Cross-Sectional Comparison of Quality of Life and Illness Intrusiveness in Patients Who Are Treated with Nocturnal Home Hemodialysis versus Peritoneal Dialysis

Edwin Fong, Joanne M. Bargman, and Christopher T. Chan
Toronto General Hospital–University Health Network, Toronto, Ontario, Canada

Background and objectives: Nocturnal home hemodialysis provides excellent biochemical and metabolic control of uremia; however, extensive training is necessary and technical barriers exist for intensive home hemodialysis compared with the relative simplicity of peritoneal dialysis. It was hypothesized that nocturnal home hemodialysis is associated with improved quality of life but higher illness intrusiveness compared with peritoneal dialysis.

Design, setting, participants, & measurements: All home dialysis patients at the University Health Network were approached to complete the Kidney Disease Quality of Life-Short Form, Beck Depression Inventory, and Illness Intrusiveness Survey during February to June 2006.

Results: Sixty-nine percent of all eligible patients completed the survey. Of the three domains derived from the Kidney Disease Quality of Life-Short Form, there was no difference in the kidney disease component summary, physical component summary, and the mental component summary between the two groups. There was a trend toward better sexual function in the nocturnal home hemodialysis group; however, nocturnal home hemodialysis patients experienced less social support than the peritoneal dialysis group. There was no difference between the nocturnal home hemodialysis and peritoneal dialysis patients with respect to the Beck Depression Index. Total illness intrusiveness score was similar between the nocturnal home hemodialysis and peritoneal dialysis patients.

Conclusions: This study suggests that nocturnal home hemodialysis is not perceived as a more intrusive treatment and demonstrates that patients who are on peritoneal dialysis have similar perceived symptomatic control of their kidney disease.

Concise Methods

This protocol was approved by the Research Ethics Board of the Toronto General Hospital–University Health Network. All patients who had ESRD and were undergoing NHD or PD were deemed eligible for this study when they remained on either NHD or PD for a minimum of 3 mo. All patients were required to have a working knowledge of their dialysis regimen before study participation.

Patients’ perception of their well-being and the balance between treatment effectiveness and illness intrusiveness have become an integral component of assessing the human cost of chronic disease and its interventions (1). Determinants of health-related quality of life (QOL) have been examined using longitudinal and cross-sectional studies in patients with ESRD (2–4). Multiple factors are known to influence health-related QOL in ESRD, including clinical manifestations of disease, nutritional status, inflammation, treatment modality adverse effects, and rapport with care providers (5–8). Uncommonly, in-center conventional hemodialysis (CHD) has a profound negative impact on the QOL of patients with ESRD. In addition, patients with poor QOL have an elevated risk for hospitalization, worse hemodialysis outcomes, and increased likelihood of death even after adjustment for their demographic and comorbid factors (9,10).

Home peritoneal dialysis has been suggested to provide superior QOL compared with in-center CHD in the face of similar health status in both patient populations (11,12). Nocturnal home hemodialysis (NHD; 8 to 10 h during sleep, 5 to 7 nights per week) provides more frequent and higher dosage of hemodialysis than CHD (three sessions per week, 4 h per session). Preliminary data have suggested improvements in QOL and symptoms of depression after conversion from CHD to NHD (13). NHD has also been found, in both short- and long-term studies, to reverse several important risk factors or markers of adverse cardiovascular outcomes (14). Although NHD affords excellent uremia control, extensive training and set-up time are necessary for its performance and technical challenges exist (e.g., self-cannulation) compared with the relative simplicity of PD. Furthermore, preservation of residual renal function in PD patients is associated with improved QOL (15). Given the clinical importance of patients’ perceived well-being relative to treatment intrusiveness, additional information is needed to delineate the differences in QOL and illness intrusiveness in patients who are on NHD versus PD. We hypothesized that NHD would be associated with improved QOL but higher illness intrusiveness compared with PD.
of English. None had any acute illness or was hospitalized. Written
informed consent was obtained from each patient. Surveys were mailed
to our patient cohorts during February to June 2006. At 3 wk, a fol-
low-up telephone call was placed to ascertain whether patients had
received their survey. A repeat mailing was sent after our telephone
reminder. Survey results were included in the study when they were
returned within 4 mo of mailing. All dialysis-related blood tests were
obtained via standardized protocols, and their results were stored in an
electronic database. All responses were anonymous.

