Treatment of Perioperative Myocardial Infarction

Tightrope walk between thrombosis and bleeding

Kantonsspital St. Gallen

Hans Rickli
Pat. history: K.W. ♂, 1941

- Elective hip replacement in spinal anaesthesia
  - Arterial hypertension treated with ACE-inhibitor
- 1 hour after uneventful surgery: Ongoing chest pain
- BP left arm: 102/70 mmHg, Pulse 90/‘, reg. SR
- ECG

04.03.2013
<table>
<thead>
<tr>
<th>Patient:</th>
</tr>
</thead>
<tbody>
<tr>
<td>HF 93/min</td>
</tr>
<tr>
<td>Orsion: 70°</td>
</tr>
<tr>
<td>SINUSRHYTHMUS</td>
</tr>
<tr>
<td>LAGE VP NORMAL</td>
</tr>
<tr>
<td>ORS: INF</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Intervalle:</th>
</tr>
</thead>
<tbody>
<tr>
<td>RR 646 ms</td>
</tr>
<tr>
<td>-38°</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Werte:</th>
</tr>
</thead>
<tbody>
<tr>
<td>P 124 ms</td>
</tr>
<tr>
<td>Q 140 ms</td>
</tr>
<tr>
<td>S 98 ms</td>
</tr>
<tr>
<td>R 314 ms</td>
</tr>
<tr>
<td>QT 393 ms</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Werte (mm):</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sokol. 1.51 mU</td>
</tr>
</tbody>
</table>

**10 mm/mV**

**MÖGLICHER AKUTER ANTERIORE R INFARKT**

**UNBESTÄTISSERTER BEREICH**

**04.03.2013**
Perioperative MI

- Size of the problem (epidemiology, prognosis)
- Pathophysiology
- Treatment
- Prevention
Size of the adult non-cardiac surgical cohort and average risk of cardiac complications

- **Netherlands (16 Mio)**
  - 250,000 major non-cardiac surgical procedures per year (1991–2005) → annual rate of 1.5%

- **Europe (500 Mio)**
  - Estimate of 7 million major non-cardiac surgical procedures annually
    - MI = most important perioperative vascular complication (POISE-Study)

- **Major complications rate** varying from 1.7 to 3.5%

---

Pathophysiology
Hypercoagulability

Plaque rupture / Thrombosis

Sympathetic tone↑

Myocardial ischemia

O₂ demand ↑

Hypercoagulability

Plaque rupture / Thrombosis

Myocardial ischemia

O₂ demand ↑

Hypovolemia

O₂ Supply ↓

Anemia

..... walk between thrombosis and bleeding
Definition perioperative MI

**Appendix Table 2. Defining Features of Perioperative MI**

- Elevated cardiac biomarker level
  - Ischemic symptoms
  - Q waves
  - ST-segment elevation
  - ST-segment depression
  - T-wave inversion
  - Coronary artery intervention
  - Cardiac imaging evidence of MI

---

### Definition perioperative MI

#### Appendix Table 2. Defining Features of Perioperative MI

<table>
<thead>
<tr>
<th>Feature</th>
<th>Count (Percentage)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elevated cardiac biomarker level +</td>
<td></td>
</tr>
<tr>
<td>Ischemic symptoms</td>
<td>144 (34.7)</td>
</tr>
<tr>
<td>Q waves</td>
<td>51 (12.3)</td>
</tr>
<tr>
<td>ST-segment elevation</td>
<td>44 (10.6)</td>
</tr>
<tr>
<td>ST-segment depression</td>
<td>130 (31.3)</td>
</tr>
<tr>
<td>T-wave inversion</td>
<td>90 (21.7)</td>
</tr>
<tr>
<td>Coronary artery intervention</td>
<td>29 (7.0)</td>
</tr>
<tr>
<td>Cardiac imaging evidence of MI</td>
<td>108 (26.0)</td>
</tr>
</tbody>
</table>

Management perioperative MI

- Perioperative ACS
  - Same management as without non-cardiac surgery?
ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation

The Task Force on the management of ST-segment elevation acute myocardial infarction of the European Society of Cardiology

Authors/Task Force Members: Ph. Gabriel Steg (Chairperson) (France)*, Stefan K. James (Chief Writer) (Norway), Luigi P. Badano (Italy), Carina Blomstrom Lundqvist (Sweden), Michael A. Borges (United Kingdom), Kenneth Dickstein (Norway), Gregory Ducrocq (France), Francisco Fernández-Aracil (Spain), Pantaleo Giannuzzi (Italy), Sigrun Halvorsen (Norway), Kurt Huber (Germany), Juhani Knuuti (Finland), Mattie J. Lenzen (Netherlands), Kostas Kostis (Greece), Arnoud van't Hof (Netherlands), Petr Widimsky (Czech Republic), Doron Zipes (USA)

ESC Committee for Practice Guidelines (CPG): Jeroen J. Bax (Chairperson) (The Netherlands), Claudio Ceconi (Italy), Veronica Dean (France), Christi Deaton (UK), Roberto Festuccia (Italy), Emmanouil Hadj�loucas (Greece), David Hasdai (Israel), Arno Hoes (Netherlands), Paulus Kirchhof (Germany), Jonathan Lau (China), Andrej Lonc (Slovenia), Caroline E. McDonald (UK), Theresa McDonagh (UK), Cyril Moulin (France), Bogdan A. Popescu (Romania), Frank Reiber (Switzerland), Michael Schachinger (Austria), Paul Schenkel (Germany), Per Anton Sirnes (Norway), Michal Tendera (Poland), Adam Torbicki (Poland), Alexander van der Wall (Netherlands), Olaf Windecker (Switzerland)

