Cardiac anesthesia and intensive care

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Cardiac anesthesia

Anesthesia and intensive care
Cardiac procedures - anesthesia

• Cardiac surgical procedures:
  – coronaries, valves, septal defects
  – aorta
  – pericardial diseases (fluid, tumor)
  – transplant
  – congenital diseases

• Anesthesia – intensive therapy:
  – Patient safety
  – Ensure the conditions for surgical procedure
Preoperative assessment

• Assessment of patient’s state
  – Age, gender
  – Anamnesis: previous operations, diseases, smoking, infections
  – Medications
  – Examinations: chest X-ray, abdominal US, respiratory function test, echo, carotid US, laboratory parameters
  – Possible inflammatory focuses: OL, Gynec, Urol, Dent

• Evaluate the risk of procedure
Preoperative assessment

• Risk – benefit evaluation (mortality and morbidity connected to procedure)

• Inform the patient

• Score systems:
  – Euroscore
  – Parsonnet score
  – Cleveland Clinic score
  – French score
  – Pons score
**EUROSCORE**

<table>
<thead>
<tr>
<th>Score</th>
<th>Expected mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-2 low risk</td>
<td>0,8%</td>
</tr>
<tr>
<td>3-5 middle risk</td>
<td>3%</td>
</tr>
<tr>
<td>6 - high risk</td>
<td>11,2%</td>
</tr>
</tbody>
</table>

EuroScore has the highest predictive value for mortality

<table>
<thead>
<tr>
<th>Factor</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age 60-65</td>
<td>1</td>
</tr>
<tr>
<td>66-70</td>
<td>2</td>
</tr>
<tr>
<td>71-75</td>
<td>3</td>
</tr>
<tr>
<td>76-80</td>
<td>4</td>
</tr>
<tr>
<td>80&lt;</td>
<td>5</td>
</tr>
<tr>
<td>Female gender</td>
<td>1</td>
</tr>
<tr>
<td>COPD</td>
<td>1</td>
</tr>
<tr>
<td>Extracard arteriopathy</td>
<td>2</td>
</tr>
<tr>
<td>Neurological dysfunction</td>
<td>2</td>
</tr>
<tr>
<td>Previous cardiac surgery</td>
<td>3</td>
</tr>
<tr>
<td>Creatinine &gt; 200 µmol/l</td>
<td>2</td>
</tr>
<tr>
<td>Active endocarditis</td>
<td>3</td>
</tr>
<tr>
<td>Critical perioperative state</td>
<td>3</td>
</tr>
<tr>
<td>Unstable angina</td>
<td>2</td>
</tr>
<tr>
<td>EF 30-50%</td>
<td>1</td>
</tr>
<tr>
<td>EF&lt; 30%</td>
<td>3</td>
</tr>
<tr>
<td>Recent myocardial infarct</td>
<td>2</td>
</tr>
<tr>
<td>Pulmonary pressure &gt; 60mmHg</td>
<td>2</td>
</tr>
<tr>
<td>Emergency operation</td>
<td>2</td>
</tr>
<tr>
<td>Other than isolated CABG</td>
<td>2</td>
</tr>
<tr>
<td>Surgery on thoracic aorta</td>
<td>3</td>
</tr>
<tr>
<td>Post-infarct septal rupture</td>
<td>4</td>
</tr>
</tbody>
</table>
Anesthesia

• Patient’s state – possibly complications
  – Monitoring
  – Induction of anesthesia
  – Transfusion, bleeding
  – Other complications
Anesthesia - Monitoring

- Basic monitoring:
  - ECG,
  - Invasive BP,
  - CVP (central venous line),
  - SpO₂,
  - Urine output
  - Temperature
  - (+ large-bore peripheral venous line)

- Transoesophageal echocardiography (TOE or TEE)
- Invasive haemodynamic monitor:
  - Swan-Ganz catheter
  - PiCCO (Pulse Conture Cardiac Output)
- Near InfraRed Spectroscopy, BiSpectral index
Transoesophageal echocardiography
Swan-Ganz catheter

Catheter in the pulmonary artery via right heart
- Pressures: pulmonary art pressure, pulm capillary wedge press.
- Thermodilution measurement: cardiac output, vascular resistance (SVR)
PiCCO

Spec. arterial catheter + central venous line (transpulmonary technic):

- Thermodilution measurement – volumes, cardiac output, SVR, others

- Continuous cardiac output, SVR, others
Procedure

„on-pump“

Induction of anesthesia

„off-pump CABG“

Surgical preparation

CardioPulmonary Bypass
(Extracorporeal circulation)

Weaning from CPB

Positioning of the heart

Bleeding control

Chest closure
Anesthesia – induction, maintenance

The goal is the hemodynamic stability!!!

