

Retrospective Analysis of Pre-and Post-Operative Laboratory Findings of Patients Undergoing Kidney Transplantation

Böbrek Nakli Yapılan Hastaların Ameliyat Öncesi ve Sonrası Laboratuvar Bulgularının Retrospektif Analizi

¹Maral KARGIN^a, ²Sevim GÜLER^b, ³Berna BAYIR^c, ⁴Ayşe ŞAHİN TUTAK^d, ⁵Mehmet Şükrü ARSLAN^e,
⁶Garip BEKFİLAVİOĞLU^d

^aDepartment of Psychiatry, Girne İlim University Faculty of Nursing, Kyrenia, Turkish Republic of Northern Cyprus

^bDepartment Nursing, Division of Internal Medicine, Adıyaman University School of Health, Adıyaman, Türkiye

^cDepartment Nursing, Division of Public Health Nursing, KTO Karatay University School of Health Sciences, Konya, Türkiye

^dDepartment of Internal Medicine, Adıyaman University Training and Research Hospital, Adıyaman, Türkiye

^eMersin Tarsus University Faculty of Medicine Health Research and Application Center, Mersin, Türkiye

ABSTRACT Objective: This study was conducted to review the sociodemographic characteristics of kidney transplant patients and the changes in preoperative and postoperative laboratory findings. Material and Methods: This is a retrospective study including 130 patients who underwent kidney transplantation between January 2015 and June 2019. This research was conducted at the Turgut Özal Medical Center Organ Transplant Hospital between August and December 2019 in the form of a four-month file archive review. File archive was used to access the data. The demographic characteristics of these patients, clinical and laboratory findings, donor characteristics, pre-transplant chronic diseases, pre-transplant dialysis duration and dialysis types were retrospectively analyzed to evaluate post-transplant infection and survival. Results: In the study, it was determined that patient survival rates were higher in transplants from a cadaver donor compared to transplants from a living donor. When the values before and after the transplantation were compared, it was found that the difference between the mean values of albumin, calcium, leukocytes, hemoglobin, hematocrit, platelets and international normalized ratio before and after transplantation was statistically significant. Conclusion: In this patient group, it may be suggested to carry out studies on nursing that provide sustainable, professional, holistic, evidence-based care and raise awareness, and to add the study findings to nursing practices in order to achieve the expected goals in improving the quality of life and survival.

ÖZET Amaç: Bu araştırma, böbrek nakli yapılan hastaların ameliyat öncesi ve sonrası laboratuvar bulgularındaki değişiklikleri gözden geçirmek amacıyla yapılmıştır. Gereç ve Yöntemler: Ocak 2015 ile Haziran 2019 tarihleri arasında böbrek nakli yapılan 130 hastayı içeren retrospektif bir çalışmadır. Bu araştırma, Turgut Özal Tıp Merkezi Organ Nakli Hastanesinde Ağustos-Aralık 2019 tarihleri arasında 4 aylık bir dosya arşivi incelemesi şeklinde yürütüldü. Verilere erişmek için dosya arşivi kullanıldı. Bu hastaların demografik özellikleri, klinik ve laboratuvar bulguları, donör özellikleri, nakil öncesi kronik hastalıkları, nakil öncesi diyaliz süreleri ve diyaliz türleri, nakil sonrası enfeksiyon ve sağkalım değerlendirmek için geriye dönük olarak analiz edildi. Bulgular: Çalışmada, kadavra vericisinden yapılan nakillerde, canlı vericiden yapılan nakillere kıyasla hasta sağkalım oranlarının daha yüksek olduğu belirlendi. Transplant öncesi ve sonrası değerler karşılaştırıldığında, albumin, kalsiyum, lökosit, hemoglobin, hematokrit, trombosit ve uluslararası normalleştirilmiş oran ortalama değerlerinin transplantasyon öncesi ve sonrası arasındaki farkın istatistiksel olarak anlamlı olduğu bulundu. Sonuç: Bu hasta grubunda beklenen hedeflere ulaşmak için sürdürülebilir, profesyonel, bütüncül, kanıta dayalı bakım sağlayan ve farkındalık yaratan hemşirelik çalışmalarının yapılması ve araştırma bulgularının hemşirelik uygulamalarına eklenmesi önerilebilir.