Document Reviewers: David Hasdai (CPG Review Coordinator) (Israel), Felicity Astin (USA), Elisabet Aström-Olsson (Sweden), Andrzej Budaj (Poland), Peter Clemmensen (Denmark), Jean-Philippe Collet (France), Kevin Fox (UK), Ahmet Fuat (UK), Oliviа Gustiene (Lithuania), Christian W. Hamm (Germany), Petr Kala (Czech Republic), Patrizio Lancellotti (Belgium), Aldo Pietro Maggioni (Italy), Béla Merkely (Hungary), Franz-Josef Neumann (Germany), Massimo F. Piepoli (Italy), Frans Van de Werf (Belgium), Freek Verheugt (Netherlands), Lars Wallentin (Sweden)
Management perioperative MI

- Perioperative ACS
  - Same management as without non-cardiac surgery
  - Modification according to surgical circumstances
    - Bleeding risk
    - Access (femoral vs radial)
Prehospital and in-hospital management, and reperfusion strategies within 24 h of FMC

**STEMI diagnosis**

- **Primary-PCI capable center**
  - Preferably < 60 min
  - **Primary-PCI**
  - **Rescue PCI**
    - Immediately
    - Preferably 3-24 h
  - Coronary angiography

- **EMS or non primary-PCI capable center**
  - PCI possible < 120 min?
    - Yes
      - Immediate transfer to PCI center
      - Preferably ≤ 90 min
      - ≤ 60 min in early presenters
      - No
      - Immediate fibrinolysis
    - No
      - Preferably ≤ 30 min
      - Immediate transfer to PCI center
      - Successful fibrinolysis
      - Immediate fibrinolysis

---

*The time point the diagnosis is confirmed with patient history and ECG ideally within 10 min from the first medical contact (FMC). All delays are related to FMC (first medical contact).

Cath = catheterization laboratory; EMS = emergency medical system; FMC = first medical contact; PCI = percutaneous coronary intervention; STEMI = ST-segment elevation myocardial infarction.*

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European Heart Journal (2012) 33, 2569–2619
doi:10.1093/eurheartj/ehs215
## Reperfusion therapy

<table>
<thead>
<tr>
<th>Recommendations</th>
<th>Class</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reperfusion therapy is indicated in all patients with symptoms of myocardial</td>
<td>I</td>
<td>A</td>
</tr>
<tr>
<td>duration and persistent ST-segment elevation or (presumed) left bundle branch</td>
<td></td>
<td></td>
</tr>
<tr>
<td>block (LBBB).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reperfusion therapy (preferably primary PCI) is indicated in all patients with</td>
<td>I</td>
<td>C</td>
</tr>
<tr>
<td>evidence of ongoing ischaemia, even if symptoms have started &gt; 12 h beforehand</td>
<td></td>
<td></td>
</tr>
<tr>
<td>or if pain and ECG changes have been stuttering.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reperfusion therapy with primary PCI should be considered in stable patients</td>
<td>IIb</td>
<td>B</td>
</tr>
<tr>
<td>presenting 12-24 h after symptom onset.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Routine PCI of a totally occluded artery &gt; 24 h after symptom onset in stable</td>
<td>III</td>
<td>A</td>
</tr>
<tr>
<td>patients without ongoing ischaemia (regardless of whether fibrinolysis was</td>
<td></td>
<td></td>
</tr>
<tr>
<td>given) is not recommended.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

ECG = electrocardiogram; i.v. = intravenous; LBBB = left bundle branch block; PCI = percutaneous coronary intervention.
Periprocedural anti thrombotic medication in primary PCI

<table>
<thead>
<tr>
<th>Recommendations</th>
<th>Class</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Antiplatelet therapy</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aspirin oral or i.v. (if unable to swallow) is recommended</td>
<td>I</td>
<td>B</td>
</tr>
<tr>
<td>An ADP-receptor blocker is recommended in addition</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Options are:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Prasugrel in clopidogrel-naive patients, if no history of bleeding disorder, age &lt; 75 years.</td>
<td>I</td>
<td>B</td>
</tr>
<tr>
<td>• Ticagrelor.</td>
<td>I</td>
<td>B</td>
</tr>
<tr>
<td>• Clopidogrel, preferably when prasugrel or ticagrelor not available or contraindicated.</td>
<td>I</td>
<td>C</td>
</tr>
</tbody>
</table>

ADP = adenosine diphosphate.

