Acute Myocardial Infarction and underlying stenosis severity

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The majority of ACS occur at the site of mild lesions.

The mythe of the “dangerous” plaque
(Vulnerable) Plaque: Facts and Fiction

**FACTS:**
- plaques are very common
- majority of plaques has an excellent prognosis with medical treatment
- only few plaques are vulnerable
- strongest indicator with respect to prognosis is associated *ischemia*

**FICTION:**
- every plaque is vulnerable
- every vulnerable plaque leads to ACS
- most ACS occurs in mild plaques
- screening of vulnerability can be done by imaging
Acute Coronary Syndromes most often occur at the site of mild stenoses.

Underlying Stenosis Severity of Abrupt Total Occlusions

Falk, Shah and Fuster, Circulation 1995

“Acute Coronary Syndromes most often occur at the site of mild stenoses”
Do Myocardial Infarctions Evolve from Mild Stenoses?

Serial Angiographic (Retrospective) Studies in Patients with MI and a Prior Coronary Angiogram

No QCA, No IVUS but unblinded “eyebolling”

<table>
<thead>
<tr>
<th>Study</th>
<th>Number of Patients</th>
<th>Delay Angio-MI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambrose et al. ACC 1988</td>
<td>23</td>
<td>1 month to 7 years</td>
</tr>
<tr>
<td>Little et al. Circulation 1988</td>
<td>42</td>
<td>4 days to 6.3 years</td>
</tr>
<tr>
<td>Giroud et al. AJC 1992</td>
<td>92</td>
<td>1 month to 11 years</td>
</tr>
<tr>
<td>Moise et al. AJC 1984</td>
<td>116</td>
<td>39 months</td>
</tr>
<tr>
<td>Webster et al JACC 1990</td>
<td>30</td>
<td>55 months</td>
</tr>
<tr>
<td>Hackett et al AJC 1989</td>
<td>10</td>
<td>21 months</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>313</strong></td>
<td><strong>A few days to 11 years (average 3.9 years!!!)</strong></td>
</tr>
</tbody>
</table>
THE MYTHE OF
THE “DANGEROUS” PLAQUE

The hypothesis of the occurrence of acute MI on such previously non-significant plaque is based upon

- 6 small retrospective studies
- with a total of 313 patients
- in whom the “index” catherization was performed an average of 3.9 years before the acute event

All other literature (21 “meta-analyses” and hundreds of references), refer to these 6 studies !!!
To investigate the **risk of an individual plaque or stenosis** to rupture, not a retrospective analysis of selected patients experiencing an acute coronary syndrome should be studied, but **prospective follow-up over years** is mandatory in unselected patients!

In such study in >2500 stenoses, performed by Aldermann, Stenosis severity was strongly correlated to the risk of occlusion and events:  
*The risk of a severe stenosis was 20 x higher than for a non-significant plaque.*

Similar data have been obtained by IVUS and at pathologic Studies.
Coronary Occlusion at 5 Years as a Function of Stenosis Severity

Adapted from Alderman et al. J Am Coll Cardiol 1993
IVUS Examination: Clinical Outcome after Deferred Interventions

- 300 pts; 13 mos F-U
- CSA = only independent predictor of events
- Independent predictors of TLR: diabetes, min CSA, AS
- When CSA > 4 mm$^2$:  
  - event rate: 4%
  - TLR: 2.8%

Abizaid AS et al. Circulation, 1999
Severity of Coronary Atherosclerosis at Sites of Plaque Rupture with Occlusive Thrombosis

Area Stenosis = \( \frac{\text{Vessel area} - \text{lumen area}}{\text{Vessel area}} \)

<table>
<thead>
<tr>
<th>Area Stenosis (%)</th>
<th>% of Total Number (n=182) of Stenoses</th>
</tr>
</thead>
<tbody>
<tr>
<td>67-75%</td>
<td>0</td>
</tr>
<tr>
<td>76-80%</td>
<td>10</td>
</tr>
<tr>
<td>81-90%</td>
<td>30</td>
</tr>
<tr>
<td>&gt;90%</td>
<td>60</td>
</tr>
</tbody>
</table>

Mean = 91% Area Stenosis
\(~ 68\% \) Diameter Stenosis

Qiao J-H et al. JACC 1991
250 consecutive patients with ST-elevation MI in the Catharina Hospital:

• reasonable estimation of pre-infarct stenosis severity possible in 156 patients

• angio’s divided in 4 groups:

  group 1: spontaneous reperfusion at first angio view
  group 2: reperfusion after easy and uncomplicated wiring
  group 3: reperfusion after non-trivial wiring
  group 4: no reperfusion.

  angiographic assessment possible in gr 1 & 2

Frobert et al CCI, 2007, 70: 958-965
Group 1: spontaneous reperfusion at first angio
Group 2: reperfusion after easy and uncomplicated wiring
Group 3: reperfusion after complicated wiring
not suitable for analysis
Stenosis Severity at Primary PCI in AMI

- 156 stenoses with distal flow enabling accurate QCA out of 250 consecutive Acute MI’s
- In 92 %, underlying stenosis was > 50%
- In 71 %, underlying stenosis was > 70%

Frobert et al CCI, 2007, 70: 958-965
250 consecutive patients with ST-elevation MI in the Catharina Hospital:

- underlying stenosis angiographically significant in 92% of the cases

- At meticulous anamnesis, 80% of patients had recurrent chest pain in the year before the acute myocardial infarction occurred!!

_Frobert et al CCI, 2007, 70: 958-965_
Non-significant “plaques”:  
Are 20 x more frequent than severe lesions. So, even if 50% of ACS would be related to such plaque, its individual risk is 20 times lower than the risk of a severe stenosis.

Non-significant “plaques”:  
Are often not giving complaints and therefore not treated in a similar way as a physiologically significant stenosis (aspirin, statines, stenting). Therefore, the “natural” outcome of severe lesions is positively influenced, whereas mild lesions remain silent and progress.
CONCLUSIONS:

• In contrary to what is often believed, the majority of acute myocardial infarctions occur on previously significant stenosis, especially when also hemodynamically significant.

• The risk of an individual mild or moderate plaque to rupture is extremely small and definitely < 1% per year with good medical treatment. *(Defer study, Courage trial)*

• In 80% of cases, AMI is preceded by repetitive episodes of ischemia in the year before

• PCI of (hemodynamically) significant stenosis makes sense, relieves angina and often improves outcome *(FAME study !)*

• non-significant stenosis can better be treated medically
COURAGE TRIAL: SOME CRITICAL NOTES

• How representative is the Courage Trial?
  only 6% of eligible patients were truly included

• Two-way negative bias for PCI group:
  1. In PCI group, selection of lesions to be stented was on the basis of angiography → at least 30% unnecessary stents, which unfavourably affects prognosis
  2. In PCI group, also a number of ischemic lesions must have been missed, which also unfavourably affects prognosis (ACIP-trial, Circulation 1996)

In terms of functional class the PCI group did better than the medical group, particularly in patients with proven ischemia!