**Instruments**

Health-related QOL was measured using Kidney Disease Quality of
Life-Short Form (KDQOL-SF) Version 1.3. The KDQOL-SF includes 36
items derived from a generic, validated instrument (SF-36) as well as 43
kidney disease–targeted items and one overall health-rating item. This
instrument has been validated in the ESRD population (16). The patient
responses to the KDQOL-SF were used to determine scores for the
kidney disease component summary (KDCS), mental component sum-
mary, and the physical component summary. The KDCS was derived
from 11 subscales: Symptoms, effects of kidney disease, burden of
kidney disease, work status, cognitive function, quality of social inter-
action, sexual function, sleep, social support, dialysis staff encoura-
gement, and patient satisfaction.

The Beck Depression Inventory (BDI) was used to ascertain depres-
sive symptoms in our patient populations. The BDI was previously
validated in the ESRD population (17). It is composed of 21 items
ranked from 0 to 3. Depression is suggested by a score of >15 in ESRD.

Perceived intrusiveness of ESRD was measured using the intrusive-
ness ratings scale, which is composed of a 13-item index divided into
five subscales: Physical well-being and diet; work and finances; marital,
family, and sexual relations; recreation and social relations; and other
aspects of life (18). Patients’ comorbid status was quantified using the
modified Charlson Index (19).

**Statistical Analyses**

Data are presented as means ± SE. χ² test was used for between-
group comparisons for categorical variables. An unpaired t test was
used for between-group comparisons for normally distributed vari-
ables. Multivariate regression analysis was used to adjust for potential
confounding variables. A two-tailed P < 0.05 (SAS 8.2; SAS Institute,
Cary, NC) was required for significance.

For ascertainment of the influence of residual renal function on QOL,
PD patients were stratified a priori according to their documented
creatinine clearance (>3 ml/min per d) closest to the time of the survey.
ANOVA was then applied to test for significant differences among PD
patients (with or without residual renal function) and NHD patients.

**Results**

The study population consisted of 93 patients with ESRD (36
NHD and 57 PD). Of the eligible patients with ESRD, 69% (72%
NHD and 67% PD) responded. Their baseline characteristics are
summarized in Table 1.

Overall, the majority of NHD and PD patients were male (67
[NHD] versus 55% [PD]; P = 0.28) and had similar comorbid
status as assessed by the modified Charlson Index (1.14 ± 0.25
[NHD] versus 1.82 ± 0.33 [PD]; P = 0.14). NHD patients were
younger (49 ± 2 versus 61 ± 2 yr; P < 0.001), although they had a
similar renal replacement vintage as PD patients (10.8 ± 1.7
[NHD] versus 7.6 ± 1.0 yr [PD]; P = 0.1). There was a trend
toward increased frequency of renal transplants in NHD pa-
tients (31 [NHD] versus 14% [PD]; P = 0.08). NHD patients also
tended to be more educated than PD patients. There were no
differences in the frequency of patients who lived alone (25
[NHD] versus 18% [PD]; P = 0.41).

Compared with NHD, plasma urea and creatinine concen-
trations were higher in PD patients. NHD patients had higher
hemoglobin concentration than the PD population (124
[NHD] versus 117 ± 2 g/L [NHD]; P = 0.026). Plasma albumin
and calcium were higher in the NHD cohort in comparison
with the PD patients (39 ± 2 [NHD] versus 37 ± 2 g/L [PD]; P <
0.001) and (2.41 ± 0.03 [NHD] versus 2.27 ± 0.30 mmol/L [PD];
P = 0.002), respectively. Plasma phosphate was lower (1.11 ±