European Heart Journal (2012) 33, 2569–2619
doi:10.1093/eurheartj/ehs215
Periprocedural anti thrombotic medication in primary PCI, \textit{con't}

<table>
<thead>
<tr>
<th>Recommendations</th>
<th>Class</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>GP IIb/IIIa inhibitors should be considered for bailout therapy if there is angiographic evidence of massive thrombus, slow or no-reflow or a thrombotic complication.</td>
<td>IIa</td>
<td>C</td>
</tr>
<tr>
<td>Routine use of a GP IIb/IIIa inhibitor as an adjunct to primary PCI performed with unfractionated heparin may be considered in patients without contraindications.</td>
<td>IIb</td>
<td>B</td>
</tr>
<tr>
<td>Upstream use of a GP IIb/IIIa inhibitor (vs. in-lab use) may be considered in high-risk patients undergoing transfer for primary PCI.</td>
<td>IIb</td>
<td>B</td>
</tr>
<tr>
<td>Options for GP IIb/IIIa inhibitors are (with LoE for each agent):</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Abciximab</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>• Eptifibatide (with double bolus)</td>
<td>B</td>
<td></td>
</tr>
<tr>
<td>• Tirofiban (with a high bolus dose)</td>
<td>B</td>
<td></td>
</tr>
</tbody>
</table>

GP = glycoprotein; i.v. = intravenous; lab = catheterization laboratory.
Periprocedural anti thrombotic medication in primary PCI, *con’t*

<table>
<thead>
<tr>
<th>Recommendations</th>
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<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Anticoagulants</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>An injectable anticoagulant must be used in primary PCI.</td>
<td>I</td>
<td>C</td>
</tr>
<tr>
<td>Bivalirudin (with use of GP IIb/IIIa blocker restricted to bailout) is recommended over unfractionated heparin and a GP IIb/IIIa blocker.</td>
<td>I</td>
<td>B</td>
</tr>
<tr>
<td>Enoxaparin (with or without routine GP IIb/IIIa blocker) may be preferred over unfractionated heparin.</td>
<td>IIb</td>
<td>B</td>
</tr>
<tr>
<td>Unfractionated heparin with or without routine GP IIb/IIIa blocker must be used in patients not receiving bivalirudin or enoxaparin.</td>
<td>I</td>
<td>C</td>
</tr>
<tr>
<td>Fondaparinux is not recommended for primary PCI.</td>
<td>III</td>
<td>B</td>
</tr>
<tr>
<td>The use of fibrinolysis before planned primary PCI is not recommended.</td>
<td>III</td>
<td>A</td>
</tr>
</tbody>
</table>
## Definition perioperative MI

### Elevated cardiac biomarker level

<table>
<thead>
<tr>
<th>Feature</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ischemic symptoms</td>
<td>144</td>
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<td>108</td>
<td>(26.0)</td>
</tr>
</tbody>
</table>


*Note: The highlighted text indicates a correction to the original document.*
Troponin after non-cardiac surgery: Meta-analysis

Fig. 4. Adjusted odds ratio for an increased postoperative troponin measurement to predict all-cause mortality based on duration of follow-up.

Characteristics and Short-Term Prognosis of Perioperative Myocardial Infarction in Patients Undergoing Noncardiac Surgery
A Cohort Study

![Graph showing cumulative mortality over time after surgery for symptomatic and asymptomatic MI, and isolated cardiac biomarker or enzyme level elevation.]

<table>
<thead>
<tr>
<th>Time After Surgery, d</th>
<th>Asymptomatic MI</th>
<th>Symptomatic MI</th>
<th>Isolated Cardiac Biomarker or Enzyme Level Elevation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>5</td>
<td>0.05</td>
<td>0.10</td>
<td>0.05</td>
</tr>
<tr>
<td>10</td>
<td>0.10</td>
<td>0.15</td>
<td>0.10</td>
</tr>
<tr>
<td>15</td>
<td>0.15</td>
<td>0.20</td>
<td>0.15</td>
</tr>
<tr>
<td>20</td>
<td>0.20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Patients at risk, n

<table>
<thead>
<tr>
<th></th>
<th>Symptomatic MI</th>
<th>Asymptomatic MI</th>
<th>Isolated cardiac biomarker or enzyme level elevation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Symptomatic MI</td>
<td>144</td>
<td>271</td>
<td>697</td>
</tr>
<tr>
<td>130</td>
<td>126</td>
<td>665</td>
<td></td>
</tr>
<tr>
<td>118</td>
<td>106</td>
<td>658</td>
<td></td>
</tr>
<tr>
<td>Isolated cardiac biomarker or enzyme level elevation</td>
<td>226</td>
<td>214</td>
<td>645</td>
</tr>
</tbody>
</table>

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NSTEMI-Guidelines: What’s new?

ESC Guidelines for the management of acute coronary syndromes in patients presenting without persistent ST-segment elevation

The Task Force for the management of acute coronary syndromes (ACS) in patients presenting without persistent ST-segment elevation of the European Society of Cardiology (ESC)

Authors/Task Force Members: Christian W. Hamm (Chairperson) (Germany)*, Jean-Pierre Bassand (Co-Chairperson)*, (France), Stefan Agewall (Norway), Jeroen Bax (The Netherlands), Eric Boersma (The Netherlands), Hector Bueno (Spain), Pio Caso (Italy), Dariusz Dudek (Poland), Stephan Gielen (Germany), Kurt Huber (Austria), Magnus Ohman (USA), Mark C. Petrie (UK), Frank Sonntag (Germany), Miguel Sousa Uva (Portugal), Robert F. Storey (UK), William Wijns (Belgium), Doron Zahger (Israel).

