ANALYSIS OF CLINICAL PREDICTORS ASSOCIATED WITH SURVIVAL OF KIDNEY GRAFT AND KIDNEY TRANSPLANT RECIPIENTS

PhD thesis

Adam Remport

Basic Medicine Doctoral School

Semmelweis University

Supervisor: Dr. László Rosivall MD, D.Sc

Official reviewers:
Dr. Péter Sótonyi jun. MD, Ph.D
Dr. György Deák MD, Ph.D

Head of the Final Examination Committee:
Dr. Péter Sótonyi MD, D.Sc., Full member of Hungarian Academy of Science

Members of the Final Examination Committee:
Dr. Edit Szederkényi Ph.D
Dr. András Tislér Ph.D

Budapest, 2012

Introduction

Chronic kidney disease (CKD) is recognized as a major health problem affecting approximately 10% of the population of developed countries. The definition and the stages of CKD was introduced by the National Kidney Foundation Disease Outcome Quality Initiative (K/DOQI) to provide accurate assessement of the frequency and severity of CKD. The classification is based on estimated glomerular filtration rate (eGFR) and patients with values less than 15 ml/min/1,73m^2 may suffer from end stage renal disease (ESRD) which would necessitate renal replacement therapy(RRT), dialysis treatment or kidney transplantation.

A clear survival benefit associated with renal transplantation was shown and this has made transplantation the preferred treatment for ESRD patients medically cleared for transplantation. The development of transplant programs had been supported after it was clearly demonstrated that succesful transplantation reduced the long-term healthcare costs. Arising prevalence of ESRD, together with stable or declining rates of organ donation has led to a critical shortage of kidneys available for transplantation,. At the same time the need to improve long term allograft survival has also been made clear by epidemiologic studies.

The risk of cardiac death in dialysis patients is 10-20 times greater compared to the general population. This is likely due to both the presence of traditional risk factors and also of nontradiotional ones such as CKD dependent mineral and bone disorders, interdialytic weight gain, anemia and protein-energy wasting also called malnutrition-inflammation complex syndrome(MICS). In fact, increased time on dialysis therapy prior to transplantation has been shown to deleteriously affect patient and/or graft survival in retrospective United States registry analyses. Conflicting results have recently been published in European ESRD populations and the negative impact of pre-transplant dialysis time on

patient and graft survival was not confirmed in an inicident cohort of French transplant recipients. Based on these results the dialysis duration time may be an important modifiable risk factor of outcome measures.

Succesful kidney transplant recipients has definitely lower renal function than healthy people and their majority belongs to CKD3 stage. In the non-transplant population the degree of renal impairment correlates with the prevalence of several risk factors as hypertension, anemia, left ventricular hypertrophy, hypo-albuminemia, mineral and bone disorders, dyslipidemia, and the overall risk of all-cause and CV mortality. Few previous studies showed association between serum creatinine levels and the risk of graft loss and death after kidney transplantation. CKD staging of transplant recipients by eGFR was adopted in international guidelines, but association of reduced eGFR with posttransplant outcomes has not been well defined yet. The addition of mycophenolate-mofetil(MMF) to calcineurin-inhibitor(CNI) – corticosteroid combination decreased the occurence and severity of acute rejections and improved long-term graft and patient survival after kidney transplantation. It has remained unanswered whether the use of MMF could modulate the impact of impaired renal function on outcome in kidney-transplant recipients.

Several studies demonstrated that renal anemia is a risk factor for cardiovascular events and for mortality in non-transplant CKD and dialyzed patients. Until now, post-transplant anemia (PTA) has been an underrecognised and undertreated problem in renal transplant recipients. Only a few studies with conflicting results have been published so far on the association between PTA and kidney transplant outcomes.

In our work we analysed the association of pre-transplant dialysis duration, kidney graft function and post-transplant anemia with long-term survival of renal allografts and kidney transplant patients.

Hypotheses, aims of study

In our studies the following hypotheses pertaining the potential effect of time on dialysis prior to kidney transplantation were tested:

1. Time on dialysis prior to renal transplantation was associated with long-term mortality of kidney transplant recipients
2. Time on dialysis prior to renal transplantation was associated with long-term death censored graft loss.

