Anestezie v kardiochirurgii

Tomáš Kotulák
KAR IKEM
úvod

v posledních letech:

- není nový zásadní vývoj
- nová doporučení ACCF/AHA 2011
- nové techniky (TAVI, thorakoskopie...)
- monitoring: TEE, PAC,
úvod

2011 ACCF/AHA guideline for coronary artery bypass graft surgery: Executive summary

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

Developed in Collaboration With The American Association for Thoracic Surgery, Society of Cardiovascular Anesthesiologists, and Society of Thoracic Surgeons

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The Journal of Thoracic and Cardiovascular Surgery

Thursday, September 13, 2012
**úvod**

### Size of Treatment Effect

<table>
<thead>
<tr>
<th>CLASS I</th>
<th>Benefit &gt;&gt; Risk</th>
<th>Procedure/Treatment SHOULD be performed/ administered</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLASS IIa</td>
<td>Benefit &gt;&gt; Risk</td>
<td>Additional studies with focused objectives needed IT IS REASONABLE to perform procedure/administer treatment</td>
</tr>
<tr>
<td>CLASS IIb</td>
<td>Benefit &gt;&gt; Risk</td>
<td>Additional studies with broad objectives needed; additional registry data would be helpful Procedure/Treatment MAY BE CONSIDERED</td>
</tr>
<tr>
<td>CLASS III No Benefit or CLASS III Harm</td>
<td>Procedure/ Test</td>
<td>Treatment</td>
</tr>
</tbody>
</table>

#### LEVEL A
- Multiple populations evaluated*
- Data derived from multiple randomized clinical trials or meta-analyses
- Recommendation that procedure or treatment is useful/effective
- Sufficient evidence from multiple randomized trials or meta-analyses

#### LEVEL B
- Limited populations evaluated*
- Data derived from a single randomized trial or nonrandomized studies
- Recommendation that procedure or treatment is useful/effective
- Evidence from single randomized trial or nonrandomized studies

#### LEVEL C
- Very limited populations evaluated*
- Only consensus opinion of experts, case studies, or standard of care
- Recommendation that procedure or treatment is useful/effective
- Only diverging expert opinion, case studies, or standard of care

**Suggested phrases for writing recommendations**
- should
- is recommended
- is indicated
- is useful/effective/beneficial

**Comparative effectiveness phrases**
- treatment/strategy A is recommended/indicated in preference to treatment B
- treatment/strategy A is probably recommended/indicated in preference to treatment B
- treatment/strategy A should be chosen over treatment B
- it is reasonable to choose treatment A over treatment B

**COR III: No Benefit**
- is not recommended
- is not indicated
- should not be performed/administered/other
- is not useful/beneficial/effective

**COR III: Harm**
- harmful
- potentially harmful
- causes harm
- associated with excess morbidity/mortality
- should not be performed/administered/other
2. PROCEDURAL CONSIDERATIONS: RECOMMENDATIONS

2.1. Anesthetic Considerations

Class I

1. Anesthetic management directed toward early postoperative extubation and accelerated recovery of low- to medium-risk patients undergoing uncomplicated CABG is recommended.\(^5\)\(^-\)\(^7\) (Level of Evidence: B)

2. Multidisciplinary efforts are indicated to ensure an optimal level of analgesia and patient comfort throughout the perioperative period.\(^8\)\(^-\)\(^12\) (Level of Evidence: B)

3. Efforts are recommended to improve interdisciplinary communication and patient safety in the perioperative environment (eg, formalized checklist-guided multidisciplinary communication).\(^13\)\(^-\)\(^16\) (Level of Evidence: B)

4. A fellowship-trained cardiac anesthesiologist (or experienced board-certified practitioner) credentialed in the use of perioperative transesophageal echocardiography is recommended to provide or supervise anesthetic care of patients who are considered to be at high risk.\(^17\)\(^-\)\(^19\) (Level of Evidence: C)
Class IIa

1. Volatile anesthetic-based regimens can be useful in facilitating early extubation and reducing patient recall.\(^{6,20-22}\) (Level of Evidence: A)

Class IIb

1. The effectiveness of high thoracic epidural anesthesia/analgesia for routine analgesic use is uncertain.\(^{23-26}\) (Level of Evidence: B)

Class III: Harm

1. Cyclooxygenase-2 inhibitors are not recommended for pain relief in the postoperative period after CABG.\(^{27,28}\) (Level of Evidence: B)
2. Routine use of early extubation strategies in facilities with limited backup for airway emergencies or advanced respiratory support is potentially harmful. (Level of Evidence: C)
2.3. Intraoperative Transesophageal Echocardiography

Class I

1. Intraoperative transesophageal echocardiography should be performed for evaluation of acute, persistent, and life-threatening hemodynamic disturbances that have not responded to treatment.\(^{45,46}\) (Level of Evidence: B)

2. Intraoperative transesophageal echocardiography should be performed in patients undergoing concomitant valvular surgery.\(^{45,47}\) (Level of Evidence: B)