ESC Guidelines for the management of acute coronary syndromes in patients presenting without persistent ST-segment elevation; Europ Heart J 2011
Same decision making algorithm in ACS in difficult surgical circumstances

ESC Guidelines for the management of acute coronary syndromes in patients presenting without persistent ST-segment elevation; Europ Heart J 2011
### Risikostratifizierung

<table>
<thead>
<tr>
<th>Recommendations</th>
<th>Class</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood has to be drawn promptly for troponin (cardiac troponin T or I) measurement. The result should be available within 60 min. The test should be repeated 6–9 h after initial assessment if the first measurement was not conclusive. Repeat testing after 12–24 h is advised if the clinical condition is still suggestive of ACS.</td>
<td>I</td>
<td>A</td>
</tr>
<tr>
<td>A rapid rule-out protocol (0 and 3 h) is recommended when highly sensitive troponin measurement is available.</td>
<td>I</td>
<td>B</td>
</tr>
<tr>
<td>An echocardiogram is recommended for all patients to evaluate regional and segmental wall motion abnormalities in or rule out differential diagnoses.</td>
<td>I</td>
<td>C</td>
</tr>
<tr>
<td>Coronary angiography is indicated in patients in whom the existence of myocardial ischemia has to be determined (see Section 5.4).</td>
<td>I</td>
<td>C</td>
</tr>
<tr>
<td>Coronary CT angiography should be considered in patients with intermediate likelihood of CAD when other diagnostic procedures are inconclusive.</td>
<td>IIa</td>
<td>B</td>
</tr>
<tr>
<td>In patients without recurrence of pain, negative troponin tests, and a low risk score, a non-invasive stress test for inducible ischemia should be considered before deciding on an invasive strategy.</td>
<td>I</td>
<td>A</td>
</tr>
</tbody>
</table>

ESC Guidelines for the management of acute coronary syndromes in patients presenting without persistent ST-segment elevation; Europ Heart J 2011
Troponin-Erhöhung ≠ ACS

Important examples of Troponin-elevation without ACS

- Chronic or acute renal dysfunction
- Severe congestive heart failure – acute and chronic
- Hypertensive crisis
- Tachy- or bradyarrhythmias
- Pulmonary embolism, severe pulmonary hypertension
- Inflammatory diseases, e.g. myocarditis
- Acute neurological disease, including stroke, or subarachnoid haemorrhage
- Aortic dissection, aortic valve disease or hypertrophic cardiomyopathy

ESC Guidelines for the management of acute coronary syndromes in patients presenting without persistent ST-segment elevation; Europ Heart J 2011
Goal of preoperative evaluation

Detection of unrecognized or underestimated cardiovascular conditions with prognostic impact and therapeutic priority.
Comorbidity

Potential for improvement

cardial
pulmonary
infectious
endocrine
thromboembolic

Urgency

Op-Risk

Benefit

Operate!

Wait/delay

Adapted from European Guidelines
Poldermans D, et al; Eur Heart J 2009; 30: 2769-812
A stepwise approach

Step 1: Urgent surgery

Step 2: Active or Unstable cardiac conditions

Step 3: What is the risk of the surgical procedure?

Step 4: What is the functional capacity of the patient?

Step 5: In patients with moderate or low functional capacity consider the risk of surgical procedure

Step 6: Consider cardiac risk factors

Step 7: Consider non invasive tests
Step 3: Risk of surgical procedure: 30-day CV death and MI

<table>
<thead>
<tr>
<th>Low risk &lt; 1%</th>
<th>Intermediate risk &lt; 1-5%</th>
<th>High risk &gt; 5%</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Breast</td>
<td>- Abdominal</td>
<td>- Aortic &amp; major vascular surgery</td>
</tr>
<tr>
<td>- Dental</td>
<td>- Carotid</td>
<td>- Peripheral vascular surgery</td>
</tr>
<tr>
<td>- Endocrine</td>
<td>- Peripheral arterial angioplasty</td>
<td></td>
</tr>
<tr>
<td>- Eye</td>
<td>- Endovascular aneurysm repair</td>
<td></td>
</tr>
<tr>
<td>- Gynaecology</td>
<td>- Head and neck surgery</td>
<td></td>
</tr>
<tr>
<td>- Reconstructive</td>
<td>- Neurological</td>
<td></td>
</tr>
<tr>
<td>- Orthopaedic- minor (knee surgery)</td>
<td>- Orthopaedic major (hip &amp; spine)</td>
<td></td>
</tr>
<tr>
<td>- Urologic</td>
<td>- Pulmonary/renal/liver transplant</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Urologic- major</td>
<td></td>
</tr>
</tbody>
</table>

www.escardio.org
Incremental value of high-sensitive troponin T in addition to the revised cardiac index for peri-operative risk stratification in non-cardiac surgery

Michael Weber¹,²*, Andreas Luchner³, Seeberger Manfred⁴, Christian Mueller⁴, Christoph Liebetrau¹, Axel Schlitt⁵, Svetlana Apostolovic⁶, Radmilo Jankovic⁶, Dragic Bankovic⁷, Marina Jovic⁷, Veselin Mitrovic¹, Holger Nef¹, Helge Mollmann¹, and Christian W. Hamm¹

Table 13 Clinical risk factors

<table>
<thead>
<tr>
<th>Risk Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angina pectoris</td>
</tr>
<tr>
<td>Prior MI¹</td>
</tr>
<tr>
<td>Heart failure</td>
</tr>
<tr>
<td>Stroke/transient ischaemic attack</td>
</tr>
<tr>
<td>Renal dysfunction (serum creatinine &gt;170 µmol/L or 2 mg/dL or a creatinine clearance of &lt;60 mL/min)</td>
</tr>
<tr>
<td>Diabetes mellitus requiring insulin therapy</td>
</tr>
</tbody>
</table>

¹According to the universal definition of MI. ³⁴
hospital mortality in association hsTnT levels and the revised cardiac index
Pre-interventional antithrombotic management

Figure 3  Algorithm for pre-operative management of patients considered for/undergoing surgery treated with dual antiplatelet therapy.

