Epicardial fat volume as a predictor of coronary vulnerable plaques using cardiac computed tomography in the patients with zero calcium score


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Disclosure: No conflict of interest to declare
Background

- A zero coronary artery calcium score by cardiac CT might exclude most clinically relevant coronary artery disease (CAD) in asymptomatic subjects.
  

- Recently, the measurement of epicardial adipose tissue (EAT) using cardiac CT has been shown to be a reliable marker of coronary atherosclerosis, and greater epicardial fat volume (EFV) is associated with CAD.

The relationship between EFV and CAD in early stage coronary atherosclerosis without calcification is unknown.
Potential role of adipocytes in the process of coronary atherosclerosis

P.M. Gorter et al., *Atherosclerosis*, 197 (2008)
Purpose

To investigate the influence of EFV on coronary atherosclerosis without calcification using cardiac CT.
From May 2008 to December 2010, cardiac CT (Brilliance 64, Phillips) was performed on 1202 consecutive patients. Of these patients, 401 patients (33%) had a calcium score of zero.

Cardiac CT for coronary angiography and calcium scoring (n = 1202)

Patients with positive calcium score (n = 801: 67%)

Patients with zero calcium score (n = 401: 33%)

Patients with previous PCI or CABG, old MI and known cardiomyopathy were not included.
In this study, CAD was determined by the presence of significant coronary artery stenosis (>50% luminal narrowing) and/or vulnerable plaques on cardiac CT.
Coronary plaque assessment

By ZIO, Ziosoft Co, Japan.

Axial image

Avg: 40.78 HU
SD: 14.17
Area: 1.09mm²

More than five randomly selected regions of interest (> 1.0 mm²) were positioned within each plaque, and the minimum density value was decided as the plaque density.

Lipid rich plaque (LRP):
Plaque with CT density < 50 HU

Positive coronary remodeling:
RI (remodeling index) > 1.05

Vulnerable plaque:
LRP with positive coronary remodeling

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Epicardial fat volume quantification

- EAT area (blue) on axial image was determined by tracing a single region of interest (green).
- Fat voxels were identified using threshold attenuation values of $-30$ to $-200$ HU.
- EFV ($\text{cm}^3$) was obtained as the sum of the EAT areas with 2 mm thick for the whole heart.
Assessment of coronary atherosclerosis using cardiac CT

<table>
<thead>
<tr>
<th>Presence</th>
<th>Patients with zero calcium score (n=401)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Presence of NCPs</td>
<td>145 (36%)</td>
</tr>
<tr>
<td>Presence of vulnerable plaques</td>
<td>65 (16%)</td>
</tr>
<tr>
<td>Presence of significant coronary artery stenosis</td>
<td>36 (8%)</td>
</tr>
</tbody>
</table>

NCP: noncalcified plaque
Patients with and without CAD

Patients with zero calcium score (n = 401)

Patients without CAD (n = 311: 78%)

Patients with CAD (n = 90: 22%)

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## Patient characteristics

<table>
<thead>
<tr>
<th></th>
<th>Patients without CAD (n=311)</th>
<th>Patients with CAD (n=90)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age (yrs)</strong></td>
<td>62±11</td>
<td>65±11</td>
<td>&lt; 0.05</td>
</tr>
<tr>
<td><strong>Gender (Male)</strong></td>
<td>124 (40%)</td>
<td>49 (54%)</td>
<td>&lt; 0.05</td>
</tr>
<tr>
<td><strong>Coventional risk factors</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Obesity BMI (kg/m²) ≥25</td>
<td>98 (32%)</td>
<td>36 (40%)</td>
<td>0.13</td>
</tr>
<tr>
<td><strong>Hypertension</strong></td>
<td>171 (55%)</td>
<td>68 (76%)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td><strong>Diabetes</strong></td>
<td>81 (26%)</td>
<td>44 (49%)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td><strong>Dyslipidemia</strong></td>
<td>150 (48%)</td>
<td>57 (62%)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td><strong>Current smoking</strong></td>
<td>76 (24%)</td>
<td>28 (31%)</td>
<td>0.20</td>
</tr>
<tr>
<td><strong>Medical therapy</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Statins</td>
<td>64 (21%)</td>
<td>21 (24%)</td>
<td>0.59</td>
</tr>
<tr>
<td>Calcium channel blockers</td>
<td>88 (29%)</td>
<td>33 (37%)</td>
<td>0.16</td>
</tr>
<tr>
<td><strong>ACE inhibitors / ARBs</strong></td>
<td>55 (18%)</td>
<td>28 (32%)</td>
<td>&lt; 0.01</td>
</tr>
<tr>
<td><strong>Oral hypoglycemic agents</strong></td>
<td>31 (10%)</td>
<td>20 (22%)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Insulin</td>
<td>11 (4%)</td>
<td>6 (7%)</td>
<td>0.20</td>
</tr>
</tbody>
</table>
Comparison of characteristic of coronary atherosclerosis between with and without CAD

