Background

Bioimpedance
• Reflects body composition
• Is easy, inexpensive and non-invasive to perform
• Some measures of bioimpedance have been shown to predict death

Volume status
• Is difficult to assess
• Many correlates of volume status appear to be on causal pathways towards cardiovascular disease and death
• Can be manipulated
• Is a potential therapeutic target

Bioimpedance measures are reliable, and much of the variance derives from patient characteristics rather than intra- and inter-operator error and random error

The resistance (R) – Reactance (Xc) graph method described by Piccoli and colleagues can be operationalized as a dichotomous assessment of volume overload

Hypotheses

Bioimpedance measures are reliable, and much of the variance derives from patient characteristics rather than intra- and inter-operator error and random error

Methods

Patients
• Inclusion
  • Prevalent patients, on haemodialysis more than 6 months
  • Aged > 18 y
  • Stable on 3 times weekly haemodialysis
  • Consent
  • Exclusion
  • Amputees, patients with pacemakers

Bioimpedance methods
• Quadscan 4000, Bodystat Inc
• Whole body impedance at 5, 50, 100, 200
• Supine, tetrapolar lead placement
• Proprietary software to calculate phase angle, resistance and reactance
• Correct resistance and reactance for height
• Calculate vector length corrected for height from resistance and reactance
• Piccoli software to plot resistance and reactance
• Interpret each graph in duplicate
• Resolve differences by consensus

Measurements
• Measurements before midweek dialysis, two occasions, 1 week apart
• 2 observers on each occasion, masked to each other’s procedures and results
• 46 patients

ANOVA
• GLM in Minitab (copes with missing data)

Table 2. Patient characteristics

<table>
<thead>
<tr>
<th>Age, y</th>
<th>Male</th>
<th>Caucasion</th>
<th>Hypertension</th>
<th>Diabetes mellitus</th>
<th>Ischemic heart disease</th>
<th>Congestive heart failure</th>
<th>Ideal body weight, kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>60 (16)</td>
<td>69%</td>
<td>63%</td>
<td>75%</td>
<td>39%</td>
<td>9%</td>
<td>80 (18)</td>
</tr>
</tbody>
</table>

Table 1. Reliability study design

<table>
<thead>
<tr>
<th>Period 1</th>
<th>Period 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Replicate 1, observer 1</td>
<td>Replicate 1, observer 2</td>
</tr>
<tr>
<td>Replicate 2, observer 2</td>
<td>Replicate 2, observer 1</td>
</tr>
<tr>
<td>3 readings</td>
<td>3 readings</td>
</tr>
</tbody>
</table>

Results

First observation
Median phase angle was 4.63 degrees (quartiles 3.87, 5.73)
Median vector length was 258 ohm/m (quartiles 239, 304).
By the RXc graph method, 46% were volume overloaded.

Figure 1 Plots of height-corrected resistance against reactance for 48 prevalent haemodialysis patients, each on 4 occasions, stratified by gender

Table 2. Reliability study design

| Variance components for phase angle from analysis of variance using a generalised linear model, observer, patient, replicate and period all random effects, eliminating one patient with extreme low body weight (29.4 kg): Observer 0%, Patient 87%, Replicate 0%, Period 0%, Error 13%

Variance components for vector length from analysis of variance using a generalised linear model, observer, patient, replicate and period all random effects: Observer 0%, Patient 92%, Replicate 0%, Period 0%, Error 8%

Conclusion
About 90% of the observed variance in phase angle and in vector length is due to true variation between patients. The test is not operator dependent and a period of a week between tests did not account for variance beyond error variance.

References
Available from: URL: http://www.renalgate.it/formule_calcolatori/bioimpedenza.htm (last accessed 2009-10-10)