ASA = acetylsalicylic acid.
β-Blockers and perioperative cardiac events in randomized trials

All trials

Bisoprolol
- DECREASE (n=1178)
- BBSA (n=219)

Metoprolol
- POBBLE (n=103)
- DIPOM (n=921)
- maVS (n=496)
- POISE (n=8351)

Atenolol
- Wallace (n=200)

Odds ratio (95% CI)
ESC recommendations on perioperative β-blocker use

- Dose of β-blockers should be titrated, which requires treatment initiation 30 days before (optimal) & at least one week before surgery

  *It is recommended to start with a daily dose of 2.5 mg/d of bisoprolol or 50 mg of metoprolol succinate & to adjust the dose before operation to achieve a resting HR between 60 and 70b/min with SBP >100 mmHg*

- β-blockers are recommended in patients with IHD or myocardial ischaemia according to preoperative stress test

- β-blockers are not recommended in patients scheduled for low-risk surgery without risk factors
Perioperative statin use

- Durazzo et al.
  N = 100

- Lindenauer et al.
  N = 780,591

- Kertai et al.
  N = 570

- O’Neil-Callahan et al.
  N = 1,163

- Poldermans et al.
  N = 480

- Schouten et al.
  N = 497
Conclusion

- Treatment of perioperative Myocardial infarction → tightrope walk between reduction of thrombosis and prevention of bleeding
- Diagnosis of perioperative MI may be a challenge due to the lack of symptoms
- The NSTEMI/STEMI guidelines have to be adapted
  - In STEMI patients: the urgency of reopening the vessel dictate the strategy; instead of new P2Y12 inhibitors, Tirofiban may be used
  - In NSTEMI patients the strategy has to be modified Modification according to surgical circumstances
Conclusion

- Preoperative risk assessment:
  - Algorithmic form of an evidence-based stepwise approach
  - Detection of unrecognised or underestimated cardiovascular conditions with prognostic impact and therapeutic priority
- However, the physician in charge must make the ultimate judgement regarding the care of an individual patient in a multidisciplinary approach
<table>
<thead>
<tr>
<th>Step</th>
<th>Urgency</th>
<th>Cardiac condition</th>
<th>Type of surgery</th>
<th>Functional capacity</th>
<th>Number of clinical risk factors</th>
<th>LV echo</th>
<th>ECG</th>
<th>Stress Testing</th>
<th>β-Blockers</th>
<th>ACE-inhibitors</th>
<th>Aspirin</th>
<th>Statins</th>
<th>Coronary Revascularisation</th>
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<tbody>
<tr>
<td>1</td>
<td>Urgent surgery</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>III C</td>
<td>IIa C</td>
<td>III C</td>
<td>I C</td>
<td>I C</td>
<td>I C</td>
<td>I C</td>
<td>III C</td>
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<tr>
<td>2</td>
<td>Elective surgery</td>
<td>Unstable</td>
<td></td>
<td></td>
<td></td>
<td>I C</td>
<td>I C</td>
<td>III C</td>
<td>I C</td>
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<td></td>
<td>I C</td>
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<tr>
<td>3</td>
<td>Elective surgery</td>
<td>Stable</td>
<td>Low risk (&lt; 1%)</td>
<td>None</td>
<td></td>
<td>III B</td>
<td>III B</td>
<td>III C</td>
<td>III B</td>
<td>Ila C</td>
<td>IIb C</td>
<td>II a B</td>
<td>III C</td>
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<td>4</td>
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<td>Excellent or good</td>
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<td></td>
<td></td>
<td>III B</td>
<td>III B</td>
<td>III C</td>
<td>III B</td>
<td>Ila C</td>
<td>IIb C</td>
<td>II a B</td>
<td>III C</td>
</tr>
<tr>
<td>5</td>
<td>Elective surgery</td>
<td>Intermediate risk</td>
<td>Moderate or poor</td>
<td>None</td>
<td></td>
<td>III B</td>
<td>III B</td>
<td>III B</td>
<td>III A</td>
<td>Ila B</td>
<td>IIb C</td>
<td>II b B</td>
<td>III B</td>
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<tr>
<td>6</td>
<td>Elective surgery</td>
<td>High risk (&lt; 5%)</td>
<td>Moderate or poor</td>
<td>≤ 2</td>
<td></td>
<td>IIIa C</td>
<td>I B</td>
<td>II b B</td>
<td>III A</td>
<td>I B</td>
<td>IIb C</td>
<td>I B</td>
<td>II b B</td>
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<td>(no filtration)</td>
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</tbody>
</table>
Thank you!

hans.rickli@kssg.ch
Vielen Dank!
Mortality: Influence of comorbidity

11388 elective surgical tx of abdominal aortic aneurysm:

Female sex (14.4%)
Arterial hypertension (25.2%)
Diabetes mellitus (4.0%)
COPD (7.6%)
Coronary artery disease (10.5%)
Heart failure (3.8%)
Chronic renal impairment (3.6%)

Zeit ist Myokard → Ziel: ≤10min von Verdacht bis Anmeldung PCI

STEMI

12-Kanal-EKG

ST-Hebung >1 mm in Extremitäten- od. >2 mm in Brustwandableitungen? oder
(vermutlich) neu aufgetretener Linksschenkelblock?

