

Impact of Dialysis Modality on Kidney Transplantation Outcomes

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Received 9 December 2014; accepted 3 February 2015; published 9 February 2015

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Abstract

Survival benefits of renal transplantation over dialysis therapy are well established for patients with end-stage renal disease (ESRD). Transition from one treatment modality to another is common. Understanding the differences in outcomes with the various renal replacement therapies will help nephrologists to provide best advice for dialysis patients. The influence of pretransplant dialysis modality on post-transplant outcomes is not clear. An overview of the various issues related to dialysis modality on kidney transplantation outcomes is discussed in this topic review. These include allograft and recipient survival, the impact of dialysis vintage and choice of dialysis modality on transplant outcomes.

Keywords

Peritoneal Dialysis, Hemodialysis, Kidney Transplantation

1. Introduction

Dialysis and kidney transplantation are treatments for end-stage renal disease (ESRD) [1]. Survival benefits of renal transplantation over dialysis therapy are well established for patients with ESRD [2] [3]. Transition from one treatment modality to another is common [4]. Understanding the differences in outcomes with the various renal replacement therapies will help nephrologists to provide best advice for dialysis patients. A patient-nephrologist relationship that promotes shared decision-making is recommended for all patients with ESRD [4].

Hemodialysis (HD) and peritoneal dialysis (PD) are both treatment methods of filtering wastes from the body. HD uses a man-made membrane (dialyzer) to filter wastes and remove extra fluid from the blood. PD uses the

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lining of the abdominal cavity (peritoneal membrane) and a solution (dialysate) to remove wastes and extra fluid from the body. Each modality of dialysis has its advantages and disadvantages. Studies examining the effect of pre-transplant dialysis modality on graft and patient survival after kidney transplantation have produced conflicting results [5] [6]. Although some authors deny the existence of a significant influence [7], others suggest that PD or HD may affect kidney transplantation outcomes [8]. An overview of the various issues related to dialysis modality on kidney transplantation outcomes is discussed in this topic review (Table 1). These include allograft and recipient survival, the impact of dialysis vintage and choice of dialysis modality on transplant outcomes.

2. Dialysis Modality and Recipient Survival

Transplant recipients have superior survival and quality of life compared with patients treated with dialysis. The impact of dialysis modality on patient survival after kidney transplantation was the subject of controversy for many studies. HD is associated with increased risk for recipient death according to the **United States Renal Data System** (USRDS) database [1]. Compared with HD, a Cox model showed that PD immediately before transplantation predicts 6% lower risk for recipient death ($P < 0.001$) [1]. In a more recent study, compared with recipients treated with HD, those who were treated with PD before transplantation had a 10% lower all-cause mortality because of a lower rate of cardiovascular death ($P = 0.014$) [9]. PD patients may have greater native renal function at the time of transplantation, accounting for the lower risk for death after transplantation [10]. However, after exclusion of diabetic patients, no survival advantage to pre-transplant dialysis modality was found [11].

The survival was not influenced by initial dialysis modality in our experience of 78 patients (39 PD and 39 HD) [12]. Patient survivals were similar in both groups at 1, 3, 5, and 10 years after transplantation [12]. This is consistent with some findings in the literature: There was no difference in 1-year survival for patients according to modality [13]. Other studies have shown no significant differences between these two different modalities for patients' survival [14] [15].

3. Dialysis Modality and Renal Graft Survival

The pre-transplant dialysis modality can also influence graft survival. At 3 and 5 years follow-up, PD patients' showed fewer graft failures than HD patients (14% vs 20%; $P < 0.05$ and 17% vs 28%; $P < 0.05$) [8]. PD had a protective effect on renal functional recovery after transplantation and was a detrimental factor for long-term graft survival [8]. In other study, the analysis of 121 consecutive cadaveric kidney transplantation performed in this centre indicate graft survival rates at 1 year of 63.5% in the HD patients compared with 35.5% in the DP patients [16].

PD patients have a more protected volume status leading to a better renal transplantation outcome and lower incidence of post-transplant delayed graft function (DGF) [1]-[5] [17]-[19]. This is explained by the fact that patients on PD have better preserved residual kidney function. DGF was found to independently predict a significant reduction in short- and long term graft survival [20]. However, the native urine output could be mistaken for urine produced by the allograft. Only careful measurement of residual renal function at the time of transplantation would be able to fully evaluate this possibility [13].

More, PD patients were also more likely to be white than black, the latter being a known risk factor for delayed allograft function [21].

Table 1. Comparison of kidney transplantation outcomes according to dialysis modality.

Parameters	DP	HD	References
Patient survival	Better effect	Less effect	[1] [9]-[11]
Graft survival	Better effect	Less effect	[8] [13] [16]
DFG	Less frequent	More frequent	[1]-[5] [17]-[19]
Vascular thrombosis	More frequent	Less frequent	[7] [29] [30]
PTDM	More frequent	Less frequent	[11]
Weight gain	Less frequent	More frequent	[27] [28]
Infections	More frequent	Less frequent	[31]-[33]

PD: Peritoneal dialysis; HD: Hemodialysis; DFG: Delayed graft function; PTDM: Post-transplant diabetes mellitus.

