



Journal Homepage: -[www.journalijar.com](http://www.journalijar.com)

## INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)

Article DOI:10.21474/IJAR01/15681  
DOI URL: <http://dx.doi.org/10.21474/IJAR01/15681>



### RESEARCH ARTICLE

#### DETERMINANTS INFLUENCING LENGTH OF ICU STAY IN RENAL TRANSPLANT RECIPIENTS UNDERGOING GENERAL ANAESTHESIA

Girraj Sharma, Jagdeep Sharma and Y.K Batra

#### Manuscript Info

##### Manuscript History

Received: 10 September 2022

Final Accepted: 14 October 2022

Published: November 2022

##### Key words:-

Influencing Length of ICU, Renal Transplant, Recipients, General Anaesthesia

#### Abstract

**Background:** In this study, we wanted to evaluate the duration of intensive care unit (ICU) stay in renal transplant recipients and identify the perioperative factors affecting the duration of ICU stay.

**Materials And Methods:** This was a hospital based prospective cohort study conducted among 76 patients who presented with renal transplantation to the Department of Anaesthesiology and Intensive Care Unit, Max Super Speciality Hospital, Mohali of Punjab State, from May 2018 to April 2019 after obtaining clearance from Institutional Ethics Committee and written informed consent from the study participants.

**Results:** Longer ICU stay was associated with pleural effusion and left ventricular hypokinesia (p value <0.05). No significant association was found between other clinical conditions and duration of ICU stay. Longer ICU stay was associated if duration of dialysis is longer and thrice a week dialysis. This was statistically significant (p value <0.05). Higher mean serum lactate levels were associated with longer ICU stay (p value <0.05). Longer ICU stay was found in those who had lower mean arterial pressure, higher systolic blood pressure and lower urine output. This was found to be statistically significant. Longer ICU stay was associated with low blood pH, higher serum lactate and lower urine output during post-operative period. This was found to be significant

**Conclusion:** There were certain factors which affected the duration of ICU stay – Older age, higher ASA grades, longer duration of dialysis, and higher frequency of dialysis. Among the perioperative parameters- preoperative mean serum lactate levels, intraoperative lower mean arterial pressure, lower systolic blood pressure and lower urine output, post-operative low blood pH, higher serum lactate and lower urine output were associated with longer duration of ICU stay.

Copy Right, IJAR, 2022,. All rights reserved.

#### Introduction:-

##### Chronic kidney disease

Chronic kidney disease (CKD) is a common and rapidly increasing global public health problem, both in developed and developing countries. The global prevalence of CKD is estimated to be 8-16%,<sup>[1]</sup> and the disease burden is expected to grow. In India, recent studies have shown a variable prevalence ranging from 4% to 17.2% with wide regional differences.<sup>[2-3]</sup> Globally, CKD is associated with high morbidity and mortality with approximately 735,000

deaths annually.<sup>[4]</sup> Thus, CKD is the 12th most common cause of death and the 17th most common cause of disability. End-stage renal disease (ESRD) represents the terminal stage of CKD and is defined by a glomerular filtration rate of <15 mL/min/1.73 m<sup>2</sup>. There is a paucity of data in India regarding true incidence of ESRD. An Indian population-based study determined the crude and age-adjusted ESRD incidence rates at 151 and 232/million populations.<sup>[5]</sup>

### Renal transplantation

Different modalities exist for renal replacement therapy (RRT), such as haemodialysis and peritoneal dialysis; however, kidney transplantation (KT) remains the treatment of choice for ESRD as it leads to longer survival and superior quality of life.<sup>[6]</sup> It is estimated that in India, 3500 patients undergo renal transplantation, 3000 new patients are put on continuous ambulatory peritoneal dialysis, and more than 15,000 patients begin maintenance haemodialysis in a year.<sup>[7]</sup>

