

---

# **Comparison of Renal Transplantation Outcomes in Patients After Peritoneal Dialysis and Hemodialysis – A Case Control Study and Literature Review**

---

Thomas Rath and Stephan Ziefle

Additional information is available at the end of the chapter

<http://dx.doi.org/10.5772/55711>

---

## **1. Introduction**

For patients with end-stage renal disease renal transplantation is the treatment of choice. However, there is still some controversy if mortality rate after renal transplantation is affected by the chosen dialysis modality.

It is widely accepted, that in terms of survival hemodialysis (HD) and peritoneal dialysis (PD) are comparable. Especially in PD-patients with preserved residual renal function, control of hypertension is achieved more easily, whereas patients with diabetes mellitus do better on HD. In general, quality of life for patients is assumed to be better with PD than with HD [1].

In a cost-modeling strategy, incorporating quality of life and social perspective aspects in Scandinavia, it was shown, that the cost per quality-adjusted life year for PD was lower compared to HD in all analyzed age groups, whereas mean survival and frequency of transplantation did not differ [2].

Despite technological advance, only 15 % of the world dialysis population is managed by PD. Therefore, a "integrated approach" suggests starting PD in alarge percentage of patients, especially when renal transplantation is expected in the next 2 or 3 years after initiation of dialysis [3].

A very interesting point became obvious when analyzing data obtained from the Dialysis Morbidity and Mortality Study Wave 2, a national random sample of more than 4000 new dialysis patients in the USA enrolled during 1996 and 1997 and followed up until 2001. There, it was shown, that transplantation rates were significantly higher for patients reporting the greatest contribution to modality selection. These results support the association of patient

autonomy with transplantation and survival, probably in favor for patients actively choosing PD as their dialysis modality [4]. Also, a small Japanese single center study in 42 patients analyzed the effect of dialysis modality on rate of kidney transplantation from living donors and transplant outcome. There were no differences between the two modalities prior to transplantation in the graft survival rate, incidence of acute rejection, and complications before and after transplantation. However, The transfer rate from PD to transplantation was significantly ( $p = 0.0036$ ) higher (4.7%) than that of HD (1.9%). Probably reflecting better cooperation between with the patients, their family and the provision of relevant information by nephrologists during PD [5].

## 2. Mortality on PD and HD

Although in 2005 the European Best Practice Guidelines for Peritoneal Dialysis conclude, on the basis of the available data, that peritoneal dialysis is a good treatment prior to renal transplantation there are contradictory survival rates reported in the literature for patients either on HD or on PD [6].

In 1995, data from the US Renal Data Systems from more than 170,000 patients showed, that prevalent patients treated with PD had a 19% higher adjusted mortality risk ( $p < 0.001$ ) than those treated with HD [7].

In a comparable analysis obtained from the Canadian Organ Replacement Register, using data from 11,970 ESRD patients who initiated treatment between 1990 and 1994 and were followed-up for a maximum of 5 years was the mortality rate ratio for CAPD/CCPD relative to hemodialysis, as estimated by Poisson regression, was 0.73. There, the increased mortality on hemodialysis compared with CAPD/CCPD was concentrated in the first 2 years of follow-up and was detectable in all subgroups defined by age and diabetes status [8].

In contrast, a study comparing two year mortality rates of patients on the waiting list for renal transplantation to a historical prospective cohort of more than 12000 PD and HD patients disclosed, that especially for patients with a body mass index (BMI) of  $\geq 26$  mortality was increased with PD as dialysis modality [9].

Nevertheless, in a cohort of more than 3000 non-diabetic patients starting dialysis there was no difference in survival for patients treated either with PD or HD [10].

Also, in the well-known, prospective Netherlands Cooperative Study on the Adequacy of Dialysis (NECOSAD) adjusted mortality rates between HD and PD patients were similar for the first two years. Thereafter, an increase in mortality especially in patients  $\geq 60$  years was detected [11].

Comparable results were seen in a prospective multicenter cohort study in 1041 patients (767 HD, 274 PD). There, the risk of mortality was equal in both groups for the first year with an increase in the second year. In addition, 25% of PD but only 5% of the HD patients switched their type of dialysis modality [12].

