Patient-related and centre-related factors influencing technique survival of peritoneal dialysis in The Netherlands

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Abstract

Background. Although technique failure occurs relatively frequently in peritoneal dialysis (PD), few data have been published on differences in technique failure between centres.

Methods. Using data from RENINE, the comprehensive dialysis registry of The Netherlands, we analysed PD technique failure rates in the period 1994–1999, with life table methods and Cox multiple regression analysis. Patient age, sex, and the presence or absence of diabetes were included in the analysis, as well as time of initiation of PD and the following centre characteristics: number of PD patients treated in the centre and percentage of patients on PD.

Results. Technique failure was higher in older patients: 2-year technique survival was 75% in those younger than 45 years, 68% in the group aged 45–64 years, and 60% in those over 64 years (P < 0.0001). Sex and diabetes made no difference in technique survival. Mean annual technique failure rates varied greatly between centres (10–59%) and correlated with the number of patients on PD in the centre (r = 0.396, P < 0.009) and with the fraction of patients on PD (r = 0.410, P < 0.006). Low technique survival rates occurred mainly in centres with less than 20 patients on PD: relative risk for technique failure 1.68 as compared with larger centres. Patients starting PD in the period 1997–1999 had better technique survival than those starting in 1994–1996 (P = 0.001).

Conclusion. PD technique survival in The Netherlands has increased in recent years. Having less than 20 PD patients in a centre or having a small fraction of patients on PD carries an increased risk of technique failure. The variability in PD technique survival between centres indicates that in many centres further improvements should be possible.

Keywords: centre size; dialysis centres; dialysis registry; patient survival; peritoneal dialysis; technique survival

Introduction

The proportion of patients on peritoneal dialysis (PD) switching to haemodialysis (HD) in The Netherlands is three times higher than the proportion of patients on HD switching to PD, and even worse results have been reported in the literature [1]. This kind of switch is usually expressed as technique failure, i.e. the percentage of patients that change their dialysis mode. Looking at the same phenomenon from a different angle, the technique survival rate can be calculated, i.e. the percentage of patients staying on a certain dialysis mode. In this kind of analysis, death and transplantation are not included, i.e. these patients are considered as lost to follow-up. As patient survival is similar in PD and HD, improvements in PD technique survival are important as they would directly translate into a higher percentage of patients on PD, which has advantages in terms of patient self-reliance and cost. Nevertheless, data on PD technique survival are relatively scarce and reflect mainly single-centre results. No nationwide data on the subject of technique failure in a European country have been published so far. In The Netherlands, a reliable comprehensive registry of dialysis patients has been in existence since 1986 (RENINE), which makes it possible to analyse PD technique failure of dialysis patients for the whole country. In the last few years the percentage of dialysis patients on PD has stabilized at around 30% in The Netherlands, with currently a total of about 1400 PD patients who are dialysed in 43 of the 46 dialysis centres. As there are large differences between centres in the number of patients and in the percentage of patients on PD, it appeared relevant to investigate how these factors affect technique survival. The influence of

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Subjects and methods

Since 1986 all Dutch dialysis centres provide their patient data to RENINE on a voluntary basis. There is broad support for this registry, which was founded by nephrologists. The 100% participation of the centres has remained the same over the years, possibly because the data required on the form have been kept very simple: the only items are name, address, date of birth, sex, primary renal disease, mode of treatment, date of start on this form of treatment, date of death, and cause of death. Comorbidity is not registered. As changes, for example of treatment modality, are monitored with update forms, the track record of each dialysis patient in The Netherlands is known with respect to the characteristics mentioned above. Each year a full printout of the data of all their patients is sent to the centres to check the accuracy and correct possible errors. For the purpose of the analysis presented, data from 1994 to 1999 were used except for the data presented in Figure 1, which gives follow-up of the cohort of patients starting dialysis in 1993–1997. From the beginning of 1994 until the end of 1999 the prevalent number of PD patients in The Netherlands increased from 1082 to 1438, while a total of 4049 patients started PD in this period. Patients were followed up to January 2000.