### Factors influencing ICU stay

There are many factors influencing morbidity and mortality in renal transplant patients. The key factors related to the recipient include their age, human leukocyte antigen (HLA) matching, HLA immunization, ethnic background, time on dialysis and cardiovascular co-morbidities.<sup>[8]</sup> Age at the time of transplantation is clearly co-related with long-term outcome, as well as the stay of patient in intensive care unit.<sup>[9]</sup> Increased incidence of acute rejection has been observed in transplant patients as a result of poor HLA matching.<sup>[10,11]</sup> Time spent on dialysis is another very important factor influencing the outcome of kidney transplant. Meier-Kriesche et al. in their review on the impact of pre transplant dialysis on outcomes in renal transplantation summated that longer time on dialysis, adversely affected the outcome.<sup>[12]</sup> Cardiovascular complications at the time of transplantation is another parameter to consider, as the time spent on dialysis is correlated with the number of cardiovascular complications.<sup>[13]</sup> Infections and surgical complications among renal transplant recipients are also associated with extended ICU stay. Studies have shown sepsis to be a prominent factor responsible for overall ICU mortality. Other key factors impacting ICU admission and stay include requirement of mechanical ventilation and use of vasoactive drugs.<sup>[14]</sup>

### Rationale for the present study

With the rapid increase in the number of kidney transplant surgeries, there is an increasing need to assess the factors affecting morbidity, mortality and length of stay in ICU among renal transplant recipients. Since a prolonged ICU stay proves to be a major economic burden for the patients and their families, efforts to reduce the length of stay in ICU will be beneficial in terms of better patient survival as well as improved cost effectiveness.<sup>[15]</sup> Although extensive studies have been done on factors impacting the longterm outcome in kidney transplant patients, there have been very few studies to co-relate the duration of ICU stay and long term outcome among transplant recipients. Unearthing the predictors of extended ICU stay and avertable complications will not only improve the immediate outcome but will also have a lasting impact on the long term consequences. This study is an attempt to elicit the major perioperative factors and parameters that influence the duration of ICU stay among renal transplant recipients.

### Aims and Objectives:-

1. To ascertain the duration of ICU stay in renal transplant recipients.
2. To identify the perioperative factors affecting the duration of ICU stay.

### Materials And Methods:-

This was a hospital based prospective cohort study conducted among 76 patients who presented with renal transplantation to the Department of Anaesthesiology and Intensive Care Unit, Max Super Speciality Hospital, Mohali of Punjab State, from May 2018- April 2019 after obtaining clearance from Institutional Ethics Committee and written informed consent from the study participants.

### Inclusion Criteria

The inclusion criteria were

1. Patient aged >18 years of age
2. Both sexes
3. ASA grades- 1 to 4
4. ABO compatible and incompatible

**Exclusion Criteria**

Exclusion criteria included

1. Patients who had to undergo emergency renal transplantation.
2. Patients who were not willing to give consent.

**Sample Size Determination**

Sample size calculation for the study =  $Z^2 \times p \times q / L^2$

Z= standard deviation

P= prevalence/incidence (incidence of advanced chronic kidney disease is taken, assuming all patients with chronic renal failure require renal transplantation)

Q= 1-prevalence

L= relative error

As per previous literature, the incidence of advanced stages of chronic renal failure in India<sup>2-3</sup> is 15 % (range 4-17.2%), relative error =8%, and Z=1.96,

Sample size =  $(1.96)^2 \times 15 \times 85 / 8 \times 8$

=  $3.8416 \times 1275 / 64$

= 4898/64

=76

Total sample size =76

Thus for the present study, a total of 76 study participants were recruited.

**Statistical Methods:-**

Data entry was done with Statistical Package for Social Sciences (SPSS IBM) version 21.0 and data entry checks was done at regular intervals to ensure valid entries. Analysis of data was done with SPSS IBM version 21.0. Both univariate and bivariate analysis was done. Proportions were calculated for qualitative variables and mean with standard deviation were done for quantitative variables. Required tests of significance were applied. Independent t test and chi square tests were applied. Significance of p value is taken as  $p < 0.05$ . Multivariate analysis for controlling for other factors affecting length of ICU stay was done using multiple logistic regressions.