The following hypotheses pertaining the association of transplant kidney function – eGFR and CKD – with outcome measures were tested:

1. The function of renal allograft showed a positive association with long-term patient survival.
2. The function of renal allograft showed a postitive association with long-term death censored kidney graft survival.
3. The use of MMF in the immunosuppressive combination may modify the associations detailed above.

In relation to PTA the following hypotheses were tested:

1. The presence of PTA was associated with long-term mortality of kidney transplant recipients
2. The presence of PTA was associated with long-term death censored graft loss.

Methods

My PhD thesis is based on three studies. The methods of these studies are summarized in this chapter.

Sample of patients and data collection

All mentioned analysis involved the studies had a common patient population. All patients over the age of 18 years (n=1067) who were regularly followed at a single kidney transplant outpatient clinic at the Department of Transplantation and Surgery, Semmelweis University, Budapest were invited to participate in a prevalent cohort study. The baseline assessment was conducted between August 2002 and February 2003 (Transplantation and Quality of Life-Hungary Study (TransQoL-HU Study)). This study was carried out to assess sleep and mood disorders, health related quality of life and the prevalence of PTA in renal transplant recipients. The study was approved by the Ethics Committee of the Semmelweis University. The study was conforming to ICP Good Clinical Practices Guidelines and the Declaration of Helsinki. Before enrolment, the patients received detailed written and verbal information regarding the aims and protocol of the study.

Out of the 1067 eligible patients 64 refused to participate in the study or dropped out due to exclusion criteria (acute rejection or significant infection within a month). Different number of patients related to each study had incomplet relevant medical history data or were lost during follow up. (non-participants). The study population, therefore, included 926 patients (participants) in the pre-transplant dialysis duration study, 985 patients in the transplant kidney function study and 938 patients in the PTA study.

From the time of the baseline visit, patients were followed up for approximately 4 years (median, [interquartile range - IQR]: 46, [6] months) during the PTA study and 5 years (median, [interquartile range - IQR]: 58, [8] months) in the other two studies. Data on two pre-defined outcomes were collected during follow-up: mortality with functioning graft (1) and death censored graft loss (return to dialysis) (2). Patients who returned to dialysis, died with functioning graft or were lost during follow-up were censored at the appropriate time. The

cause of death was classified as cardiovascular, infectious, malignant, and unspecified.

Demographic data and details of medical history were collected at enrollment when information about age, gender, etiology of chronic kidney disease (CKD), the presence or absence of diabetes, hypertension and other co-morbidities were obtained. Co-morbidity score was assessed by the End-stage Renal Disease Severity Index (ESRD-SI) and it was calculated as the number of co-morbid conditions reported by patients. Results of our earlier studies have suggested that self-reported co-morbidity score provided valuable information and showed correlation with the overall clinical condition of patients. Laboratory data were extracted from the patients` charts and from the electronic laboratory database of the hospital. The following laboratory parameters were tabulated: hemoglobin (Hb), C-reactive protein, serum creatinine, blood urea nitrogen (BUN), serum albumin. Pre-transplant dialysis duration was calculated by total time on dialysis, independently the type of dialysis, before transplantation.

Transplantation-specific data

Transplant related data extracted from the medical records included the following information: (including) current immunosuppressive treatment, other medications, transplant "vintage", i.e. time elapsed since the time of the transplantation, type of donor (deceased or living), number of HLA mismatch (HLA-A, HLA-B, HLA-DR), cold ischaemic time (CIT), donor's gender and age, pre-transplant panel reactive antibodies (PRA) and history of delayed graft function and cumulative prevalence of acute rejection. Delayed graft function (DGF) was defined as the need for dialysis on the first week after transplantation. Acute rejection was defined in the patients who received anti-rejection therapy between the time of transplant to study baseline. Graft biopsies to confirm the diagnosis of acute rejections were not routinely performed prior

to our study baseline. The cumulative prevalence of acute rejection reported here includes both early (≤6 months) and late (>6 months) acute rejection.

Standard maintenance immunosuppressive therapy generally consisted of prednisolone, either cyclosporine A microemulsion formulation (CsA) or tacrolimus, combined with mycophenolate-mofetil (MMF) or azathioprine or sirolimus. For certain analyses patients were classified as CNI-users and CNI-non-users based on the use of any CNI (CsA or tacrolimus). Based on the use of MMF patients were also classified as MMF-users and MMF-non-users.

