Mortality Comparison of Hemodialysis and Peritoneal Dialysis Patients at a Single Japanese Center

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To investigate whether peritoneal dialysis (PD) is useful as a first modality in Japan, where hemodialysis (HD) is used in 97% of all patients on maintenance dialysis, we used intention-to-treat (ITT) and as-treated analyses to examine patient survival at our center, where HD and PD are used almost equally.

In the ITT analysis, survival was significantly better in the PD group than in the HD group (p = 0.009). Meanwhile, the as-treated analysis did not reveal any significant differences in survival between the HD and PD groups. Survival for patients who underwent combined therapy with PD and HD was very good at 93.75% after 4 years, despite a young age of introduction (56 years).

Our results confirm the usefulness of PD as an initial modality of maintenance dialysis and indicate that combined therapy can serve as a useful treatment option for dialysis patients.

Key words
Patient survival, hemodialysis, combination therapy, intention-to-treat

Introduction
The number of patients undergoing maintenance dialysis for chronic renal failure in Japan was more than 310,000 in 2014, making Japan a leading provider of dialysis worldwide. Peritoneal dialysis (PD) was being used by approximately 9000 of those patients—a mere 2.9% of dialysis patients overall. The number of PD patients has stayed mostly the same since 1995 (1).

Compared with hemodialysis (HD), PD has a smaller effect on hemodynamics. It also has other comparative advantages such as no need for blood access and fewer dietary restrictions. However, besides PD-specific complications such as peritonitis and exit-site infection, another recognized disadvantage of PD is the occurrence of inadequate dialysis when residual renal function is reduced.

Japan has long had very advanced HD technology, yielding a 5-year survival rate of approximately 60% and a 10-year survival rate of approximately 40%, which are 10%–20% better than rates reported for HD in other countries (1). Conversely, few reports examining PD-related survival can be found, and no studies have compared survival rates when PD and HD are equally used.

Insurance in Japan began to cover combined therapy with PD and HD in 2010 (2). Combined therapy is performed to improve fluid control by increasing the dialysis dose when stable dialysis treatment cannot be achieved with PD alone—that is, when inadequate dialysis or fluid overload occurs (2). In Japan, only about 1500 kidney transplantation procedures are performed annually, and emphasis is placed on using PD or HD for long-term maintenance rather than as a bridge to transplantation, which is the more common approach in other countries. Researchers in Japan therefore independently developed the combined-therapy concept, and according to the Japanese Society for Dialysis Therapy, approximately 20% of PD patients were receiving such therapy in 2014 (2).

In the present study, we examined patient survival at our center, where PD and HD are used almost equally. Our aim was to investigate outcomes with combined therapy, but here, we discuss the usefulness of PD as an initial modality in maintenance dialysis.

Methods
Our study included 226 patients in whom HD or PD was introduced at our dialysis center between

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October 1, 2009, and September 30, 2014. The study patients included those who underwent dialysis management at our center and whose survival could be confirmed. Patients who survived after transfer to another hospital partway through treatment or who underwent transplantation during the study period were excluded from the analysis. The PD group comprised patients in whom PD could be initiated after insertion of a Tenckhoff catheter, and the HD group comprised patients who were able to undergo HD using an arteriovenous shunt that was created at our center. Patients in both groups who died after dialysis using the catheter was stopped were excluded from the study population.

The Kaplan–Meier method was used to analyze survival, and the log-rank test was used to test for significant differences. The analysis software used was Statcel3 (OMS Publishing, Saitama, Japan). Survival was examined in intention-to-treat (ITT) and as-treated (AT) analyses.

For the ITT analysis, patients who had originally been introduced to PD were placed in the PD group even if they were later switched to HD, and patients who underwent a combination of PD and HD were also placed in the PD group. For the AT analysis, patients who had originally been introduced to PD and who were later switched to HD were included in the HD group, and patients who underwent a combination of PD and HD were still placed in the PD group (Figure 1).

For the ITT analysis, the PD group included 117 patients, and the HD group included 109 patients. Mean age at the time of dialysis introduction was $64.8 \pm 11.8$ years in the PD group and $71.0 \pm 10.8$ years in the HD group, with patients in the PD group being significantly younger. The estimated glomerular filtration rate at the time of dialysis introduction was $7.79 \pm 10.18$ mL/min in the PD group and $7.08 \pm 9.9$ mL/min in the HD group (no significant difference between the groups). The incidence of diabetes mellitus was $52.14\%$ in the PD group ($n = 61$) and $56.88\%$ in the HD group ($n = 62$), which was not different between the groups.

