Contrast Echocardiography

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Contrast Echocardiography
Relation of µbubbles to red blood cells

8.10^8 ml^{-1} 4.3 µm

Contrast Echocardiography

Effect of low acoustic energy on μ-bubbles size

ultrasound pressure

compression

rarefaction

μ-bubble radius
Contrast Echocardiography
Effect of high acoustic energy on $\mu$ bubbles
Contrast Echocardiography
Effect of acoustic energy on μbubbles scattering properties

- MI < 0.3
- Non-linear scattering properties
- Fundamental and harmonic frequencies

- MI > 1.0
- Non-linear scattering properties
- Harmonic frequency

- 0 kPa
- 100 kPa
- 1MPa

μbubble destruction
Stimulated acoustic emission
Contrast Echocardiography

Destruction of contrast by ultrasound

Time (ms) vs. Intensity (dB) graph showing the destruction of contrast by ultrasound.
Contrast Echocardiography

- Left ventricular opacification
- Myocardial perfusion
- Assessment of reperfusion and myocardial viability
Contrast Echocardiography
Left ventricular opacification

*Improved endocardial border delineation*

- reduced inter- and intra-observer variability
- improved detection of regional wall motion abnormalities
- improved calculation of LV volumes and ejection fraction
Contrast Echocardiography

Inter-institutional agreement according to image quality

Contrast Echocardiography
Contrast Echocardiography
Contrast Echocardiography
NA, 67 y.o. male
Contrast Echocardiography
NA, 67 y.o. male
Contrast Echocardiography
Effect of left ventricular opacification on accuracy of DbE

Dolan et al. Am Heart J 2001;142:908
Contrast Echocardiography

- Left ventricular opacification
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Contrast Echocardiography
Real-time perfusion imaging using power modulation
Contrast Echocardiography
MCE versus MIBI for assessment of myocardial blood volume


LAD adenosine

LAD stenosis + adenosine

LAD occlusion

LAD / Cx ratio

MCE MBV

\(^{99m}\)Tc-MIBI

\(\mu\)spheres

Contrast Echocardiography

How do we get from myocardial blood volume to myocardial blood flow?

DYNAMIC IMAGING
Contrast Echocardiography
Quantification of myocardial blood flow

Flash

1st cardiac cycle
2nd cardiac cycle
3rd cardiac cycle
4th cardiac cycle
5th cardiac cycle

time
Contrast Echocardiography
Real-time perfusion imaging using power modulation

Van Camp et al., JASE 2003;16:263
Contrast Echocardiography
Real-time perfusion imaging using power modulation

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Van Camp et al., JASE 2003;16:263
Contrast Echocardiography
MN, 50 y.o. male

Peltier et al. JACC 2004;43:257
Contrast Echocardiography
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DIPYRIDAMOLE MCE

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DIPYRIDAMOLE MCE

DIPYRIDAMOLE SPECT

Peltier et al. JACC 2004;43:257
Contrast Echocardiography

MN, 50 y.o. male

DIPYRIDAMOLE MCE

DIPYRIDAMOLE SPECT

Peltier et al. JACC 2004;43:257
Contrast Echocardiography
Dipyridamole real-time Power Modulation

β slope (s⁻¹)

<table>
<thead>
<tr>
<th>Condition</th>
<th>Rest</th>
<th>Dip</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 50%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>50-70%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>70-90%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt; 90%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

n=292
n=32
n=92
n=42

* Peltier et al. JACC 2004;43:257
Contrast Echocardiography
Dipyridamole real-time Power Modulation

\[ y = 2.65 \times (1-e^{-0.09(x-100)}) \]

\[ r = 0.85 \]

Peltier et al. JACC 2004;43:257
Contrast Echocardiography
Dipyridamole real-time Power Modulation

β reserve

Area under the curve
= 0.85

A * β reserve

Area under the curve
= 0.86

Peltier et al. JACC 2004;43:257
Contrast Echocardiography
Dipyridamole RTCE: Prognostic implications

Tsusui et al. *J Circulation* 2005;112:1444
Contrast Echocardiography

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Contrast Echocardiography
T.V.H. - ♂ - 46 year old

10.43 am : ECG
Contrast Echocardiography
T.V.H. - ♂ - 46 year old

11.43 am
Coronary angiography
Contrast Echocardiography
T.V.H. - ♂ - 46 year old

11.53 am : direct angioplasty and stenting
Contrast Echocardiography
Assessment of the « no-reflow » phenomenon by i.c. MCE

Before PTCA  After PTCA

Average segmental score

Acute  Chronic

## Contrast Echocardiography

Detection of myocardial viability with intravenous MCE

<table>
<thead>
<tr>
<th></th>
<th>Early MCE</th>
<th>Late MCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity</td>
<td>21%</td>
<td>62%</td>
</tr>
<tr>
<td>Specificity</td>
<td>89%</td>
<td>85%</td>
</tr>
<tr>
<td>PPV</td>
<td>63%</td>
<td>78%</td>
</tr>
<tr>
<td>NPV</td>
<td>57%</td>
<td>72%</td>
</tr>
</tbody>
</table>

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