Half of our patients (49%) had been transplanted prior to 1997, when the immunosuppression protocol had been different than after. The introduction of MMF to the routine management in early 1997 resulted in a substantial change in our immunosuppressive practices. Tacrolimus was introduced instead of cyclosporine A microemulsion formulation in 2000 and was used in many cases. The indication of induction therapy remained unchanged during the entire analyzed period. ATG or OKT3 has been used exclusively until recently, when antiCD-25 monoclonal antibodies were introduced even in some cases of moderate immunological risk.

Patient groups

In addition to analyzing pre-transplant dialysis duration as a continuous variable, we also divided the study cohort into three different groups based on pre-transplant dialysis duration (1: dialysis time less than 1 year; 2: 1-3 years on dialysis and 3: more than 3 years on dialysis prior to transplantation) in order to obtain more easily interpretable results.

Estimated glomerular filtration rate (eGFR) was calculated using the abbreviated Modification of Diet in Renal Disease (aMDRD) study formula:

eGFR (ml/min per 1.73 m2) = 186 x $(S_{Cr})^{-1.154}$ x $(Age)^{-0.203}$ (x 0.742 if femal

Based on the eGFR, patients were classified into groups corresponding to CKD stages suggested by (K/DOQI) guidelines:
group 1, eGFR≥60 (CKD 1-2); group 2, eGFR: 30-59 (CKD3); group 3, eGFR: <30 (CKD4-5).
Anemia was defined according to the anemia guideline of the American Society of Transplantation: hemoglobin under 130 g/l in adult males, and 120 g/l in adult females.

Statistical methods

Statistical analysis was carried out using the SPSS 10.0, 15.0 and STATA 8.0 software. Continuous variables were compared using Student's t-test, the Mann-Whitney U test or analysis of variance (ANOVA), as appropriate. Categorical variables were analyzed with Chi-square test. In all statistics, two-sided test were used and the result were considered statistically significant if p was <0.05. To assess variables associated with outcome, univariate and multivariable Cox proportional hazards analyses and Kaplan-Meier plots with Log Rank test were used. Multivariable regression models included all significant predictors from the corresponding univariate models; in addition, all models included age, eGFR and gender.
We also reanalyzed our multivariable model using left truncation Cox survival analysis. Proportional hazards assumptions were tested using scaled Schoenfeld residuals and were met in all our models. Variance influence factors (VIF) were used to indicate colinearity between independent variables. Patients were censored at the time of return to dialysis or the end of the follow-up period.

Results

Association of pre-transplant dialysis duration with outcome

The mean age of the study population was 49±13 years (ranging from 18 to 76 years), 59% were male and 17% had diabetes. Mean estimated eGFR was 50±22 ml/min/1.73m^2, mean serum albumin was 42±3 g/l. The median time since transplantation at enrollment was 55 months. The cumulative prevalence of delayed graft function was 28%, most of the patients have 3 HLA mismatches and the average cold ischemic time was 22 hour. At the time of enrollment 87% of the sample (759 patients) were taking prednisolone and more than two thirds (603 patients, 70%) were on cyclosporine A therapy. The number of patients taking MMF was 554 (64%). Almost 20% (154 patients) were taking tacrolimus and 105 (12%) patients were taking azathioprine. Nineteen patients (2%) were given sirolimus. Nine percent of the study population had one or more previous kidney transplants.

The cohort was followed-up for a period of approximately five years. Over 3828 person-years, 152 patients died (crude mortality rate = 40/1000 person-years) and over 3509 person-years 106 patients returned to dialysis (crude rate of graft loss = 30/1000 person-years). During the follow-up 21% of patients died of cardiovascular complications, 19% died of malignant disorders, 28% of the deaths were related to infectious complications and 32% of the patients died of unknown causes.

Univariate analysis of predictors of mortality and graft loss

Longer time on dialysis prior to transplantation was significantly associated with mortality and death-censored graft loss, as it is clearly demonstrated by the Kaplan-Meier analysis. To identify variables significantly predicting negative outcomes, univariate Cox proportional hazard analyses were performed. A significant association was found between pre-transplant dialysis duration and mortality ($HR_{\text{for each month increase}}$= 1.007; 95% CI: 1.003-1.011). In these analyses age, male gender, lower eGFR, lower serum albumin, higher serum C-Reactive

Protein (CRP) level, number of co-morbid conditions, presence of diabetes mellitus and hypertension and transplantation "vintage" were also associated with mortality.

