ORIGINAL ARTICLE

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Renal transplantation outcomes in patients on chronic peritoneal dialysis: are they different from patients on chronic haemodialysis?

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ABSTRACT

Background: The impact of pretransplantation renal replacement therapy on the outcome after renal transplantation is the subject of longstanding debate. In earlier times it was suggested that renal transplantation outcomes were worse in peritoneal dialysis patients, but now it is well accepted that they are at least similar to those of haemodialysis patients. Some studies, however, feel there could be some differences between these two groups of patients as to the incidence of delayed graft function and acute rejection.

Aims: To review the outcomes of kidney transplantation in a group of patients treated with chronic peritoneal dialysis and to compare the results with those of a matched population on haemodialysis.

Methods: We retrospectively reviewed the clinical data of 48 peritoneal dialysis patients who received a kidney transplant from a cadaveric heart-beating donor in our unit between January 2000 and December 2008 and compared the results with those of 48 haemodialysis patients who received a graft from the same donor.

Results: Demographic characteristics, time on dialysis and aetiology of chronic kidney disease were similar between the groups; there were also no differences in cold ischaemia time, HLA matches, presensitisation degree and use of calcineurin inhibitors. Patients on peritoneal dialysis received more frequently induction with monoclonal antibodies (41.7 *vs*. 20%, p=0.047) and showed a lower rate of delayed graft function (8.3 *vs*. 27.1%, p=0.015) and a lower incidence of acute rejection (6.3 *vs*. 31%, p=0.003). The rate of early (in the first month after transplantation) and late (after the first month) infections was similar in the groups. Graft and patient survivals were not statistically different in peritoneal dialysis and haemodialysis patients, albeit slightly better in peritoneal dialysis patients.

Conclusions: Patients on peritoneal dialysis do well after kidney transplantation. In this study, the incidence of some complications (such as delayed graft function and acute rejection) was lower than in patients on haemodialysis. There was also a trend towards a better overall patient and graft survival in peritoneal dialysis patients.

Key-Words:
Haemodialysis; outcomes; peritoneal dialysis; renal transplantation.

INTRODUCTION

Renal transplantation is still the preferred renal replacement therapy (RRT), as it is superior to dialysis in terms of quality of life and long-term mortality risk[1-3]. Because pre-emptive kidney transplantation is not an option due to the lack of a suitable organ, most end-stage renal disease (ESRD) patients undergo dialysis while awaiting a kidney donor[3].

Although peritoneal dialysis (PD) is an established form of RRT, its exact place in the treatment of ESRD has been a matter of longstanding discussion. Indeed, in spite of the increase in the number of patients with ESRD who start RRT yearly, PD is used for approximately 15% of the dialysis population worldwide[4]. Financial issues and a lack of patient knowledge of the various modalities of RTT could explain this small prevalence. Furthermore, evidence suggests an equal (or even better) patient survival on PD than haemodialysis (HD), at least in the first years of dialysis treatment[5,6].

In addition to the known advantages of PD on the preservation of residual renal function (along with its cardiovascular benefits), anaemia management, hepatitis prevention, quality of life and costs, many reports have mentioned a benefit over HD in kidney transplantation[7,8]. Most of these beneficial effects are related to the reduced rates of delayed graft function (DGF) and acute renal failure after kidney transplantation, and their influence on long-term graft function[9,10]. However, a greater incidence of acute rejection episodes (ARE)[11] and posttransplant infections[12] have been reported to be associated with PD in some studies. The better preservation of immunocompetence in PD patients is one possible explanation of these findings.

The purpose of this study was to evaluate the influence of dialysis modality on the outcomes of kidney transplant recipients, concerning the incidences of DGF, ARE, rates of posttransplant infections/malignancies and graft and patient survival.

PATIENTS AND METHODS

This study included a cohort of 48 patients on a chronic PD programme (Group 1) who received a cadaveric heart-beating renal allograft and another of 48 HD patients (Group 2), who received a graft from the same donor, between January 2000 and December 2008, in the Renal Transplantation Unit of Hospitais da Universidade de Coimbra. The following data were obtained for all patients: age, gender, weight (kilograms), time on dialysis, aetiology of ESRD, HLA compatibilities, Panel Reactive Antibody (PRA) titer, cold ischaemia time, immunosupression at the time of transplantation (including induction with mono- or polyclonal antibodies), episodes of acute rejection in the first three months after transplantation (based on histological criteria from graft biopsy), DGF, infectious complications, graft and recipient survival and cause of death or graft loss, when applicable.