**Results:-**

S. No.	Study Participants' Profile	Duration of ICU Stay		pValue
		<48 Hours N (%)	>48 Hours N (%)	
1.	<b>Sex</b>			0.271
	Male	41(83.7)	8(16.2)	
	Female	25(92.6)	2(7.4)	
2.	<b>Age group</b>			0.524
	40-50	30(90.9)	3(9.1)	
	51-60	27(81.8)	6(18.2)	
	>60	9(90)	1(10)	
3.	<b>BMI*</b>			<b>0.047</b>
	<18.5	31(88.6)	4(11.4)	
	18.5-22.9	17(89.5)	2(10.5)	
	23-24.9	13(76.5)	4(23.5)	
	>25	5(100)	0	
4.	<b>ASA grade</b>			<b>0.032</b>
	2	61(88.4)	8(11.6)	
	3	5(71.4)	2(28.6)	
<b>Association between Some Selected Patient Related Factors and Duration of ICU Stay. (N=76)</b>				
<b>Chi Square Test Applied, p Value &lt;0.05 is Significant</b>				
<b>Table 1</b>				

Chi square test was applied to look for any association between duration of ICU stay and sex, age group, BMI and ASA grades. Longer ICU stay was associated with males, overweight patients (as per BMI criteria) and patients with higher ASA grades. This was found to be statistically significant. ( $p < 0.05$ ) There was no influence of age group on duration of ICU stay.

S. No.	Clinical Condition	Duration of ICU stay		OR(95% CI)	pValue
		<48 hours N(%)	>48 hours N(%)		
1.	<b>History of Diabetes</b> Yes No	60(85) 6(100)	10(15) 0	-	-
2.	<b>History of Hypertension</b> Yes No	7(87.5) 59(86.8)	1(12.5) 9(13.2)	1.06 (0.11-9.72)	0.954
3.	<b>Pleural Effusion</b> Yes No	9(13.6) 57(86.4)	9(90) 1(10)	3.1(1.36-7.4)	<b>0.021</b>
4.	<b>Pericardial Effusion</b> Yes No	7(100) 59(85.5)	0 10(14.5)	1.1(1.06-1.28)	0.280
5.	<b>Left Ventricular Hypokinesia</b> Yes No	4(6) 62(94)	9(90) 1(10)	2.0(1.23-7.3)	<b>0.039</b>
6.	<b>Ejection Fraction</b> <30% 30% to 50% >50%	7(100) 10(76.9) 49(87.5)	0 3(23.1) 7(12.5)	-	0.333
7.	<b>Dilated Cardiomyopathy</b> Yes No	9(90) 57(86.4)	1(10) 9(13.6)	1.4 (0.16-12.6)	0.751
<b>Association between Clinical Condition Before Surgery and Duration of ICU Stay. (N=76)</b>					
<b>Chi Square Test Applied, p Value &lt;0.05 is Significant</b>					

Table 2

Chi square test was applied to look for any association between duration of ICU stay and diabetes, hypertension, pleural effusion, pericardial effusion, left ventricular hypokinesia, ejection fraction and dilated cardiomyopathy. Longer ICU stay was associated with pleural effusion and left ventricular hypokinesia. (p value <0.05). No significant association was found between other clinical conditions and duration of ICU stay.

S. No.	Dialysis Details	Duration of ICU Stay		pValue	
		<48 Hours N (%)	>48 Hours N (%)		
1.	<b>Duration of Dialysis</b> < 6 months 6 months to 1 year >1 year	4(6) 8(12) 54(82)	0 2(20) 8(80)	<b>0.0123</b>	
2.	<b>Frequency of Dialysis</b> Twice a week Thrice a week	54(91.5) 12(70.6)	5(8.5) 5(29.4)	<b>0.024</b>	
<b>Association between Dialysis History and Duration of ICU Stay. (N=76)</b>					
Chi square test applied, p value <0.05 is significant					
Preoperative Parameters	Mean (SD)	t Value	Mean Difference	95% CI	pValue
<b>Mean Arterial Pressure</b> < 48 hours >48 hours	65.44(±13.9) 62.0(±5.6)	0.765	3.439	-5.5- 12.39	0.447
<b>Blood pH</b> < 48 hours >48 hours	7.2(±0.08) 7.2(±0.09)	0.268	0.007	-0.048- -0.06	0.790
<b>Serum Lactate</b> < 48 hours	1.97(±0.92)	-0.138	-0.0427	-0.658 - -0.122	<b>0.021</b>

>48 hours	3.12(±0.76)				
<b>Association between Preoperative Parameters and Duration of ICU Stay. (N=76)</b>					
<b>Independent t Test Applied, p Value&lt;0.05 is Significant</b>					

Table 3

Longer ICU stay was associated if duration of dialysis is longer and thrice a week dialysis. This was statistically significant. (p value <0.05). Independent t test was applied to find out any difference in mean values of preoperative mean arterial pressure, preoperative blood pH, pre-operative blood lactate with the duration of ICU stay. Higher mean serum lactate levels were associated with longer ICU stay. (p value <0.05).

