Abstract: 237

SUV Quantification in DPD Scintigraphy

Authors:
PR Scully1, E Morris2, K Patel1, B Saberwal1, S Chadalavada1, G Testanera1, S Subhani1, S Ferreira1, N Hartman3, M Mullen1, P Elliott1, M Fontana4, PN Hawkins4, JC Moon1, LJ Menezes1, 1Barts Health NHS Trust, Barts Heart Centre - London - United Kingdom of Great Britain & Northern Ireland, 2St Bartholomew's Hospital, Clinical Physics - London - United Kingdom of Great Britain & Northern Ireland, 3Abertawe Bro Morgannwg University HB, Nuclear Medicine - Port Talbot - United Kingdom of Great Britain & Northern Ireland, 4University College London, National Amyloidosis Centre - London - United Kingdom of Great Britain & Northern Ireland,

Topic(s): Single Photon Emission Computed Tomography (SPECT)

Citation:
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Background:
99mTc-3,3-diphosphono-1,2-propanodicarboxylic acid scintigraphy is reported using the Perugini visual grading system of the late planar image (0 negative, 1-3 increasingly positive). They also describe a semi-quantitative technique using the early and late planar images to calculate heart and whole-body (WB) retention, as well as a heart/WB ratio.

Single photon emission computed tomography (SPECT) offers a 3D representation of organ radioactivity and therefore SPECT/CT quantification may improve image interpretation and provide a superior means of measuring amyloid burden.

Methods:
Heart and WB retention, as well as heart/WB ratio were calculated by comparing regions of interest placed over the heart, kidneys and bladder on the early and late planar images.
Hybrid Recon was used to reconstruct the SPECT/CT of the chest and display standardised uptake values (SUV). The peak SUV was recorded from volumes of interest placed over the heart and paraspinal muscle.

Results:
75 patients (aged 82±9 years, 52% male) with a range of DPD results (32 grade 0, 10 grade 1, 28 grade 2, 5 grade 3) were included. The peak cardiac SUV increased from grade 0 to 2, but plateaued at grade 3 (p<0.001), which likely reflects competition for tracer by skeletal muscle - as evidenced by an increasing paraspinal muscle peak SUV from grade 0 (0.56±0.15) to grade 3 (1.16±0.36) (p<0.001). Heart and WB retention, as well as heart/WB ratio increased with DPD grade (p<0.001).

Peak cardiac SUV had the highest AUC of 0.997 for detecting any cardiac amyloid, followed by heart retention (0.925), heart/WB ratio (0.884) and WB retention (0.796). A peak cardiac SUV of 3.13 had a 95% sensitivity and 100% specificity for any cardiac amyloid. For a similar sensitivity, a heart retention of 3.85 had a specificity of 69%, a WB retention of 72.65 had a specificity of 47% and a heart/WB ratio of 4.55, a specificity of 44%.

Conclusion:
SPECT/CT derived peak cardiac SUV offers the highest diagnostic accuracy compared to heart and WB retention, as well as heart/WB ratio, without the need for the early planar acquisition. It may offer a means of monitoring disease progression/treatment response, although grade 3 interpretation is likely confounded by skeletal muscle uptake.
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Results for each DPD quantification technique by Perugini Grade:

<table>
<thead>
<tr>
<th></th>
<th>Grade 0</th>
<th>Grade 1</th>
<th>Grade 2</th>
<th>Grade 3</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak Cardiac SUV</td>
<td>1.33±0.51</td>
<td>3.93±1.30</td>
<td>12.01±3.69</td>
<td>11.08±1.16</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Heart Retention</td>
<td>3.54±0.83</td>
<td>4.73±0.73</td>
<td>5.98±1.57</td>
<td>6.70±0.98</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Whole-Body Retention</td>
<td>73.9±8.35</td>
<td>81.15±6.97</td>
<td>82.78±7.14</td>
<td>89.70±4.91</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Heart/Whole-Body Ratio</td>
<td>4.78±0.94</td>
<td>5.84±0.69</td>
<td>7.21±1.87</td>
<td>7.50±1.23</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Figure 1: ROC curve for detecting any cardiac amyloid using the peak cardiac SUV, the whole-body and heart retention and the heart/whole-body ratio.