• Premedication: benzodiazepins

• Induction:
  – benzodiazepine, propofol, thiopental, etomidate
  – Fentanyl, sufentanyl
  – Pancuronium, rocuronium, pipecuronium, …
  – Antibiotic profilaxis

• Maintenance:
  – Propofol infusion – TIVA
  – Inhalation agents: sevoflurane, desflurane,
  – Glucose 40% + insulin – normoglycaemia
  – I.v. fluid

• Mild hypotension - bleeding control

Both usable during CPB
Anesthesia – cardiopulmonary bypass

- Continuous or pulsatile flow - Countered cardiac output
- Prime (fluid in the CPB machine)
- Cardioplegic solution
- Activation of thrombocytes
- Heparine (300 IU/kg)
- Activation of inflammatory system
- Activation of complement cascade

Haemodilution

Coagulopathy

Systemic Inflammatory Response Syndrome (SIRS)

„Normal” laboratory-parameter changes (WBC, CRP, PCT) after procedure
Anesthesia – weaning from CPB

To rebuild the patient’s normal circulation

– Normalisation of metabolic state
– Normalisation of body temperature
– Normalisation of heart rhythm – defibrillation, pacemaker

• Gradual loading - heart takes over the pump function – pump stops

• Loading of reservoir content
  – Blood pressure control
  – Right and left ventricle function
Anesthesia – postbypass period

Haemodynamic stability, bleeding control

• Inotrope, vasoconstrictor
  – Low systemic vascular resistance after CPB, protamine effect
    • Vasoconstrictor: noradrenalin, phenylephrine, epinephrine
  – Left or/and right heart failure
    • Inotrope: dobutamine, milrinone, levosimendan
    • Mechanical support: IABP, ECMO

Invasive hemodynamic monitoring, TEE
Anesthesia – Mechanical circulatory support

• **IntraAortic Balloon Pump**
  – makes „extra“ pulse wave toward coronaries and brain
  – Improves the coronary and brain circulation

• **Contraindications:**
  • Severe aortic valve insufficientia
  • Aortic dissection
  • Severe aortoiliac occlusive disease
Anesthesia – Mechanical circulatory support

- **ExtraCorporeal Membrane Oxygenation** (ExtraCorporeal Life Support)
  - Similar to CPB used during operation
  - Veno-Arterial ECMO
Anesthesia – postbypass period

Haemodynamic stability, bleeding control

• Fluid management
  – I.v. fluids, transfusion

• Transfusion
  – Packed red blood cell, FFP, Tct
  – Factor concentrates (Prothrombin Complex Concentrate, Fibrinogen Concentrate, Activated factor VII concentrate)

• Protamine (1:1 Heparine)

• Tranexamic acid – continuous infusion from start of the procedure

Point of Care tests
(Blood gas, Activated Clotting Time, Thrombelastography)
Laboratory tests
Postoperative Intensive Care

Patient usually is not wakened and extubated in the operating theatre

- Tasks on ICU:
  - To ensure hemodynamic stability
  - Bleeding control
  - Weaning from mechanical ventilation
  - Pain management
  - Physiotherapy
Postoperative Intensive Care

• To ensure hemodynamic stability:
  – Monitoring
  – Fluid therapy
  – Metabolic stability
  – Reduction of catecholamine dose

• Bleeding control
  – Hourly check – severe > 100 -200ml/h (bodyweight!)
  – Medical therapy (as above)
  – Surgery - reoperation
Postoperative Intensive Care

• Weaning from ventilator:
  – Stable hemodynamic state
  – Normal blood gas parameters and temperature
  – Adequate muscle force
  – Minimal pain

extubation

O₂ supplementation (face mask, nasal)
Postoperative Intensive Care

Pain

- Sympathetic tone↑
  - Vasoconstriction - RR↑
  - Tachycardia
  - Work of breathing↑

- Blood flow↓ (e.g. bowel)
- Afterload↑

- O₂ demand↑

- Chronic pain syndrome

Hypoxia – organ function↓
Postoperative Intensive Care

- Pain management
  - Opioids: morphine, sufentanil
    - Nausea – dehydrobensperidol, ondansetron
    - Drowsiness
  - NSAIDs: diclofenac, Ibuprophen,…
    - Kidney function ?
    - Bleeding ?
  - Paracetamol
  - Tramadol
    - nausea

- Traditional method: i.v. opioid base and NSAID and/or paracetamol
- Multimodal therapy – without opioids
Postoperative Intensive Care

- Pain management
  - I.V.:
    - Continuous infusion
    - I.V. infusion
    - Patient Controlled Analgesia – special pump
  - Per os
  - Epidural catheter (sympathetic tone↓ ↔ local effect, antithrombotic th?)
Postoperative Intensive Care

Fast track: there are not fixed, accepted definition: extubation within 8 hours – decrease the ICU and hospital length of stay – decrease the costs

- Patient selection: good condition, not complicated procedure (adult, elective surgery, etc.)
- Drugs: to know how you administer
- Safe management: extubation and ICU discharge criteria
Postoperative Intensive Care - Complications

- **Bleeding**
- **Pericardial tamponade** – hemodynamic instability, RR↓, Urine output↓, CVP↑ - operation
- **Kidney function↓** - diuretics, Hemodialysis
- **Breathing problems** – phrenic nerve injury – physiotherapy, stimulation
- **Atrial fibrillation** (40% after cardiac surgery) – ions, ß-blocker, amiodarone