Intraoperative Parameters	Mean (SD)	t Value	Mean Difference	95% CI	pValue
<b>Mean Arterial Pressure</b>					
< 48 hours	79(±5)	2.549	5.103	1.114- 9.092	<b>0.013</b>
>48 hours	74(±5)				
<b>Blood pH</b>					
< 48 hours	7.27(±0.08)	-0.314	-0.0093	-0.6833- 0.4972	0.754
>48 hours	7.28(±0.09)				
<b>Systolic Blood Pressure</b>					
< 48 hours	160(±12)	1.865	7.755	-0.53- 16.03	<b>0.046</b>
>48 hours	172(±10)				
<b>Urine Output</b>					
< 48 hours	410(±101)	1.006	33.030	-32.36-98.42	<b>0.013</b>
>48 hours	377(±55)				

**Association between Intraoperative Parameters and Duration of ICU Stay. (N=76)**

Independent t test applied, p value<0.05 is significant

Postoperative Parameters	Mean (SD)	t Value	Mean Difference	95% CI	pValue
<b>Mean Arterial Pressure</b>					
< 48 hours	66(±11)	0.015	0.058	-7.553- 7.668	0.490
>48 hours	66(±10)				
<b>Blood pH</b>					
< 48 hours	7.3(±0.07)	-0.058	-0.00142	-0.050- -0.047	<b>0.019</b>
>48 hours	7.1(±0.08)				
<b>Serum lactate</b>					
< 48 hours	2.01(±0.86)	-1.183	-0.3418	-0.917 - 0.2341	<b>0.032</b>
>48 hours	3.36(±0.71)				
<b>Urine output</b>					
< 48 hours	459(±99)	-3.963	-72.000	-108.36- -35.63	<b>0.012</b>
>48 hours	322(±56)				
<b>Serum creatinine</b>					
< 48 hours	2.79(±0.54)	0.625	0.1224	-0.2680- 0.5128	0.084
>48 hours	2.67(±0.77)				
<b>Haemoglobin</b>					
< 48 hours	9.8(±2.5)	1.96	1.646	-0.025-3.319	0.099
>48 hours	8.1(±1.3)				
<b>INR</b>					
< 48 hours	1.70(±0.12)	0.386	15.29	-63.67- 94.25	0.441
>48 hours	1.76(±0.)				

**Association between Postoperative Parameters and Duration of ICU Stay. (N=76)**

Independent t Test Applied, p Value<0.05 is Significant

Table 4

Independent t test was applied to find any difference in mean values of intraoperative parameters such as mean arterial pressure, blood pH, systolic blood pressure and urine output. Longer ICU stay was found in those who had

lower mean arterial pressure, higher systolic blood pressure and lower urine output. This was found to be statistically significant. Analysis was done between duration of ICU stay and postoperative parameters such as mean arterial pressure, blood pH, serum lactate, urine output, serum creatinine, haemoglobin and INR values. Longer ICU stay was associated with low blood pH, higher serum lactate and lower urine output during post-operative period. This was found to be significant.

S. No.	Postoperative Findings	Duration of ICU Stay		OR (95% CI)	pValue
		<48 hours N (%)	>48 hours N (%)		
1.	<b>ARDS Occurrence</b>			1.17 (1.064-1.305)	0.187
	Yes	10(100)	0		
	No	56(84.8)	10(15.2)		
2.	<b>Delirium in Postoperative Period</b>			1.241 (0.138-11.13)	0.847
	Yes	8(88.9)	1(11.1)		
	No	58(86.6)	9(13.4)		
3.	<b>Atrial Fibrillation in Postoperative Period</b>			2.0(0.23-17.318)	0.522
	Yes	12(92.3)	1(7.7)		
	No	54(85.7)	9(14.3)		

**Association between Post-operative Findings and Duration of ICU Stay. (N=76)**

**Chi Square Test Applied, p Value <0.05 is Significant**

**Table 5**

There was no statistically significant association of ARDS occurrence, atrial fibrillation and delirium in post-operative period with duration of ICU stay.