**Table 1. Baseline patient characteristics**

<table>
<thead>
<tr>
<th>Variable</th>
<th>NHD</th>
<th>PD</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yr; mean ± SD)</td>
<td>49 ± 12</td>
<td>61 ± 13</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Male (%)</td>
<td>67</td>
<td>55</td>
<td>0.28</td>
</tr>
<tr>
<td>Race (%)</td>
<td></td>
<td>0.16</td>
<td></td>
</tr>
<tr>
<td>white</td>
<td>73</td>
<td>52</td>
<td></td>
</tr>
<tr>
<td>black</td>
<td>6</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>Asian</td>
<td>9</td>
<td>28</td>
<td></td>
</tr>
<tr>
<td>other</td>
<td>12</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Highest education level (%)</td>
<td></td>
<td>0.051</td>
<td></td>
</tr>
<tr>
<td>elementary school</td>
<td>0</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>high school</td>
<td>28</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>college/undergraduate</td>
<td>53</td>
<td>43</td>
<td></td>
</tr>
<tr>
<td>postgraduate</td>
<td>19</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>Previous kidney transplant (%)</td>
<td>31</td>
<td>14</td>
<td>0.08</td>
</tr>
<tr>
<td>Living alone (%)</td>
<td>25</td>
<td>18</td>
<td>0.41</td>
</tr>
<tr>
<td>Charlson Index (mean ± SD)</td>
<td>1.14 ± 0.25</td>
<td>1.82 ± 0.33</td>
<td>0.14</td>
</tr>
<tr>
<td>Years of renal replacement (yr; mean ± SD)</td>
<td>10.8 ± 1.7</td>
<td>7.6 ± 1.0</td>
<td>0.10</td>
</tr>
</tbody>
</table>

aNHD, nocturnal home hemodialysis; PD, peritoneal dialysis.
and plasma albumin levels were applied to multivariate regression models to assess perceived level of social support, age, gender, level of education, history of renal transplant, comorbid illness index, BDI, and plasma albumin levels. The results from these models are summarized in Table 4.

Similarly, there was no difference in the BDI scores between the two patient groups (11.7 ± 1.0 [NHD] versus 18.4 ± 0.8 [PD]; P = 0.026). Total illness intrusiveness score was similar between the two patient groups (11.7 ± 1.0 [NHD] versus 18.4 ± 0.8 [PD]; P = 0.026). Of the various subcategories that composed the total illness intrusiveness score, all domains were similar between the two groups (Table 4).

For ascertainment of the influence of potential confounders on perceived level of social support, age, gender, level of education, history of renal transplant, comorbid illness index, BDI, and plasma albumin levels were applied to multivariate regression modeling. After adjustment for these variables, the perceived level of social support remained lower in the NHD group versus the PD patients (11.7 ± 1.0 [NHD] versus 18.4 ± 0.8 [PD]; P = 0.026). We did not discern additional differences among our patients by stratifying according to residual renal function (data not shown).

Discussion

Patients’ perceived level of wellness is arguably the most important health outcome for those who undergo renal replacement therapy. In addition, there is an emerging body of literature that associates poor QOL with nutritional status, dialysis adherence, hospitalizations, and survival of patients with ESRD (20). Although QOL is an important aspect of the assessment of a patient with ESRD, the balance between intrusion and efficacy of dialysis therapy must be weighed carefully. This study was the first to compare QOL, depressive symptoms, and illness intrusiveness of both kidney disease and treatment modalities among our patients. Our data do not support the notion that augmented solute clearance alone deter-

Table 2. Comparisons of biochemical indices between NHD and PD patients

<table>
<thead>
<tr>
<th>Variable</th>
<th>NHD</th>
<th>PD</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plasma creatinine (μ mol/L)</td>
<td>503 ± 34</td>
<td>800 ± 43</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Hemoglobin concentration (g/L)</td>
<td>124 ± 2</td>
<td>117 ± 2</td>
<td>0.026</td>
</tr>
<tr>
<td>Plasma urea (mmol/L)</td>
<td>11.7 ± 1.0</td>
<td>18.4 ± 0.8</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Plasma calcium (mmol/L)</td>
<td>2.41 ± 0.03</td>
<td>2.27 ± 0.30</td>
<td>0.002</td>
</tr>
<tr>
<td>Plasma phosphate (mmol/L)</td>
<td>1.11 ± 0.06</td>
<td>1.63 ± 0.07</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Plasma albumin (g/L)</td>
<td>39 ± 2</td>
<td>37 ± 2</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Table 3. Comparisons of KDQOL values between NHD and PD patients