### **3. Renal transplantation in PD-patients – first experience**

The first experience about the use of peritoneal dialysis in patients waiting for renal transplantation were published in some very early reports describing the feasibility of PD for patients awaiting renal transplantation[13-15]. Also in a small series of 15 patients the experience with renal transplantation in PD-patients was reported. Despite the fact, that some of the PD patients had peritonitis at the time of transplantation, no differences in graft survival were shown [16].

Similar results were published in an early study with a group of 44 patients, showing comparable results for patients with PD compared to HD patients[17].

Also, a small study in 9 PD patients reported significantly greater and longer wound drainage in PD patients. However, the incidence of acute rejection episodes, delayed graft function, graft arterial thrombosis and graft function recovery was not different [18].

### **4. PD versus HD and survival after renal transplantation**

In a retrospective analysis of 61 PD and 159 HD patients there were no differences in survival of patients or grafts between the two treatment groups. One year after transplantation the percentages of survivors who had received continuous ambulatory peritoneal dialysis and hemodialysis were 88% and 91% respectively, and overall graft survival was 66% and 72%, respectively [19]. Similar results were reported from 42 PD patients, either treated with CAPD for more than 26 weeks or less than 26 weeks in comparison with 55 HD patients, irrespectively if treated with azathioprine + prednisolone or cyclosporine + prednisolone [20]. A retrospective analysis of 389 patients transplanted between Juli,1974, and July 1985, also evaluated the effect of dialysis modality on transplantation and mortality rates. By correcting for the influence of different variables and using time-dependent treatment co-variables, the bias adjusted estimates of the relative risk of death did not differ significantly from one another [21]. A cohort analysis of 500 first renal transplant recipients (241 on CAPD, 259 on HD) showed identical graft and patient survival after five years. However in 37 PD patients post-transplant peritoneal dialysis was necessary, while 10 patients developed peritonitis [22].

In 54 patients with renal transplantation after PD compared to 48 patients after HD with an immunosuppressive regimen consisting of prednisolone, azathioprine and cyclosporine there no significant difference in patient mortality and survival or graft survival between the groups. The incidences of infections were also similar in the two groups [23].

### **5. PD and complications after renal transplantation**

There is some concern with respect for the risk of infections, especially peritonitis caused by the peritoneal catheter in PD patients. In a retrospective single center analysis the experience

with 18 renal transplantations in 16 PD patients was reported. In two cases cultures of the peritoneal catheter removed a few days after successful transplantation were positive. Nevertheless, with adequate antibiotic treatment none of the patients ever developed clinical peritonitis [24].

A cohort analysis of 500 first renal transplant recipients (241 on CAPD, 259 on HD) showed identical graft and patient survival after five years. However, 10 PD patients developed peritonitis [21]. Also, in a series of 100 patients undergoing simultaneous pancreas-kidney (SPK) transplantation (25 PD patients, 75 HD patients) frequency of abdominal infections, one year pancreas-graft survival rates, acute rejection episodes, kidney graft survival rates, or length of hospital stay did not differ between the two groups[25].

The question of peritonitis in peritoneal dialysis patients after renal transplantation was also addressed by a retrospective, single center study of 232 PD patients. In total, 30 peritonitis episodes with predominantly *Staphylococcus aureus* (10/30) or gram-negative bacteria (12/30) were observed. Risk factors associated with post-transplant peritonitis were the total number of peritonitis episodes, previous peritonitis with *S. aureus* bacteria, male sex, technical surgical problems at the time of transplantation, more than two rejection episodes, permanent graft non-function, and urinary leakage [26].

Comparable results are reported in a two-center study on post-transplant PD-related complications in 137 PD patients. There, only in a minority of the patients (n=19) PD-catheters were removed on the time of transplantation. In the remaining 118 patients the peritonitis rate was 7% [27].

In the European Best Practice Guidelines for Peritoneal Dialysis it is recommended to remove the catheter early after transplantation, nevertheless the catheter could be left in situ for 3–4 months despite a functioning graft. The guidelines also state, that peritonitis and exit site infections in transplanted patients should be treated using the ISPD guidelines 6.

In the last years the problem of post-transplant diabetes mellitus (PTDM) has gained more attention. A single center study reports on the occurrence of PTDM in 72 renal transplant recipients. In univariate analysis, the factors associated with the elevated risk of PTDM appearance were treatment by PD, older recipient age, positive family history of diabetes, hypertensive nephropathy as end-stage renal disease cause, higher body mass index at transplantation, and the graft from an older donor [28].

