Prediction of Inpatient Survival and Graft Loss in Rehospitalized Kidney Recipients

E. Nemati, V. Pourfarziani, A.M. Jafari, S. Assari, M. Moghani-Lankarani, H. Khedmat, N. Bagheri, and S.H. Saadat

ABSTRACT

Introduction. Despite a sizeable amount of research conducted hitherto into predictors of renal transplantation outcomes, there are scarce, data on predictors of in-hospital outcomes of post–kidney transplant rehospitalization. This study sought to provide a user-friendly prediction model for inpatient mortality and graft loss among rehospitalized kidney recipients.

Method. This retrospective review of 424 consecutive kidney recipients rehospitalized after kidney transplantation between the years 2000 and 2005 used multiple logistic regression analysis to evaluate predictors of hospitalization outcomes.

Results. Multivariate analysis showed that age at admission, diabetes mellitus as the cause of end-stage renal disease (ESRD), admission due to cerebrovascular accident (CVA), surgical complications were predictors of in-hospital death; age at transplantation, surgical complications, and rejection were predictors of graft loss. Equation for prediction of in-hospital death was Logit(death) $-0.304 *$ age at transplantation (year) $+ 0.284 *$ age at admission (year) $+ 1.621 *$ admission for surgical complication $+ 4.001 *$ admission for CVA-ischemic heart disease $+ 2.312 *$ diabetes as cause of ESRD. Equation for prediction of in-hospital death was Logit(graft loss) $= 0.041 *$ age at transplantation (year) $+ 1.184 *$ admission for graft rejection $+ 1.798 *$ admission for surgical complication.

Conclusions. Our prediction equations, using simple demographic and clinical variables, estimated the probability of inpatient mortality and graft loss among re-hospitalized kidney recipients.

KIDNEY TRANSPLANTATION, albeit a treatment of choice for chronic renal failure with a high percentage of patient survival and long-term graft survival, can result in serious posttransplant complications.[1] Long-term medical complications of renal transplantation are of great significance[2] in that they are responsible for the rehospitalization of more than half of the renal recipients during the first posttransplant year[3] and even multiple readmissions in some cases.[4]

Despite its widespread use to identify predictors of inpatient outcomes in different diseases,[5] multiple regression models have rarely been employed to predict outcomes of posttransplant rehospitalizations of renal recipients. The majority of researchers have tended to focus on prediction indices of mortality and graft loss among the total population of kidney recipients.[6,7] By trying to determine the rates of inpatient graft loss and patient survival after rehospitalization, the present study sought to provide a user-friendly prediction model for inpatient mortality and graft loss.

METHODS

We conducted a retrospective study of 424 consecutive kidney recipients rehospitalized between 2000 and 2005. Between 1992 and August 2006, a total of 2269 renal transplantations were performed in our hospital. Rehospitalization was defined as a

From the Nephrology/Urology Research Center (NURC) (E.N., V.P., H.K., N.B., S.H.S.) and Clinical Research Unit (A.M.J., S.A., M.M.L.), Baqiyatallah Medical Sciences University, Tehran, Iran.

This study was fully supported and funded by Baqiyatallah Medical Sciences University.

Address reprint requests to Eghlim Nemati, Baqiyatallah University of Medical Sciences, Vanak Square, Mollasadra Ave 19945-587, Tehran 1435915371 Iran. E-mail: eghlim.nemati@gmail.com

0041-1345/07/$–see front matter
doi:10.1016/j.transproceed.2007.03.093

Table 1. Age at Admission, Age at Transplantation, and Admission Duration in Groups in Terms of Inpatient Outcomes

	Patient			Graft		
	Death	Survived	*P*	Loss	Survived	*P*
Age at admission	53.22 ± 10.07	39.79 ± 13.80	.004	34.66 ± 14.72	40.54 ± 13.6	.026
Age at transplantation	52.33 ± 9.53	39.71 ± 14.02	.008	33.92 ± 15.47	40.56 ± 13.79	.017
Admission duration	13.44 ± 11.53	11.59 ± 10.45	.720	16.15 ± 21.33	11.23 ± 8.82	

hospital admission for any reason after discharge from the initial transplant hospitalization. Patient age, sex, etiology of end-stage renal disease (ESRD), length of hospital stay, and transplantation admission interval (ie, the time interval between initial transplantation and rehospitalization) were extracted from patient hospital records. In-hospital graft and patient survivals were also registered.

Primary diagnoses recorded in the hospital discharge records were classified in broad categories of undetermined; cancer; cerebrovascular accident (CVA); infection; rejection; surgical complications; drug complications; stone; and miscellaneous etiologies such as posttransplant diabetes mellitus, benign prostatic hyperplasia, posttransplant hypertension, anemia, intestinal necrosis, transient thrombotic purpura, and cholestasis.