As primary endpoints we defined graft and patient survival. The secondary endpoints were the complications in the earlier and the long-term posttransplantation period. DGF was defined, in accordance with other studies, as the need for dialysis immediately after transplantation. The infectious episodes occurring in the first month after transplantation were defined as early complications. Malignancies and infections after the first month posttransplantation were considered as late complications.

All data was computed using the SPSS software program for Windows™ (version 15.0: SPSS, Chicago, IL, USA). Numerical variables are shown as mean ± standard deviation and were compared using Student's *t*-test (considering a normal distribution). Chi-square and Fisher's exact tests were used in the comparison of categorical variables. Recipient and graft survival was evaluated by the Kaplan-Meier method; for the differences in survival, a log-rank test was used. A *P* value less than 0.05 was considered statistically significant.

RESULTS

Table I shows baseline characteristics of the receptors (PD and HD patients), including major causes of ESRD.

We found no statistically significant differences between the groups, regarding age, gender, weight, time on dialysis and aetiology of ESRD. PD prescriptions were heterogeneous in group 1, but following standard criteria eight patients were on automatic peritoneal dialysis (APD) and the remaining on continuous ambulatory peritoneal dialysis (CAPD). In this

Table I

Baseline characteristics of the receptors (PD and HD patients)

Characteristic	PD (n=48)	HD (n=48)	*p*
Age (years)	37 ± 15	40 ± 12	NS
Male Gender	75%	66.7%	NS
Weight (kg)	68 ± 15	66 ± 14	NS
Time on dialysis (months)	33 ± 29	45 ± 37	NS
Prior renal transplant	10.4%	2.1%	NS
Aetiology of ESRD			
Diabetes	8.3%	10.4%	NS
Chronic Pyelonephritis	16.7%	14.6%	NS
Autosomal Dominant Polycystic Kidney Disease (ADPKD)	4.2%	12.5%	NS
Chronic Glomerulonephritis	33.3%	16.7%	NS
Other/Undetermined	37.5%	45.9%	NS

group, three patients had previously been on HD and five had received a kidney graft. In HD patients, the dialysis strategy was to dialyse 3 times a week for 4 hours per session, with blood flow rates higher than 250 ml/min and dialysate flows of 500 ml/min. The dialysate was standard in all patients (Na 138 mmol/L, K 1-2 mmol/L, HCO_3 33 mmol/L, Ca 1.5 mmol/L and Mg 0.75 mmol/L) and a biocompatible HD membrane was used. In this group, only one patient had received a previous kidney transplant and none had been on PD before.

Table II

Groups transplantation-related data

	PD (n=48)	HD (n=48)	p
Cold ischaemia time (hours)	18.8 ± 5.8	19.4 ± 5.4	NS
HLA compatibilities			
A	0.60 ± 0.58	0.55 ± 0.62	NS
B	0.48 ± 0.55	0.52 ± 0.62	NS
DR	1.09 ± 0.72	1.17 ± 0.68	NS
Total	2.17 ± 1.10	2.06 ± 1.06	NS
PRA › 50%	8.3%	6.3%	NS
Induction with polyclonal antibodies	6.3%	10.4%	NS
Induction with monoclonal antibodies	41.7%	20.8%	0.047[a]
Basal Immunosuppression			
Cyclosporine A	37.5%	37.5%	NS
Tacrolimus	54.2%	50%	NS
Mycophenolate mofetil	89.6%	89.6%	NS
Mycophenolic acid	6.3%	4.2%	NS
Azathioprine	0%	4.2%	NS
Sirolimus	12.5%	12.5%	NS
Prednisone at discharge	87.5%	85.4%	NS

[a] 2-sided

Table II shows the groups transplantation-related data.

There were no differences in HLA compatibilities and in the number of hypersensitised patients (defined as PRA titer higher than 50%) between the groups. Differences in cold ischaemia time were also not statistically significant, despite the fact that all HD patients underwent a dialysis session before transplant surgery. After this session, post-HD weight was 500 g higher than the established dry weight for each patient, in order to maintain a certain degree of hypervolaemia before the transplantation procedure.