PD may be associated with an increased risk for graft thrombosis. At least, a single center experience revealed that in 915 consecutive renal transplantations CAPD was associated with a growing frequency of renal allograft thrombosis (7.3% vs. 3.6 %,  $p<0.02$ ). No differences in transplant characteristics, including hemodynamics, hematological parameters, immunosuppressive therapy, graft anatomy and preservation, were observed between the cases with graft thrombosis and a matched control group of 88 patients [29].

After renal allograft failure, patients may chose PD as their primary treatment option again. For this situation, it was shown, that after a failed renal transplantation PD-patients are prone to greater risk of death compared to PD-patients never transplanted. In addition, time to first

peritonitis, subsequent episodes of peritonitis, catheter change, or transfer to hemodialysis occurred at a much faster rate in patients with a failed transplant [30].

For patients returning to PD after graft failure, there may be a survival advantage in maintaining them on long-term immunosuppressive therapy. At least, a decision analytic model comparing the use of immunosuppression after transplant failure and return to peritoneal dialysis with immunosuppressive withdrawal, lead the authors to conclude, that there may be a survival advantage in maintaining patients on long-term immunosuppression [31].

## **6. PD and the occurrence of delayed graft function after renal transplantation**

It is well known, that delayed graft function (DGF) and acute renal failure (ARF) after renal transplantation negatively influence short- and long-term graft outcome, therefore it is of interest to know if peritoneal dialysis affects occurrence or severity of DGF after renal transplantation.

A study in 250 patients (70 PD, 180 HD) evaluated the influence of dialysis modality on transplant outcomes. Among HD patients, 16% displayed DGF, versus 12% of PD patients. Multivariate analysis showed that factors affecting DGF were mode of dialysis, serum concentrations of parathyroid hormone and C-Reactive-Protein, and hemoglobin levels. Also after 3 and 5 years follow-up, PD patients showed fewer graft failures than HD patients (14% vs. 20%; and 17% vs. 28%[32].

In an analysis of 92 PD patients and 587 HD patients there was higher immediate graft function, less delayed graft function and less patients with never functioning grafts in the PD group. The groups were comparable except for a higher prevalence of diabetes ( $p < 0.05$ ) and a shorter time on dialysis ( $p < 0.01$ ) in PD patients [33].

A retrospective study in 40 PD and 79 HD patients receiving their first renal transplant analyzed the occurrence and frequency of DGF and acute renal failure. Both, DGF and ARF were observed less in the PD group than in the HD group. In a multivariate model, the authors could show that PD as pre-transplantation modality favorably modified the relative risk of developing DGF and ARF after renal transplantation[34]. A single center analysis in more than 650 patients (92 PD, 587 HD) reports a higher rate of DGF in HD patients (39.5% vs. 22.5%) and a higher rate of never functioning grafts in HD patients compared to PD patients (14% vs. 9%). When potential risk factors for DGF were compared, no relevant differences could be found [33].

Also for PD patients on automated peritoneal dialysis (APD), a retrospective matched-pairs study with 67 APD-patients showed favorable effects for PD on initial graft function (patients with a creatinine clearance below 10 ml/min 6 days after surgery) after post-mortem renal transplantation [35].

A recent retrospective single center analysis in 38 PD and 268 HD patients describes a higher incidence of DGF and primary allograft failure for HD patients, but was no difference in acute rejection episodes, long-term survivals, or renal function [36].

A case control study the incidence of DGF, defined as necessity to perform dialysis after transplantation, was analyzed in 117 PD and HD patients with a follow-up of 6 months. When matching the patients for age, sex, HLA compatibility PD-patients developed less DGF (23.1%) than HD patients (50.4%). In addition the decline of creatinine levels after transplantation was faster in PD patients. However, PD patients developed more acute rejection episodes, than HD patients, but creatinine levels after 6 weeks and 6 months were not different between the groups [37].

Besides a bundle of published single center experiences with renal transplantation in PD patients we do have at least two registry studies reporting on the effect of pre-transplant dialysis modality on renal transplant results.

