Calculation of an 'Adequate' Kt/V in the Individual Patient

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Dear Sir,

The value of Kt/V has proved to be useful in evaluating hemodialysis (HD) from the point of view of clearing the internal environment of urea [1]. Recent years have seen discussion over what value of Kt/V is adequate for urea. Parker [2] concludes ‘there is no need to continue the dialogue of whether a Kt/V of 1.3 is better than 1.1, or whether 1.5 is better than 1.3. Clear results are available. Delivery of dialysis in a range less than 1.5 is subtotal.’

However, in everyday practice, we encounter individuals on regular HD receiving different quantities of protein, who have different body weight (BW), and the HD regiments employed may also differ. Is the above Kt/V adequate in all these different situations?

In our study, we sought to develop a formula which would make it possible to evaluate Kt/V for each individual in terms of their BW, intensity of protein catabolism, and the frequency of dialysis sessions. The formula is based on the premise that Kt/V will be adequate if, under a stabilized metabolic status and sufficient protein intake (1.2 g/kg/day or more), the plasma concentration of urea varies within the required range (i.e., predialysis plasma concentrations do not exceed 30 mmol/l). If we neglect urea recycling and the production of nonurea catabolites, the relationship between the amount of urea produced within the interdialysis and dialysis intervals, and the amount of urea eliminated from the body during the above period of time, can be expressed by the following formula:

\[ K \cdotJCdt + U \times T + F \times T = o \cdot NPCR \times BW \times 5.7 \times T \]

(1)

In this formula, K J Cdt is the amount of urea eliminated during HD, U is the amount of urea eliminated by residual renal function per 1 day, F is the fecal elimination of N per 1 day (expressed as a corresponding amount of urea), T is the sum of interdialysis and dialysis intervals expressed in days. Considering the exponential decrease in plasma urea concentration during HD, the t value of \(JCdt\) can be calculated on the basis of the following formula:

\[ \frac{\ln C - \ln C_{post}}{\ln C_{pre} - \ln C_{post}} \times t \]

(2)
where C_{pre} and C_{post} are the plasma concentrations of urea before and after HD, \( t \) is the HD duration in minutes. Further, if we accept single pool distribution of urea, the relationship between the distribution volume of urea (\( V \)), given in ml, and dry BW can be expressed by the formula: \( V = 580 \times \text{BW} \). With respect to the above relations, formula 1 can be adapted as follows:

\[
K_{t/V} = \frac{\text{NPCR} \times \text{BW} \times 5.7}{\ln \left( \frac{C_{pre}}{C_{post}} \right)} - (U + F) \times 580 \times \text{BW}
\]

Table 1. Average value (x), SD and ranges of BW, plasma urea concentration before (\( C_{pre} \)) and after (\( C_{post} \)) dialysis, normalized protein catabolic rate (NPCR) and Kt/V

<table>
<thead>
<tr>
<th>BW (kg)</th>
<th>CPRE (mmol/l)</th>
<th>Cpost (mmol/l)</th>
<th>NPCR (g/kg/day)</th>
<th>Kt/V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range 42.0-78.5</td>
<td>20.0-38.0</td>
<td>5.8-13.6</td>
<td>1.19-1.88</td>
<td>1.00-1.72</td>
</tr>
<tr>
<td>x</td>
<td>64.0</td>
<td>28.8</td>
<td>9.7</td>
<td>1.48</td>
</tr>
<tr>
<td>SD</td>
<td>10.4</td>
<td>5.2</td>
<td>2.3</td>
<td>0.17</td>
</tr>
</tbody>
</table>

Lowrie and Lew [3] showed that adequate HD treatment requires a urea reduction ratio (URR) of 65% or higher. Modifying formula 3 so as to make \( C_{post} = \frac{C_{pre}}{3} \) and with F assumed to be 60 mmol (corresponding to 1.7 g N), we get:

\[
2.8 \times \left[ \text{NPCR} \times \text{BW} \times 5.7 - \frac{K_{t/V}}{U + 60} \right] \times T = \frac{C_{pre} \times \text{BW}}{U + 60} \]

We used formula 4 to calculate adequate Kt/V in 15 individuals on regular HD whose NPCR value was repeatedly examined using dialysate analysis, T equalled 2 in all cases. For an adequate Kt/V, a CPRE = 25 mmol/l was presumed.

Table 1 summarizes the results of our measurements. It is evident from the data obtained that an adequate value of Kt/V was close to 1.5, but there were large interindividual differences (as indicated by the large range of the values). In an individual whose BW = 70 kg, NPCR = 1.2 g/kg/day, \( T = 2 \), and \( C_{pre} = 25 \text{ mmol/l} \), the calculated adequate Kt/V would be 1.34. The assumption that the examined individual apparently were not in an adverse protein metabolic status is supported by the finding that repeatedly monitored serum levels of albumin were within the normal range.

In practice, to calculate adequate Kt/V using formula 4 instead of measured NPCR, the recommended protein intake (in g/kg/day) and, for \( C_{pre} \), the required values are substituted.

References


Nephron 1996;74:225-226
Schück Kasliková