Compliance With the Peritoneal Dialysis Prescription is Poor\textsuperscript{1,2}

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The adequacy of peritoneal dialysis in terms of urea and creatinine kinetics is becoming better established (1,2). Weekly creatinine clearance of more than 50 L normalized to body surface area are currently recommended for minimally adequate dialysis. The delivery of an adequate peritoneal dialysis prescription is dependent on the compliance of the patient with that prescription. Keen et al. (3) have found overall compliance with prescribed exchanges in continuous ambulatory peritoneal dialysis to be only 78\%. The purpose of this study was to determine the compliance of a group of patients on peritoneal dialysis through the use of creatinine generation rates. The utility of measured creatinine generation compared with estimated creatinine production depends on whether the patient is in the steady state while dialysate and urine are collected for analysis. Appreciating the overall compliance of peritoneal dialysis patients may alter the way in which it is prescribed.

METHODS

Creatinine production was measured in 64 stable peritoneal dialysis patients. Thirty-five percent of the patients studied had diabetic nephropathy as the cause of their underlying renal disease. The mean age was 53 yr (range, 24 to 76 yr). Thorough histories were taken, inquiring specifically about compliance with the prescribed exchanges.

Creatinine production was measured from 24-h dialysate and urine collections and the extrarenal degradation of creatinine \( S_{cr} \) described by Mitch and Walser (4):

\[
\text{Extrarenal degradation (mg/day)} \quad = 0.4 \times S_{cr} \times \text{body weight (kg)} \quad (\text{Eq. 1})
\]

Patients were told to bring their 24-h dialysate and urine into the clinic 24 to 48 h before their visit. The total measured creatinine production was equal to the sum of the creatinine in the 24-h dialysate and urine as well as the extrarenal degradation.

Estimated creatinine production was based on the formulas developed by Cockcroft and Gault (5,6) as shown below:

Men: Creatinine production (mg/kg per day)

\[
= 28 - (0.2 \times \text{age}_{yr}) \quad (\text{Eq. 2})
\]

Women: Creatinine production (mg/kg per day)

\[
= 23.8 - (0.17 \times \text{age}_{yr}) \quad (\text{Eq. 3})
\]

The percent difference between the measured and estimated creatinine production (cr prod) should be close to zero and was calculated as shown:

\[
\text{Percent Difference} = \frac{[\text{Measured} - \text{Estimated}_{cr \text{prod}}]}{(\text{Estimated}_{cr \text{prod}}) \times 100} \quad (\text{Eq. 4})
\]

Percent differences are reported as the mean ± SE. Ninety-nine percent confidence intervals are given where appropriate. The \( t \) test was used to detect statistically significant differences between means. Linear regression was used to correlate measured and estimated creatinine production.

RESULTS

By history, nine patients admitted to noncompliance with their dialysis prescription. Fifty-five patients denied any noncompliance. Table 1 shows the mean percent difference between the measured and estimated creatinine production in these two groups of patients. In a patient who is complaint, the measured creatinine production should be very close to that estimated on the basis of Cockcroft and Gault formulas, and thus, the percent difference should be
TABLE 1. Percent difference between estimated and measured creatinine production in the compliant and noncompliant groups

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Compliant</th>
<th>Noncompliant</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>55</td>
<td>9</td>
</tr>
<tr>
<td>Percent Differencea</td>
<td>+4 ± 3</td>
<td>+57 ± 8</td>
</tr>
<tr>
<td>± SE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>99% Confidence Interval</td>
<td>(-4) - (+12)</td>
<td>(+36) - (+78)</td>
</tr>
</tbody>
</table>

a Determination of compliance was based on history for this analysis.

b Percent difference equals the difference between the measured and estimated creatinine production divided by the estimated creatinine production; see Text.

very close to zero. As seen in Table 1, the compliant group had a mean percent difference with a confidence interval that included zero. The noncompliant group had significantly more measured creatinine than estimated, resulting in a very high percent difference. The difference between the two groups' mean percent difference was statistically significant (P < 0.01).

Choosing a percent difference of +24% (which is the average of the upper value of the 99% confidence interval for the compliant group and the lower value of the 99% confidence interval for the noncompliant group), 17 of the 64 patients, or 26%, were noncompliant with their dialysis exchanges.

Figure 1 shows the correlation between the measured and estimated creatinine production in the compliant patients. For this analysis, compliance was defined as those patients having a percent difference in creatinine production of less than 24%, as defined above. The correlation for this compliant group (R = 0.91) was statistically significant (P < 0.05). The regression line is almost exactly on the line of identity. The noncompliant patients are also shown in the figure.

DISCUSSION

The method of comparing measured and estimated creatinine production to detect compliance with the peritoneal dialysis prescription is an important component to the assessment of adequate dialysis. The blood, dialysate, and urine samples needed to determine the urea weekly Kt/V or creatinine clearance can easily be used to calculate creatinine production. The method relies on the assumption that the patients not routinely doing all of their exchanges before the requested collection of dialysate and urine will have a higher serum creatinine concentration than if all prescribed exchanges were done. This higher serum creatinine level before the collection of the prescribed number of exchanges causes a washout of extra creatinine into the dialysate, thus overestimating the measured creatinine production. Measured creatinine production exceeding the estimated production may occur with noncompliance, increased consumption of meat before the collection, or early peritonitis with increased creatinine clearance. When this method is used to detect noncompliance with the dialysis prescription, care must be taken to assure that these other factors are not responsible for the increased creatinine production.

Our study found a 26% noncompliance rate with the peritoneal dialysis prescription. This is important for the nephrologist to realize because noncompliance is an important reason for peritoneal dialysis technique failure, accounting for about 11% of those transferred to hemodialysis (7). The identification of noncompliant patients through the use of creatinine generation rates will hopefully provide an opportunity to modify either the dialysis prescription, making it more convenient (e.g., change to cycler therapy, increase dialysate volume per exchange), or the patient's understanding of the importance of doing all prescribed exchanges.

REFERENCES

may be only 78%. Peritoneal Dial Int 1993; 13: S16.