Instead of the peritoneal equilibration test (PET), the dialysis adequacy and transport test (DATT) is an easy and convenient method to classify peritoneal transport type. However, the peritoneal transport characteristics obtained from the DATT and the PET are not same in some cases. In the present study, we investigated the ability of the DATT to identify peritoneal transport characteristics in a clinical setting, and we analyzed the characteristics of patients with a discrepancy between the DATT and the PET.

We studied 106 patients on continuous ambulatory peritoneal dialysis (CAPD) who underwent 198 simultaneous DATTs and PETs. The 24-hour dialysate-to-plasma ratio of creatinine (D/PCr) from each DATT was compared with the adjusted 4-hour D/P Cr from the corresponding PET. Based on the degree of the mean discrepancy between the 24-hour D/P Cr and the adjusted 4-hour D/P Cr, the patients were divided into three groups:

- Group A patients had 24-hour D/P Cr values that were lower than the adjusted 4-hour D/P Cr values (n = 13).
- Group B patients had 24-hour D/P Cr values that were equivalent to the adjusted 4-hour D/P Cr values (n = 156).
- Group C patients had 24-hour D/P Cr values that were higher than the adjusted 4-hour D/P Cr values (n = 29).

The comparative analysis among the three groups was adjusted for peritoneal transport characteristics, dialysis adequacy indices, nutrition status, and daily dialysis prescription.

The 24-hour D/P Cr from the DATT correlated significantly with the 4-hour D/P Cr (γ = 0.759, p < 0.0001). In 156 cases (78.8%), the D/P Cr values from the DATT and the PET showed reasonable agreement; but, in 42 cases (21.2%), the values were discordant. In 94 cases (47.5%), the peritoneal transport groups as classified by the DATT and the PET were discordant. The mean difference in D/P Cr between the DATT and the PET was 0.07 ± 0.08, and the DATT differed significantly from the PET in categorizing the low and low-average transport groups (p < 0.05). A significant difference was seen between the three groups in daily exchange volume (group A: 7384.6 ± 1502.2 mL; group B: 7537.3 ± 1087.7 mL; group C: 6675.9 ± 1414.6 mL; p < 0.05) and in the frequency of daily exchanges (group A: 3.7 ± 0.8 exchanges; group B: 3.8 ± 0.4 exchanges; group C: 3.4 ± 0.7 exchanges; p < 0.05).

We confirmed that the DATT is an easy and convenient method of identifying peritoneal membrane transport instead of the PET, and that the DATT can be generalized to patients receiving various dialysis prescriptions and to patients receiving four daily exchanges. However, the DATT may be less accurate for CAPD patients with low or low-average transport, and the higher value of D/P Cr derived from the DATT, as compared with the PET, is attributable to longer dwell times and a lower dwell volume.

**Key words**
Dialysis adequacy and transport test, peritoneal transport

**Introduction**

The peritoneal equilibration test (PET) has found acceptance as the “gold standard” for identifying peritoneal membrane transport characteristics and determining individual peritoneal dialysis prescriptions (1–3). But despite its important value, the PET is not widely used in clinical practice because it is time-consuming and requires staff support and several dialysate samples (4). Moreover, using the PET, a clinician cannot obtain a true measure of the patient’s
daily solute clearance and net ultrafiltration volume from dialysis (5,6).

As a part of the attempt to develop an easier test for identifying peritoneal transport type, Rocco et al. (7) introduced the dialysis adequacy and transport test (DA TT). The DA TT requires only a serum sample and an aliquot of a 24-hour dialysate collection. Available studies show that the value for the 24-hour dialysate-to-plasma ratio of creatinine (D/P Cr) derived from the DA TT correlates significantly with the 4-hour D/P Cr value derived from the PET. That is, the DA TT can be used instead of the PET to determine peritoneal transport (4–8). Moreover, the DA TT has the additional advantage of proving the daily solute clearance and ultrafiltration volume from dialysis (4). The DA TT is also less expensive and is preferred over the PET by patients (5).

However, in clinical practice, the 24-hour D/P Cr of the DA TT and the 4-hour D/P Cr of the PET fail to reasonably agree in some cases. In the present study, we investigated the accuracy of the DA TT as compared with the PET for the identification of peritoneal transport characteristics, and we looked into the characteristics of patients that showed a discrepancy between the two tests.