Keywords: Kidney transplant; autoimmune disease; retrospective studies; clinical laboratory techniques

Anahtar Kelimeler: Böbrek nakli; otoimmün hastalık; retrospektif çalışmalar; klinik laboratuvar teknikleri

Kidney transplantation is the best treatment option for patients with end-stage renal disease.¹ According to the 2019 data compiled by the Global Observatory on Donation Transplantation, a center

for worldwide organ donation transplantation in cooperation with the World Health Organization, the number of patients who received kidney transplantation from cadavers and living donors in 2011 was

Correspondence: Berna BAYIR

Department Nursing, Division of Public Health Nursing, KTO Karatay University School of Health Sciences, Konya, Türkiye

E-mail: berna.bayir@karatay.edu.tr



Peer review under responsibility of Türkiye Klinikleri Journal of Nursing Sciences.

Received: 15 Mar 2022

Received in revised form: 02 Jul 2022

Accepted: 04 Aug 2022

Available online: 17 Aug 2022

2146-8893 / Copyright © 2022 by Türkiye Klinikleri. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

76,118.² In 2018, kidney transplantation ranked first among solid organ transplantations all over the world. The number of kidney transplants reached 95,479 and 36% of these transplants were from living donors.³

According to the data of the Organ Tissue Transplantation and Dialysis Services Department in Türkiye, there are 72 active and licensed kidney transplant centers. In these centers, 3,418 kidney transplants were performed in 2016, 3,863 in 2019, and 1,565 chronic kidney failure patients as of 7 September 2020. Finally 1,760 chronic kidney failure patients in 2022.⁴ The data show us that the number of kidney transplant patients is increasing day by day in parallel with the number of patients diagnosed with chronic kidney failure in the world and in Türkiye.³ Unfortunately, despite the increase in the number of patients waiting for organs, the rate of organ donation needless to say, not much has changed.⁵ Body integrity among the reasons for not donating desire not to spoil, to be exploited commercially, to think that it is not religiously appropriate, distrust of doctors, hospital fear of not being cared for before dying completely, not believing in brain death, having thoughts such as organ mafia can be counted.⁶

In recent years, a better understanding of the causes of organ rejection, especially after organ transplantation, has significantly increased the success of kidney transplantation in parallel with new developments in drugs that prevent and treat rejection.⁷ Advances in surgical methods and the use of effective antimicrobial drugs have a great role in this success. While positive developments in immunosuppressive treatments and surgical methods led to a significant increase in post-transplant care and short-term graft survival, no dramatic increase was found in long-term graft survival.⁸ A successful kidney transplant improves quality of life and reduces the risk of mortality in most patients.³ In addition, since immunosuppressive treatments make patients susceptible to infections, malignancies and cardiovascular system diseases, patients should be followed up closely after transplantation. Close follow-up after transplantation is very important in terms of mortality and morbidity, especially in the period one week after transplantation.⁹ Part of these living conditions is prolonging survival,