A large retrospective analysis compared transplantation rates in PD and HD and outcomes after transplantation in more than 22000 patients. The risk for early graft failure was higher for PD patients despite DGF was less common [6]. Over the entire follow-up period, the adjusted risk for death-censored graft failure was 1.15 (1.04 to 1.26) times higher in PD vs. HD ($P < 0.05$), but mortality and overall graft failure rates were not different. Pre-transplant dialysis modality did not affect outcomes for patients who survived with a functioning kidney for at least 3 months. However, in adjusted Cox analyses restricted to the first 3 months, PD was associated with a 1.23 (1.09 to 1.39) times higher risk for early graft failure ($P < 0.001$) and a 1.33 (1.16 to 1.53) times higher risk for death-censored graft failure ($P < 0.001$) [6].

Post-transplant allograft survival is not influenced by the pre-transplant dialysis modality in many others studies [7] [9] [14] [15]. There was no significant difference in the risk of graft failure or DGF [10]. This result is consistent with our experience [12]. Some have found HD to be a risk factor for DGF [18]. In fact, HD exacerbates immune disturbances by causing recurrent activation of several inflammatory response pathways, oxidative stress and free radical production that can contribute to DGF [22]. Differences in biocompatibility between PD and HD, particularly in patients on HD using bio-incompatible membranes, could potentially contribute to differences in cadaveric allograft recovery. The transplanted kidney is already stressed by ischemia and reperfusion injury, conditions, that affect free radical production. This oxidative stress is less in PD than HD patients [23].

4. Dialysis Modality and Post Kidney Transplantation Complications

The rates of early and late post-transplant complications were similar between 745 PD and HD patients who underwent a first renal transplantation. DFG, post-transplant acute tubular necrosis (ATN), chronic allograft nephropathy (CAN), infection, cardiovascular disease, malignancy, and bone disease in the late post-transplant period, were similar in the 2 groups [9] [24] [25]. Other studies have shown no significant differences between these two different modalities for post-transplant complications [14] [15].

The potential impact of pre-transplant dialysis modality on development of new-onset post-transplant diabetes mellitus (PTDM) has been the subject of several controversies. Treatment with PD before transplantation was a risk factor for subsequent development of PTDM for some authors [11], but not for others [26]. Results of these studies should be interpreted with caution because varying definitions for the diagnosis of PTDM have been used, and screening for diabetes mellitus varies from one transplant center to another. It might be expected that, compared with HD patients, patients on PD would experience less weight gain post transplantation because the significant calorie load from glucose-containing solution has been removed [27] [28].

More, PD is associated with an increased risk of allograft thrombosis [29] [30]. There were a significantly higher odds of renal vascular thrombosis in peritoneal dialysis (PD)-compared with hemodialysis (HD)-treated patients (OR = 1.87, $P = 0.001$) [29]. Some hypotheses include the hyper-coagulable state associated with PD because of albumin loss in effluent and the increased production of certain coagulation factors [7].

Several studies have noted a higher incidence of infections in patients on PD in the first month after transplantation [31]. The potential risk of infectious complications is attributed to the remaining PD catheter [32] [33]. Others have found no difference between the dialysis modality in the rate of post-transplant infections [19]-[34]. However, others studies have reported a higher rate of post-transplant infections in patients on HD [35]. In our study, this result could not be confirmed [12].

Differences in results reported in the literature are due to small patient populations, the most part of studies did not account for pretransplantation variables during dialysis treatment (such as obesity, muscle mass, and serum albumin) [36], which have been shown to be associated with post-transplant outcomes. The previous studies are also based on data in the late 20th century. The current immunosuppressive regimen has been considerably different, including use of mycophenolate-mofetil or rapamycin, greater use of induction therapy, and increasing use of steroid-free regimens [37]. This could moderate the currently results. There is no clear evidence suggesting a significant advantage of either PD or HD as treatment modality, medical practitioners cannot limit patients to patronage of either one or the other procedure unless the decision is an informed one. Patients are then free to select a pre-transplant modality tailored to their requirements and convenience.

5. Conclusion

This review will provide a basis for further prospective studies exploring the impact of dialysis modality on kidney transplantation outcomes. Renal transplantation is the ideal renal replacement therapy in patients with

ESRD. Although preemptive transplantation is the preferred therapy, most potential recipients require dialysis before transplantation. Comparative effects of various modalities of dialysis on patient and graft survivals have been extensively investigated; however, there is no consensus on the impact. More research is needed to depict the true impact of pre-transplant dialysis modality on patient and allograft survival.

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List of Abbreviations

ESRD: End-stage renal disease;
PD: peritoneal dialysis;
HD: hemodialysis;
USRDS: United States Renal Data System;
DGF: delayed graft function;
ATN: acute tubular necrosis;
CAN: chronic allograft nephropathy;
PTDM: post-transplant diabetes mellitus.

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