<table>
<thead>
<tr>
<th>Variable</th>
<th>NHD</th>
<th>PD</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Symptom problem list</td>
<td>76.3 ± 2.5</td>
<td>71.9 ± 2.6</td>
<td>0.22</td>
</tr>
<tr>
<td>Effect of kidney disease</td>
<td>61.5 ± 3.7</td>
<td>60.7 ± 2.7</td>
<td>0.85</td>
</tr>
<tr>
<td>Burden of kidney disease</td>
<td>37.0 ± 4.4</td>
<td>47.0 ± 3.8</td>
<td>0.092</td>
</tr>
<tr>
<td>Work status</td>
<td>48.6 ± 7.6</td>
<td>36.0 ± 5.4</td>
<td>0.17</td>
</tr>
<tr>
<td>Cognitive function</td>
<td>75.6 ± 4.8</td>
<td>81.4 ± 2.2</td>
<td>0.27</td>
</tr>
<tr>
<td>Quality of social interaction</td>
<td>73.5 ± 3.0</td>
<td>75.8 ± 2.3</td>
<td>0.55</td>
</tr>
<tr>
<td>Sexual function</td>
<td>81.7 ± 5.4</td>
<td>61.8 ± 9.0</td>
<td>0.07</td>
</tr>
<tr>
<td>Sleep</td>
<td>52.8 ± 3.9</td>
<td>54.1 ± 2.7</td>
<td>0.79</td>
</tr>
<tr>
<td>Social support</td>
<td>65.7 ± 5.3</td>
<td>79.2 ± 2.8</td>
<td>0.027</td>
</tr>
<tr>
<td>Dialysis staff encouragement</td>
<td>89.2 ± 2.6</td>
<td>85.7 ± 2.8</td>
<td>0.37</td>
</tr>
<tr>
<td>Patient satisfaction</td>
<td>75.5 ± 4.3</td>
<td>79.2 ± 2.7</td>
<td>0.46</td>
</tr>
</tbody>
</table>

0.06 [NHD] versus 1.63 ± 0.07 mmol/L [PD]; P < 0.001) in the NHD patients (Table 2).

Overall, the KDCS was similar between the NHD and PD groups (75.1 ± 3.5 [NHD] versus 68.2 ± 3.9 [PD]; P = 0.20). Physical component summary (55.0 ± 2.3 [NHD] versus 52.3 ± 1.8 [PD]; P = 0.35) and mental component summary (61.6 ± 4.7 [NHD] versus 60.0 ± 3.5 [PD]; P = 0.77) did not show any difference between the two study cohorts.

Among the subcategories of the KDCS, the perceived amount of social support was less in the NHD group compared with the PD patients (66.0 ± 5.2 [NHD] versus 79.0 ± 2.8 [PD]; P = 0.027). There was also a trend toward less burden of kidney disease, an emotional reaction to the effect of kidney disease, in the PD population (36.0 ± 4.4 [NHD] versus 47.0 ± 3.8 [PD]; P = 0.092). There was a trend toward better sexual function in the NHD group (82.0 ± 5.4 [NHD] versus 62.0 ± 9.0 [PD]; P = 0.07). The remainder of the KDCS components yielded little difference between the two study populations and are summarized in Table 3.

Similarly, there was no difference in the BDI scores between the two patient groups (11.7 ± 1.0 [NHD] versus 12.1 ± 1.4 [PD]; P = 0.52). Total illness intrusiveness score was similar between the two patient groups (17.0 ± 1.3 [NHD] versus 15.0 ± 0.9 [PD]; P = 0.40). Of the various subcategories that composed the total illness intrusiveness score, all domains were similar between the two groups (Table 4).

For ascertainment of the influence of potential confounders on perceived level of social support, age, gender, level of education, history of renal transplant, comorbid illness index, BDI, and plasma albumin levels were applied to multivariate regression modeling. After adjustment for these variables, the perceived level of social support remained lower in the NHD group versus the PD patients (64.9 ± 5.2 [NHD] versus 76.0 ± 2.8 [PD]; P = 0.04). We did not discern additional differences among our patients by stratifying according to residual renal function (data not shown).
Table 4. Comparisons of illness intrusiveness score between NHD and PD patients

<table>
<thead>
<tr>
<th>Variable</th>
<th>NHD</th>
<th>PD</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical well-being and diet</td>
<td>3.81 ± 0.3</td>
<td>3.98 ± 0.20</td>
<td>0.65</td>
</tr>
<tr>
<td>Work and finance</td>
<td>3.77 ± 0.35</td>
<td>3.30 ± 1.64</td>
<td>0.27</td>
</tr>
<tr>
<td>Marital, sexual, and family relations</td>
<td>3.32 ± 0.31</td>
<td>2.78 ± 0.22</td>
<td>0.16</td>
</tr>
<tr>
<td>Recreation and social relations</td>
<td>3.23 ± 0.28</td>
<td>3.11 ± 0.18</td>
<td>0.72</td>
</tr>
<tr>
<td>Other aspects of life</td>
<td>2.46 ± 0.25</td>
<td>2.47 ± 0.20</td>
<td>0.96</td>
</tr>
</tbody>
</table>