Sofortige PCI: ACS Hotline 071 494 11 11, 071 494 63 36, EKG an: ACS@kssg.ch
Spital ohne Katheterlabor: Verlegung in Zentrumsstital

Atmung - O₂ bis SaO₂ ≥ 94%, max. 99%; Oberkörper 30° hochlagern
Kreislauf - Bei Tachyarrhythmie oder Hypertonie: Metoprolol 5mg über 1min iv, max. 3x innert 15min (KI: bei Kokain, Schock, BDsys <100mmHg, HF < 45/min, PQ-Intervall >0.24ms, schweres Asthma)
Gerinnung - falls nicht vorbestehend: ASS 500mg iv/po
- UFH 5000IE iv als Bolus
- Ticagrelor (Brilique®) 2x90mg po
Schmerz - Bei AP: max. 3 Sprühstösse/Kaukapseln Nitroglyzerin, dann 10-20µg/min iv falls BDsys >100mmHg
- Morphin 0.1 mg/kgKG iv, (cave bei instabilen Ap resp. NSTEMI), ev. Tropisetron (Navoban®) 2mg in
100ml NaCl 0.9% über 15min iv

Wiederholung 12-Kanal EKG nach 10 Minuten
Monitoring: EKG, Blutdruck, Puls, SaO₂, Schmerzscore
Troponin, CK, Kreatinin, Hb, Tc, PTT, Quick/INR, Lipide*

* Lipide: Gesamt-, LDL-, HDL-Cholesterin und Triglyceride
Management in case of periop. ACS

- $O_2$; continuous monitoring
- 12 lead ECG and biomarkers
- Echo
- In case of angina pectoris/ischemic signs: Nitroglycerin s.l. 0.4 bis 0.8mg, Nitroderm TTS 5-10. Zielblutdruck Syst. 110-130mmHg. Vermeiden von Hypotonie, Hypertonie und Tachykardie
- Tx if chest pain with Morphin i.v.
- Nausea: Tropisetron (Navoban) 2mg ad KI
- Tx of anemia and hypovolemia (Goal of Hb >8g/dl)
Periop. MI, management: Ongoing Chest pain, ECG-changes or hemodynamic instability

- **Hemodyn. stable (BP syst. > 100mmHg)**
  - i.v. nitroglycerine (start with 10-20 µg/Min)
  - Betablockade (start with 1mg i.v. max. 5 mg),
    Goal heart rate 70-80 bpm. No Betablockade in case of heart failure

- **Hemodyn. Unstable**
  - Echo (TTE, intraop. TEE)

Local guidelines 05/2012
Management periop. ACS

- i.v. Aspirin 100mg/d, no Loading-Dose
- i.v. Heparin: Start mit 10’000 – 15’000 (-20’000) IE/d; no Bolus; Goal pict: maximal 70 bis 105 sec
- Dual antiplatelet therapy if possible
  - Individual and interdisciplinary approach (Cardiologist, Surgeon, Anaesthesiologist)

Guidelines KSSG 05/2012
Cardiogenic shock:
  - Hemodynamic support (discuss with anesthesiologist)

Risikostratifikierung individually and interdisciplinary approach (Cardiologist, Surgeon, Anaesthesiologist)
  - If possible coronary angiography
Additional measures: Catheter close to spinal cord

- Catheter close to spinal cord have to been withdrawn (Plavix), Prasugrel (Efient) or Ticagrelor (Brilique)
- Other option to Clopidogrel, Prasugrel or Ticagrelor use of Tirofiban (Aggrastat®) catheter can be left there for analgesia
Ossär und pulmonal metastasierendes Prostata-Karzinom
  - Von den Onkologen geschickt zur Standortbestimmung bei AP CCS II
Bekannte KHK mit
  - Stabiler AP CCS I-II unter Therapie (2 Stockwerke problemlos)
  - Subjektiv und formal pathologischer Fahrradergometrie 18.9.2012
Geleistet werden 60 Watt (49%-Soll, 2.8 Mets). HF-Anstieg von 72 auf 101/min (73%-Soll). BDsys von 114/75 auf 170/82. Max DP 17170, DPF 2.0. Abbruch erfolgt wegen ST-Senkungen von 4mm.
Vorbestehende horizont. ST-Senkung von 1mm unter U3-6, unter Belastung signifikante Zunahme U2-6 auf 4mm (deszendierend).