a life that could be beneficial for the graft, and a possible project that could be close to the organ. Providing access to this area can be ensured by continuing to optimize pre and post-operative care and starting education after discharge. During these periods, the clinical nurse takes an active role in care and treatment. In the preoperative period, the clinical nurse provides education to the patient about post-transplant treatments, immunosuppressive drug program, exercises, diet and important complications that may occur. With this training, she/he tries to ensure that the patient can provide self-care after kidney transplantation on her own or with support, and adopt this lifestyle, which is aimed at protecting the graft organ. Post-operative care; hemodynamic status and vital signs, fluid-electrolyte balance, cardiovascular, pulmonary, neurological, gastrointestinal, hematological system functions, surgical site, wound drainage amount, psychosocial status, immunosuppressive drug administration, and follow-up of complications arising from transplantation.⁹ It is possible to reach the goals by providing the care of the patients in the pre- and post-operative period by an experienced and professional multidisciplinary team. Nurses, who are one of the most important members of the multidisciplinary team, have serious responsibilities at every stage of the kidney transplant process. Well-planned care and follow-up provided by nurses before and after kidney transplantation significantly increases the success of transplantation.¹⁰ Problems such as hypervolemia, hyponatremia, hyperkalemia, metabolic acidosis, hyperphosphatemia and hypocalcemia that may be seen in patients are first determined by laboratory findings. Thanks to the nurses' duty of observation, such deviations are detected early and appropriate nursing interventions are planned. This situation has great effects in preventing serious problems that may occur.¹¹ This study was conducted to review the sociodemographic characteristics of kidney transplant patients and the changes in preoperative and post-operative laboratory findings.

RESEARCH QUESTION

1. What is the difference between pre-transplant and post-transplant laboratory findings of kidney transplant patients?

2. How do some personal characteristics affect the findings for kidney transplantation?

MATERIAL AND METHODS

TYPE OF RESEARCH

The research is a cross-sectional type of retrospective research, which is one of the descriptive research types.

STUDY DESIGN AND SAMPLE

The archive records of 130 patients who underwent kidney transplantation in the Organ Transplantation Unit of Turgut Özal Medical Center between January 2015 and June 2019 were examined. The population of the study consisted of all patients who had a kidney transplant between 2015-2019. Since the population size was at an accessible level, sample selection was not made and the entire population was reached.

DATA COLLECTION METHODS

Before starting to examine the files from the file archive of the organ transplant clinic, data collection tools in the form of questionnaires were created by the researchers. Demographic characteristics and routine laboratory data such as gender, age, height, weight, smoking/alcohol use, pre-transplant drug use, hypertension and diabetes mellitus, dialysis duration and type, donor type, postoperative infection and survival status were examined by the researchers. The first week after transplantation; albumin, blood urea nitrogen, creatine, Na⁺, K⁺, Ca²⁺, Mg, white blood cell (WBC), hemoglobin (Hgb), hematocrit (Hct), platelet, international normalized ratio (INR), aspartate transaminase (AST), alanine transaminase (ALT) values were recorded.

ANALYSIS OF DATA

In the analysis of demographic data, mean, standard deviation, frequency and percentage methods were used as descriptors. In the comparison of laboratory data of the pre-transplant and post-transplant periods; paired t-test was used. The significance level was defined as $p < 0.05$ at the 95% confidence interval. The data were analyzed with the Kolmogorov-Smirnov test, in which the data were normally distributed.

ETHICAL CONSIDERATIONS

After obtaining ethical approval from the Firat University Non-Interventional Research Ethics Committee (date: July 29, 2019, no: 97132852/050.01.04), approval was obtained from the institution where the file archive will be examined. There is no requirement for a personal informed consent form in retrospective studies. Therefore, consent form was not used in this study. The principles of the Declaration of Helsinki were complied with at every stage of the research. Necessary permissions were obtained from the Turgut Özal Medical Center Organ Transplantation Department for the examination of the archive files during the data collection phase of the study.

RESULTS

The mean age of the patients was determined to be approximately 38 years. It was determined that the majority of the transplanted patients were male individuals who did not smoke or drink alcohol. It was determined that 79% of them did not use medication before the transplant, 46.2% had hypertension and 11.5% had diabetes. When we look at the dialysis times before the transplant; it was determined that dialysis was applied to the patients for a minimum of 1 and a maximum of 7 years, and 24.6% of them were preemptive (Table 1).

