TECHNIQUE FAILURE AND CENTER SIZE IN A LARGE COHORT OF PERITONEAL DIALYSIS PATIENTS IN A DEFINED GEOGRAPHIC AREA

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**Background:** Hemodialysis (HD) and peritoneal dialysis (PD) are both viable options for renal replacement therapy. Technique failure has been shown to be a major problem in PD therapy.

**Objective:** To examine the relationship between center size and PD technique failure.

**Setting:** ESRD Network #1 (NW1).

**Design:** Retrospective review of NW1 database.

**Patients and Methods:** 5003 incident PD patients between 2001 and 2005 in 105 PD units were included. Patients were grouped into 2 based on center size: group A, patients in units with ≤25 patients, and group B, patients in units with >25 patients. Outcome measures were analyzed for the first and second years of PD therapy. Patients were censored at transplantation, transfer to HD, or death.

**Outcome Measures:** Technique failure and mortality reported as death in Standard Information Management Systems (SIMS) database (NW1 data system).

**Results:** Technique failure rates were significantly higher in group A for year 1 (odds ratio: 1.36, \(p = 0.005\)) and for year 2 (odds ratio: 1.35, \(p = 0.03\)). Mortality rates were not statistically different between the 2 groups.

**Conclusion:** Technique failure was higher in units with ≤25 patients than in units with >25 patients. There was no difference in mortality between the 2 groups. The majority of patients in NW1 receive care in small units.

**Key Words:** Center size; technique failure.

**Technique failure rate** is defined as the proportion of dialysis patients switching from one modality to another. Even though mortality rates in patients on hemodialysis (HD) and peritoneal dialysis (PD) have been shown to be comparable (1–3), technique failure occurs more frequently in PD (1,4–7) and remains a major problem with this dialysis modality. The major causes of technique failure are peritonitis, ultrafiltration failure, and psychosocial issues (1). However, other factors may contribute to technique failure. One factor that has been suggested is center size. There are limited studies on the effect of center size on technique failure and mortality. Previous studies comparing center size and technique failure or mortality were based on reviews of the Netherlands dialysis database (RENINE), a Canadian database, and a Baxter Healthcare database (8–10). These studies suggest that increased experience with PD may result in improved outcomes, with reduced technique failure rates in larger centers. However, there are conflicting results when comparing mortality rates. The present study was done to evaluate the effect of center size on technique failure or mortality in a defined geographic area in the United States (ESRD Network #1). Of the 18 networks in the United States, Network #1, which includes the New England states, has the highest PD utilization rate: 11% of prevalent end-stage renal disease (ESRD) patients in this area are maintained on PD compared to 8% in the general USA ESRD patient population based on the 2005 Summary Report of the ESRD Networks’ Annual Reports submitted to Centers for Medicare and Medicaid Services (CMS) (11).

**Patients and Methods**

This study was designed to determine if there is a difference in technique failure and mortality between units caring for 25 patients or fewer versus those caring for more than 25 patients. This study is based on data from the database maintained by Network #1. Network #1 staff analyzed the data. The Network maintains a database called Standard Information Management System (SIMS) that tracks the number of patients starting PD.
technique failure and center size

Mortality rate for year 2

= \frac{\text{# of pts that died during 2nd year of PD}}{\text{Adjusted # of pts in 2nd year of PD}}.

The number of patients was adjusted for transplantation and patients moving out of the area by censoring these patients. The data were analyzed using the SAS software (SAS 9.1.3; SAS Institute, Cary, NC, USA) and differences between the groups were calculated using the chi-square.

The sample size calculation for this study was based on a power analysis that assumed a 25% survival or technique failure benefit in the larger centers compared with the smaller centers. On the basis of the USRDS 2007 database (adjusted first year PD mortality for 2004 of 16.5%), we calculated that a sample size of 2280 would be needed to detect an absolute survival difference of 25%, assuming a power of 80% and a two-tailed alpha level of 0.05.