In a similar set of analyses pre-transplant dialysis duration ($HR_{\text{for each month increase}}$= 1.007; 95% CI: 1.003-1.012) was also significantly associated with re-initiation of maintenance dialysis. Univariate analyses identified age, non use of CNI, presence of acute rejection, lower eGFR and lower serum hemoglobin level as significant predictors of death censored graft loss.

Multivariable analyses

To examine independent association between pre-transplant dialysis duration and mortality, three multivariable models were built. In the final model all variables associated with mortality at a level of $p<0.15$ in the univariate Cox models and donor type and donor age were included. Accordingly, age, gender, eGFR, serum albumin, serum CRP, serum hemoglobin, transplantation vintage, CNI non use, presence of hypertension, number of co-morbid conditions, donor type and donor age were the co-variables entered into the final multivariable Cox proportional hazard model in addition to pre-transplant dialysis duration. Qualitatively, all three models gave similar results. Based on these models pre-transplant dialysis duration was a significant, independent risk factor for mortality ($HR_{\text{for each month increase}}$= 1.011; 95% CI: 1.005-1.016; $p<0.001$) in kidney transplanted patients.

All three models showed qualitatively similar results when death censored graft loss was examined as the outcome measure. In these models pre-transplant dialysis duration was a significant, independent risk factor for death-censored graft loss ($HR_{\text{for each month increase}}$= 1.008; 95% CI: 1.001-1.015; $p=0.025$) Model 3 demonstrated that patients with less than 1 year on dialysis (HR= 0.498; 95% CI: 0.302-0.820; $p=0.006$) and 1-3 years on dialysis prior to transplantation

(HR= 0.577; 95% CI: 0.371-0.899; p=0.015) had significantly better 5 year survival after transplantation compared to those with more than 3 years on dialysis pre-transplant.

Association of transplant kidney function with outcome

The mean age of the study population was 49±12 years; the prevalence of diabetes was 15% and the prevalence of hypertension was 65%. The mean eGFR was 49±19 ml/min/1.73m^2, mean serum albumin was 41±3 g/l, and mean hemoglobin was 133±19g/l. The median transplant vintage was 59 months; the median dialysis time prior to transplantation was 22 months. At the time of enrolment almost 90% of the patients (858 patients, 87%) were taking prednisolone and more than two thirds (713 patients, 72%) were on cyclosporine A. The number of patients taking mycophenolate-mofetil (MMF) was 605 (61%). Somewhat more than 10% of the patients were taking tacrolimus (135 patients [14%]) or azathioprine (134 patients [14%]), respectively. Seventeen patients (2%) were given sirolimus. The immunosuppressive drug use was similar in the CKD groups, except for steroid and sirolimus, which were the highest in the CKD 4-5 group. Only 149 (15%) patients were taking angiotensin converting enzyme inhibitors (ACEI) or angiotensin receptor blockers (ARB).

The average cold ischaemic time was 21.5 hours and delayed graft function was documented in 27% of the patients. The cumulative prevalence of acute rejection (includes early and late acute rejection) since the time of transplant to study baseline was 45%. Eight percent of the total acute rejection rate was steroid resistant.

The cohort was followed for 5 years (median 58 months; IQR: 10). Over 3964 person-years, 163 patients (16%) died (crude mortality rate: 41/1000 person-

years) and over 3629 person-years 120 patients returned to dialysis (crude rate of graft failure = 33/1000 person-years). During the follow-up, 23% of death occurred due to cardiovascular complications, 17% from malignant disorders, 26% of deaths were related to infectious complications and 34% of the patients died from unknown causes.

Univariate analysis of predictors of mortality and graft failure

The number of patients in the three CKD stages was: 265 (27%), 561 (57%) and 159 (16%) for groups 1-3, respectively. All outcomes were more frequent in groups 2 and 3 (i.e. in the groups with worse CKD stages), compared to group 1. CKD stages showed significant association with mortality (death with functioning graft) and graft failure, as it is clearly demonstrated by the Kaplan-Meier analysis. There was no association between the cause of death and graft function, nor have we found any association between causes of death and the elapsed time after transplantation, or the immunosuppressive medications used.