Laboratory data of the patients before and first week after transplantation were recorded. When the values compared with one week interval were examined, it was found that the difference between the mean values of albumin, calcium, leukocyte, Hgb, Hct, thrombocyte and INR values before and after transplantation was statistically significant ($p < 0.05$) (Table 2).

DISCUSSION

As the number of kidney transplants increases, long-term follow-ups before and after surgery and good knowledge of complications are important in terms of mortality or morbidity rates. It has been emphasized that there is a male dominance in kidney transplant patients all over the world and this difference is due to the high economic power of men or the fact that women are generally donors.¹² In a study, an

TABLE 1: Socio-demographic characteristics of the patients.

Variables (n=130)	Minimum-maximum	$\bar{X}\pm SD$	
Age (years)	3.5-70	38.06±14.74	
Height (cm)	73-190	163.84±17.18	
Weight (kg)	11-150	64.67±18.66	
Operation time (hours)	80-1,455	256.28±232.25	
		n	%
Gender	Female	46	35.4
	Male	84	64.6
Cigarette	Yes	20	15.4
	No	110	84.6
Alcohol	Yes	1	0.8
	No	129	99.2
Pre-transplant drug use	Yes	51	39.2
	No	79	60.8
Hypertension	Yes	60	46.2
	No	70	53.8
Diabetes mellitus	Yes	15	11.5
	No	115	88.5
	Preemptive	32	24.6
	Less than 1 year	39	30.0
Dialysis time	1-6 years	36	27.7
	7 years and above	23	17.7
	Hemodialysis	79	60.8
	Peritoneal dialysis	13	10.0
Donor	Living donor	100	76.9
	Cadaver	30	23.1
Postoperative infection	Yes	24	18.5
	No	106	81.5
Survival rate by donor type	Living donor	97	30
	Cadaver	97.6	100

SD: Standard deviation.

TABLE 2: Blood values of the patients before and one week after surgery.

Variables	Preop		Postop		Significance p value
	Preop (minimum-maximum)	Preop ($\bar{X}\pm SD$)	Postop (minimum-maximum)	Postop ($\bar{X}\pm SD$)	
Albumin	0.13-4.80	3.45±0.61	1.00-4.30	2.93±0.42	0.046*
Urea	7.60-150.00	58.44±31.92	3.34-151	39.31±29.67	0.672
Creatine	0.64-41.00	7.79±4.22	0.40-10.40	1.97±1.73	0.295
Sodium	125.00-143.00	136.96±3.19	119.00-156.00	135.82±4.76	0.997
Potassium	3.29-7.18	4.72±0.79	2.90-5.90	4.07±0.56	0.239
Calcium	5.00-13.60	8.74±1.16	5.70-10.10	8.39±0.81	0.0001**
Magnesium	1.20-5.10	2.34±0.45	1.00-2.83	1.97±0.31	0.840
Leukocyte	2.60-24.50	8.43±3.30	2.00-29.80	8.35±4.46	0.0001**
Hemoglobin	5.00-17.80	10.65±2.40	5.30-14.10	8.90±1.78	0.0001**
Hematocrit	15.50-56.30	32.07±7.36	9.20-39.90	26.38±5.49	0.0001**
Platelets	54.00-446.00	220.13±67.86	40.00-428.00	180±71.67	0.0001**
INR	0.80-3.80	1.04±0.29	0.10-9.90	1.08±0.84	0.0001**
ALT	6.00-149.00	19.51±17.86	5.00-292.00	50.00±55.92	0.131
AST	4.00-69.00	16.25±10.88	5.00-167.00	24.76±24.34	0.491

*p<0.05; **p<0.01; t-test on independent groups; summary statistics (p) are given as values; SD: Standard deviation; INR: International normalized ratio; AST: Aspartate transaminase; ALT: Alanine transaminase.

opinion was expressed that the rate of end-stage renal disease in women was lower than that of men and/or that they could not find a family donor.¹³ In a study conducted in Türkiye, it was stated that 63% of the patients were male, but the reasons were not emphasized.¹⁴ In this study, in accordance with the literature, male dominance was observed in patient rates in terms of gender (male n=84, female n=46). It is thought that male dominance in the number of cases may be related to economic power and gender discrimination when it is associated with the socio-cultural and economic level of the region where the research was conducted. It can be thought that the value and economic power that the cultural structure ascribes to the male gender is due to the concentration of the male gender.

