Coronary Flow Reserve Versus CT Scan Study To Differentiate Non-ischemic From Ischemic Dilated Cardiomyopathy

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Imaging in Atherosclerosis

Cardiovascular Risk Factors:
- Traditional
- Genetic
- Emerging

Plaque rupture, instability of plaque

Acute CV event - Chronic ischemia (resting WMA)

Inducible Ischemia (WMA, SEcho, CFR)

Obstructive arterial process

Non Obstructive plaque (US)

Morphostruttural Alterations of Vascular Arterial Wall (IMT)

Functional alteration of vascular wall (FMD, stiffness parameters)

Cardiovascular Risk Factors: Traditional, Genetic, Emerging
Background (1)

-To highlight the underlying mechanism responsible for heart failure (HF) is mandatory for a correct prognostical stratification. In fact, to highlight as earlier as possible the presence of a coronary stenosis could change greatly our management of the disease with an important impact on the outcome of patients with HF.

- Coronary flow reserve assessment is a good prognostical marker but it can fail for identifying HF due to coronary stenosis.

- CT-Scan has been recently proposed as a reliable tool enables to offer anatomic information about the principal coronary arteries.
Sixty-Four-Slice Multidetector Computed Tomography: An Accurate Imaging Modality for the Evaluation of Coronary Arteries in Dilated Cardiomyopathy of Unknown Etiology

Daniele Andreini, MD; Gianluca Pontone, MD; Antonio L. Bartorelli, MD; Piergiuseppe Agostoni, MD, PhD; Saima Mushtaq, MD; Erika Bertella, MD; Daniela Trabattoni, MD; Gaia Cattadori, MD; Sarah Cortinovis, MD; Andrea Annoni, MD; Alice Castelli, MD; Giovanni Ballerini, MD; Mauro Pepi, MD

Figure 1. Dilated cardiomyopathy associated with severe CAD. Head-to-head comparison of invasive coronary angiography (left panel) compared with MDCT multiplanar reconstruction (right panel). White arrows show significant stenosis on the proximal segments of left anterior descending artery (LAD), first marginal branch (M1), and right coronary artery (RCA).

Anatomical approach to CAD: CT scan

Obstructive CAD on MSCT (≥50%)

n=40; intermediate likelihood of CAD

Schuijf et al, JACC 2006
Background (3)

Survival in Patients with LV Dysfunction

- CAD: 74% of all HF mortality
- No CAD: 83% survivors
- CAD: 62% survivors

Time (years)

Survival (percent)

from Felker et al. J Am Coll Cardiol 2002;39:210-218

n=1921
p<0.001
The additional prognostic value of coronary flow reserve on left anterior descending artery in patients with negative stress echo by wall motion criteria. A Transthoracic Vasodilator Stress Echocardiography Study

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**Diagram:**
- **Sensitivity:** 91, 89, 91, 88
- **Specificity:** 74, 77, 85, 76
- **Accuracy:** 93, 86, 85, 95
- **PPV:** 70, 76, 85
- **NPV:** 91, 89, 95

Legend:
- **CFR**
- **WMA**
- **CFR-WMA**

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Rigo, Am J Card 2005
Methods: ultrasound findings of coronary arteries: LAD II III

Rigo, Cardiovascular Ultrasound 2008

Lad: mid-distal tract

Feasibility 98% pts

Normal values

MFV=25±7 cm/s
Aim of the Study

To compare the reliability and the relative diagnostic value of Echo and coronary flow reserve of LAD in Dilated cardiomyopathy with computer tomography multi-detector (CT) and with coronary angiography (CA).
Study population

Since 2009 we have enrolled 121 consecutive Heart failure patients (EF<45%) from 2 centers: Mestre-Venice (Italy), Parma (Italy)

Each patient underwent:

1) ECHOCARDIOGRAPHY (Transthoracic: we adopted a vascular dedicated software) - TTE-Doppler mapping of LAD (we assessed with TT-Doppler the mid distal tract of LAD)

- Stress Echo: Dipyridamole (0.84 mg/kg/over 6’)
  Coronary flow reserve on LAD (CFR= Hyperemic DFV/baseline DFV → abnormal CFR value <2)

2) CT SCAN multidetector (64): >50%

  Calcium score (Agaston score)

3) CORONARY ANGIOGRAPHY: >50%
## Study population
121 consecutive pz with EF < 45%