Relationships among QOL, morbidity, and dialysis dosage was first ascertained by the National Cooperative Dialysis Study (21); however, subsequent randomized, controlled trials failed to show any dramatic increase in QOL associated with an augmentation in solute clearance. Indeed, the Hemodialysis (HEMO) study did not yield any “clinically meaningful benefits” in QOL of either the dosage or the flux intervention arm, despite a clear separation in fractional urea and β2-microglobulin clearances (22). Similarly, the investigators from the Adequacy of Peritoneal Dialysis in Mexico study found no long-term beneficial effect in QOL by increasing peritoneal small solute clearance in their study population (23). In contrast, enthusiastic reports of improved QOL with intensive hemodialysis have been observed using before-and-after designs (24,25). In the context of the results of this study, how does one reconcile the lack of increased benefits in QOL for patients who undergo NHDD compared with PD? First, the potential beneficial effect of NHD versus conventional in-center hemodialysis was not the principal focus of the study and could not be dismissed. Second, we used a cross-sectional study design to ascertain at one point in time the QOL in home dialysis patients; we did not compare the sustainability of the reported QOL among PD and NHD patients. To our knowledge, QOL tends to diminish over time in patients with ESRD (26,27), especially in PD patients with a decline in residual renal function (15). It is possible that NHD patients are able to maintain their QOL scores better than PD patients or vice versa. Finally, the ultimate derivation of QOL perceived by an individual is complex, so it is reasonable to suggest that augmentation of uremic solute alone should not be considered the principal determinant of QOL in the ESRD population.

Given that the human cost of chronic disease management must include an appropriate balance among illness intrusion, therapeutic efficacy, and QOL, it is important to acknowledge the similarity in illness intrusive score between PD and NHD patients. It has been widely supposed that NHD would be a more intrusive therapy compared with the simplicity of PD. It is therefore interesting to note that our results do not support this assumption. Rather, our data were consistent with previous literature indicating that there was little difference among patients who underwent dialysis at home (28). In contrast, conventional in-center hemodialysis patients have uniformly the worst illness intrusiveness score (28). Taken together with our data, it is tempting to propose that the quantification of illness intrusiveness in ESRD cannot be simply be a reflection of the complexity of the technology but rather the sum of patients’ coping strategies (29), social support (30,31), and illness behavior (32) in addition to the technical challenges of the medical intervention. In light of this hypothesis, it is important to comment that NHD patients exhibited a lesser degree of perceived social support in comparison with the PD cohort, perhaps reflecting the demand of intensive home hemodialysis. The determinants of perceived intrusion and control over one’s illness requires further exploration, especially given the present momentum in allocating patients with ESRD toward home-based dialysis regimens.

Although perceived QOL is an important determinant of well-being of patients with ESRD, the actual therapeutic efficacy of intensive hemodialysis should not be minimized. In this respect, we were able to discern multiple biochemical differences between NHD and PD patients. The clinical benefits of higher albumin and hemoglobin levels in conjunction with normalization of phosphate are beyond the scope of this study; however, on the basis of published literature, each of these indicators has been robustly validated to provide survival benefits in dialysis patients (33–35). The clinical advantages of intensive hemodialysis continue to be of great interest among various investigating groups, which will require ultimate substantiation by randomized, controlled trials (36).

Conclusions
Choosing a dialysis modality is a difficult decision to make for most patients with ESRD. Our study showed that among well NHD and PD patients, similar QOL, depressive symptoms, and illness intrusiveness scores were observed. This study also highlights two important points: The complexity in determining subjectively derived parameters in a chronic disease population and that the increase in solute clearance alone is insufficient in determining QOL. Our study is limited by its cross-sectional observational nature. We also did not account for the impact of duration of home therapy alone on QOL and illness intrusiveness. To our knowledge, these are the only available data comparing two home dialysis modalities in the present era. Additional research is required to delineate the interactions among complex medical interventions (dialysis modality) and patients’ illness behavior, coping strategies, and social support so as to individualize best the delivery of optimal ESRD care in the home setting (37,38).

Acknowledgments
We thank the staff of the Toronto General Hospital Home Hemodialysis and Peritoneal Dialysis programs.
Disclosures

None.

References

30. White N, Bichter J, Koeckeritz J, Lee YA, Munch KL: A