In a cohort study in which short and long-term graft survival analyzes were performed between 1986 and 2015, the mean age of the patients was found to be 48.07.¹⁵ In a study conducted with 157 patients with renal transplantation (RT) in our country, the mean age of the patients was found to be 30.4±9.8 years.¹⁶ In this study, it is thought that the mean age of the patients was 38.06±14.74 years, which is similar to the literature, and that the young average age of the patients may be reflected in the improvement of patient survival and graft survival in the long term.

It has been reported that the presence of one or more chronic diseases such as hypertension and diabetes in kidney transplant patients adversely affects the quality of life of patients.¹⁷ However, when we look at the data compiled by the Turkish Society of Nephrology from 27 centers in 2018, it was seen that hypertension ranks first in the etiology of end-stage renal disease and diabetes mellitus ranks second in the etiology of end-stage renal disease in a total of 940 kidney transplant patients.¹⁸ In this study, it was determined that 46.2% of the patients had hypertension and 11.5% had diabetes.

In the study, when the survival level was evaluated according to the donor type after kidney transplantation, it was determined that the survival rate from a cadaver donor was higher than that of a living donor (100%). Graft survival in living donors is longer than in cadavers, which is due to the shorter

duration of cold ischemia, and 1, 5, and 10 year graft and patient survival in living donors are 95%, 80%, 70%, and 97%, respectively. It has been reported that it is around 90 and 86%.¹⁹ According to OPTN/SRTR 2018 data, it was found that graft survival continued to improve after living donor transplantation and five-year survival increased by 90%.¹ In this study, files up to the last 5 years were reviewed and the survival of enrolled patients was evaluated. The results showed that the survival rate was consistent with the literature.

All 3 infections are associated with hepatic dysfunction. An early increase in liver enzyme levels in kidney transplant patients may be a clinical manifestation of cytomegalovirus (CMV) infection, as well as the effect of one or more immunosuppressive therapy or the presence of a primary hepatocellular abnormality involving the bile duct.²⁰ In the patient group of this study, an increase was observed in AST and ALT values in the first week after transplantation. Transient elevated liver enzyme levels are a common finding in kidney transplant recipients, usually within a month of transplant.

As a result of the research findings; it was determined that there was a significant change in the calcium, leukocyte, Hgb, Hct, platelet and INR values of the patients after kidney transplantation, and this was a statistically significant difference (Table 2). In this direction, when the literature is reviewed, it is mentioned that in the advanced stages of kidney failure, calcium is withdrawn from the bones and the plasma Ca²⁺ electrolyte level is increased. Therefore, its value in blood plasma increases.²¹ After this success, as the system becomes active, plasma is used. A post-RT montage laboratory finding is hypomagnesemia.²² If these individuals are not described with a value small enough to be called hypomagnesemia, they are described with a smaller value by comparison.

In this study, it was determined that there was a decrease in the Hgb levels of the patients after RT, at a level that required blood transfusion. The results show parallelism with the literature information. A statistically significant decrease in Hgb and Hct levels was recorded in the postoperative first week, and

replacement therapy was applied when necessary. However, these values are expected to be higher in the future.

In this study, it is seen that the leukocyte (WBC) values of the patients before the transplantation decreased from 8.43 to 8.35 at a statistically significant level after the transplantation ($p=0.0001$). It has been shown that approximately 30% of patients require Hb <8 g/dL or transfusion in the early period after kidney transplantation.²³ The findings of this study were consistent with the literature, and a statistically significant decrease in Hgb and Hct levels was recorded in the first week after transplantation, and supportive treatment was applied when necessary.