Data from the United Network of Organ Sharing on all cadaveric graft recipients who were dialysis-dependent at the time of transplantation were analyzed with respect to different outcomes in the immediate post-transplant period for HD or PD patients. In total more than 9000 patients were evaluated, showing that PD patients were on dialysis for a shorter period of time, were more likely to be white, had a better HLA match, and had a lower PRA. After adjusting for comorbidities, the odds of oliguria were 1.60 times higher in black HD patients compared with PD patients and 1.29 times higher in white HD patients. Also, the odds of requiring dialysis in the first week were 1.56 times higher in black HD patients versus PD patients and 1.40 times higher in white HD patients. The rate of acute rejection was similar during the first hospitalization. Therefore, the authors suggest that there may be an association between hemodialysis and delayed graft function assuming that differences in biocompatibility between the two modalities could potentially be responsible [38].

A large retrospective analysis compared transplantation rates in PD and HD and outcomes after transplantation in more than 22000 patients from the years 1995 to 1998 in a US cohort. PD patients were more likely to be transplanted and their death censored graft failure was higher. However, mortality and overall graft failure were not different. Interestingly, the risk for early graft failure was higher for PD patients despite DGF was less common [39].

## **7. Own experience with PD and renal transplantation**

Because of the in part contradictory data published in the literature we analyzed our own population of renal transplant recipients with the means of a retrospective case control study. Therefore, we chose 50 consecutive peritoneal dialysis patients transplanted since 1999. For match-pair-analysis, and as control group we selected the next hemodialysis patient subsequently transplanted after each PD patient. Follow-up data were available with a maximum of ten years after transplantation.

Kruskal-Wallis Test and Chi-Square-Test were calculated, with assuming a  $p < 0.05$  as significant, for statistical purposes.

The PD-group consisted out of 28 male and 22 female patients with a mean age of 48.7 +/- 11.5 years (HD: 31 m, 19 w, 49,8 +/-13, p=n.s.) quite reflecting the German dialysis population. With respect to time on renal replacement therapy, cytomegalo-virus-status, HLA-mismatch, proportion of living donors, age, sex and initial immunosuppression there were no differences between the groups.

Although, during follow up more less PD-patients (n=3) than HD-patients (n=8) died, this difference did not reach statistical significance. With respect to graft failure, transplant loss (n=18) occurred significantly more in HD patients (n=13) than in PD patients (n=5). Nevertheless, mean serum-creatinine after 1, 2 and 5 years was not significant different between the groups. Also, delayed graft function was reported in only 4 PD patients compared to 10 HD patients (p<0.05).

To summarize, in our retrospective match-pair analysis patients on PD before renal transplantation developed less delayed graft function and had less graft loss during follow-up than patients on HD before transplantation.

## 8. Conclusion

Peritoneal dialysis (PD) is an established method of renal replacement therapy. PD and hemodialysis (HD) seem to be equivalent for long-term survival of the patients. Nevertheless, there is a beneficial effect of PD on patient survival after initiation of dialysis therapy. Probably, better preservation of residual renal function in PD patients compared to HD patients may be responsible for this effect.

Renal transplantation is the best treatment option for patients with endstage renal disease. The potential risk of infectious complications in PD patients after renal transplantation is attributed to the remaining PD catheter. However, this risk seems to be low and without effect on graft survival. For patients on HD a higher percentage of delayed graft function after renal transplantation is constantly reported in the literature. Nevertheless, long time patient and graft survival are not different between both treatment modalities.

Our own long-time clinical experience is congruent with the published literature and proves that peritoneal dialysis is a valuable treatment option for patients with end stage renal disease waiting for renal transplantation.

## Author details

Thomas Rath\* and Stephan Ziefle

\*Address all correspondence to: [trath@westpfalz-klinikum.de](mailto:trath@westpfalz-klinikum.de)

Department of Nephrology and Transplantation Medicine, Westpfalz-Klinikum GmbH, Kaiserslautern, Germany

