lobbedez T, Levaltier B, et al., editors. (2006). The evolution of weight and body composition in renal transplant recipients: two-year longitudinal study. Transplantation proceedings, Elsevier.
25. Berglund F, Killander J, Pompeius R. (1975). Effect of trimethoprim-sulfamethoxazole on the renal excretion of creatinine in man. *The Journal of urology, 114*(6):802-8.
26. Hallan S, Åsberg A, Lindberg M, Johnsen H. (2004). Validation of the Modification of Diet in Renal Disease formula for estimating GFR with special emphasis on calibration of the serum creatinine assay. *American journal of kidney diseases, 44*(1):84-93.
27. Baar W, Kaufmann K, Silbach K, Jaenigen B, Pisarski P, Goebel U, et al. (2020). Early postoperative use of diuretics after kidney transplantation showed increase in delayed graft function. *Progress in Transplantation, 30*(2):95-102.
28. Koning OH, Ploeg RJ, Van Bockel JH, Groenewegen M, van der Woude FJ, Persijn GG, et al. (1997). RISK FACTORS FOR DELAYED GRAFT FUNCTION IN CADAVERIC KIDNEY TRANSPLANTATION: A Prospective Study of Renal Function and Graft Survival after Preservation with University of Wisconsin Solution in Multi-Organ Donors: 1. *Transplantation, 63*(11):1620-8.
29. Kim J, Pyeon T, Choi JI, Kang JH, Song SW, Bae H-B, et al. (2019). A retrospective study of the relationship between postoperative urine output and one year transplanted kidney function. *BMC anesthesiology*.;19:1-10.