Beurteilung: Subjektiv positive und formal elektrisch positive
B.H. ♂, 1931

- **Ossär und pulmonal metastasierendes Prostata-Karzinom**
  - Von den Onkologen geschickt zur Standortbestimmung bei AP CCS II (keine Frage einer Op)

- **Bekannte KHK mit**
  - Stabiler AP CCS I-II unter Therapie (2 Stockwerke problemlos)
  - Subjektiv und formal pathologischer Fahrradergometrie 18.9.2012

- **Medikamente:**
  - OAK wegen St.n.LE 8/2010 + ASS 100 mg 1xtgl
  - Bilol 5mg 1-0-0
  - Nitroderm TTS 10 (8-20h)
  - Atorvastatin 20 mg ½- 0 - 0
  - Prednison 5 mg 1-0-0
B.H. ♂, 1931

- Ossär und pulmonal metastasierendes Prostata-Karzinom
  - Von den Onkologen geschickt zur Standortbestimmung bei AP CCS II
- Bekannte KHK mit
  - Stabiler AP CCS I-II unter Therapie (2 Stockwerke problemlos)
  - Subjektiv und formal pathologischer Fahrradergometrie 18.9.2012
- Am 21.9. eingetreten auf Urologie für TUR‘P am 24.9. (Urlaub)
Management perioperative MI

Betablocker postoperativ „pausiert“
Management perioperative MI
### Laborwerte

<table>
<thead>
<tr>
<th>Variable</th>
<th>Normalbereich</th>
<th>Wert</th>
</tr>
</thead>
<tbody>
<tr>
<td>Creatinin</td>
<td>&lt;10,0 mg/dL</td>
<td>1.7</td>
</tr>
<tr>
<td>Troponin I</td>
<td>&lt;0.04 ng/mL</td>
<td>3.0</td>
</tr>
<tr>
<td>CK-MB Masse</td>
<td>&lt;44 ng/mL</td>
<td>211.8</td>
</tr>
<tr>
<td>Magnesium</td>
<td>1.9-2.9 mg/dL</td>
<td>91</td>
</tr>
<tr>
<td>Kalium</td>
<td>3.7-5.1 mmol/L</td>
<td>4.3</td>
</tr>
</tbody>
</table>

**Anmerkungen:**

- Konservatives Vorgehen bei hämodynamisch stabilem Patienten in palliativer Situation.

**Management perioperative MI**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Wert</th>
</tr>
</thead>
<tbody>
<tr>
<td>CRP</td>
<td>83 mg/L</td>
</tr>
<tr>
<td>Troponin I</td>
<td>1.7 ng/mL</td>
</tr>
<tr>
<td>CK-MB Masse</td>
<td>211.8 ng/mL</td>
</tr>
<tr>
<td>Magnesium</td>
<td>91 mg/dL</td>
</tr>
<tr>
<td>Kalium</td>
<td>4.3 mmol/L</td>
</tr>
</tbody>
</table>

**Probenannahme:**

- Zeit: 06:26

**Probeninhalt:**

- EDTA-Plasma

**Probenmaterial/Präanalytik:**

- 30116
Troponin ≠ Myokardinfarkt

Non-cardiac diseases
Critically ill patients
High dose chemotherapy
Primary pulmonary hypertension
Pulmonary embolism
Renal failure
Subarachnoid haemorrhage
Scorpion envenoming
Sepsis and septic shock
Stroke
Ultra-endurance exercise (marathon)

Ammann P et al. BMJ 2004
2009 ACCF/AHA Focused Update on Perioperative Beta Blockade

A Report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines

Developed in Collaboration With the American Society of Echocardiography, American Society of Nuclear Cardiology, Heart Rhythm Society, Society of Cardiovascular Anesthesiologists, Society for Cardiovascular Angiography and Interventions, Society for Vascular Medicine, and Society for Vascular Surgery

2009 Writing Group to Review New Evidence and Update the 2007 Guidelines on Perioperative Cardiovascular Evaluation and Care for Noncardiac Surgery

Circulation 2007;116;e418-e499;
Guidelines for pre-operative cardiac risk assessment and perioperative cardiac management in non-cardiac surgery

The Task Force for Preoperative Cardiac Risk Assessment and Perioperative Cardiac Management in Non-cardiac Surgery of the European Society of Cardiology (ESC) and endorsed by the European Society of Anaesthesiology (ESA)

Authors/Task Force Members: Don Poldermans; (Chairperson) (The Netherlands)*; Jeroen J. Bax (The Netherlands); Eric Boersma (The Netherlands); Stefan De Hert (The Netherlands); Erik Eekhout (Switzerland); Gerry Fowkes (UK); Bulent Gorenek (Turkey); Michael G. Hennerici (Germany); Bernard Iung (France); Malte Kelm (Germany); Keld Per Kjeldsen (Denmark); Steen Dalby Kristensen (Denmark); Jose Lopez-Sendon (Spain); Paolo Pelosi (Italy); François Philippe (France); Luc Pierard (Belgium); Piotr Ponikowski (Poland); Jean-Paul Schmid (Switzerland); Olav F. M. Sellevold (Norway); Rosa Sicari (Italy); Greet Van den Berghe (Belgium); Frank Vermassen (Belgium)
7.2. Perioperative Medical Therapy (UPDATED)

7.2.1. Recommendations for Perioperative Beta-Blocker Therapy (UPDATED)

Class I

1. Beta blockers should be continued in patients undergoing surgery who are receiving beta blockers for treatment of conditions with ACCF/AHA Class I guideline indications for the drugs. (Level of Evidence: C)