Patients and methods

Patients
We studied 106 patients who underwent 198 simultaneous DA TT and PET procedures. All patients had been treated with continuous ambulatory peritoneal dialysis (CAPD) for at least 3 months and had been free of peritonitis for at least 1 month at the time of the study. All patients were clinically stable with no sign of ultrafiltration failure or loss of solute clearance. Table 1 gives the clinical characteristics of the patients and the causes of end-stage renal disease. Mean age of the patients was 51.6 ± 13.0 years; 48 patients (45.3%) had diabetes. Mean duration of CAPD before the study was 10.5 ± 9.9 months.

In trying to find the cause of the difference between the DA TT and the PET, we adjusted the 4-hour D/P Cr values by adding 0.05 to the actual 4-hour D/P Cr values. That calculation is founded on the theory that the mean of the D/P Cr value from the 24-hour collection is 0.05 points higher than the mean of the 4-hour D/P Cr value derived from the PET by Rocco (7). Based on the discrepancy between the mean 24-hour D/P Cr values and the adjusted 4-hour D/P Cr values, we divided the patients into three groups:

- Group A patients had 24-hour D/P Cr values that were lower than the adjusted 4-hour D/P Cr values (n = 13).
- Group B patients had 24-hour D/P Cr values that were equivalent to the adjusted 4-hour D/P Cr values (n = 156).
- Group C patients had 24-hour D/P Cr values that were higher than the adjusted 4-hour D/P Cr values (n = 29).

The comparative analysis between three groups was adjusted for peritoneal transport characteristics, dialysis adequacy indices, nutrition status, and daily dialysis prescription.

Dialysis adequacy and transport test
The method for the DA TT was described by Rocco and colleagues (7). Without changing their usual schedule of dialysis, patients bring to the clinic all the bags of spent dialysate used during the preceding 24 hours. [For his study of the DA TT, Rocco enrolled only patients who were using four exchanges daily (7). However—unlike Rocco, who was analyzing the correlation between the DA TT and the PET in clinical practice—we did not standardize the daily dialy-
sis prescription of exchanges and dwell volume.] The effluent from all the bags is mixed well in a container, the total volume of the dialysate is recorded, and a 10-mL sample is obtained for appropriate laboratory tests. On the day that the 24-hour collection concludes, a blood sample is drawn. At the same time, a 24-hour urine sample is collected to calculate the residual glomerular filtration rate as an average of 24-hour urinary urea and creatinine clearance.

**Peritoneal equilibration test**
The PET procedure was performed as described by Twardowski *et al.* (10), using 2 L of 4.25% glucose dialysate. Each patient underwent a PET immediately after the 24-hour dialysate collection was completed. The $D/P_{Cr}$ at 4 hours was calculated after correction of glucose interference, and the drainage volume at 4 hours was recorded.

**Statistical analysis**
For this study, we used the statistical software program SPSS for Windows, version 11.0 (SPSS Inc., Chicago, IL, U.S.A.). All data are expressed as mean ± standard deviation. The Pearson correlation coefficient, Student $t$-test, and analysis of variance were used in the statistical analysis. Statistical significance was accepted if $p < 0.05$.

**Results**

**Correlation between DATT and PET**
By the DATT, the mean 24-hour $D/P_{Cr}$ in all patients was $0.75 ± 0.11$; by the PET, the mean 4-hour $D/P_{Cr}$ was $0.68 ± 0.11$. Figure 1 shows a scattergram that demonstrates the relationship between the DATT and the PET. The coefficient of correlation between the two variables was $0.759 (p < 0.0001)$. In 156 cases (78.8%), the DATT and the PET $D/P_{Cr}$ values showed reasonable agreement, but in 42 (21.2%) cases, the values were discordant.