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<th>Presence of NCPs</th>
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<tbody>
<tr>
<td>Presence of NCPs</td>
<td>56 (39%)</td>
<td>89 (99%)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Presence of vulnerable plaques</td>
<td>0 (0%)</td>
<td>65 (72%)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Presence of significant coronary artery stenosis</td>
<td>0 (0%)</td>
<td>36 (40%)</td>
<td>&lt; 0.001</td>
</tr>
</tbody>
</table>
Comparison of cEFV and frequency of patients with increased cEFV

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<th>Patients with CAD (n=90)</th>
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<tbody>
<tr>
<td>cEFV (cm³/m²)</td>
<td>46.6 ± 25</td>
<td>56.2 ± 21</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Frequencies of patients with increased cEFV</td>
<td>37 (12%)</td>
<td>22 (24%)</td>
<td>&lt; 0.01</td>
</tr>
</tbody>
</table>

cEFV: EFV divided by body surface area
Increased cEFV: (> 71.7 cm³/m²: mean ± standard deviation)
Multivariate analysis for the presence of the \textit{coronary artery stenosis} in patients without coronary artery calcification

Multivariate logistic regression analysis was performed for clinical factors with $p < 0.1$ in univariate analysis.

- **Male**: $p < 0.01$, OR 3.10 (1.37 – 7.04)
- **Age (> 65 y.o.)**: $p < 0.01$, OR 3.06 (1.36 – 6.91)
- **Hypertension**: $p = 0.23$, OR 1.66 (0.73 – 3.80)
- **Diabetes**: $p < 0.001$, OR 4.33 (2.02 – 9.28)
- **Dyslipidemia**: $p = 0.06$, OR 2.14 (0.98 – 4.69)
- **Smoking**: $p = 0.71$, OR 1.18 (0.49 – 2.82)
- **Increased cEFV ($> 71.7 \text{ cm}^3/\text{m}^2$)**: $p = 0.33$, OR 1.57 (0.63 – 3.94)
Multivariate logistic regression analysis was performed for clinical factors with $p<0.1$ in univariate analysis.

- **Male**: $p = 0.17$, OR 1.48 (0.85–2.57)
- **Hypertension**: $p < 0.01$, OR 2.45 (1.31–4.58)
- **Diabetes**: $p = 0.16$, OR 1.51 (0.85–2.66)
- **Dyslipidemia**: $p = 0.17$, OR 1.48 (0.84–2.59)
- **Increased cEFV ($> 71.7 \text{cm}^3/\text{m}^2$)**: $p < 0.001$, OR 2.43 (1.25–4.73)
Limitation

- These data were obtained not from the general population but from outpatients.

- Subjects receiving cardiac CT in this study were already taking prescribed medications.

- It is not evident whether coronary atherosclerosis is exaggerated according to total amount of EAT or peri-coronary fat.
Conclusion

The measurement of EFV using cardiac CT is a useful marker for the presence of vulnerable plaques even in patients without coronary artery calcification.
Thank you for your attention!

Awa Dance festival
Tokushima

Tokyo

Ohnaruto Bridge
and Naruto whirlpools