To identify variables significantly associated with negative outcome, univariate Cox proportional hazard analyses were performed. A significant association was found between eGFR and mortality ($HR_{\text{for each 10 ml/min decrease}}$= 1.262; 95% CI: 1.151-1.384) and CKD 4-5 was associated with worse survival compared to CKD 1-2 (HR= 3.046; 95% CI: 1.983 – 4.679). In these analyses age, male gender, the presence of diabetes or hypertension, time on dialysis prior to transplantation, transplant vintage at baseline, the number of co-morbid conditions, serum CRP, serum albumin and hemoglobin were all predictors of mortality. We did not find any association between panel reactive antibody titer, cold ischaemic time, first or re-transplant status, use of CNI, use of MMF, use of steroid, use of azathioprine, age or gender of donor versus mortality.

In a similar set of analyses significant association was found between eGFR and graft failure ($HR_{\text{for each 10 ml/min decrease}}$= 1.385; 95% CI: 1.239-1.549) (Table 2.). In

these analyses age, time on dialysis prior to transplantation, serum hemoglobin, history of delayed graft function, history of acute rejection, non-use of CNI and HLA mismatches were predictors of graft failure (Table 2.). We did not find any association between panel reactive antibody titer, cold ischaemic time, first or re-transplant status, use of MMF, use of steroid, use of azathioprine, age or gender of donor versus graft failure.

Multivariable analyses

All variables significantly associated with mortality and/or graft failure in the univariate models were included in the multivariable analysis. In this model eGFR was significant and independent predictor of mortality. Each 10 ml/min/1.73m^2 decrease in eGFR was associated with a 1.271 fold higher mortality risk in the study population ($p<0.001$; CI: 1.121-1.440). Additionally, in a different multivariable Cox proportional hazard model, where CKD stage instead of eGFR was entered, CKD stage 4-5 (HR=2.678, 95% CI: 1.494-4.802) was associated with significantly increased mortality risk compared to CKD stage 1-2.

The eGFR was also significantly associated with graft failure. All variables significantly associated with mortality and/or graft function in the univariate models were included in the multivariable analysis. In this model graft function was significant and independent predictor of graft failure ($HR_{\text{for each 10 ml/min decrease}}$: 1.355, 95% CI: 1.157-1.588, $p<0.001$) after correction for potential covariables. Additionally, CKD stage 4-5 (HR=3.631, 95% CI: 1.672-7.884) significantly increased the risk of graft failure compared to CKD stage 1-2. The difference between CKD stage 3 versus CKD stage 1-2 was not statistically significant, but there seemed to be a trend with worse CKD stage being associated with increasing hazard of poor outcome.

Association of posttransplant anemia with outcome

The mean age of study population was 49±13 years, 59% were males and 17% were diabetics. Mean estimated eGFR was 49±22 ml/min/1.73m^2, mean serum albumin was 42±3 g/l, the median time since transplantation at enrollment was 55 months. At the time of enrolment 823 patients, (88%) were taking prednisolone and more than two thirds (657 patients, 70%) were on cyclosporine A therapy. The number of patients taking MMF was 585 (62%). Anemic patients had significantly lower eGFR and serum albumin levels than non-anemic individuals. The cohort was followed-up for a period of about four years (median 46 months). Over 3188 person-years, 118 patients died (crude mortality rate = 37 /1000 person-years) and over 2998 person-years 79 patients returned to dialysis (crude rate of graft failure = 26 /1000 person-years). During the follow-up 23% of patients died from cardiovascular complications, 18% died from malignant disorders, 30% of the deaths were related to infectious complications and 29% of the patients died from other or unknown causes.
Patients without anemia had significantly better survival than those with anemia, as it is clearly demonstrated by the Kaplan-Meier analysis and similar association was found for graft failure, as well.

Univariate analysis of predictors of mortality and graft failure

A significant association was found between hemoglobin and mortality ($HR_{\text{for each 1 g/l decrease}}$= 1.016; 95% CI: 1.007-1.025), and also between anemia and mortality (HR= 2.092; 95% CI: 1.458-3.003). In these analyses age, male gender, lower eGFR, lower serum albumin, higher serum C-Reactive Protein (CRP) level, co-morbidity, presence of diabetes mellitus, presence of hypertension, pre-transplant time on dialysis and transplantation “vintage” were also associated with mortality. We did not find any association between

mortality and the administration of ACEI or ARB or the different immunosuppressive drugs.

