Evaluation of body composition monitor for assessment of nutritional status in hemodialysis patients

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Outline

- Introduction
- Methods
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- Discussion
- Conclusions
- Limitations
Introduction

- Hemodialysis (HD) patients
  - suffer from both muscle mass wasting and fat mass accumulation (Malhotra et al., 2017).

- Subjective global assessment (SGA)
  - recommended as a composite method to assess nutritional status (National Kidney Foundation, 2000, Fouque et al., 2007).
  - a sensitive nutritional assessment tool for patient follow-up (Santin et al., 2017).
  - however, it is unable to quantify muscle mass.
Introduction

- Body composition monitor
  - provides bedside assessment of volume status, lean tissue mass and fat mass (Broers et al., 2015).
- Whether BCM-derived parameters can be used to assess HD patients’ nutritional status and diagnose malnutrition remains unclear.
Methods

Aim

to determine the accuracy of BCM parameters to diagnose malnutrition

Study design

This study was a retrospective study
Methods

- **Study population**
  - Inclusion criteria
    - having a record of annual nutritional assessment
    - being more than 18 years old
    - on maintenance HD 3 times weekly for at least 3 months
  - Exclusion criteria
    - had contraindications to perform body composition assessment
Methods

- **Body composition**

  - Body Composition Monitor (BCM; Fresenius Medical Care, Germany)

  - Low lean tissue index (LTI) was defined as under the 10th percentile of the respective normal distribution (Marcelli et al., 2015).
Methods

- Anthropometric measurements
  - Height and body weight
  - Triceps skin-fold thickness (TSF)
  - Mid-arm circumference (MAC)
  - Handgrip strength (HGS)
Methods

- **Subjective global assessment (SGA)**
  - Grade A was considered well-nourished,
  - Grade B and C were grouped together as malnourished (Makhija & Baker, 2008).
Methods

- **Biochemical parameters**
  - serum urea, serum creatinine (SCr), serum albumin, pre-albumin, hemoglobin, triglycerides, total cholesterol and serum high-sensitivity C-reactive protein (hs-CRP)
  - being obtained from routine blood collection.
Methods

Data collection

- BCM was measured approximately 20-30 minutes before an HD session by a trained nurse.
- Anthropometric measurements and SGA interviews were performed before dialysis treatment by a trained nurse.
- Biochemical parameters were performed within 2 weeks of BCM measurements.
Methods

Data collection

Body composition, HGS, and anthropometric and biochemical data were collected in December 2015.

Information on mortality was checked at the end of December 2016.
Methods

Data analysis

- Pearson or Spearman correlations
  - determine the correlation coefficients between LTI and biochemical and anthropometric variables and muscle function.
Methods

- **Data analysis**
  - Kappa coefficient tests
    - determine the agreement between SGA and LTI for evaluating malnutrition
    - A value of 0.4 or less indicates low agreement, and a value of 0.7 or greater indicates high agreement
Methods

Data analysis

Kaplan-Meier curves & log-rank tests
determine the prognostic value of the LTI on mortality in the study population
## Results

