**Determination of Dialysis Dose - A Clinical Comparison of Methods**

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**Introduction and Objectives**

Within the dialysis community quality standards have been debated extensively; the European Best Practice Guidelines recommended as minimum treatment dose an equilibrated Kt/V = 1.2. In clinical practice this minimum threshold value is not achieved for each and every patient. Clinical practice guidelines such as NKF-KDOQI or European Best Practice Guidelines recommend regular measurements of the delivered haemodialysis dose Kt/V using a validated method. Nowadays, automatic on-line measurements are available, as alternatives to the conventional method with blood samples, adjacent laboratory analysis of urea concentrations and subsequent calculation.

**Methods**

The clinical trial was designed as prospective, observational, international, multi-centre study to compare the different methods of dialysis dose assessment in clinical routine. Kt/Vb, Kt/VOCM, and Kt/VBCM were determined. The dialysis dose measured via blood samples, laboratory analysis of the urea concentration and application of Daugirdas’ formula is evaluated in this study as standard method (Kt/Vb).

The dialysis dose measured via automatic On-line Clearance Monitor (OCM) with anthropometric estimate (Vc) of the urea distribution volume V is the second method determined in this study (Kt/VOCM).

For a more accurate Kt/V measured by OCM the urea distribution volume V is additionally measured by the Body Composition Monitor (BCM, Fresenius Medical Care) instead of being only estimated. This is the third method to determine dialysis dose (Kt/VBCM).

In this study these 3 different methods to determine dialysis dose were simultaneously applied in each patient. The trial was planned as a study with all eligible patients of each study centre, thus a nearly complete cross-section of those patients, who comply with the selection criteria.

**Results**

18 European dialysis centres participated in this prospective clinical trial. 1606 patients on haemodialysis (HD) or on-line HDF (oHDF) were screened whether eligible for the study. 1089 patients were enrolled, and 1076 patients had full data set and were finally analyzed, see Fig. 1.

In the analysis cohort 38% of the patients were treated by HD and 62% by oHDF, for patient characteristics see Table 1: The mean values for oHDF in comparison to HD show lower age (-5.4 years), more males (+3.5 %), slightly higher BMI (+0.1 kg/m2) and more anuric patients (+15 %).

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>OCFD</th>
<th>HD</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age range</td>
<td>66 ± 13.8</td>
<td>75 ± 13.9</td>
<td>0.001</td>
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<tr>
<td>Sex</td>
<td>57 ± 40.6</td>
<td>54 ± 45.8</td>
<td>0.584</td>
</tr>
<tr>
<td>BMI</td>
<td>26.1 ± 5.3</td>
<td>26.0 ± 5.1</td>
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<tr>
<td>Estimated</td>
<td>Body mass index</td>
<td>301 ± 28.6</td>
<td>281 ± 25.3</td>
</tr>
</tbody>
</table>

For treatment data see Table 2: The mean values for oHDF in comparison to HD show longer treatment duration (+26 min), more processed blood (+1.5 %), slightly higher pre- and post-dialysis body weight (+1.4 kg and ±1.2 kg) and higher ultrafiltration volume (+6 L/L).

**Discussion**

Methods to quantify dialysis dose based on blood sampling are critical concerning proper timing, compliance with recommended methods, and are known for occasional mistakes in sampling, storage or transport of the samples or in laboratory errors of measuring urea.

The second generation Daugirdas’ formula was modelled in 1993 from 500 HD sessions with a total error in an acceptable 5% range throughout the investigated range of dialysis patients. Outliers were incidentally observed for Kt/V due to falsely high urea reduction ratio (+95 %) possible measurement or laboratory errors, whereas OCM based dose measurements Kt/VOCM and Kt/VBCM delivered realistic values. Correlation between Kt/Vb (without outliers) and Kt/VBCM was 0.81, and 0.82 between Kt/Vb (without outliers) and Kt/VOCM, see also Fig. 3.

Comparison between Kt/Vb and Kt/VOCM shows acceptable agreement over the whole range, independent of Kt/V, see Fig. 4.

Methodological improvements of the dialysis dose assessment by the On-line Clearance Monitor can reduce the degree of missing data and improve the clinical handling of the monitor. Thus, we recommend using the OCM for clinical routine and further investigations.

**Conclusions**

Due to the automated procedure the on-line clearance measurement with the Watson formula displayed the best correlation of the urea distribution volume measured by Body Composition Monitor Kt/VBCM with the urea distribution volume measured by Body Composition Monitor Kt/Vb. To achieve the best fit of the urea distribution volume measured by Body Composition Monitor Kt/Vb to the urea distribution volume measured by Body Composition Monitor Kt/VOCM, this study examined the correlation of the urea distribution volume measured by Body Composition Monitor Kt/VOCM with the urea distribution volume measured by Body Composition Monitor Kt/Vb.

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