In a similar set of analyses both hemoglobin ($HR_{\text{for each 1 g/l decrease}}$= 1.027; 95% CI: 1.016-1.038) and the presence of anemia (HR= 2.934; 95% CI: 1.882-4.574) were significantly associated with re-initiation of maintenance dialysis. The univariate analyses also identified age, presence of diabetes mellitus, pre-transplant time on dialysis, lower eGFR and lower serum albumin level as significant predictors of graft failure. No association was found between graft failure and the administration of ACEI or ARB or different immunosuppressive drugs in this analysis.

Multivariable analysis of mortality and graft loss

All variables that showed significant association with the outcome measures in the univariate Cox models were considered for inclusion in the multivariable models. Based on these models the presence of anemia is significantly and independently associated with both mortality (HR= 1.690; 95% CI: 1.115-2.560) and also with graft failure (HR= 2.465; 95% CI: 1.485-4.090) in kidney transplanted patients. Hemoglobin was also significantly associated with mortality ($HR_{\text{for each 1 g/l decrease}}$= 1.011; 95% CI: 1.001-1.022) and graft failure ($HR_{\text{for each 1 g/l decrease}}$= 1.019; 95% CI: 1.006-1.032) in similar models.

Conclusion

Association of pre-transplant dialysis duration with outcome

In this study I demonstrated that longer duration of dialysis prior to kidney transplantation was associated with worse outcome (survival and death censored graft loss) in a prevalent cohort of kidney transplant recipients. This association was independent of several other important co-variables. In our prevalent cohort every month spent on dialysis prior to transplantation was associated with a 1%

increase in risk of either dying or returning to dialysis within the five year follow up period. The results showed that compared to three or more years of pre-transplant dialysis duration less than 1 year on dialysis prior to transplant was associated with substantially (50%) lower mortality risk after transplantation. The use of MMF was not associated with outcome in this prevalent cohort. Based on these results we suggest that preemptive or early kidney transplantion should be considered for all potentially eligible patients.

Association of transplant kidney function with outcome

In this study I demonstrated that lower eGFR was associated with worse survival and increased risk of graft failure over five years in kidney transplant recipients. After controlling for several important co-variables, patients with CKD stage 4-5 had almost 2.7 times higher risk to die within five years compared to patients with CKD stage 1-2. Furthermore, in similar analysis patients with CKD stage 4-5 had almost 4 times higher risk to return to dialysis during the same follow-up period than patients with CKD stage 1-2. Our multivariable analysis showed the eGFR might have a non linear effect on negative outcome; however each 10 ml/min/1,73m^2 decrease in eGFR increased the five year mortality risk by 27 percent. In summary, we found in this prevalence cohort study, enrolling patients among whom MMF use was very prevalent in contrast to previous reports analyzing similar questions, that eGFR was independently and significantly associated with mortality and graft failure in kidney transplant recipients even after extensively controlling for clinical covariables.

Association of posttransplant anemia with outcome

In this study I demonstrated that the presence of anemia was associated with survival and graft failure in kidney transplanted patients. After controlling for

several important co-variables, patients with anemia had 1.69 times higher chance to die within four years than patients without anemia. Furthermore, after adjustment for co-variables, anemic patients had a 2.46 times higher chance to return to dialysis during the same follow-up period than patients with higher hemoglobin levels, and each 1 g/l decrement in the level of blood hemoglobin increased the odds of graft failure by 1.9% during the 46 months follow-up period. In conjunction with earlier data, our results call for a consideration of clinical trials to assess whether treatment of post-transplant anemia can reduce mortality and improve graft survival in kidney transplant recipients. Furthermore, the optimal target Hb level for kidney transplant patient population will have to be determined in the future.

Publications related to thesis:

1. Molnar MZ, Czira ME, Rudas A, Ujszaszi A, Lindner A, Fornadi K, Kiss I, **Remport A,** Novak M, Kennedy SH, Rosivall L, Kovesdy CP, Mucsi I Association of the Malnutrition-Inflammation Score with clinical outcomes in kidney transplant recipients. Am J Kidney Dis 2011; 58:(1): 101-108.