### Table 1: Participant characteristics and body composition

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
<th>Low LTI (n = 57)</th>
<th>Normal LTI (n = 66)</th>
<th>t/Z/χ²</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age (y)</strong></td>
<td>62.21±12.10</td>
<td>63.26±13.89</td>
<td>61.30±10.34</td>
<td>-1.632b</td>
<td>0.103</td>
</tr>
<tr>
<td>**Gender (n, %)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>70 (56.9)</td>
<td>31 (25.2)</td>
<td>39 (31.7)</td>
<td>0.276c</td>
<td>0.599</td>
</tr>
<tr>
<td>Female</td>
<td>53 (43.1)</td>
<td>26 (21.1)</td>
<td>27 (22.0)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Dialysis vintage (m)</strong></td>
<td>96.93±65.83</td>
<td>101.46±69.72</td>
<td>93.02±62.56</td>
<td>-0.540b</td>
<td>0.589</td>
</tr>
<tr>
<td><strong>Diabetes mellitus (n, %)</strong></td>
<td>25 (20.3)</td>
<td>12 (9.8)</td>
<td>13 (10.6)</td>
<td>0.035c</td>
<td>0.852</td>
</tr>
<tr>
<td>Yes</td>
<td>98 (79.7)</td>
<td>45 (36.6)</td>
<td>53 (43.1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td><strong>Kt/V</strong></td>
<td>1.63±0.29</td>
<td>1.68±0.19</td>
<td>1.59±0.34</td>
<td>-2.559b</td>
<td>0.010</td>
</tr>
<tr>
<td><strong>SCr (umol/ L)</strong></td>
<td>1011.48±163.75</td>
<td>968.44±158.50</td>
<td>1048.65±160.18</td>
<td>2.783a</td>
<td>0.006</td>
</tr>
<tr>
<td><strong>Albumin (g/ L)</strong></td>
<td>41.01±3.26</td>
<td>40.18±3.57</td>
<td>41.72±2.79</td>
<td>2.685a</td>
<td>0.008</td>
</tr>
<tr>
<td><strong>Pre-albumin (mg/ L)</strong></td>
<td>331.32±72.74</td>
<td>311.67±73.48</td>
<td>348.00±68.17</td>
<td>2.866a</td>
<td>0.005</td>
</tr>
<tr>
<td><strong>Hemoglobin (g/ L)</strong></td>
<td>110.43±14.22</td>
<td>110.01±14.97</td>
<td>110.79±13.64</td>
<td>0.302a</td>
<td>0.763</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>Low LTI (n = 57)</td>
<td>Normal LTI (n = 66)</td>
<td>t/Z/χ²</td>
<td>p</td>
</tr>
<tr>
<td>--------------------------</td>
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</tr>
<tr>
<td>Total cholesterol (mmol/L)</td>
<td>4.07±1.03</td>
<td>4.08±1.00</td>
<td>4.06±1.07</td>
<td>-0.134&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.893</td>
</tr>
<tr>
<td>Triglycerides (mmol/L)</td>
<td>2.45±1.53</td>
<td>2.25±1.00</td>
<td>2.62±1.87</td>
<td>-0.769&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.442</td>
</tr>
<tr>
<td>hs-CRP (mg/ L)</td>
<td>6.53±18.19</td>
<td>9.76±25.67</td>
<td>3.74±6.03</td>
<td>-2.547&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.011</td>
</tr>
<tr>
<td>SGA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Malnutrition</td>
<td>69(56.1)</td>
<td>40(70.18)</td>
<td>29(43.9)</td>
<td>8.548&lt;sup&gt;c&lt;/sup&gt;</td>
<td>0.003</td>
</tr>
<tr>
<td>LTI</td>
<td>12.46±2.67</td>
<td>10.55±1.81</td>
<td>14.11±2.13</td>
<td>9.902&lt;sup&gt;a&lt;/sup&gt;</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>FTI</td>
<td>9.87±3.69</td>
<td>10.83±3.87</td>
<td>9.04±3.34</td>
<td>-2.746&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.007</td>
</tr>
<tr>
<td>BMI (kg/ m²)</td>
<td>23.20±3.57</td>
<td>22.33±3.64</td>
<td>23.95±3.35</td>
<td>-2.757&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.006</td>
</tr>
<tr>
<td>WC (cm)</td>
<td>87.49±10.13</td>
<td>86.92±11.30</td>
<td>87.99±9.06</td>
<td>0.581&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.562</td>
</tr>
<tr>
<td>TSF (mm)</td>
<td>12.04±7.17</td>
<td>11.03±4.46</td>
<td>12.92±8.82</td>
<td>-1.153&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.249</td>
</tr>
<tr>
<td>MAMC (cm)</td>
<td>21.96±2.77</td>
<td>21.45±2.23</td>
<td>22.40±3.11</td>
<td>-2.721&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.007</td>
</tr>
<tr>
<td>HGS (kg)</td>
<td>24.62±10.31</td>
<td>21.14±10.38</td>
<td>27.67± 9.31</td>
<td>3.677&lt;sup&gt;a&lt;/sup&gt;</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Notes: <sup>a</sup>: independent t-test; <sup>b</sup>: Mann-Whitney U-test; <sup>c</sup>: χ²-test. Kt/V represents the dose of hemodialysis, an abbreviation of (K<sub>urea</sub> × T<sub>d</sub>) / V<sub>urea</sub> K<sub>urea</sub> (milliliters/minute); SCr, serum creatinine; BMI, body mass index; WC, waist circumference; TSF, triceps skinfold thickness; MAMC, mid-arm muscle circumference; SGA, subjective global assessment; Hb, hemoglobin; HGS, handgrip strength; hs-CRP, high-sensitivity C-reactive protein.
## Results

Table 2: Correlation between LTI and anthropometric, biochemical parameters and muscle function