<table>
<thead>
<tr>
<th>Category</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age, yrs±SD</strong></td>
<td>69±16</td>
</tr>
<tr>
<td><strong>Gender M/F</strong></td>
<td>91/30</td>
</tr>
<tr>
<td><strong>Risk factors and patient history</strong></td>
<td></td>
</tr>
<tr>
<td>Hypertension*</td>
<td>70 (58)</td>
</tr>
<tr>
<td>Hypercholesterolaemia †</td>
<td>69 (57)</td>
</tr>
<tr>
<td><strong>Current Smokers</strong></td>
<td>44 (36)</td>
</tr>
<tr>
<td><strong>Diabetes mellitus</strong></td>
<td>35 (29)</td>
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<tr>
<td><strong>Family history of CAD</strong></td>
<td>20 (16)</td>
</tr>
<tr>
<td><strong>Reduced ejection fraction, LVEF &lt;50%</strong></td>
<td>172 (24)</td>
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<tr>
<td><strong>Known CAD</strong></td>
<td>6 (5)</td>
</tr>
<tr>
<td><strong>Coronary angiography</strong></td>
<td></td>
</tr>
<tr>
<td>PtS with CAD&gt;50%</td>
<td>62 (51)</td>
</tr>
<tr>
<td><strong>Number of diseased (&gt;50%) vessels</strong></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>16 (13)</td>
</tr>
<tr>
<td>2</td>
<td>19 (16)</td>
</tr>
<tr>
<td>3</td>
<td>27 (22)</td>
</tr>
<tr>
<td><strong>CT angiography</strong></td>
<td></td>
</tr>
<tr>
<td>Calcium score (±SD)</td>
<td>178 (222)</td>
</tr>
<tr>
<td>PtS with CAD&gt;50%</td>
<td>61 (50)</td>
</tr>
<tr>
<td><strong>Echo &amp; StressEcho</strong></td>
<td></td>
</tr>
<tr>
<td>Baseline LVEF, % (±SD)</td>
<td>36 (6)</td>
</tr>
<tr>
<td>PtS with CFR-LAD &lt;2</td>
<td>91 (75)</td>
</tr>
</tbody>
</table>
RESULTS (1)
CFR vs CT scan Imaging in Dilated Cardiomyopathy

<table>
<thead>
<tr>
<th>ROC-derived cut point</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>NPV</th>
<th>PPV</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>in detecting a stenosis &gt; 50%</td>
<td></td>
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<td></td>
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<tr>
<td>CFR &lt; 1.5</td>
<td>90%</td>
<td>77%</td>
<td>78%</td>
<td>89%</td>
<td>86%</td>
</tr>
<tr>
<td>MDCT</td>
<td>92%</td>
<td>93%</td>
<td>95%</td>
<td>91%</td>
<td>92%</td>
</tr>
</tbody>
</table>
Results (2)

The added value ..

IN DETECTING A LAD STENOSIS > 50%...
ROC Curve Analysis

Data set: CFR_LAD(+ve), CG(-ve)

Area under ROC curve by extended trapezoidal rule = 1,959121

Wilcoxon estimate of area under ROC curve = 0,906563
DeLong standard error = 0,152031: 95% CI = 0,608588 to 1

Optimum cut-off point selected = 1,605
Results (4)

The added value in detecting a LAD STENOSIS > 50%...
Clinical case 1 “HF – CHD”

- Male 71 years old
- Hypertension
- History of dyspnea (PE 3 mo. earlier)
- Resting Ecg: abnormal (LBBB; QRS=180 ms)
Clinical case 1 “HF CHD”

LAD
CFR=1,1
Clinical case 2 “HF No-CAD”

• Male 64 years old with atypical chest pain (III^ Cl NYHA)
• Hypertension, insuline resistance, smoker
• Resting Ecg: LVH-RA
Clinical case 2 “HF No-CAD”

LAD-CFR=2.2

Rest  Peak
Conventional risk factors for coronary disease were fairly useful in predicting DCM due to coronary disease (global chi square=43,3). By progressively adding CaS, CFR-LAD and finally CTA, we provided increasingly accurate information (p<0.001 for all sequential comparisons) for predicting the underlying cause of DCM correctly.

By integrating ultrasound coronary Echo-Doppler study with CT scan we could draw a new roadmap to diagnose “earlier and non invasively” the patients with ischemic dilated cardiomyopathy to select and address to a prompt interventional revascularization.