2. Molnar MZ, Czira ME, Rudas A, Ujszaszi A, Haromszeki B, Kosa JP, Lakatos P, Beko G, Sarvary E, Varga M, Fornadi K, Novak M, Rosivall L, Kiss I, **Remport A**, Goldsmith DJ, Kovesdy CP, Mucsi I. Association between the malnutrition-inflammation score and post-transplant anaemia Nephrol Dial Transplant 2010 26:(6): 2000-2006.

3. Molnar MZ, Keszei A, Czira ME, Rudas A, Ujszaszi A, Haromszeki B, Kosa JP, Lakatos P, Sarvary E, Beko G, Fornadi K, Kiss I, **Remport A**, Novak M, Kalantar-Zadeh K, Kovesdy CP, Mucsi I. Evaluation of the Malnutrition-inflammation score in kidney transplant recipients. Am J Kidney Dis. 2010;56(1):102-111

4. **Remport A,** Keszei A, Vamos EP, Novak M, Jaray J, Rosivall L, Mucsi I, Molnar MZ. Association of pre-transplant dialysis duration with outcome in kidney transplant recipients: a prevalent cohort study. Int Urol Nephrol. 2011; 43(1): 215-224

5. **Remport A,** Molnar MZ, Ambrus C, Keszei A, Torok S, Vamos EP, Kiss I, Jaray J, Novak M, Rosivall L, Mucsi I. Impaired renal function is associated with mortality in kidney-transplanted patients. Int Urol Nephrol. 2010; 42(3): 799-809
6. Molnar MZ, Czira M, Ambrus C, Szeifert L, Szentkiralyi A, Beko G, Rosivall L, **Remport A,** Novak M, Mucsi I. Anemia is associated with mortality in kidney-transplanted patients--a prospective cohort study. Am J Transplant. 2007 Apr;7(4):818-24.

7. Molnar MZ, Novak M, Ambrus C, Kovacs A, Pap J, **Remport A,** Szeifert L, Mucsi I. Anemia in kidney transplanted patients. Clin Transplant. 2005 Dec;19(6):825-33.

Other publications:

1. Molnar MZ, Langer RM, **Remport A**, Czira ME, Rajczy K, Kalantar-Zadeh K, Kovesdy CP, Novak M, Mucsi I, Rosivall L. Roma ethnicity and clinical outcomes in kidney transplant recipients. Int Urol Nephrol, 2011.nov.4.

2. Szentkiralyi A, Czira ME, Molnar MZ, Kovesdy CP, **Remport A**, Szeifert L, Vamos EP, Juhasz J, Turanyi CZ, Mucsi I, Novak M. High risk of obstructive sleep apnea is a risk factor of death censored graft loss in kidney transplant recipients: an observational cohort study. Sleep Med. 2011; 12 (3): 267-273

3. Kovesdy CP, Molnar MZ, Czira ME, Rudas A, Ujszaszi A, Sarvary E, Ambrus C, Szathmari M, **Remport A**, Mucsi I. Diagnostic accuracy of parathyreoid hormone levels in kidney transplant recipients with moderate-to-advanced CKD. Nephron Clin Pract. 2010; 118(2):c78-c85

4. Ambrus C, Molnar MZ, Czira ME, Rosivall L, Kiss I, **Remport A,** Szathmari M, Mucsi I. Calcium, phosphate and parathyroid metabolism in kidney transplanted patients. Int Urol Nephrol. 2009; 41: 1029-1038.

5. Cseprekál O, Kis E, Schäffer P, Othmane Tel H, Fekete BC, Vannay A, Szabó AJ, **Remport A,** Szabó A, Tulassay T, Reusz GS. Pulse wave velocity in children following renal transplantation. Nephrol Dial Transplant. 2009 Jan;24(1):309-15.

6. Varga M, Rajczy K, Telkes G, Hídvégi M, Péter A, **Remport A,** Korbonits M, Fazakas J, Toronyi E, Sárváry E, Kóbori L, Járay J. HLA-DQ3 is a probable risk factor for CMV infection in high-risk kidney transplant patients. Nephrol Dial Transplant. 2008 Aug;23(8):2673-8.

7. Molnar MZ, Novak M, Szeifert L, Ambrus C, Keszei A, Koczy A, Lindner A, Barotfi S, Szentkiralyi A, **Remport A,** Mucsi I. Restless legs syndrome, insomnia, and quality of life after renal transplantation. J Psychosom Res. 2007 Dec;63(6):591-7.