<table>
<thead>
<tr>
<th>Variables</th>
<th>LTI</th>
<th>FTI</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMI</td>
<td>0.289**</td>
<td>0.644***</td>
</tr>
<tr>
<td>TSF</td>
<td>-0.066</td>
<td>0.622***</td>
</tr>
<tr>
<td>MAMC</td>
<td>0.469***</td>
<td>0.131</td>
</tr>
<tr>
<td>WC</td>
<td>0.048</td>
<td>0.695***</td>
</tr>
<tr>
<td>Albumin</td>
<td>0.253**</td>
<td>-0.111</td>
</tr>
<tr>
<td>Pre-albumin</td>
<td>0.298**</td>
<td>-0.029</td>
</tr>
<tr>
<td>Triglycerides</td>
<td>-0.069</td>
<td>0.234*</td>
</tr>
<tr>
<td>SCr</td>
<td>0.417***</td>
<td>-0.054</td>
</tr>
<tr>
<td>HGS</td>
<td>0.699***</td>
<td>-0.340***</td>
</tr>
</tbody>
</table>

Notes: * p<0.05; **p<0.01; ***p<0.001; BMI, body mass index; TSF, triceps skinfold thickness; MAMC, mid-arm muscle circumference; WC, waist circumference; SCr, serum creatinine; HGS, handgrip strength.
## Results

Table 3: Agreement between LTI and SGA in categorizing malnutrition

<table>
<thead>
<tr>
<th>SGA</th>
<th>Moderately-severely malnourished</th>
<th>Well-nourished</th>
<th>( \kappa )</th>
<th>( p )</th>
<th>CI (95%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LTI</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>40</td>
<td>17</td>
<td>0.26</td>
<td>0.003</td>
<td>0.093-0.437</td>
</tr>
<tr>
<td>Normal</td>
<td>29</td>
<td>37</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: \( \kappa \) = index of agreement between the 2 techniques for assessment of malnutrition; LTI: lean tissue index; Low LTI was defined as under the 10\(^{th}\) percentile of the distribution of reference values; Normal LTI was defined as between 10-90\(^{th}\) of the reference values.
Results

Figure 1: Survival analysis

Figure 1 Kaplan-Meier survival curves showing 12-month survival according to patients’ lean tissue index (LTI). In patients with a low LTI, the mortality increases ($n = 123; \log\text{-rank } \chi^2 = 8.164; p = 0.004$).
Discussion

46.3% of the patients in our study had an LTI below the 10th centile of the reference values.

in line with findings reported by Marcelli et al. (2015), in which approximately half of the patients had a low LTI.
Discussion

- The findings of this study support its value for nutritional assessment,
  - as both FTI and LTI were associated with multiple anthropometric and laboratory parameters.
Discussion

- Low LTI patients had high risk of mortality
  - Consistent with Marcelli et al. (2015)'s study
    - patients with low LTI had poorer outcomes,
    - patients with both LTI and FTI within the 10th-90th centiles of the healthy population had the best survival,
    - high FTI had protective advantages in patients with low LTI.
Discussion

- No significant association was found between FTI and mortality in our study.

- It could be the ratio of lean to fat mass that exerts differential impact on health outcomes in the HD population (Malhotra et al., 2017, Marcelli et al., 2015).
Discussion

- The agreement between LTI and SGA was poor

- Similar observations were reported by a previous study, in which the sensitivity and specify of LTI to diagnose patients with low SGA was poor in 455 peritoneal dialysis patients (Paudel et al., 2015).
Discussion

Possible reasons

- reference values of BCM parameters were based on the results of 1,000 healthy subjects (Paudel et al., 2015).
- a single BCM measurement was used to diagnose malnutrition.
- muscle wasting was accompanied with fat mass accumulation.
Limitations

- A retrospective study with a relatively small sample size and single centre design.
- Measurement of BCM was performed before dialysis treatment.
Conclusions

- BCM provides a reliable assessment of lean and fat tissue mass separately.
- Even though a low lean tissue index strongly predicted the overall mortality for HD patients, it was not able to diagnose malnourished patients.
References


References


Welcome to Renji Hospital

Renji Hospital

- first western-type hospital in Shanghai and one of the oldest in China
- affiliated to Shanghai Jiao Tong University School of Medicine
- possess 2000 beds, has 50 clinical and technical department
- served more than 4 million patients/year
Historical buildings preservation
Cultural heritage
Nutrition Assessment
Body composition, Anthropometric measurements