### Discussion:-

The age of the study participants ranged from 40-74 years with mean ( $\pm$ SD) age being 52 ( $\pm$ 8.5) years. Among the study participants, 17(22.4%) were overweight and 35(46.1%) were obese. With respect to co morbidities, 70(92%) study participants had history of diabetes and 8(10.5%) had hypertension. The duration and frequency of dialysis among the participants varied. Dialysis for less than 6 months in 5.3%, 6 months to 1 year in 13.2%, more than one year in 81.6%. The frequency is thrice a week in majority of patients (77.6%) and twice a week in 22.4%. Among the study participants, pleural effusion was found in 18 (23.7%), pericardial effusion was seen in 7(9.2%), left ventricular hypokinesia in 13(17.1%), dilated cardiomyopathy in 10(13.2%) and ejection fraction more than 50 % in 56(76.7%).

### Duration of ICU stay

The length of ICU stays also varied among the study participants. It was <36 hours in majority of patients (78.9%), followed by 36 to 72 hours in 11.8% and > 72 hours in 9.2%. Immediate extubation after surgery was done in 62(81.6%) participants. The median (range) duration of ICU stay was 5 (2-11 days). Similarly, another study evidenced the median length of ICU stay to be 6 (3 to 13) days.<sup>[16]</sup> In a study by Sadaghdar H et al.<sup>[17]</sup> a median stay of 5 days in ICU post transplantation has been reported. However, the range of ICU stay was minimum of 2 days to a maximum of 11 days, which could be attributed to factors such as health status of the patients including BMI, age and co morbid conditions. During post-operative period, ARDS developed in 10(13.2%), delirium occurred in 9(11.8%) and atrial fibrillation in 13 (17.11%) participants.

### Factors affecting the duration of ICU stay

#### Weight of the participants and ASA grades

Longer ICU stay was associated with overweight patients and those with higher ASA grades. This was found to be statistically significant. (p value <0.05). From previous studies it was found that patient's overweight and older age might reduce the length of hospitalization.<sup>104-106</sup> It was also observed in another study that the duration of ICU stay was much shorter among younger age transplants. In that study, a multivariate analysis has proven age to be an influencing factor for duration of ICU stay as well as mortality.<sup>[18]</sup>

Younger age group has better immunity and faster recovery after surgery, which makes duration of ICU stay much lesser. This fact in the present study has been in line with the previous similar studies. In our study, it was also found

that longer ICU stay was associated with pleural effusion and left ventricular hypokinesia. (p value <0.05) Co-morbid conditions and obesity were also noted as important factors that influence ICU stay.

#### **Duration of dialysis**

Longer ICU stay was associated with longer duration of dialysis and increased frequency of dialysis. (p value <0.05) A study by Naghibi O et al.<sup>[19]</sup> also showed that duration of pre-transplant dialysis affected the length of hospitalization in kidney transplant recipients. Thus the duration of pre-transplant dialysis was found to be independently associated with predicting an increased length of hospitalization.

#### **Perioperative parameters**

It was found from the analysis that higher preoperative mean serum lactate levels were associated with longer ICU stay. Among intraoperative parameters, longer ICU stay was noticed in those who had lower mean arterial pressure, higher systolic blood pressure and decreased urine output. Longer ICU stay was associated with low blood pH, higher serum lactate and decreased urine output during post-operative period. This was found to be significant. In a previous study, mechanical ventilation requirement and need for use of vasoactive drugs was found to influence the duration of ICU stay and mortality.<sup>[20]</sup> Similarly, in another study,<sup>[18]</sup> serum creatinine and the total urine output had a profound influence on length of ICU stay and mortality. Thus, it can be concluded that intraoperative and certain post-operative parameters have a role in influencing the ICU stay.

#### **Conclusion:-**

It was found from our study that the duration of stay in ICU is varied. It was <36 hours in majority (78.9%), followed by 36 to 72 hours in 11.8% and > 72 hours in 9.2%. The median duration of ICU stay was T 5 days (2-11 days). There were certain factors which affected the duration of ICU stay – Older age, higher ASA grades, longer duration of dialysis, and higher frequency of dialysis. Among the perioperative parameters – pre-operative mean serum lactate levels, intra-operative lower mean arterial pressure, lower systolic blood pressure and lower urine output, post-operative low blood pH, higher serum lactate and lower urine output were associated with longer duration of ICU stay.