RESULTS

There were 5003 patients in the study. A total of 3025 were included in group A and 1978 patients were in group B. The baseline characteristics of the study population are summarized in Table 1. There was a similar proportion of males and females in both groups. In both groups the majority of the patients were white. There was a higher percentage of patients with diabetes mellitus in group B although the difference was not statistically significant.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Group A</th>
<th>Group B</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient proportion [n (%)]</td>
<td>3025 (60.5)</td>
<td>1978 (39.5)</td>
<td>0.1521</td>
</tr>
<tr>
<td>Year 1</td>
<td>1843 (61.3)</td>
<td>1165 (38.7)</td>
<td>0.0014</td>
</tr>
<tr>
<td>Year 2</td>
<td>1182 (59.2)</td>
<td>813 (40.8)</td>
<td></td>
</tr>
<tr>
<td>Gender (%)</td>
<td></td>
<td></td>
<td>0.5713</td>
</tr>
<tr>
<td>Female</td>
<td>46</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>54</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>Race (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>85</td>
<td>64</td>
<td></td>
</tr>
<tr>
<td>African-American</td>
<td>7</td>
<td>24</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>8</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Age (average; years)</td>
<td>61</td>
<td>61</td>
<td></td>
</tr>
<tr>
<td>Diabetes mellitus (% of total)</td>
<td>39</td>
<td>43</td>
<td>0.5652</td>
</tr>
</tbody>
</table>

a Group A includes centers with \leq 25 peritoneal dialysis patients; group B includes centers with >25 patients. ESRD Network #1 Standard Information Management database.
statistically significant. The average age in both groups was similar. At the end of year 1, 1843 patients remained on PD in group A and 1165 patients in group B; at the end of year 2, 1182 patients remained on PD in group A and 813 in group B (Figure 1).

Table 2 shows the relationship between center size and mortality and technique failure. For all patients, death and technique failure rates were 14.3% and 14.2% during year 1 and 15.4% and 13.0% during year 2 respectively. As shown in Figure 2, there was a statistically significant higher technique failure rate in group A than in group B for both year 1 [odds ratio (OR): 1.36, \( p = 0.005 \) and year 2 (OR: 1.35, \( p = 0.03 \)]. There was no statistical difference in mortality rates (reported as deaths) between the groups for year 1 or year 2 (Figure 3).

**DISCUSSION**

The present study demonstrates that technique failure rates were significantly higher in PD units with \( \leq 25 \) patients than in units with >25 patients at the end of both year 1 and year 2. The calculated rates of technique failure were 31% higher during year 1 and 30% higher during year 2 in small centers (group A). However, death rates were not significantly different between the two groups (\( p = 0.53 \) and \( p = 0.41 \) for years 1 and 2 respectively). Importantly, more PD patients in Network #1 receive care in smaller centers (\( \leq 25 \) patients/center) than in bigger centers. African-Americans have a lower mortality on PD but a higher technique failure rate on PD (1,12–14). The study population was mostly white but group B had a higher percentage of African-Americans than group A. We do not think that this has an impact on our study results because, despite the larger percentage of African-Americans and patients with diabetes mel-

![Figure 1 — Number of patients by peritoneal dialysis center size: centers with \( \leq 25 \) patients (Group A); centers with >25 patients (Group B).](image)

![Figure 2 — One- and 2-year technique failure rates for peritoneal dialysis centers with \( \leq 25 \) patients (Group A) and >25 patients (Group B).](image)

![Figure 3 — One- and 2-year mortality rates for peritoneal dialysis centers with \( \leq 25 \) patients (Group A) and >25 patients (Group B).](image)

<table>
<thead>
<tr>
<th>TABLE 2</th>
<th>Relationship Between Center Size (^a) and Technique Failure and Mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Group A ([ n \ (%) ])</td>
</tr>
<tr>
<td>Patients in first year of PD</td>
<td>1843 (61.3)</td>
</tr>
<tr>
<td>Deaths</td>
<td>257 (13.9)</td>
</tr>
<tr>
<td>Switched to HD</td>
<td>287 (15.6)</td>
</tr>
<tr>
<td>Patients in second year of PD</td>
<td>1182 (59.2)</td>
</tr>
<tr>
<td>Deaths</td>
<td>176 (14.9)</td>
</tr>
<tr>
<td>Switched to HD</td>
<td>170 (14.4)</td>
</tr>
</tbody>
</table>

PD = peritoneal dialysis; HD = hemodialysis.

\(^a\) Group A includes centers with \( \leq 25 \) peritoneal dialysis patients; group B includes centers with >25 patients.
litus, group B had a lower technique failure rate than group A.