Data were analyzed using SPSS version 13. Stepwise multiple logistic regression analysis was performed to find prediction models for graft loss and patient mortality. The significance level for variable entry and removal was .1. Independent variables in this model consisted of sex, age, marital status, age at transplantation, level of education, monthly income, and etiology of ESRD including diabetes and other causes. Dependent variables were graft loss and patient mortality.

RESULTS

Of the 424 kidney recipients rehospitalized after kidney transplantation, 297 (70%) subjects were man and 127 (30%) were woman. Mean value ± SD for patient age were 39.9 ± 14.0 years and 40.0 ± 13.8 years at transplantation and at admission, respectively. The sources of the kidney graft were living related donors (25, 6%), cadavers (28, 6.5%), and living unrelated donors (371, 87.5%). Age at admission and age at transplantation are presented in Table 1.

Rehospitalization was due to cancer (4, 0.9%), CVA (3, 0.7%), infection (189, 44.6%), rejection (200, 47.2%), surgical complications (26, 6.1%), stone (14, 3.3%), drug complications (19, 4.5%), miscellaneous (24, 5.7%), and undetermined diagnosis (24, 5.7%).

Table 2. The Causes of Rehospitalization, Death, and Graft Loss After Kidney Transplantation

Cause	Rehospitalized	Death	Graft Loss
Cancer	4 (0.9%)	—	—
CVA	3 (0.7%)	—	1 (2.9%)
Infection	189 (44.6%)	5 (55.6%)	11 (31.4%)
Rejection	200 (47.2%)	4 (44.4%)	27 (75%)
Surgical complications	26 (6.1%)	2 (22.2%)	5 (13.9%)
Stone	14 (3.3%)	—	—
Drug complications	19 (4.5%)	1 (11.1%)	—
Miscellaneous	24 (5.7%)	1 (11.1%)	2 (5.6%)
Undetermined diagnosis	24 (5.7%)	—	1
Total	424	9	36

There were nine deaths (2.1%); six patients had functional kidneys and three patients had nonfunctional kidneys at the time of death. There were also 36 cases of graft loss, resulting in three deaths. The deaths were caused as due to infection (5, 55.6%), rejection (4, 44.4%), surgery complications (2, 22.2%), drug complications (1, 11.1%), or miscellaneous (1, 11.1%) (Table 2). Death was correlated with higher age at admission (53.22 ± 10.07 vs 39.79 ± 13.80 years, $P = .004$) and transplantation (52.33 ± 9.53 vs 39.71 ± 14.02 years, $P = .008$) but not admission duration (13.44 ± 11.53 vs 11.59 ± 10.45 days, $P = .720$). Predictor variables of posttransplant death were age at admission (odds ratio [OR] = 1.32, 90% confidence interval [CI]: 1.04 to 1.69), diabetes mellitus as the cause of ESRD (OR = 10.09, 90%CI: 2.47 to 41.22), admission due to CVA (OR = 54.64, 90%CI: 4.91 to 607.16), and admission due to surgical complications (OR = 5.05, 90%CI: 1.17 to 21.76) (Table 3). These predictors provided an equation for prediction of in hospital death as following: Logit(death) = −0.304 * age at transplantation (year) + 0.284 * age at admission (year) + 1.621 * surgical complication + 4.001 * CVA-ischemic heart disease + 2.312 * diabetes as cause of ESRD.

Table 3. Correlates of in-Hospital Death and Graft Loss

	Death		Graft Loss	
	%	*P*	%	*P*
Age				
>60	8.1	.037	9.2	.178
≤60	1.6		2.7	
Sex				
Male	2	.827	8.8	.759
Female	2.4		7.9	
Cause of ESRD				
Diabetes mellitus	8.2	.019	4.1	.132
Other	1.3		11.2	
Length of stay				
<14 d	3.3	.243	9.2	.638
≥14 d	1.7		7.8	
Causes of admission				
Cancer	0		0	
CVA	0		33.3	
Infection	2.6		5.8	
Rejection	2		13.5	
Surgical complications	7.7		19.2	
Stone	0		0	
Drug complications	5.3		0	
Miscellaneous	4.2		8.3	

Graft loss was caused by CVA (1, 3%), infection (11, 31%), rejection (27, 75%), surgical complications (5, 14%), miscellaneous (2, 6%), and undetermined diagnosis (1 patient 3%) (Table 2). Graft loss was correlated with lower age at admission (34.66 ± 14.72 vs 40.54 ± 13.6 years, $P = .026$) and transplantation (33.92 ± 15.47 vs 40.56 ± 13.79 years, $P = .017$) but not with admission duration. Predictor variables of graft loss were age at transplantation (OR = 1.04, 90%CI: 1.03 to 1.05), admission due to surgical complications (OR = 6.04, 90%CI: 2.57 to 14.16), and admission due to rejection (OR = 3.26, 90%CI: 1.55 to 6.85) (Table 3). This model provided following outcome: Logit(graft loss) = 0.041 ∗ age at transplantation (year) + 1.184 ∗ rejection + 1.798 ∗ surgical complication.