#### **References:-**

1. Coresh J, Selvin E, Stevens LA, Manzi J, Kusek JW, Eggers P, et al. Prevalence of chronic kidney disease in the United States. *JAMA* 2007;298(17):2038-47.
2. Singh AK, Farag YM, Mittal BV, Subramanian KK, Reddy SR, Acharya VN, et al. Epidemiology and risk factors of chronic kidney disease in India - Results from the SEEK (Screening and early evaluation of kidney disease) study. *BMC Nephrol* 2013;14(1):114.
3. Singh NP, Ingle GK, Saini VK, Jami A, Beniwal P, Lal M, et al. Prevalence of low glomerular filtration rate, proteinuria and associated risk factors in North India using Cockcroft-Gault and modification of diet in renal disease equation: An observational, cross-sectional study. *BMC Nephrol* 2009;10(1):1-13.
4. Lozano R, Naghavi M, Foreman K, Lim S, Shibuya K, Aboyans V, et al. Global and regional mortality from 235 causes of death for 20 age groups in 1990 and 2010: a systematic analysis for the Global Burden of Disease Study 2010. *Lancet* 2012;380(9859):2095-128.
5. Modi G, Jha V. Incidence of ESRD in India. *Kidney Int* 2011;79(5):573.
6. Garcia GG, Harden P, Chapman J. World Kidney Day Steering Committee. The global role of kidney transplantation. *Lancet* 2012;379(9820):e36-8.
7. Agarwal SK, Srivastava RK. Chronic kidney disease in India: challenges and solutions. *Nephron Clin Pract* 2009;111(3):c197-203.
8. Legendre C, Canaud G, Martinez F. Factors influencing long-term outcome after kidney transplantation. *Transpl Int* 2014;27(1):19-27.
9. Gondos A, Doehler B, Brenner H, Opelz G. Kidney graft survival in Europe and the United States: strikingly different long-term outcomes. *Transplantation* 2013;95(2):267-74.
10. Frei U, Noeldeke J, Machold-Fabrizii V, Arbogast H, Margreiter R, Fricke L, et al. Prospective age-matching in elderly kidney transplant recipients: a 5-year analysis of the Eurotransplant Senior Program. *Am J Transplant* 2008;8(1):50-7.
11. Boesmuller C, Biebl M, Scheidl S, Oellinger R, Margreiter C, Pratschke J, et al. Long-term outcome in kidney transplant recipients over 70 years in the Eurotransplant Senior Kidney Transplant Program: a single center experience. *Transplantation* 2011;92(2):210-6.

12. Meier-Kriesche HU, Schold JD. The impact of pretransplant dialysis on outcomes in renal transplantation. *Semin Dial* 2005;18(6):499.
13. Jardine AG, Gaston RS, Fellstroem BC, Holdaas H. Prevention of cardiovascular disease in adult recipients of kidney transplants. *Lancet* 2011;378(9800):1419-27.
14. Nicolet L, Heng AE, Souweine B, Mahnès G, Aublet B, Gazuy N, et al. Outcome of renal transplant recipients and graft survival in the ICU. *Crit Care* 2001;5(Suppl1):P221.
15. Gruenberg DA, Shelton W, Rose SL, Rutter AE, Socaris S, McGee G. Factors influencing length of stay in the intensive care unit. *Am J Crit Care* 2006;15(5):502-9.
16. de Carvalho MA, Pestana JO, Freitas FG, Machado FR, Júnior HT. Predictors of mortality in renal transplant recipients with severe sepsis and septic shock. *Crit Care* 2013;17(Suppl4):P36.
17. Sadaghdar H, Chelluri L, Bowles SA, Shapiro R. Outcome of renal transplant recipients in the ICU. *Chest* 1995;107(5):1402-5.
18. Aldawood A. The course and outcome of renal transplant recipients admitted to the intensive care unit at a tertiary hospital in Saudi Arabia. *Saudi J Kidney Dis Transplant* 2007;18(4):536-40.
19. Zeraati AA, Naghibi M, Kianoush S, Ashraf H. Impact of slow and delayed graft function on kidney graft survival between various subgroups among renal transplant patients. *Transplant Proc* 2009;41(7):2777-80.
20. El-Agroudy A, Alqahtani AM, Dandi B, Farid E, Taher A, Alaradhi A. Course and outcome of renal transplant recipients admitted to the intensive care unit (ICU): long term follow-up. *Transplantation* 2018;102:S637.