Class IIa

1. Beta blockers titrated to heart rate and blood pressure are probably recommended for patients undergoing vascular surgery who are at high cardiac risk owing to coronary artery disease or the finding of cardiac ischemia on preoperative testing. (Level of Evidence: B)

2. Beta blockers titrated to heart rate and blood pressure are reasonable for patients in whom preoperative assessment for vascular surgery identifies high cardiac risk, as defined by the presence of more than 1 clinical risk factor. (Level of Evidence: C)

3. Beta blockers titrated to heart rate and blood pressure are reasonable for patients in whom preoperative assessment identifies coronary artery disease or high cardiac risk, as defined by the presence of more than 1 clinical risk factor, who are undergoing intermediate-risk surgery. (Level of Evidence: B)

Class IIb

1. The usefulness of beta blockers is uncertain for patients who are undergoing either intermediate-risk procedures or vascular surgery in whom preoperative assessment identifies a single clinical risk factor in the absence of coronary artery disease. (Level of Evidence: C)

2. The usefulness of beta blockers is uncertain in patients undergoing vascular surgery with no clinical risk factors who are not currently taking beta blockers. (Level of Evidence: B)

Class III

1. Beta blockers should not be given to patients undergoing surgery who have absolute contraindications to beta blockade. (Level of Evidence: C)

2. Routine administration of high-dose beta blockers in the absence of dose titration is not useful and may be harmful to patients not currently taking beta blockers who are undergoing noncardiac surgery. (Level of Evidence: B)
...should be continued.....

Class IIb

1. The usefulness of beta blockers is uncertain for patients who are undergoing either intermediate-risk procedures or vascular surgery in whom preoperative assessment identifies a single clinical risk factor in the absence of coronary artery disease.★★ (Level of Evidence: C)

2. The usefulness of beta blockers is uncertain in patients undergoing vascular surgery with no clinical risk factors★★ who are not currently taking beta blockers.★★★★ (Level of Evidence: B)

Class III

1. Beta blockers should not be given to patients undergoing surgery who have absolute contraindications to beta blockade. (Level of Evidence: C)

2. Routine administration of high-dose beta blockers in the absence of dose titration is not useful and may be harmful to patients not currently taking beta blockers who are undergoing noncardiac surgery.★★★★★ (Level of Evidence: B)
Class IIb

1. The usefulness of beta blockers is uncertain for patients who are undergoing either intermediate-risk procedures or vascular surgery in whom preoperative assessment identifies a single clinical risk factor in the absence of coronary artery disease. (Level of Evidence: C)

2. The usefulness of beta blockers is uncertain in patients undergoing vascular surgery with no clinical risk factors who are not currently taking beta blockers. (Level of Evidence: B)

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1. Beta blockers should not be given to patients undergoing surgery who have absolute contraindications to beta blockade. (Level of Evidence: C)

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2. Routine administration of high-dose beta blockers in the absence of dose titration is not useful and may be harmful to patients not currently taking beta blockers who are undergoing noncardiac surgery. (Level of Evidence: B)

---

...should be continued.....

...titrate patients at risk...

Without titration= contraindication
Pathophysiology of perioperative ischemia

1. chronic mismatch in the supply-to-demand ratio of blood flow response to metabolic demand, which clinically resembles stable IHD due to a flow limiting stenosis in coronary conduit arteries

2. Coronary plaque rupture due to vascular inflammatory processes presenting as acute coronary syndromes
# Reperfusion therapy

<table>
<thead>
<tr>
<th>Recommendations</th>
<th>Class</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reperfusion therapy is indicated in all patients with symptoms of &lt;12 h duration and persistent ST-segment elevation or (presumed) new LBBB.</td>
<td>I</td>
<td>A</td>
</tr>
<tr>
<td>Reperfusion therapy (preferably primary PCI) is indicated if there is evidence of ongoing ischaemia, even if symptoms may have started &gt; 12 h beforehand or if pain and ECG changes have been stuttering.</td>
<td>I</td>
<td>C</td>
</tr>
<tr>
<td>Reperfusion therapy with primary PCI may be considered in stable patients presenting 12-24 h after symptom onset.</td>
<td>IIb</td>
<td>B</td>
</tr>
<tr>
<td>Routine PCI of a totally occluded artery &gt; 24 h after symptom onset in stable patients without signs of ischaemia (regardless of whether fibrinolysis was given or not) is not recommended.</td>
<td>III</td>
<td>A</td>
</tr>
</tbody>
</table>

ECG = electrocardiogram; i.v. = intravenous; LBBB = left bundle branch block; PCI = percutaneous coronary intervention.
Mortality: Causes (after surgical tx of abdominal aortic aneurysm)

- Overlapping causes: 24%
- Surgical causes: 66%
- Complication due to comorbidities: 10%

Step 4: Functional capacity of the patient scheduled for intermediate or high-risk surgery

Functional Capacity

1 MET
Can you...
- Take care of yourself?
- Eat, dress, or use the toilet?
- Walk indoors around the house?
- Walk 100 m on level ground at 3 to 5 km per h

4 METs
Can you...
- Climb two flights of stairs or walk uphill?
- Run a short distance
- Do heavy work around the house like scrubbing floors or lifting or moving heavy furniture?
- Participate in strenuous sports like swimming, singles tennis, football, basketball, or skiing?

Greater than 10 METs