Statistical methods

The main analysis was performed with life table methods. Differences between curves were tested for significance with the Log Rank test. A result with \( P < 0.05 \) was considered significant. For the data on technique survival, patient death was considered as lost to follow-up, i.e. censored. A temporary change of dialysis technique for less than 3 months was not considered a change of technique. Although the emphasis of this paper is on PD technique survival, as a check we also analysed patient survival in order to exclude confounding effects of differences in clinical practice between centres. A policy that leads to a relatively late switch to HD might increase technique survival but decrease patient survival. In the patient survival analysis, patient death was the only terminal event; change of dialysis technique or transplantation was considered as lost to follow-up.

To take into account a possible correlation between various risk factors a Cox multiple regression analysis was performed for technique survival as well as for patient survival. For both analyses the following covariants were considered: centre size less than 20 patients, starting PD in the first 3 years of the study (1994–1996), age, male sex, and diabetes.

Results

Patient characteristics

To see what happens to individual patients we analysed the cohort of patients starting dialysis from 1993 to 1997 (Figure 1).

In the first 2 years after the start of dialysis, the proportion of patients on PD switching to HD was higher than vice versa. Because of concern that patients with PD failure might have developed such a bad physical condition that their survival on HD might also be impaired, patient survival of this group in HD was compared with survival of all other patients starting HD. As can be seen in Figure 2 there is no difference in survival between these two groups, showing that the feared deleterious effect of PD failure on patient survival, if present, is of limited magnitude.

In our data there is no evidence of an effect of sex or diabetes on the rate of technique failure (not shown). There is an effect of age, however. Those over 65 years have a somewhat lower technique survival than younger age groups (3–4): 75, 68, and 60% 2-year survival, respectively, for the groups 0–44, 45–64, and more than 64 years (Figure 3).

Comparing the cohort of all patients starting in 1994–1996 with those starting in 1997–1999 a significant improvement in technique survival was found (Figure 4). Apparently, the combination of technical improvements and more experience in the centres resulted in this favourable development.

In all three age groups mentioned above, a trend towards improvement was present (not shown).

Centre characteristics

On January 1, 2000 the number of PD patients varied from seven to 80 (mean 34, SD 18) in the 43 dialysis centres. The percentage of patients on PD in the centres varied from 12 to 65% (mean 31%, SD 12%).

There was no significant correlation between the total number of patients per centre and the share of patients treated with PD. We analysed whether the fraction of older patients on PD differed between centres. These differences existed and ranged from 0 to 58%. A higher share of PD among elderly patients went along with a higher share among young patients \((r = 0.657, P < 0.001)\) and, therefore, probably reflects mainly the emphasis given to PD in the centres.

Technique survival varied greatly between centres with an average annual technique failure rate in the
range of 10–59% (mean 22%, SD 11%) between 1994 and 1999.

We correlated the failure rate and a number of centre characteristics and found that it was related to the number of patients on PD \( (r = -0.396, P = 0.009; \text{Figure 5}) \). Looking at it from a slightly different angle, we found that failure rate also correlated with the share of patients on PD \( (r = -0.410, P = 0.006; \text{Figure 6}) \).

If the centres were split in a group of centres with less than 20, 20–32, and more than 32 patients only the technique survival in centres with less than 20 patients was lower; the middle-sized and large centres showed no difference in technique survival (Figure 7).

**Cox regression analysis**

The multiple regression analysis confirmed the result of the technique survival analysis. Results for technique survival are presented in Table 1.

Centre size less than 20 patients was associated with a substantial increased risk of technique failure compared with centres with more patients. Starting PD in the earlier years (1994–1996) and older age also were significant risk factors for technique failure. Sex and diabetes did not carry an increased risk for technique failure.

Cox analysis of patient survival (see Table 2) showed no increased mortality risk in small centres compared with larger centres, nor a difference in mortality
between males and females. Similar to the technique survival analysis, an increased risk was found with a start in the period 1994–1996 and with higher age. Patients with diabetes showed increased mortality risk.