**Results**

As Figure 2 shows, survival in the ITT analysis was significantly better in the PD group than in the HD group. The 1-, 2-, 3-, and 4-year survival rates were, respectively, $80.9\%$, $75.4\%$, $65.1\%$, and $65.1\%$ in the HD group and $93.8\%$, $87.5\%$, $84.2\%$, and $79.4\%$ in the PD group. Those results show that PD was superior to HD as a first modality in maintenance dialysis. However, in the AT analysis, no significant difference in survival was observed between the HD and PD groups (Figure 3). That finding indicates that the survival of patients who switched from HD to PD was good.

In the ITT analysis, the patients analyzed as the PD group included 21 patients who underwent combined...
therapy with PD and HD. The mean age of those combined-therapy patients was 56 ± 8.8 years, and their mean estimated glomerular filtration rate was 7.0 ± 2.6 mL/min. As shown in Figure 4, when the combined-therapy patients were excluded, no significant difference in survival was observed between the PD and HD groups. Furthermore, the 4-year survival rate of patients who received combined therapy was extremely good at 93.75% (Figure 5). Those results reveal that the better survival seen in the PD group compared with the HD group (Figure 2) was attributable to the good survival in the combined-therapy group.

Discussion and conclusions
Despite the fact that the present study was conducted in a single facility in Japan, an ITT analysis found that the PD group experienced better survival than the HD group. In contrast, an AT analysis revealed no significant difference between the groups. Overall, the results show that PD is superior to HD as a first modality in maintenance dialysis.

Our report could be the first study in Japan showing the usefulness of PD as an initial modality of renal replacement therapy. A large-scale study in the United States found that, in both ITT and AT analyses, the 1-year survival rate was better with PD, although as shown in our ITT analysis, the 5-year survival rate with PD was almost equal to or worse than the rate with HD (3). Our study included patients who underwent PD plus HD (combined therapy) in the PD group. The survival in the combined-therapy group was very good, with a 4-year survival rate of 93.75%. Furthermore, all 5 patients who were switched from combined therapy to HD were still alive. That switch
to HD after a period of combined therapy that started initially with PD alone could have produced the good survival seen in the PD group in the ITT analysis and could have increased the survival in the HD group in the AT analysis.

The usefulness of combined therapy with PD and HD is being investigated primarily in Japan in an attempt to capitalize on the advantages of both modalities by increasing the dialysis efficiency to provide adequate dialysis in PD patients with reduced residual renal function (4). The usefulness of combined therapy will have to be elucidated in future large-scale studies, but the possibility of facilitating the onset of encapsulating peritoneal sclerosis through the long-term continuous use of PD in combined therapy is an added issue to be addressed.

Our study also revealed that fewer patient deaths occurred within 1.5 years of dialysis start in the PD group than in the HD group. Moreover, a study in the United States found that patients on PD had a better 1-year survival rate. Those findings suggest that the treatment required to improve survival during the 1.5-year period after HD introduction should be investigated.

Compared with other countries, Japan performs far fewer renal transplantations (approximately 1500 procedures annually), which is a huge disadvantage to end-stage renal failure patients in Japan and the reason that dialysis therapy has been emphasized more as a maintenance therapy than as a bridge to transplantation. Consequently, the number of facilities offering HD in Japan exceeds 3000, allowing the therapy to be received anywhere in Japan. By contrast, PD is offered primarily at advanced medical centers such as university hospitals; it is not widely available. In addition, disseminating PD throughout Japan is difficult: In other countries, PD was originally developed as a bridge therapy to transplantation (which is not the case in Japan), and little research into long-term survival with PD therapy has been conducted in Japan. Because of those idiosyncrasies of renal failure medicine in Japan, studies into long-term (5-year) survival with PD and HD are essential to determine whether PD is useful as a dialysis therapy for Japanese patients.

A study in the United States found that PD was superior to HD in terms of its 2-year survival rate (48%), although more and more reports are revealing that, with respect to long-term survival, PD is no different than HD (3,5,6). The results from the United States highlight the usefulness of PD as a bridge to transplantation rather than as a maintenance therapy. In the present study, we showed that survival was better with PD than with HD, and that in ITT analysis, survival was very good in the combined-therapy group. Those results suggest that PD should be considered an initial modality in maintenance dialysis, and that, although future large-scale survival analyses are needed, combined therapy could, in the meantime, be a good option for improving the life expectancy of dialysis patients.

Disclosures
SK is a participant on advisory boards for JMS Corporation and the speaker’s bureau of Baxter Corporation.

References

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