Anaesthesia for the cardiac patient for non-cardiac surgery
Preoperative assessment

János Gál
The role of the anaesthesiologist (1846-2013)
Consequences of incorrect preoperative risk assessment

- 6x increase in mortality!
- Australian Incident Monitoring Study (AIMS-2000)
  - Inadequate risk stratification 11,6% (478/6271)
  - Complications 3,1 % (197)
  - Major morbidity 23, death 7
  - >50% definitely, further 21% probably avoidable
Mosaics of the lecture

- Cardiac risk stratification
- Screening tools
- Preoperative PCI???
- Problems with patients with stents
- Pharmacological risk reduction
- Patients with PM/ICD
Risks of anaesthesia of cardiac patients in non-cardiac surgery

- 60% of patients due to anesthesia has some kind of heart disease (80% above age of 60)
- Periop. cardiac complication develops in 4%
- 17-74% of coronary disease patients suffers myocardial ischemia

Mangano DT. Anesthesiology 1990; 72: 153-184
Risks of anaesthesia of cardiac patients in non-cardiac surgery

- Myocardial infarction accounts for 10–40% of postoperative fatalities, it is the major determinant of perioperative mortality associated with non-cardiac surgery.
- Nonfatal MI in the periop. period is associated with a 20-fold increased risk of late mortality.

Landesberg G. J Cardiothorac Vasc Anesth 2003; 17:90–100
Perioperative myocardial infarction

- Surgical trauma
- Anesthesia/analgesia
- Intubation/extubation
- Pain
- Hypothermia
- Bleeding/anemia
- Fasting

- Anesthesia/analgesia
- Hypothermia
- Bleeding/anemia

- Inflammatory state
  - ↑ TNF-α
  - ↑ IL-1
  - ↑ IL-6
  - ↑ CRP
  - Plaque fissuring

- Hypercoagulable state
  - ↑ PAI-1
  - ↑ factor VIII
  - ↑ platelet reactivity
  - ↓ antithrombin III

- Stress state
  - ↑ catecholamine and cortisol levels
  - Coronary artery shear stress
  - ↑ BP
  - ↑ HR
  - ↑ FFAs
  - ↑ relative insulin deficiency
  - ↑ oxygen demand

- Hypoxic state
  - ↓ oxygen delivery

- Acute coronary thrombosis
  - Myocardial ischemia
Cardiac risk stratification

- Lee’s revised Cardiac risk index
- MET (metabolic equivalent)
- Risk of surgical procedure
- Localization of operation
- Further perioperative tests if needed
  - Myocardial perfusion scintigraphy
  - Dobutamine stress echocardiography
### Lee’s Revised Cardiac Risk Index

<table>
<thead>
<tr>
<th>Clinical variable</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>High-risk surgery (i.e., intraperitoneal, intrathoracic, or suprainguinal vascular surgery)</td>
<td>1</td>
</tr>
<tr>
<td>Coronary artery disease</td>
<td>1</td>
</tr>
<tr>
<td>Congestive heart failure</td>
<td>1</td>
</tr>
<tr>
<td>History of cerebrovascular disease</td>
<td>1</td>
</tr>
<tr>
<td>Insulin treatment for diabetes mellitus</td>
<td>1</td>
</tr>
<tr>
<td>Preoperative serum creatinine level greater than 2.0 mg per dL (180 µmol per L)</td>
<td>1</td>
</tr>
</tbody>
</table>

**Total:**  

### Interpretation of Risk Score

<table>
<thead>
<tr>
<th>Risk class</th>
<th>Points</th>
<th>Risk of complications*(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Very low</td>
<td>0</td>
<td>0.4</td>
</tr>
<tr>
<td>II. Low</td>
<td>1</td>
<td>0.9</td>
</tr>
<tr>
<td>III. Moderate</td>
<td>2</td>
<td>6.6</td>
</tr>
<tr>
<td>IV. High</td>
<td>3+</td>
<td>11.0</td>
</tr>
</tbody>
</table>
### TABLE 4. Estimated Energy Requirements for Various Activities, Based on Duke Activity Status Index\textsuperscript{a}

<table>
<thead>
<tr>
<th>MET Range</th>
<th>Activity Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 MET</td>
<td>Can you…</td>
</tr>
<tr>
<td></td>
<td>take care of yourself?</td>
</tr>
<tr>
<td></td>
<td>eat, dress, or use the toilet?</td>
</tr>
<tr>
<td></td>
<td>walk indoors around the house?</td>
</tr>
<tr>
<td></td>
<td>walk 1 or 2 blocks on level ground at 2-3 mph (3.2-4.8 kph)?</td>
</tr>
<tr>
<td>&lt;4 METs</td>
<td>Can you…</td>
</tr>
<tr>
<td></td>
<td>do light work around the house, such as dusting or washing dishes?</td>
</tr>
<tr>
<td>≥4 METs</td>
<td>Can you…</td>
</tr>
<tr>
<td></td>
<td>climb a flight of stairs or walk up a hill?</td>
</tr>
<tr>
<td></td>
<td>walk on level ground at 4 mph (6.4 kph)?</td>
</tr>
<tr>
<td></td>
<td>run a short distance?</td>
</tr>
<tr>
<td></td>
<td>do heavy work around the house, such as scrubbing floors or lifting or moving heavy furniture?</td>
</tr>
<tr>
<td></td>
<td>participate in moderate recreational activities, such as golf, bowling, dancing, doubles tennis, or throwing a baseball or football?</td>
</tr>
<tr>
<td>≥10 METs</td>
<td>Can you…</td>
</tr>
<tr>
<td></td>
<td>participate in strenuous sports, such as swimming, singles tennis, football, basketball, or skiing?</td>
</tr>
</tbody>
</table>

\textsuperscript{a} MET = metabolic equivalent.
Adapted from \textit{J Am Coll Cardiol},\textsuperscript{3} with permission from Elsevier.