Less pre- and post-transplant platelet counts increase the risk of bleeding in patients, but until now there is no data on the clinical significance of post-transplant thrombocytopenia after kidney transplantation. Specifically associated with thrombocytopenia are immunosuppressive drugs and severe sepsis, viral infection such as CMV or parvovirus (parvovirus-B19, and thrombotic microangiopathy). There was no indication for transfusion.

CONCLUSION

As a result, the data obtained in the study, in which the demographic characteristics and changes in laboratory parameters observed in the first week after transplantation of kidney transplant patients of approximately 4 years, were reviewed, showed that the

values of kidney transplant patients were compatible with the world and Turkish literature. It has been determined that the success of these results positively affects the level of graft survival. In parallel with these findings, which positively affected the survival level, a high rate of survival was also found in the study conducted.

Source of Finance

During this study, no financial or spiritual support was received neither from any pharmaceutical company that has a direct connection with the research subject, nor from a company that provides or produces medical instruments and materials which may negatively affect the evaluation process of this study.

Conflict of Interest

No conflicts of interest between the authors and / or family members of the scientific and medical committee members or members of the potential conflicts of interest, counseling, expertise, working conditions, share holding and similar situations in any firm.

Authorship Contributions

Idea/Concept: Maral Kargın, Berna Bayır; **Design:** Maral Kargın, Berna Bayır; **Control/Supervision:** Maral Kargın, Sevim Güler; **Data Collection and/or Processing:** Maral Kargın, Sevim Güler, Berna Bayır, Ayşe Şahin Tutak, Mehmet Şükrü Arslan, Garip Bekfilavioğlu; **Analysis and/or Interpretation:** Maral Kargın, Ayşe Şahin Tutak; **Literature Review:** Maral Kargın, Sevim Güler; **Writing the Article:** Maral Kargın; **Critical Review:** Berna Bayır, Sevim Güler; **References and Findings:** Maral Kargın, Sevim Güler, Berna Bayır, Ayşe Şahin Tutak, Mehmet Şükrü Arslan, Garip Bekfilavioğlu; **Materials:** Maral Kargın, Berna Bayır.

REFERENCES

1. Organ Procurement and Transplantation Network [Internet]. [Cited: September 5, 2020]. 2018. Available from: [\[Link\]](#)
2. GODT Global Observatory on Donation and Transplantation Activities Executive summary. World Health Organization 2017 Report, (2019). Cited: November 4, 2022. Available from: [\[Link\]](#)
3. GODT Global Observatory on Donation and Transplantation Activities. World Health Organization 2018 Report, (2020). Cited: November 4, 2022. Available from: [\[Link\]](#)
4. T.C. Ministry of Health Organ Tissue Transplantation and Dialysis Services Department (2019). Organ transplant statistics. Cited: November 4, 2020. Available from: [\[Link\]](#)
5. Cevik C, Cigerci Y, Ozyurek P, Buyukyoruk SN, Cakar K, Halat S. Organ nakli ve bağış hakkında sağlık alanı dışındaki akademisyenlerin görüşleri [Opinions of academician outside the field of health about organ transplantation and donation]. Kocatepe Medical Journal. 2019;20(1):9-13. [\[Crossref\]](#)
6. Koçak A, Aktaş EÖ, Şenol E, Kaya A, Bilgin UE. Ege Üniversitesi Tıp Fakültesi öğrencilerinin organ nakli ve bağış hakkındaki bilgi düzeyi [Ege University Faculty of Medicine undergraduates' knowledge level regarding organ donation and transplantation]. Ege Tıp Dergisi. 2010;49(3):153-60. [\[Link\]](#)
7. Andre M, Huang E, Everly M, Bunnapradist S. The UNOS renal transplant registry: review of the last decade. Clin Transpl. 2014;1-12. [\[PubMed\]](#)
8. Legendre C, Canaud G, Martinez F. Factors influencing long-term outcome after kidney transplantation. Transpl Int. 2014;27(1):19-27. [\[Crossref\]](#) [\[PubMed\]](#)