DISCUSSION

Providing data regarding in-hospital mortality and graft loss rates of 2% and 8.5%, respectively, the current study presented predictors of age at admission, etiology of ESRD, and cause of admission as a user-friendly prediction index to estimate inpatient outcome of kidney recipients at the time of hospitalization.

It is noteworthy that the predictive value of age[8] and cause of ESRD has already been noted in the existing literature on the subject.[9,10] The reported mortality rates of rehospitalized kidney recipients tends to vary in terms of primary admission causes; while they are low in cases of lymphocele (0%),[11] prostate center,[12] nephrolithiasis,[13] ureteral stenosis,[14] and localized prostate cancer,[15] they tend to rise in cases such as cytomegalovirus,[16,17] Kaposi's sarcoma,[18] and ARDS,[19] reaching maximum levels for some types of fungal infections (100%).[20]

Whereas infection and rejection were the most common causes for inpatient death in our study, infection and cardiovascular disease have been reported elsewhere to be the leading causes of posttransplant mortality.[21–24].

In our study, graft loss was mainly the result of graft rejection and infection. Other related studies have introduced graft rejection and patient death[8,25,26] or cardiovascular disease, infections, and malignancy[27] as the main culprits for graft loss. It has also been reported that if a patient is readmitted due to etiologies other than graft rejection, the finger of blame for graft loss can be pointed at decreased immunosuppression usually in the wake of an active infection.[28]

Data on post–kidney transplant rehospitalizations tended to be convoluted for variety of reasons. First, not all rehospitalizations were necessarily the result of a post–kidney transplant complication. Second, some patients were likely to be repeatedly rehospitalized for a whole host of reasons. And third, patients recruited into studies showed variable lengths of follow-up.[29]

The primary diagnosis was undetermined in 5.7% of all rehospitalizations in our study, which is a problem that other authors have previously encountered.[30] It is also noteworthy that we opted for "primary diagnosis" at the expense of "cause of death" in our study not just because the specific cause of death was elusive in most cases,[30,31] but also because our regression model required variables that could be easily measured at the time of transplantation. The last point needing clarification is that although living donors were the providers of almost all the kidneys in our series, we compared our results with those studies using cadaveric donations.[10]

In-hospital mortality, generally considered as a main quality indicator of a health care system,[32] can be reduced through the patient's judicious reaction to the onset of symptoms, timely diagnosis, effective diagnostic methods, efficient nursing, application of efficacious in-hospital therapies, and active involvement of health care organizations,[33] all of which require sufficient funding.[34]

In conclusion, we recommend our user-friendly prediction model be validated before it be used to predict inpatient outcomes of kidney recipients at the time of readmission. Prevention and proper treatment of infections and graft rejection, the main culprits for graft loss or death in kidney recipients, should be of utmost importance.

REFERENCES

1. Senija R, Jasminka D, Kenana A, et al: Our experiences in kidney transplantation and monitoring of kidney graft outcomes. Bosn J Basic Med Sci 5:43, 2005
2. Silkensen JR: Long-term complications in renal transplantation. J Am Soc Nephrol 11:582, 2000
3. Neylan JF, Sullivan EM, Steinwald B, et al: Assessment of the frequency and costs of posttransplantation hospitalizations in patients receiving tacrolimus versus cyclosporine. Am J Kidney Dis 32:770, 1998
4. Pour-Reza-Gholi F, Labibi A, Farrokhi F, et al: Signs and symptoms of cytomegalovirus disease in kidney transplant recipients. Transplant Proc 37:3056, 2005
5. Sahasakul Y, Chaithiraphan S, Panchavinnin P, et al: Multivariate analysis in the prediction of death in hospital after acute myocardial infarction. Br Heart J 64:182, 1990
6. Goldfarb-Rumyantzev AS, Scandling JD, Pappas L, et al: Prediction of 3-yr cadaveric graft survival based on pre-transplant variables in a large national dataset. Clin Transplant 17:485, 2003
7. Hernandez D, Rufino M, Bartolomei S, et al: A novel prognostic index for mortality in renal transplant recipients after hospitalization. Transplantation 79:337, 2005
8. Lund F, Thaysen JH, Ladefoged J, et al: Long term survival and graft function after cadaver kidney transplantation. Acta Chir Scand Suppl 472:9, 1976
9. Lufft V, Dannenberg B, Schlitt HJ, et al: Cardiovascular morbidity and mortality in patients with diabetes mellitus type I after kidney transplantation: a case-control study. Clin Nephrol 61:238, 2004
10. Wolfe RA, Ashby VB, Milford EL, et al: Comparison of mortality in all patients on dialysis, patients on dialysis awaiting transplantation, and recipients of a first cadaveric transplant. N Engl J Med 341:1725, 1999
11. Bailey SH, Mone MC, Holman JM, et al: Laparoscopic treatment of post renal transplant lymphoceles. Surg Endosc 17:1896, 2003
12. Hafron J, Fogarty JD, Wiesen A, et al: Surgery for localized prostate cancer after renal transplantation. BJU Int 95:319, 2005
13. Abbott KC, Schenkman N, Swanson SJ, et al: Hospitalized nephrolithiasis after renal transplantation in the United States. Am J Transplant 3:465, 2003