## References

- [1] Alloatti S, Manes M, Paternoster G, et al. Peritoneal dialysis compared with hemodialysis in the treatment of end-stage renal disease. *J Nephrol* 2000;13:331-42
- [2] Sennfalt K, Magnusson M, Carlsson P. Comparison of hemodialysis and peritoneal dialysis--a cost-utility analysis. *Perit Dial Int* 2002;22:39-47
- [3] Gradaus F, Ivens K, Peters AJ, et al. Angiographic progression of coronary artery disease in patients with end-stage renal disease. *Nephrol Dial Transplant* 2001;16:1198-202
- [4] Stack AG, Martin DR. Association of patient autonomy with increased transplantation and survival among new dialysis patients in the United States. *Am J Kidney Dis* 2005;45:730-42
- [5] Mitome J, Yamamoto H, Kato N, et al. [Dialysis as bridge therapy for renal transplantation: single center experience, a comparison of hemodialysis and continuous ambulatory peritoneal dialysis]. *Nippon Jinzo Gakkai Shi* 2005;47:813-20
- [6] Dombros N, Dratwa M, Feriani M, et al. European best practice guidelines for peritoneal dialysis. 9 PD and transplantation. *Nephrol Dial Transplant* 2005;20 Suppl 9:ix34-ix35
- [7] Bloembergen WE, Port FK, Mauger EA, Wolfe RA. A comparison of mortality between patients treated with hemodialysis and peritoneal dialysis. *J Am Soc Nephrol* 1995;6:177-83
- [8] Fenton SS, Schaubel DE, Desmeules M, et al. Hemodialysis versus peritoneal dialysis: a comparison of adjusted mortality rates. *Am J Kidney Dis* 1997;30:334-42: published online , doi:S0272638697001686 [pii]
- [9] Inrig JK, Sun JL, Yang Q, et al. Mortality by dialysis modality among patients who have end-stage renal disease and are awaiting renal transplantation. *Clin J Am Soc Nephrol* 2006;1:774-9
- [10] Traynor JP, Thomson PC, Simpson K, et al. Comparison of patient survival in non-diabetic transplant-listed patients initially treated with haemodialysis or peritoneal dialysis. *Nephrol Dial Transplant* 2011;26:245-52: published online , doi:gfg361 [pii]; 10.1093/ndt/gfq361 [doi]
- [11] Termorshuizen F, Korevaar JC, Dekker FW, et al. Hemodialysis and peritoneal dialysis: comparison of adjusted mortality rates according to the duration of dialysis: analysis of The Netherlands Cooperative Study on the Adequacy of Dialysis 2. *J Am Soc Nephrol* 2003;14:2851-60



- [12] Jaar BG, Coresh J, Plantinga LC, et al. Comparing the risk for death with peritoneal dialysis and hemodialysis in a national cohort of patients with chronic kidney disease. *Ann Intern Med* 2005;143:174-83: published online , doi:143/3/174 [pii]
- [13] Goldsmith Ei, Whitsell JC, Skelley K, Lubash Gd. Repeated peritoneal dialysis in preparation for renal transplantation. *Surg Gynecol Obstet* 1965;121:42-6
- [14] Brunner FP, Scheitlin W. [Experiences with peritoneal dialysis in the preparation for kidney transplantation]. *Z Gesamte Exp Med* 1967;143:358-61
- [15] Cohen SL, Percival A. Prolonged peritoneal dialysis in patients awaiting renal transplantation. *Br Med J* 1968;1:409-13
- [16] Gokal R, Ramos JM, Veitch P, et al. Renal transplantation in patients on continuous ambulatory peritoneal dialysis. *Proc Eur Dial Transplant Assoc* 1981;18:222-7
- [17] Diaz-Buxo JA, Walker PJ, Burgess WP, et al. The influence of peritoneal dialysis on the outcome of transplantation. *Int J Artif Organs* 1986;9:359-62
- [18] Hrvacevic R, Maksic D, Aleksic S, et al. [Outcome of kidney transplantation in patients on peritoneal dialysis]. *Vojnosanit Pregl* 2001;58:471-4
- [19] Donnelly PK, Lennard TW, Proud G, et al. Continuous ambulatory peritoneal dialysis and renal transplantation: a five year experience. *Br Med J (Clin Res Ed)* 1985;291:1001-4
- [20] Evangelista JB, Jr., Bennett-Jones D, Cameron JS, et al. Renal transplantation in patients treated with haemodialysis and short term and long term continuous ambulatory peritoneal dialysis. *Br Med J (Clin Res Ed)* 1985;291:1004-7
- [21] Burton PR, Walls J. Selection-adjusted comparison of life-expectancy of patients on continuous ambulatory peritoneal dialysis, haemodialysis, and renal transplantation. *Lancet* 1987;1:1115-9
- [22] O'Donoghue D, Manos J, Pearson R, et al. Continuous ambulatory peritoneal dialysis and renal transplantation: a ten-year experience in a single center. *Perit Dial Int* 1992;12:242, 245-2, 249
- [23] Kang Z, Fang G, Chen W. A comparative study of the outcome of renal transplantation in peritoneal dialysis and hemodialysis patients. *Chin Med Sci J* 1992;7:49-52
- [24] Steinmuller D, Novick A, Braun W, et al. Renal transplantation of patients on chronic peritoneal dialysis. *Am J Kidney Dis* 1984;3:436-9
- [25] Padillo-Ruiz J, Arjona-Sanchez A, Munoz-Casares C, et al. Impact of peritoneal dialysis versus hemodialysis on incidence of intra-abdominal infection after simultaneous pancreas-kidney transplant. *World J Surg* 2010;34:1684-8: published online , doi: 10.1007/s00268-010-0527-z [doi]