9. Escobedo W. Kidney transplantation. In: Cupples S, Lerret S, McCalmont V, Ohler L, eds. Core Curriculum for Transplant Nurses. 2nd ed. China: Wolters Kluwer; 2017. p.617-59.
10. Koken ZÖ, Sezer RE. Böbrek transplantasyonunda bakım [Care in kidney transplantation]. Türkiye Klinikleri Surgical Nursing-Special Topics. 2018;4(2):149-56. [Link]
11. Yarlağadda S, Perazella MA. Acute renal failure in the hospital: diagnosis and management. Hospital Physician. 2006;(42):51-8. [Link]
12. Jindal RM, Ryan JJ, Sajjad I, Murthy MH, Baines LS. Kidney transplantation and gender disparity. Am J Nephrol. 2005;25(5):474-83. [Crossref] [PubMed]
13. Naghibi O, Naghibi M, Nazemian F. Gender disparity in kidney transplantation. Saudi J Kidney Dis Transpl. 2008;19(4):545-50. [PubMed]
14. Aytutuldu A, Kurtaran B, Paydas S, Candevir A, Balal M, Demir E, et al. Renal transplantasyon sonrası erken dönemde görülen üriner sistem infeksiyonlarının epidemiyolojisi ve risk faktörleri [Epidemiology and risk factors of early urinary tract infections after renal transplantation]. Ankem Journal. 2010;24(4):220-6. [Link]
15. Suleymanlar G, Ates K, Seyahi N. Nephrology, dialysis and transplantation in Turkey. T.R. Ministry of Health and Turkish Society of Nephrology Joint Report 2018. Cited: November 4, 2022. Available from: [Link]
16. Olcucuoglu E, Gonenc F. Renal transplantasyonda on yıllık cerrahi immunolojik ve sağkalım sonuçları [Ten-year surgical immunological and survival outcomes in renal transplantation]. Med Res Rep. 2020;3(2):29-34. [Link]
17. Kizilisik AT, Feurer ID, VanBuren DH, Wise P, Van Buren D, Hopkins J, et al. Effects of diabetes and cadaveric organs on functional performance and health-related quality of life after kidney transplantation. Am J Surg. 2003;186(5):535-9. [Crossref] [PubMed]
18. Turkish Society of Nephrology Renal Registry Data. Cited: November 4, 2022. Available from: [Link]
19. Coemans M, Süsal C, Döhler B, Anglicheau D, Giral M, Bestard O, et al. Analyses of the short- and long-term graft survival after kidney transplantation in Europe between 1986 and 2015. Kidney Int. 2018;94(5):964-73. [Crossref] [PubMed]
20. Mesar I, Kes P, Hudolin T, Basic-Jukic N. Rescue therapy with sirolimus in a renal transplant recipient with tacrolimus-induced hepatotoxicity. Ren Fail. 2013;35(10):1434-5. [Crossref] [PubMed]
21. Azim M, Kraut JA. Chronic kidney disease. In: Rakek D, Kellerman RD, eds. Conn's Current Therapy. 1st ed. PA, The US: Elsevier Inc; 2019. p.1027-32.
22. Margreiter R; European Tacrolimus vs Ciclosporin Microemulsion Renal Transplantation Study Group. Efficacy and safety of tacrolimus compared with ciclosporin microemulsion in renal transplantation: a randomised multicentre study. Lancet. 2002;359(9308):741-6. [Crossref] [PubMed]
23. Poesen R, Bammens B, Claes K, Kuypers D, Vanrenterghem Y, Monbaliu D, et al. Prevalence and determinants of anemia in the immediate postkidney transplant period. Transpl Int. 2011;24(12):1208-15. [Crossref] [PubMed]