8. Barotfi S, Molnar MZ, Almasi C, Kovacs AZ, **Remport A,** Szeifert L, Szentkiralyi A, Vamos E, Zoller R, Eremenco S, Novak M, Mucsi I. Validation of the Kidney Disease Quality of Life-Short Form questionnaire in kidney transplant patients. J Psychosom Res. 2006 May;60(5):495-504.

9. Novak M, Molnar MZ, Ambrus C, Kovacs AZ, Koczy A, **Remport A,** Szeifert L, Szentkiralyi A, Shapiro CM, Kopp MS, Mucsi I. Chronic insomnia in kidney transplant recipients. Am J Kidney Dis. 2006 Apr;47(4):655-65.

10. Varga M, **Remport A,** Hídvégi M, Péter A, Kóbori L, Telkes G, Fazakas J, Gerlei Z, Sárváry E, Sulyok B, Járay J. Comparing cytomegalovirus prophylaxis in renal transplantation: single center experience. Transpl Infect Dis. 2005 Jun;7(2):63-7.

11. Sarvary E, Nagy P, Benjamin A, Szoke M, **Remport A,** Jansen J, Nemes B, Kobori L, Fehervari I, Sulyok B, Perner F, Varga M, Fazakas J, Lakatos M, Szabo M, Toth A, Járay J. Mutation scanning of the p53 tumor suppressor gene in renal and liver transplant patients in Hungary. Transplant Proc. 2005 Mar;37(2):969-72.

12. Molnar MZ, Novak M, Ambrus C, Szeifert L, Kovacs A, Pap J, **Remport A,** Mucsi I. Restless Legs Syndrome in patients after renal transplantation. Am J Kidney Dis. 2005 Feb;45(2):388-96.

13. Mucsi I, Molnar MZ, Ambrus C, Szeifert L, Kovacs AZ, Zoller R, Barótfi S, **Remport A,** Novak M. Restless legs syndrome, insomnia and quality of life in patients on maintenance dialysis.Nephrol Dial Transplant.2005 Mar;20(3):571-7

14. Toronyi E, **Remport A,** Járay J, Máthé Z, Borka P, Perner F. Evaluation of various immunosuppressive regimes in second renal transplants. Transplant Proc. 2001 May;33(3):2315-6.

15. **Remport A,** Sasvári I, Toronyi E, Borka P, Lázár N, Járay J, Perner F. Mycofenolate mofetil-cyclosporine immunosuppression of kidney transplantation recipients with two different corticosteroid doses. Transplant Proc. 2001 May;33(3):2302-3.

16. Borka P, Jakab J, Rajczy K, **Remport A,** Járay J, Hoffer I, Perner F. Temporary donor-derived B-lymphocyte microchimerism leading to hemolysis in minor AB0-incompatible renal transplantation. Transplant Proc. 2001 May;33(3):2287-9.

17. Sárváry E, Nemes B, Járay J, Dinya E, Borka P, Varga M, Sulyok B, **Remport A,** Tóth A, Perner F. Prediction of early renal graft function by the measurement of donor urinary glutathione S-transferases. Transplantation. 2000 Apr 15;69(7):1397-402.

18. Toronyi E, Alföldy F, Járay J, **Remport A,** Máthé Z, Szabó J, Gáti Z, Perner F. Attitudes of donors towards organ transplantation in living related kidney transplantations Transpl Int. 1998;11 Suppl 1:S481-3.

19. Toronyi E, Alföldy F, Járay J, **Remport A,** Hidvégi M, Dabasi G, Telkes G, Offenbacher E, Perner F. Evaluation of the state of health of living related kidney transplantation donors. Transpl Int. 1998;11 Suppl 1:S57-9.

20. Toronyi E, Járay J, Nemes B, **Remport A,** Hidvégi M, Perner F. Comparative analysis of kidneys retrieved from the same donor and transplanted into different recipients. Transpl Int. 1998;11 Suppl 1:S32-4.

21. **Remport A,** Jansen J, Halmos O, Alföldy F, Járay J, Perner F, Rusz A, Kovács G, Karsza A. .Endourological management of late upper urinary tract complications in kidney transplant patients. Transplant Proc. 1997 Feb-Mar;29(1-2):142.