In this cohort, all patients received an intravenous bolus of methylprednisolone (500 mg) immediately before surgery, followed by decreasing intravenous doses of 250 mg and 125 mg on the second and fourth posttransplantation day. Thymoglobulin (Thymoglobulin®, Genzyme) was the polyclonal antibody used as an induction therapy in 8 patients, at 1.5 mg/kg/day, for 3-5 days (started immediately before transplantation). Basiliximab (Simulect®, Novartis) or daclizumab (Zenapax®, Roche Inc.) were the monoclonal antibodies used in the induction of 28 and 2 patients, respectively. Basiliximab was administered at 20 mg before transplantation and on the fourth day after. Daclizumab was administered at 1 mg/kg for five days, starting on the day of the transplant surgery. PD patients received induction with monoclonal antibodies more frequently (41.7% *vs.* 20.8%, p=0.047), but there were no differences in polyclonal antibody use between the groups. Calcineurin inhibitors (either ciclosporin or tacrolimus) were used in the majority of immunosuppression schemes in both groups, along with antimetabolites (mycophenolate mofetil, mycophenolic acid or azathioprine) and prednisone (Table II). Based mainly on immunological criteria, corticosteroids were discontinued on the month after discharge from renal transplantation in 6 PD patients (Group 1) and 7 HD patients (Group 2).

Early and late posttransplantation complications are described in Table III. The overall incidences of DGF and AR in the PD group were significantly lower (AR: 6.3 *vs.* 31.3%, p=0.003; DGF 8.3 *vs.* 27.1%, p=0.030). The average AR episodes per patient was also significantly lower in this group (0.06 *vs.* 0.38 AR episode/patient, p=0.001). All

patients were treated with pulse methylprednisolone (3 bolus, in 3 consecutive days); in the absence of response to corticosteroids (mainly due to a vascular component in the acute rejection), 4 patients (8.3%) in the HD group and 1 patient (2.1%) in the PD group also received thymoglobulin (1.5 mg/kg/day, for at least 7 days, with dose adjustment according to side effects). In the PD patients with DGF, a central venous catheter was inserted to start haemodialysis, although the peritoneal catheter was left in place.

Table III

Early and late posttransplant complications

	PD (n=48)	HD (n=48)	*p*
Early Complications			
Acute Rejection (AR)	6.3%	31.3%	0.003[a]
Delayed Graft Function (DGF)	8.3%	27.1%	0.030[a]
Infections (first month)	10.4%	4.2 %	NS
Late Complications			
Infections (after the first month)	8.3%	8.3%	NS
Neoplasia	0%	4.2%	NS
Graft Loss	8.3%	16.7%	NS
Patient Death	2.1%	8.3%	NS

[a] 2-sided

The rate of infection in the early posttransplant period was similar in both groups; it is important to note that 1 g of cefazolin was prophylactically administered during 7 days, starting immediately before the transplantation surgery. In the PD study group 2 episodes of acute pyelonephritis (in two patients) were reported; one of intra-abdominal abscess with septic shock (the result of an ileal perforation, surgery related) and another two of infection of the surgical wound (with abscess of the abdominal wall). The HD patients had 2 infectious episodes reported, one of nosocomial pneumonia (with graft loss) and another of the surgical wound.

Late posttransplantation complications were infections (after the first month) with need for hospital admission, neoplasia (*de novo*), and ultimately graft loss and patient death. Once more, the rates of these complications were not statistically different between the groups. In the PD patients we observed three acute pyelonephritis (in three individuals) and one of pneumonia, with septic shock and patient death. In HD patients, urinary tract infections were also more frequent (3 episodes in 3 different patients); one patient had a varicella-zoster infection, with septic shock and death. Concerning *de novo* neoplasia, in HD study group we reported 2 cases: one of the native kidney and one of the cervix.