The surgical procedure

<table>
<thead>
<tr>
<th>Cardiac Risk* Stratification for Noncardiac Surgical Procedures</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>High (reported cardiac risk often &gt;5 percent)</strong></td>
</tr>
<tr>
<td>Emergent major operations, particularly in patients older than 75 years</td>
</tr>
<tr>
<td>Aortic and other major vascular surgery</td>
</tr>
<tr>
<td>Peripheral vascular surgery</td>
</tr>
<tr>
<td>Anticipated prolonged surgical procedure associated with large fluid shifts and/or blood loss</td>
</tr>
<tr>
<td><strong>Intermediate (reported cardiac risk generally 1 to 5 percent)</strong></td>
</tr>
<tr>
<td>Carotid endarterectomy</td>
</tr>
<tr>
<td>Head and neck surgery</td>
</tr>
<tr>
<td>Intraperitoneal and intrathoracic surgery</td>
</tr>
<tr>
<td>Orthopedic surgery</td>
</tr>
<tr>
<td>Prostate surgery</td>
</tr>
<tr>
<td><strong>Low† (reported cardiac risk generally &lt;1 percent)</strong></td>
</tr>
<tr>
<td>Endoscopic procedures</td>
</tr>
<tr>
<td>Superficial procedures</td>
</tr>
<tr>
<td>Cataract surgery</td>
</tr>
<tr>
<td>Breast surgery</td>
</tr>
</tbody>
</table>

*—Combined incidence of cardiac death and nonfatal myocardial infarction.

Flood C. Am Fam Physician 2007;75:656-65
Sensitivity of preoperative tests regarding cardiac death and non-fatal MI (major vascular surgery)
Effect on survival of elective preoperative coronary revascularisation

Perioperative management of patients with stent (PCI, BMS, DES)

• 1990’: increasing periop. morbidity/mortality in patients with PCI going for non-cardiac surgery
• 90% of patients going for PCI get one or several stent/s
• 5% will have non-cardiosurgical intervention within 1 year!
• Periop. dilemma: bleeding or coagulation?
• 63% of anesthesiologists do not know the guideline!

Overview: prevention of periop.stent thrombosis

- Avoid preop. coronary stenting
- Stent selection (BMS-DES)
- Delay surgery
- There is no bridge therapy for PCI patients, **timing is crucial**
- Education, interdisciplinary teamwork
- Surgery only where PCI is available

Brilakis et al. JACC 2007;49,22:2145-50
Preoperative pharmacological risk reduction

- β-blockers
- Statins
- Remember there is indirect β-blocking
  - Choose proper mode of anaesthesia, EDA
  - Avoiding hypothermia
  - Avoiding anaemia
  - PM, ICD (switch off frequency enhancing and antitachycadia programs temporarily)

Targets: blood pressure, pulse, endothel

- Elective operation BP <180/110 mmHg, \( P<70/\text{min} \)
- Effective by evidence: \( \beta \)-blocker and statins
- Effective risk reduction takes 6-8 weeks!
  - Vascular/endothel changes/pleiotropic effect
  - Risk/benefit
- Intraop. low BP is more dangerous than hypertension!
- diuretics?, Ca channel blockers, (ACEI ?)

Howel SJ. Br J Anaesth 2004;92:570-583
Effects of statins

Lipid lowering effects
- decrease cholesterol
- increase HDL

Pleiotropic effects
- increase endothelial NO synthetase
- generation of ROS
- decrease endothelin-1 production
- improve thrombogenic profile
- decrease Inflammation (decrease isoprenoid production)
- decrease CRP levels
- inhibition of atherosclerosis

It takes time! ~ 30 days

Abbreviations: CRP, C-reactive protein; HDL, high-density lipoprotein; NO, nitric oxide; ROS, reactive oxygen species.
Effect of haematocrit on major postoperative cardiac events

Figure 35-7 Relationship of postoperative myocardial ischemia (yellow bars) and morbid cardiac events (blue bars) to hematocrit for 27 high-risk patients undergoing infrainguinal arterial bypass.

(Data from Nelson AH, Fleisher LA, Rosenbaum SH: The relationship between postoperative anemia and cardiac morbidity in high risk vascular patients in the ICU. Crit Care Med 21:860, 1993.)
PM, ICD: preoperative management

- Consider the underlying disease
- Check the setting and the memory of the device-specialist!
- Switch off frequency enhancer programs
- Optimizing DO$_2$: frequency adaptation
- Switch off ICD anti-tachycardia therapy
PM, ICD: intraoperative management

- Caution: Magnet???
  - Different effects: depending on the type of the device
- Bipolar>monopolar electrocauter
- Current must not flow through the generator-heart circuit
- Pulse wave monitoring
PM, ICD: postoperative management

- Postoperative check/modification
- Frequency setting (CO, DO$_2$)
- Antitachycardia therapy must be enabled, until then close monitoring!
- Frequency enhancer programs should be enabled
Summary

- Plaque fissure plays an important role in perioperative MI
- Risk stratification is important
- Indication of preoperative PCI is limited
- Beta-blockers, statins, mode of anaesthesia may improve outcome
- Stent, PM, ICD patients need special management