Operative Myokardrevaskularisation
im akuten Myokardinfarkt - Sinn oder Unsinn?

Situationen und potentielle Vorteile für ein operatives Vorgehen

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Akutes Koronarsyndrom

Klinik und Klassifikation des akuten Koronarsyndroms

Abb. 1: Das Spektrum d. akuten Koronarsyndroms (Acute coronary syndrome, ACS)

- Stationäre Aufnahme
- Arbeitsdiagnose
- EKG
- Biochemie
- Diagnose

Brustschmerz

Akutes Koronarsyndrom

Persistierende ST-Hebung

ST/T-Veränderungen

EKG normal oder unspezifisch

Troponin Anstieg/Abfall

Troponin normal

STEMI

NSTEMI Instabile Angina
Akutes Koronarsyndrom

Umgehende Koronardiagnostik

Primäre Revascularisationstrategie?
STEMI

“Delays in the timely implementation of reperfusion therapy are key issues in the management of STEMI, since the greatest benefit gained from reperfusion therapy occurs within the first 2–3 hours of symptom onset. The aim is to provide optimal care while minimizing delays, in order to improve clinical outcomes”
Patients at very high risk (as defined above) should be considered for urgent coronary angiography (in less than 2 hours). In patients at high risk, with at least one primary high-risk criterion, an early invasive strategy within 24 hours appears to be the reasonable timescale. In lower-risk subsets [...] the invasive evaluation can be delayed without increased risk but should be performed during the same hospital stay.
Akutes Koronarsyndrom

Was tun?
“Culprit-lesion PCI is usually the first choice in most patients with NSTE-ACS and multivessel disease”
“There are no specific RCTs comparing PCI with CABG in patients with NSTE-ACS.

In all trials comparing an early invasive with a late strategy, or an invasive with a medical management strategy, the decision on whether to perform CABG or PCI was left to the investigator’s discretion.”
Surgical Versus Percutaneous Revascularization for Multivessel Disease in Patients With Acute Coronary Syndromes

Analysis From the ACUITY (Acute Catheterization and Urgent Intervention Triage Strategy) Trial

Yanai Ben-Gal, MD,* Jeffrey W. Moses, MD,* Roxana Mehran, MD,* Alexandra J. Lansky, MD,* Giora Weisz, MD,* Eugenia Nikolsky, MD,* Michael Argenziano, MD,* Matthew R. Williams, MD,* Antonio Colombo, MD,† Philip E. Aylward, MB, CHB, PHD,‡ Gregg W. Stone, MD*

Ben-Gal et al. Surgical Versus Percutaneous Revascularization for Multivessel Disease in Patients With ACS (ACUITY registry). JACC Cardiovasc Interv. 2010
The ACUITY trial was a prospective open-label randomized multicenter trial that compared 3 different antithrombotic regimens for patients presenting with moderate- and high-risk ACS and treated with an early invasive management strategy. n = 13,819

Ben-Gal et al. Surgical Versus Percutaneous Revascularization for Multivessel Disease in Patients With ACS (ACUITY registry). JACC Cardiovasc Interv. 2010
Situation 1:

Z.n. PCI der „culprit lesion“, stabiler Patient

Revaskularisationsstrategie bei Vorhandensein weiterer signifikanter Stenosen?
Primary culprit-lesion PCI

Stabilized patient

Staged treatment (PCI or CABG) as recommended in patients with SCAD

„In stabilized patients, the choice of revascularization modality can be made in analogy to patients with SCAD”

Cave:

“there are no prospective studies comparing culprit-lesion PCI with early CABG. The strategy of multivessel PCI for suitable significant stenoses—rather than PCI limited to the culprit lesion—has not been evaluated in an appropriate, randomized fashion.”