Graft and patient survivals in both groups are depicted in Figures 1 and 2, respectively. The causes for patient demise were as follows: infection (n=1), neoplasia (n=1) and cardiovascular (n=2) in the HD patients. Only one patient died in the PD study group, from septic shock. Causes of graft failure were as follows: death with a functioning graft (n=1), chronic rejection (n=1), graft thrombosis (n=1) and infection (n=1) in PD patients and death with a

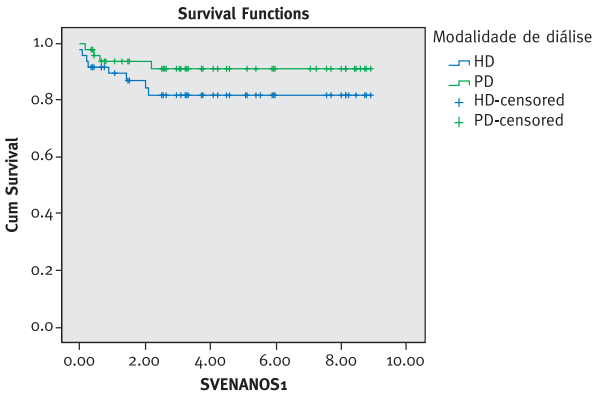

Figure 1

Graft survival in both groups; comparison of the Kaplan-Meier curves showed no significant differences using log-rank test (p=0.216).

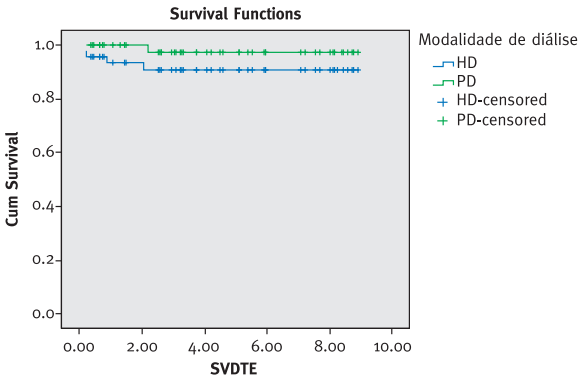

Figure 1

Patient survival in both groups; comparison of the Kaplan-Meier curves showed no significant differences using log-rank test (p=0.165).

functioning graft (n=4), chronic rejection (n=2), graft thrombosis (n=1) and infection (n=1) in HD patients. Again, there were no statistically significant differences between the groups in graft loss and patient death.

DISCUSSION

Although it is well established that patient survival after renal transplantation is not influenced by dialysis modality and despite the known benefits of PD, this modality is still underused in patients awaiting a kidney donor[13,14]. Concerning early transplant outcomes, a number of studies published to date have shown higher rates of acute rejection and infection in patients coming from PD programmes[8,12], while others have suggested no significant differences[15,16].

The methodology used in this study was based on the selection of kidneys from the same donor, one for a PD patient and the other for a HD patient. With this inclusion criterion, we selected two groups of kidney receptors with the same baseline characteristics (namely age, gender prevalence, weight, time on dialysis, previous renal transplant and aetiology of ESRD) and this fact allowed us to overcome the selection bias observed in some similar studies. Transplantation-related parameters were also quite similar in both groups, except for the use of induction with monoclonal antibodies (more frequent in patients previously on PD).

Our work shows a significantly lower incidence of DGF after kidney transplantation in PD patients. This finding is in accordance with previous studies, which suggested that PD, as a pretransplantation dialysis modality, has a protective effect on the early recovery of renal graft function[7-9].

The relatively hyperhydrated state of PD patients, with better residual renal function (not evaluated in our study due to lack of data), could explain the lower incidence of DGF. The role of volume status has been corroborated by the fact that PD patients have a greater weight loss after renal transplantation[17] and a higher mean pulmonary artery pressure immediately before transplant surgery[18]. In Group 2 (HD patients), the haemodialysis session performed early before surgery could have contributed to the higher incidence of DGF observed, perhaps by lowering the intravascular volume at the time of transplantation. This explanation, along with the prolonging of cold ischaemia time by the length of the haemodialysis treatment, was advanced by the study of Perez-Fontan *et al.*[15]. However, in our study, cold ischaemia times were similar in both groups and this cannot bear out the higher rate of DGF observed in HD patients. The volume and cold ischaemia hypotheses were challenged by the work of Van Biesen *et al.*[9]; indeed, after the adjustment of the volume status and of the cold ischaemia times, PD was still associated with a protective effect on the recovery of renal function after transplantation. This finding probably reflects an intrinsic advantage of PD over HD, as pretransplantation RRT.