To classify the peritoneal transport group by 24-hour $D/P_{Cr}$ from the DATT, we transformed the reference values for peritoneal transport group classification in the 4-hour $D/P_{Cr}$ of the PET as described by Twardowski *et al.* (10) according to the linear regression formula shown in Figure 1. The transformed cut-off values for the 24-hour $D/P_{Cr}$ by the DATT were 0.60, 0.69, and 0.82. Based on the DATT, the number of patients in each peritoneal transport group (Table II) was as follows: high, 36 (18%); high-average, 55 (28%); low-average, 74 (37%); and low, 33 (17%). In 94 cases (47.5%), the DATT classifications were discordant with the classifications produced by the PET.

The mean difference in $D/P_{Cr}$ between the DATT and the PET was $0.07 ± 0.08$. Table III shows the effect of transport type on the difference between the DATT and the PET. The mean difference between the two tests was highest in the low transport category ($p < 0.05$). The mean of the difference between the two tests correlated significantly with the 4-hour $D/P_{Cr}$ ($\gamma = -0.275, p < 0.01$, Figure 2).

---

**FIGURE 1** Correlation of dialysate-to-plasma creatinine ($D/P_{Cr}$) ratios derived from the 24-hour dialysis adequacy and transport test (DATT) and the adjusted 4-hour peritoneal equilibration test (PET). The linear regression equation is $y = 0.803x + 0.165$.

**TABLE II** Classification of patients into peritoneal transport groups according to the dialysis adequacy and transport test (DATT) and the peritoneal equilibration test (PET)

<table>
<thead>
<tr>
<th>Transport classification based on 4-hour $D/P_{Cr}$ (PET)</th>
<th>H</th>
<th>HA</th>
<th>LA</th>
<th>L</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transport classification based on 24-hour $D/P_{Cr}$ (DATT)</td>
<td>H</td>
<td>20</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>HA</td>
<td>3</td>
<td>40</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>LA</td>
<td>33</td>
<td>39</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>L</td>
<td>8</td>
<td>20</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

$D/P_{Cr}$ = dialysate-to-plasma ratio of creatinine; H = high; HA = high average; LA = low average; L = low.
Subgroup analysis

We performed a subgroup analysis of the discrepancies between the DATT and the PET; Table IV summarizes the results. A significant difference was observed between the three groups in daily exchange volume (group A: 7384.6 ± 1502.2 mL; group B: 7537.3 ± 1087.7 mL; group C: 6675.9 ± 1414.6 mL; \( p < 0.05 \)) and in the frequency of daily exchanges (group A: 3.7 ± 0.8 exchanges; group B: 3.8 ± 0.4 exchanges; group C: 3.4 ± 0.7 exchanges; \( p < 0.05 \)). The mean difference, defined as the discrepancy between the two tests, was not affected by the patient’s age, dialysis duration, diabetes status, net ultrafiltration, dialysis solution (tonicity), or residual renal function (data not shown).

Discussion

Determining an appropriate prescription for patients on CAPD requires knowledge about peritoneal membrane transport characteristics and solute clearance (1–2). The PET is recommended as a sensitive routine investigation for monitoring peritoneal membrane transport and determining the type of peritoneal dialysis therapy and the patient’s prognostic index—for example, for ultrafiltration failure (3,11). However, the PET requires staff support and several laboratory tests (5,7). Moreover, in ensuring an adequate dialysis-to-plasma creatinine (D/P\(_{Cr}\)) and the mean difference between two tests: the dialysis adequacy and transport test (DATT) and the peritoneal equilibration test (PET).

Subgroup analysis of the difference between the dialysis adequacy and transport test (DATT) and the peritoneal equilibration test (PET)

<table>
<thead>
<tr>
<th>Group</th>
<th>Group A</th>
<th>Group B</th>
<th>Group C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cases (n)</td>
<td>13</td>
<td>156</td>
<td>29</td>
</tr>
<tr>
<td>24-h D/P(_{Cr}) (DATT)</td>
<td>0.65±0.10</td>
<td>0.05±0.10</td>
<td>0.80±0.12</td>
</tr>
<tr>
<td>4-h D/P(_{Cr}) (PET)</td>
<td>0.73±0.10</td>
<td>0.68±0.09</td>
<td>0.62±0.12</td>
</tr>
<tr>
<td>Difference</td>
<td>-0.13±0.02</td>
<td>0.01±0.05</td>
<td>0.13±0.04</td>
</tr>
<tr>
<td>Total daily dialysate volume (mL)</td>
<td>7384.6±1502.1</td>
<td>7537.3±1087.7</td>
<td>6675.9±1414.6*</td>
</tr>
<tr>
<td>Total daily exchanges (n)</td>
<td>3.7±0.8</td>
<td>3.8±0.4</td>
<td>3.4±0.7*</td>
</tr>
</tbody>
</table>