Akutes Koronarsyndrom: CABG vs. PCI

Myokardinfarkt

Akutes Koronarsyndrom: CABG vs. PCI

Schlaganfall

Figure 5. Strokes According to Treatment Arm

<table>
<thead>
<tr>
<th>Source</th>
<th>Statistics for Each Study</th>
<th>Stroke/Total</th>
<th>Favors CABG</th>
<th>Favors PCI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RR (95% CI)</td>
<td>Z Value</td>
<td>P Value</td>
<td>CABG</td>
</tr>
<tr>
<td>ARTS¹,¹¹</td>
<td>0.92 (0.52-1.65)</td>
<td>-0.27</td>
<td>0.79</td>
<td>21/584</td>
</tr>
<tr>
<td>MASS II</td>
<td>1.73 (0.70-4.31)</td>
<td>1.18</td>
<td>0.24</td>
<td>12/203</td>
</tr>
<tr>
<td>CARDia³</td>
<td>7.17 (0.89-57.87)</td>
<td>1.85</td>
<td>0.06</td>
<td>7/242</td>
</tr>
<tr>
<td>SYNTAX multivessel²,¹²</td>
<td>1.14 (0.56-2.32)</td>
<td>0.38</td>
<td>0.71</td>
<td>16/547</td>
</tr>
<tr>
<td>FREEDOM¹⁹</td>
<td>1.69 (1.01-2.85)</td>
<td>1.98</td>
<td>0.05</td>
<td>37/947</td>
</tr>
<tr>
<td>Meta-analysis</td>
<td>1.36 (0.99-1.86)</td>
<td>1.91</td>
<td>0.06</td>
<td>93/2523</td>
</tr>
</tbody>
</table>

Total number of patients: 5067 (I² = 24.9% for the fixed effects model). CABG indicates coronary artery bypass graft; PCI, percutaneous coronary intervention; RR, risk ratio; for expansion of all study name acronyms, see the cited references.
Akutes Koronarsyndrom: CABG vs. PCI

Syntax Studie

Mohr F,
EACTS 2013
Erneute Revaskularisation

„Major Adverse Cardiovascular and Cerebrovascular Events“

Summary/recommendation: CABG vs. PCI in SCAD

<table>
<thead>
<tr>
<th>Condition</th>
<th>CABG</th>
<th>PCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two-vessel CAD with proximal LAD stenosis</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>Three-vessel CAD with low CAD burden (i.e., three focal stenoses, low SYNTAX score)</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>Three-vessel CAD with intermediate to high CAD burden (i.e., multiple diffuse lesions, presence of CTO, or high SYNTAX score)</td>
<td>A</td>
<td>U</td>
</tr>
<tr>
<td>Isolated left main stenosis</td>
<td>A</td>
<td>U</td>
</tr>
<tr>
<td>Left main stenosis and additional CAD with low CAD burden (i.e., one to two vessel additional involvement, low SYNTAX score)</td>
<td>A</td>
<td>U</td>
</tr>
<tr>
<td>Left main stenosis and additional CAD with intermediate to high CAD burden (i.e., three vessel involvement, presence of CTO, or high SYNTAX score)</td>
<td>A</td>
<td>I</td>
</tr>
</tbody>
</table>

Figure 5. Method of Revascularization of Multivessel Coronary Artery Disease

A = appropriate; CABG = coronary artery bypass grafting; CAD = coronary artery disease; CTO = chronic total occlusion; I = inappropriate; LAD = left anterior descending artery; PCI = percutaneous coronary intervention; SYNTAX = Synergy Between PCI With TAXUS and Cardiac Surgery; U = uncertain.
Summary/recommendation: CABG vs. PCI in SCAD

Recommendation for the type of revascularization (CABG or PCI) in patients with SCAD with suitable coronary anatomy for both procedures and low predicted surgical mortality

<table>
<thead>
<tr>
<th>Recommendations according to extent of CAD</th>
<th>CABG</th>
<th></th>
<th>PCI</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Class</td>
<td>Level</td>
<td>Class</td>
<td>Level</td>
</tr>
<tr>
<td>One or two-vessel disease without proximal LAD stenosis.</td>
<td>IIb</td>
<td>C</td>
<td>I</td>
<td>C</td>
</tr>
<tr>
<td>One-vessel disease with proximal LAD stenosis.</td>
<td>I</td>
<td>A</td>
<td>I</td>
<td>A</td>
</tr>
<tr>
<td>Two-vessel disease with proximal LAD stenosis.</td>
<td>I</td>
<td>B</td>
<td>I</td>
<td>C</td>
</tr>
<tr>
<td>Left main disease with a SYNTAX score ≤ 22.</td>
<td>I</td>
<td>B</td>
<td>I</td>
<td>B</td>
</tr>
<tr>
<td>Left main disease with a SYNTAX score 23–32.</td>
<td>I</td>
<td>B</td>
<td>IIa</td>
<td>B</td>
</tr>
<tr>
<td>Left main disease with a SYNTAX score &gt;32.</td>
<td>I</td>
<td>B</td>
<td>III</td>
<td>B</td>
</tr>
<tr>
<td>Three-vessel disease with a SYNTAX score ≤ 22.</td>
<td>I</td>
<td>A</td>
<td>I</td>
<td>B</td>
</tr>
<tr>
<td>Three-vessel disease with a SYNTAX score 23–32.</td>
<td>I</td>
<td>A</td>
<td>III</td>
<td>B</td>
</tr>
<tr>
<td>Three-vessel disease with a SYNTAX score &gt;32.</td>
<td>I</td>
<td>A</td>
<td>III</td>
<td>B</td>
</tr>
</tbody>
</table>

CABG = coronary artery bypass grafting; LAD = left anterior descending coronary artery; PCI = percutaneous coronary intervention; SCAD = stable coronary artery disease.