A significantly lower incidence of acute rejection was observed in patients previously on PD programmes (6.3 *vs.* 31.3%, p=0.003). This finding was not corroborated by most studies published to date. Although early studies showed a higher rate of acute rejections in PD patients than HD patients[19], in the era of modern immunosuppression, no one has reported a difference in the risk of rejection between both dialysis modalities[8,13,16]. The better preservation of immune function in PD patients was judged to be the cause of the higher rejection rates. In fact, in our study patients from PD received induction therapy with monoclonal antibodies (either basiliximab or daclizumab) more frequently, despite the similar use of calcineurin inhibitors, antimetabolites and corticosteroids. The reasons for this were not clear, but perhaps were related to younger age of the receptors in the PD group, to the higher levels of PRA and to the fact that in this group there was a higher number of receptors of a second transplant (10.4 *vs.* 2.1% in the HD patients); however, none of these differences attained statistical significance. Thus, the observed lower acute rejection rates in PD patients could be partially associated with the use of this type of induction (monoclonal antibodies).

The lower incidence of DGF in PD patients could also explain this lower acute rejection rate. Post-ischaemic acute tubular necrosis (the most important cause of DGF) is associated with a nonspecific inflammation that might be a trigger for acute rejection episodes[20,21]. Considering that lower rates of DGF might be related to PD itself[9], one may argue that the lower rates of acute rejection found in this

group of PD patients could be associated, not only with the more frequent use of monoclonal antibodies, but also with the dialysis modality. More studies with large numbers of PD patients are necessary to confirm the true relation between acute rejection in renal transplantation and PD.

Some studies have reported a higher rate of infectious complications in patients previously on PD[12], but this was not confirmed in our study. Indeed, we found no significant differences in the infection rates between the groups, in either the early or late post-transplant period. Although patients receiving PD before transplantation had received higher doses of immunosuppressant agents during induction (namely monoclonal antibodies), the cumulative doses of immunosuppression were higher in the HD patient group (in the treatment of the acute rejection episodes, more frequent and more serious in the latter group). None of these facts translated into a higher rate of infection in either group.

We should underline that in PD patients no episode of peritonitis or peritoneal dialysis catheter-related infection was reported. Some units continue to use the catheter after renal transplantation in case of DGF[22,23]; this is not our common practice and it is probably responsible for the absence of peritoneal catheter-related infections. The best time for peritoneal catheter removal is also a matter of debate, but we think, based on our experience, that it seems reasonable to remove it after the first month (in patients with functioning grafts), as is done in our unit.

Most previous studies have shown that graft survival is not influenced by the dialysis modality in the pretransplant period[24-27]. Our data supports this fact. Even though at the end of follow up period the overall graft survival was slightly better in the PD group (91.7 *vs*. 83.3% in HD patients), this lacked statistical significance. The limited number of patients enrolled (as in other studies[15]) could possibly justify this absence of statistical power. The better recovery of renal function after transplantation and the lower rate of acute rejection observed in this study might explain this apparently better outcome. It is necessary to conduct more studies with large numbers of PD patients in order to possibly confirm a benefit of pretransplantation PD on renal graft survival.

When we looked for the causes of graft failure in the groups, there were also no significant differences, even in the rates of graft thrombosis. Graft thrombosis was reported as the main cause of graft failure in patients previously on PD and responsible for worse graft survivals in a few studies[13,28,29], probably due to an acquired thrombophilic state (mainly resulting from the loss of anticoagulant proteins in the dialysate)[20].

Concerning patient survival, as we mentioned earlier, retrospective and prospective analyses of large numbers of patients have found similar mortality risks with PD or HD prior to renal transplantation[13,14,30,31]. In our study, PD patients exhibited a slightly better overall survival (97.9 *vs*. 91.7% in HD patients), but this difference did not attain statistical significance. As discussed earlier, the limited number of patients could explain this fact, just as the above-mentioned reasons (lower rates of DGF and acute rejection in PD patients) could also justify this apparent difference.

CONCLUSIONS

When compared to matched controls on HD, patients receiving PD who undergo renal transplantation show a lower incidence of DGF, a lower acute rejection rate and a similar incidence of infectious complications. The more frequent use of monoclonal antibodies during induction could partially justify the lower acute rejection rates in PD patients. Although in this study, graft and patient survivals were statistically similar between the groups, there was a trend towards a better overall survival (graft and patient) in the PD group. Further studies with larger number of patients on PD are needed in order to verify the possible benefits in renal transplantation of this dialysis modality.

Conflict of interest statement. None declared.

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