Discussion

To our knowledge, this is the first analysis of PD technique survival data from a comprehensive European national registry. We found that, generally, centres with a higher absolute number of PD patients or with a higher percentage of patients on PD demonstrate better technique survival. Apparently, experience counts. Furthermore, technique survival increased with time, as we can see comparing the cohort that started from 1994 to 1996 with the cohort starting from 1997 to 1999. As this increase occurred in the young and middle-aged as well as in the elderly it appears to be a consistent effect, which may be due to improved connection technology. Finally, we found that age affected technique survival in the Dutch group of patients studied: age decreases technique survival. Although the cumulative technique survival rate in general is still low, 60% at 3 years, the good news is that PD patients who arrive at HD after a previous period of PD treatment seem to have survival rates similar to those of new HD patients.

That more experienced centres have, in general, better results is perhaps not surprising. The variation between centres is too large to define exact limits, but our data suggest that having more than 30 PD patients does not increase survival. Below the number of 30 PD patients variability between centres increases greatly; about half the centres with less than 20 PD patients have technique failure rates above 35% per year. A safe conclusion appears to be that centres should aim to have at least 30 patients on PD in order to develop and maintain their experience. Having less than 20 PD patients in a centre definitely carries an increased risk of technique failure. As patient survival is not decreased in centres with less than 20 PD patients, one might postulate that these centres transfer their patients to HD at an earlier stage so that their lifespan is not diminished but the length of their stay on PD is. The PD population in a centre should also be more than a negligible minority: centres with less than 20% of their patients on PD also tend to do worse with respect to technique survival while there appears to be no additional benefit of having more than 40% of patients on PD.

The fraction of patients on PD in a certain centre depends on many variables. The attitude of the physician and the nursing staff towards PD for example comes into play. If the selection criteria for PD in a centre are very strict, the PD team possibly gets only patients in very good condition but has less chance to build up experience. As PD technique survival is generally better in centres with a high fraction of their patients on PD, the combination of a positive attitude and more opportunity for experience is probably more effective for good technique survival than very strict entry criteria for PD. This attitude and experience of doctors and nurses is probably, therefore, also the most important single factor determining technique survival. That for example the age distribution of patients in a dialysis centre is not a very important factor determining the fraction of patients on PD is suggested by the high correlation that exists between the fraction of patients on PD aged 65 years or older in a centre vs the younger group.

In the literature, we found only three previous studies with conclusions regarding differences between centres. In the USA, Port et al. [2] found in a trial with a follow-up of 12–21 months of 3109 patients that the relative risk of technique failure was 0.77 in centres with more than 20 patients as compared with smaller centres. In Italy, Maiorca et al. [3] found in a long-term study (7 years, six centres, 853 patients) that significant differences in technique survival existed between the six participating centres but they did not investigate the possible effects of centre size. A recent

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Table 1. Cox multiple regression analysis of PD technique failure

<table>
<thead>
<tr>
<th>Variables</th>
<th>Significance</th>
<th>Relative risk</th>
</tr>
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<tbody>
<tr>
<td>&lt;20 PD patients</td>
<td>P &lt; 0.0001</td>
<td>1.68</td>
</tr>
<tr>
<td>Start in 1994–1996</td>
<td>P = 0.0013</td>
<td>1.22</td>
</tr>
<tr>
<td>Age (per 10 years)</td>
<td>P &lt; 0.0001</td>
<td>1.13</td>
</tr>
<tr>
<td>Sex (male)</td>
<td>n.s.</td>
<td></td>
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<tr>
<td>Diabetes</td>
<td>n.s.</td>
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Table 2. Cox multiple regression analysis of PD patient mortality