*aClass of recommendation.

*bLevel of evidence.

*References.

Situation 2:

Z.n. PCI der „culprit lesion“, stabiler Patient

falls ACVB indiziert – wann?
Timing of In-Hospital Coronary Artery Bypass Graft Surgery for Non-ST-Segment Elevation Myocardial Infarction Patients

Results From the National Cardiovascular Data Registry ACTION Registry–GWTG (Acute Coronary Treatment and Intervention Outcomes Network Registry–Get With The Guidelines)

Shailja V. Parikh, MD,* James A. de Lemos, MD,* Michael E. Jessen, MD,† Emmanouil S. Brilakis, MD, PhD,* E. Magnus Ohman, MD,‡ Anita Y. Chen, MS,‡ Tracy Y. Wang, MD, MHS,‡ Eric D. Peterson, MD, MPH,‡ Matthew T. Roe, MD, MHS,‡ Elizabeth M. Holper, MD, MPH,* on behalf of the CRUSADE and ACTION Registry–GWTG Participants

Dallas, Texas; and Durham, North Carolina
Parikh SV et al. Timing of in-hospital coronary artery bypass graft surgery for non-ST-segment elevation myocardial infarction patients results from the National Cardiovascular Data Registry ACTION Registry JACC Cardiovasc Interv. 2010
In-hospital CABG rates after NSTEMI did not change significantly from 2002 to 2008 (ptrend 0.08), ranging between 11% and 13% (Fig. 3A). There was also no significant difference in the mean proportion of patients undergoing early (30.4%) or late (69.7%) CABG across time (Fig. 3B).

Parikh SV et al. Timing of in-hospital coronary artery bypass graft surgery for non-ST-segment elevation myocardial infarction patients results from the National Cardiovascular Data Registry ACTION Registry JACC Cardiovasc Interv. 2010
In-hospital mortality:
3.6% vs. 3.8%
(adjusted odds ratio: 1.12, 95% confidence interval: 0.71 to 1.78)

Composite endpoint (death, myocardial infarction, congestive heart failure, or cardiogenic shock):
12.6% vs. 12.4%
(adjusted odds ratio: 0.94, 95% confidence interval: 0.69 to 1.28)

were similar between patients undergoing early versus late CABG.

Parikh SV et al. Timing of in-hospital coronary artery bypass graft surgery for non-ST-segment elevation myocardial infarction patients results from the National Cardiovascular Data Registry ACTION Registry JACC Cardiovasc Interv. 2010
“As there is no randomized study comparing an early with a delayed CABG strategy, the general consensus is to wait 48–72 hours in patients who had culprit-lesion PCI and have residual severe CAD. In registries, unadjusted and adjusted analyses showed no difference in outcomes between patients undergoing early (≤48 hours) or in-hospital late (>48 hours) surgery, although CABG was delayed more often in higher-risk patients, suggesting that timing might be appropriately determined by multidisciplinary clinical judgement.

When there is continuing or recurrent ischaemia, ventricular arrhythmias, or haemodynamic instability, CABG should be performed immediately.

Patients with LM or three-vessel CAD involving the proximal LAD should undergo surgery during the same hospital stay.”
Situation 3:

PCI der „culprit-lesion“ nicht möglich

Revaskularisationsstrategie?
PCI der „culprit-lesion“ nicht möglich:

ACVB falls operabel
Situation 4:

ACS, instabiler Patient, kardiogener Schock
Akutes Koronarsyndrom und kardiogener Schock: SHOCK trial

SHOCK trial: 152 patients randomly assigned to early revascularization, PCI (n = 81) or CABG (n = 47) was performed in 128 patients with left ventricular failure resulting in shock.