Our results are consistent with prior studies comparing center size and technique survival. In a review of the Netherlands dialysis database (RENNIE) (8), Huisman et al. found that mean annual technique failure rates correlated with the number of patients on PD in a center ($r = -0.396, p = 0.009$) and with the fraction of patients on PD ($r = -0.410, p = 0.006$). They also showed that having fewer than 20 patients per unit was associated with a higher risk of technique failure (relative risk 1.68). As in our study, there was no difference in survival between small- and large-center groups. Similarly, in a review of the Baxter database consisting of three large cohorts of patients initiating PD in 1999–2001 (total of >30,000 patients), Guo and Mujais observed that centers with fewer than 20 patients had a higher technique failure rate than centers with more than 20 patients (hazard ratio 1.130, $p < 0.0001$) but had no difference in mortality (10). Schaubel et al. reviewed data from the Canadian Organ Replacement Register (CORR) and evaluated the effect of center characteristics on mortality and technique survival by center-specific cumulative number of PD patients treated using data on 17,900 patients that received PD from 1981 to 1997 (9). They found that, as the cumulative number of patients treated by a PD unit increased, covariate-adjusted mortality decreased ($p = 0.05$) and that, as the percentage of patients starting PD in a unit increased, technique failure rates decreased.

The reasons for the relationships between center size and technique failure are not clear. It has been suggested that the difference in technique failure rate might be related to having more experience in managing PD patients and the complications of PD therapy, having more staff available for patients, and responding to problems in a more timely manner. If these reasons are correct, then the reason for the lack of difference in mortality rates between larger and smaller groups is not obvious. The reason could be that the SIMS database (used in the present study) consists of all events in chronological order that allowed the attribution of death to either PD or HD, based on the time when death happened relative to change in modality. In our study, we attributed death to PD for up to 60 days after transfer to HD. This method of calculating mortality rates when dealing with technique failure was previously used by Collins et al. (3). The method seeks to avoid deaths that should be attributed to PD but that occur shortly after switching to HD.

Our study has some limitations. It is a retrospective study and therefore subject to unmeasured confound-ers. Also, the information used is strictly limited to information available in the Network database and does not include several important variables, such as additional patient demographic data, the nurse-to-patient ratio in each group, and the degree of PD specialization, that is, the proportion of PD to HD patients in each group or center. The data are also reflective of just one ESRD network in the USA and, while they may be used as a guide to other networks, they may not reflect the characteristics of other networks. Patient outcomes in the study could not be accurately adjusted for comorbidities since limited comorbidity data were available. Another limitation is the arbitrary use of a cutoff number for small centers (25 patients). There are no studies determining the exact number of patients per center at which there is a difference in patient-related outcomes. Previous studies have used an arbitrary number of 20. It is possible that the difference is a continuous one, with better patient outcomes with increasing center size, as shown by Schaubel et al. (9). Our study set an arbitrary cutoff number of 25 patients prior to collection of data. An attempt to analyze the centers based on increasing size would result in very small patient numbers that would not be significant to make reliable conclusions.

In summary, the present study shows that centers with a smaller number of PD patients have a significantly higher technique failure rate compared to larger centers but that there is no statistically significant difference in mortality rates. Despite the limitations of the study, the results are consistent with previous studies and therefore suggest that the effect of center size on technique failure rates should be taken seriously. It is concerning that the majority of PD patients in Network #1 receive care in smaller centers; this observation is consistent with the trend in other parts of the USA. A review of the Baxter database, consisting of four large cohorts of patients initiating PD in 2000–2003 (total of >40,000 patients), revealed that more than 80% of centers have fewer than 20 patients on PD (15). While encouraging smaller centers to develop PD therapy to broaden its geographic distribution and make it more available to a wider range of patients, the association with higher PD technique failure rates requires that smaller centers carefully examine their treatment regimens and consider building up their practice or consolidating with other smaller centers to improve patient outcomes. Perhaps a nationwide study looking at technique failure rates and mortality among centers will have sufficient numbers to permit comparing centers with incremental numbers and may be beneficial in determining the minimum center size required to achieve optimal technique and patient survival on PD.
DISCLOSURE

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REFERENCES