- [26] Bakir N, Surachno S, Sluiter WJ, Struijk DG. Peritonitis in peritoneal dialysis patients after renal transplantation. *Nephrol Dial Transplant* 1998;13:3178-83
- [27] Warren J, Jones E, Sener A, et al. Should peritoneal dialysis catheters be removed at the time of kidney transplantation? *Can Urol Assoc J* 2012;6:376-8: published online , doi:cuaj.12112 [pii];10.5489/cuaj.12112 [doi]
- [28] Madziarska K, Weyde W, Krajewska M, et al. The increased risk of post-transplant diabetes mellitus in peritoneal dialysis-treated kidney allograft recipients. *Nephrol Dial Transplant* 2011;26:1396-401: published online , doi:gfq568 [pii];10.1093/ndt/gfq568 [doi]
- [29] van der Vliet JA, Barendregt WB, Hoitsma AJ, Buskens FG. Increased incidence of renal allograft thrombosis after continuous ambulatory peritoneal dialysis. *Clin Transplant* 1996;10:51-4
- [30] Sasal J, Naimark D, Klassen J, et al. Late renal transplant failure: an adverse prognostic factor at initiation of peritoneal dialysis. *Perit Dial Int* 2001;21:405-10
- [31] Jassal SV, Lok CE, Walele A, Bargman JM. Continued transplant immunosuppression may prolong survival after return to peritoneal dialysis: results of a decision analysis. *Am J Kidney Dis* 2002;40:178-83: published online , doi:S0272-6386(02)00022-7 [pii];10.1053/ajkd.2002.33927 [doi]
- [32] Sezer S, Karakan S, Ozdemir Acar FN, Haberal M. Dialysis as a bridge therapy to renal transplantation: comparison of graft outcomes according to mode of dialysis treatment. *Transplant Proc* 2011;43:485-7: published online , doi:S0041-1345(11)00028-5 [pii];10.1016/j.transproceed.2011.01.027 [doi]
- [33] Perez FM, Rodriguez-Carmona A, Bouza P, et al. Delayed graft function after renal transplantation in patients undergoing peritoneal dialysis and hemodialysis. *Adv Perit Dial* 1996;12:101-4
- [34] Van Biesen W, Vanholder R, Van Loo A, et al. Peritoneal dialysis favorably influences early graft function after renal transplantation compared to hemodialysis. *Transplantation* 2000;69:508-14
- [35] Lobbedez T, Rognant N, Hurault dL, et al. Impact of automated peritoneal dialysis on initial graft function after renal transplantation. *Adv Perit Dial* 2005;21:90-3
- [36] Freitas C, Fructuoso M, Martins LS, et al. Posttransplant outcomes of peritoneal dialysis versus hemodialysis patients. *Transplant Proc* 2011;43:113-6: published online , doi:S0041-1345(10)01910-X [pii];10.1016/j.transproceed.2010.12.008 [doi]
- [37] Vanholder R, Heering P, Loo AV, et al. Reduced incidence of acute renal graft failure in patients treated with peritoneal dialysis compared with hemodialysis. *Am J Kidney Dis* 1999;33:934-40

- [38] Bleyer AJ, Burkart JM, Russell GB, Adams PL. Dialysis modality and delayed graft function after cadaveric renal transplantation. *J Am Soc Nephrol* 1999;10:154-9
- [39] Snyder JJ, Kasiske BL, Gilbertson DT, Collins AJ. A comparison of transplant outcomes in peritoneal and hemodialysis patients. *Kidney Int* 2002;62:1423-30