Mehta et al. PCI or CABG for cardiogenic shock and multivessel coronary artery disease? Am Heart J 2010
In-hospital mortality with single-vessel disease was similar in both groups (33.3% [CABG] vs 32.9% [PCI]) but was significantly lower for the CABG group in patients with 2-vessel (17.7% [CABG] vs 42.2% [PCI], P = 0.025) and 3-vessel (29.6% [CABG] vs 59.4% [PCI], P < 0.0001) CAD. Thus, in-hospital mortality remained stable in patients who had CABG, whereas it increased in the PCI cohort as the number of diseased vessels increased.
Situation 5:

ACS + mechanische Infarktkomplikation
Mechanische Infarktkomplikationen

3% RV damage
74% LV damage
5% VSD
< 2% Free wall rupture
9% MR
Others 7%

Inzidenz mechanischer Infarktkomplikationen

Mechanische Infarktkomplikationen

Inzidenz und Mortalitätsraten mechanischer Infarktkomplikationen

![Graph showing incidence and mortality rates for different complications.](image)

*aus: Hochman et al. JACC 2000*
Mechanische Infarktkomplikationen: VSD

Ventrikel septumruptur/Infarkt-VSD

Epidemiologie/zeitl. Verlauf:
0,2 (GUSTO I) - 3,9% (SHOCK registry) der Patienten mit AMI, biphasischer Häufigkeitsgipfel: innerhalb von 24 Stunden, 3-5 Tage nach Infarkt, bis zu 14 Tage nach Infarkt, früher bei Patienten nach Thrombolyse

Risikofaktoren: großer Infarkt, Alter, weibl. Geschlecht, single vessel disease, schlechte Kollateralisierung

Lokalisation:
Apical: anterior/LAD MI
Multiple VSDs in 40%
Basal: inferior MI/RCA
Direkt/einfach vs. komplex

Klin. Symptomatik hängt von der Größe des VSDs und damit Links-Rechts-Shunts ab

Therapie: Vasodilatatoren, IABP, Nachlastsenkung, chirurgische Korrektur
Mechanische Infarktkomplikationen: VSD
Mechanische Infarktkomplikationen: VSD

Mechanische Infarktkomplikationen: VSD

<table>
<thead>
<tr>
<th>Years</th>
<th>%Survival</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/12</td>
<td>67%</td>
</tr>
<tr>
<td>2/12</td>
<td>59%</td>
</tr>
<tr>
<td>1</td>
<td>57%</td>
</tr>
<tr>
<td>3</td>
<td>53%</td>
</tr>
<tr>
<td>5</td>
<td>45%</td>
</tr>
<tr>
<td>10</td>
<td>23%</td>
</tr>
<tr>
<td>20</td>
<td>4%</td>
</tr>
</tbody>
</table>

Akute Mitralklappeninsuffizienz nach Infarkt/Papillarmuskelabriss

Epidemiologie:
1% der Patienten mit MI. Biphasischer Häufigkeitsgipfel: innerhalb von 24 Stunden, typischerweise 3-5 Tage nach Infarkt

Risikofaktor: v.a. inferiorer MI

Lokalisation/Formen
- Postero-medialer Papillarmuskel (RCA+ RCX): 75%
- Antero-lateraler Papillarmuskel (LAD): 25%
- Partieller (2/3) >> Kompletter Abriss (1/3)

Schwere der Mitralklappeninsuffizienz
- Ausmaß des Papillarmuskelabriss (partiell/komplett) bestimmt das Maß der hämodynamischen Instabilität.
- Grad der hämodynamischen Instabilität ist maßgeblicher Outcome-Prädiktor.

Therapie: Mitralklappenrekonstruktion/-ersatz
Mechanische Infarktkomplikationen: akute Mitralklappeninsuffizienz

Infarktassoziiertes Papillarmuskelabriss und akute MI
Clinical Outcome After Surgical Correction of Mitral Regurgitation Due to Papillary Muscle Rupture

Mechanische Infarktkomplikationen: akute Mitralklappeninsuffizienz

Russo et al. Clinical Outcome After Surgical Correction of Mitral Regurgitation Due to Papillary Muscle Rupture
Circulation 2008
outcome of 44 operative survivors of PMR surgery compared with that of 88 propensity-matched patients with first MI diagnosed in the community who had survived the first 30 days after MI
Mechanische Infarktkomplikationen: Linksherzversagen

Assist Devices

1. Generation
Extrakorporal + RVAD

2. Generation
Intrakorporal

3. Generation

Voss et al. CardioVasc 2013
Zusammenfassung

instab. Angina/NSTE-ACS

ACS

STEMI-ACS

Koronardiagnostik

Akut PCI

Culprit-Läsion

asymptomatisch/stabil

unpassende PCI-Anatomie
nicht erfolgreiche PCI
instabil + mech. Komplikation

staged PCI

staged CABG

Notfall-OP
Interdisziplinäre Zusammenarbeit
für einen patienten-zentrierten Entscheidungsprozess