* Significant difference from the other groups (\( p < 0.05 \)).
sis prescription, the use of the 4-hour $D/P_{Cr}$ from the PET is inappropriate for calculating 24-hour creatinine clearance and ultrafiltration volume (12). By using the DATT (an easy and convenient method) instead of the PET, a clinician can obtain not only information about peritoneal membrane transport, but also a true measure of the patient’s daily solute clearance and ultrafiltration volume from dialysis (5,7).

In the present study, we found that, as reported in previous studies, the DATT correlated significantly with the PET and agreed with the PET in the classification of peritoneal transport groups (5,7,8). However, the correlation coefficient between the $D/P_{Cr}$ from the DATT and from the PET was somewhat lower than that reported by Rocco et al. (7). The difference of the means from the two tests was greater than 0.05 points. That discordance may be explained by a protocol difference between the two studies. As described by Rocco and colleagues, the DATT was validated only for patients with a fixed CAPD schedule of 4 exchanges of 2 L daily and should not be used in patients for whom dwell times, dextrose concentrations, dwell volumes vary markedly (7). However, we evaluated the correlation between the DATT and the PET in patients receiving variable dialysis prescriptions—that is, without a precise indication of the number of exchanges, the dwell volumes, and the dwell times of the daily dialysis schedule. Nevertheless, we proved the correlation between the DATT and the PET. Results from the DATT may be generalized to patients receiving varying dialysis prescriptions.

The DATT differed significantly from the PET in low and low-average transport patients—rather than in other transport categories, as shown by Busch et al. (8). The mean difference between the two tests correlated significantly with the 4-hour $D/P_{Cr}$ value (Figure 2). The higher $D/P_{Cr}$ value from the DATT is attributable chiefly to the longer dwell times associated with a 24-hour dialysate collection (4,7,12). The percentage equilibration of creatinine from the blood compartment to the dialysate compartment is only about 65% at the end of 4 hours, but the equilibration continues for 7 – 8 hours (13). The dialysate creatinine concentration inevitably increases as the dwell time becomes longer. The 24-hour $D/P_{Cr}$ is obtained from a pooled collection with varying equilibrations occurring over periods ranging from 5 hours to 9 hours (12). Thus, the 24-hour $D/P_{Cr}$ differs significantly from the 4-hour $D/P_{Cr}$, especially in low-transport situations.

We also performed a subgroup analysis that evaluated the difference between the mean values of the DATT and the PET (Table IV). In group C, as compared with the other two groups, the mean 24-hour $D/P_{Cr}$ values were higher than the adjusted 4-hour $D/P_{Cr}$ values. Also, the considerable difference in group C between the two tests was attributed to the lower dwell volumes and the longer dwell times associated with daily dialysis exchanges. The difference was not affected by the patient’s age, dialysis duration, diabetes status, net ultrafiltration, dialysis solution (tonicity), or residual renal function.

Conclusions
The DATT is an easy, convenient, and useful method for identifying peritoneal membrane transport and measuring true solute clearance and ultrafiltration volume from dialysis. We confirm that the DATT can be generalized to patients receiving varying dialysis prescriptions and to patients receiving 4 daily exchanges. However, the DATT may be less accurate for CAPD patients with low or low-average transport. The higher values of $D/P_{Cr}$ derived from the DATT, as compared with the values derived from the PET, are attributable to longer dwell times and a lower dwell volume.

References
6 Rocco MV, Jordan JR, Burkart JM. 24-hour dialysate collection for determination of peritoneal membrane transport characteristics: longitudinal follow-up data...

Corresponding author:
Yong-Lim Kim, MD, Division of Nephrology, Department of Internal Medicine, Kyungpook National University Hospital, Samdudong 50, Jungku, Daegu 700-412 South Korea.
E-mail:
ylkim@knu.ac.kr