<table>
<thead>
<tr>
<th>Variables</th>
<th>Significance</th>
<th>Relative risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;20 patients</td>
<td>n.s.</td>
<td></td>
</tr>
<tr>
<td>Start in 1994–1996</td>
<td>P = 0.0013</td>
<td>1.18</td>
</tr>
<tr>
<td>Age (per 10 years)</td>
<td>P &lt; 0.0001</td>
<td>1.63</td>
</tr>
<tr>
<td>Sex (male)</td>
<td>n.s.</td>
<td></td>
</tr>
<tr>
<td>Diabetes</td>
<td>P &lt; 0.0001</td>
<td>1.88</td>
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nationwide Canadian study [4] showed that the cumulative experience with PD of a dialysis centre affects technique survival favourably. The effect of centre size was, however, not considered in this study. Apparently differences between centres are such a sensitive issue that little investigation has been done on this subject in the field of PD. Nevertheless, better insight in the backgrounds of these differences could lead to improvements, the more so if transfer of knowledge between centres with relatively high technique survival to centres with poorer PD technique survival is realized.

As shown in Figure 2 we found that patients coming from PD and entering HD had a mortality that was not higher than the mortality of all other patients in the registry who started HD. Although this is a reassuring finding, one should keep in mind that the two groups are not matched with respect to age and comorbidity so that this conclusion cannot be drawn with certainty. The group with PD technique failure is younger and is likely to have less comorbidity than the other patients starting HD. On the other hand, the patients with PD technique failure have been in dialysis longer than the other patients starting HD, which may be a disadvantage for the former.

In both groups shown in Figure 2, i.e. in all patients starting HD, the survival curve slopes downward rather steeply at first but levels off later on. This is a well-known phenomenon, which has been shown to be age-dependent [5]. In young dialysis patients the increased mortality in the first year is hardly present, if at all, but the effect increases with age. Apparently it depends on the proportion of high-risk patients starting dialysis.

A remarkable positive finding of our study was the increase of technique survival in recent years. Recently, this has also been shown for the Canadian PD population [6]. Neither the Canadian study nor ours provides hard evidence about the factors responsible for this improvement. The Canadian study suggests a decrease in the rate of technique failure due to peritonitis. As peritonitis is the most common cause of technique failure [7], decreased peritonitis rates after the introduction of the so-called Y-system may indeed play a role. An additional technical factor may be the increased availability of cyclers and the emergence of new dialysis fluids, which make it possible to better treat or avoid fluid overload in patients with high peritoneal transport rates. Alternatively, the increasing experience with PD may play a role. Nevertheless, the nationwide 5-year PD technique survival rate in our study was only 40% so there still is much opportunity for improvement.

That age affects patient survival on PD is self-evident and widely recognized. Whether age also affects technique survival has been disputed. Genestier et al. [8] found decreased PD technique survival with age in a single-centre French study. Gentil et al. [9] found decreased technique survival in those over 60 in a Spanish regional study. Contrary to this, Port et al. [2] found that PD technique failure was more likely to occur in younger patients. Maiorca and Cancarini [1], in a review, also tend towards the conclusion that older age means better PD technique survival. In our data of over 4000 unselected PD patients, a clear-cut decrease in technique survival with age was present, with 1-year rates of 86, 80, and 73% for 0–44, 45–64, and 65 years or older, respectively, while the 3-year rates were 67, 59, and 48%.

The fact that these national registry data show relatively high technique failure rates deserves some attention. On the whole, 1-year technique survival rate was 80%, 3-year rate was 59%, and 5-year rate was 40%. After the first year with a 20% switch to HD, the switch rate, therefore, appears to remain stable up to 5 years at 10% of the initial group per year. These rates are comparable with some other data in the literature [8–10] although in three studies, of which only the first one is a multi-centre study, 5-year technique survival rates of 64–72% have been reported [3,7,10]. We have no information on the reasons for technique failure in our registry but persistent peritonitis, ultrafiltration problems, lack of dialysis adequacy, subcutaneous or external leakage, and patient compliance are probably the main causes in our patient population, as they are in the literature [7]. The improved results, which our data show for the later years, gives some hope that more experience with PD and wide application of technical improvements may lead to an improvement in technique survival, and possibly in the future also of patient survival.

References


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