14. Pozo Mengual B, Burgos Revilla FJ, Linares Quevedo A, et al: Ureteral stenosis after kidney transplantation: treatment with a self-expanding metal prosthesis. Actas Urol Esp 27:190, 2003

15. Hafron J, Fogarty JD, Wiesen A, et al: Surgery for localized prostate cancer after renal transplantation. BJU Int Feb 95:319, 2005

16. Kekec Y, Tavli S, Tokyay R, et al: Infections after kidney transplantation. Transplant Proc 24:1932, 1992

17. Kuypers DR, Vanrenterghem Y: Prophylaxis of cytomegalovirus infection in renal transplantation. Nephrol Dial Transplant 13:3012, 1998

18. Mitxelena J, Gomez-Ullate P, Aguirre A, et al: Kaposi's sarcoma in renal transplant patients: experience at the Cruces Hospital in Bilbao. Int J Dermatol 42:18, 2003

19. Shorr AF, Abbott KC, Agadoa LY: Acute respiratory distress syndrome after kidney transplantation: epidemiology, risk factors, and outcomes. Crit Care Med 31:1325, 2003

20. Temeck BK, Venzon DJ, Moskalu CA, et al: Thoracotomy for pulmonary mycosis in nonHIV-immunosuppressed patients. Ann Thorac Surg 58:333, 1994

21. Rubin RH, Wolfson JS, Cosimi AB, et al: Infection in the renal transplant recipient. Am J Med 70:405, 1981

22. Kee T, Lu YM, Vathsala A: Spectrum of severe infections in an Asian renal transplant population. Transplant Proc 36: 2001, 2004

23. Available at: http://www.usrds.org/

24. Herzog CA, Ma JZ, Collins AJ: Poor long-term survival after acute myocardial infarction among patients on long-term dialysis. N Engl J Med 339:799, 1998

25. First MR: Renal function as a predictor of long-term graft survival in renal transplant patients. Nephrol Dial Transplant 18(suppl 1):i3, 2003

26. Raiss-Jalali GA, Mehdizadeh AR, Razmkon A, et al: Effect of body mass index at time of transplantation and weight gain after transplantation on allograft function in kidney transplant recipients in Shiraz. Transplant Proc 37:2998, 2005

27. Pedroso S, Martins L, Fonseca I, et al: Renal transplantation in patients over 60 years of age: a single-center experience. Transplant Proc 38:1885, 2006

28. Kumar MS, Cridge P, Molavi A, et al: Infectious complications in the first 100 days after renal transplantation. Transplant Proc 27:2705, 1995

29. Metcalfe C, Thompson SG, Cowie MR, et al: The use of hospital admission data as a measure of outcome in clinical studies of heart failure. Eur Heart J 24:24, 2003

30. Abbott KC, Bucci JR, Cruess D, et al: Graft loss and acute coronary syndromes after renal transplantation in the United States. J Am Soc Nephrol 13:2560, 2002

31. Abbott KC, Bernet VJ, Agodoa LY, et al: Diabetic ketoacidosis and hyperglycemic hyperosmolar syndrome after renal transplantation in the United States. BMC Endocr Disord 3:1, 2003

32. Krauss J, Maclean R: Inpatient mortality: a reflection of quality care? Outcomes Manag 6:169, 2002

33. Tourangeau AE, Cranley LA, Jeffs LImpact of nursing on hospital patient mortality: a focused review and related policy implications. Qual Saf Health Care 15:4, 2006

34. Gonzalez Santos JM: Does nature of hospital financing influence early mortality after coronary artery bypass grafting? Rev Esp Cardiol May 59:414, 2006