Class IIa

1. Intraoperative transesophageal echocardiography is reasonable for monitoring of hemodynamic status, ventricular function, regional wall motion, and valvular function in patients undergoing CABG.\(^{46,48-53}\) (Level of Evidence: B)
2.4. Preconditioning/Management of Myocardial Ischemia

Class I

1. Management targeted at optimizing the determinants of coronary arterial perfusion (e.g., heart rate, diastolic or mean arterial pressure, and right ventricular or LV end-diastolic pressure) is recommended to reduce the risk of perioperative myocardial ischemia and infarction.\textsuperscript{54-58} (Level of Evidence: B)

Class IIa

1. Volatile-based anesthesia can be useful in reducing the risk of perioperative myocardial ischemia and infarction.\textsuperscript{59-62} (Level of Evidence: A)
4.4. Hormonal Manipulation

Class I

1. Use of continuous intravenous insulin to achieve and maintain an early postoperative blood glucose concentration less than or equal to 180 mg/dL while avoiding hypoglycemia is indicated to reduce the incidence of adverse events, including deep sternal wound infection, after CABG.\textsuperscript{254-256} (Level of Evidence: B)

Class IIb

1. The use of continuous intravenous insulin designed to achieve a target intraoperative blood glucose concentration less than 140 mg/dL has uncertain effectiveness.\textsuperscript{257-259} (Level of Evidence: B)

Class III: Harm

1. Postmenopausal hormonal therapy (estrogen/progesterone) should not be administered to women undergoing CABG.\textsuperscript{260-262} (Level of Evidence: B)
4.3. Management of Hyperlipidemia

Class I

1. All patients undergoing CABG should receive statin therapy, unless contraindicated. (Level of Evidence: A)
2. In patients undergoing CABG, an adequate dose of statin should be used to reduce low-density lipoprotein cholesterol to less than 100 mg/dL and to achieve at least a 30% lowering of low-density lipoprotein cholesterol. (Level of Evidence: C)

Class IIa

1. In patients undergoing CABG, it is reasonable to treat with statin therapy to lower the low-density lipoprotein cholesterol to less than 70 mg/dL in very high-risk* patients. (Level of Evidence: C)
2. For patients undergoing urgent or emergency CABG who are not taking a statin, it is reasonable to initiate high-dose statin therapy immediately. (Level of Evidence: C)

Class III: Harm

1. Discontinuation of statin or other dyslipidemic therapy is not recommended before or after CABG in patients without adverse reactions to therapy. (Level of Evidence: B)
doporučení - statiny
Preoperative statin therapy for patients undergoing cardiac surgery

1. Oliver J Liakopoulos¹, Elmar W Kuhn¹, Ingo Slottosch¹, Gernot Wassmer², Thorsten Wahlers¹

Editorial Group: Cochrane Heart Group

Published Online: 18 APR 2012
Assessed as up-to-date: 28 SEP 2010
DOI: 10.1002/14651858.CD008493.pub2

Authors' conclusions

Preoperative statin therapy reduces the odds of post-operative AF and shortens the stay on the ICU and in the hospital. Statin pretreatment had no influence on perioperative mortality, stroke, myocardial infarction or renal failure. Since analysed studies included mainly patients undergoing myocardial revascularizations the results cannot be extrapolated to patients undergoing other cardiac procedures such as heart valve or aortic surgery.
Statin Intake Is Associated With Decreased Insulin Sensitivity During Cardiac Surgery

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George Carvalho, MD, MS
Tamaki Sato, MD
Roupen Hatzakorjian, MD

Ralph Lattermann, MD, PhD
Takumi Codere-Maruyama, MD
Takashi Matsukawa, MD, PhD
Thomas Schricker, MD, PhD

OBJECTIVE—Surgical trauma impairs intraoperative insulin sensitivity and is associated with postoperative adverse events. Recently, preprocedural statin therapy is recommended for patients with coronary artery disease. However, statin is reported to increase insulin resistance and the risk of new-onset diabetes. Thus, we investigated the association between preoperative statin therapy and intraoperative insulin sensitivity in nondiabetic, dyslipidemic patients undergoing coronary artery bypass grafting.

RESEARCH DESIGN AND METHODS—In this prospective, nonrandomized trial, patients taking lipophilic statins were assigned to the statin group and hypercholesterolemic patients not receiving any statins were allocated to the control group. Insulin sensitivity was assessed by the hyperinsulinemic-normoglycemic clamp technique during surgery. The mean, SD of blood glucose, and the coefficient of variation (CV) after surgery were calculated for each patient. The association between statin use and intraoperative insulin sensitivity was tested by multiple regression analysis.

RESULTS—We studied 120 patients. In both groups, insulin sensitivity gradually decreased during surgery with values being on average ~20% lower in the statin than in the control group. In the statin group, the mean blood glucose in the intensive care unit was higher than in the control group (153 ± 20 vs. 140 ± 20 mg/dL, P < 0.001). The oscillation of blood glucose was larger in the statin group (SD, P < 0.001; CV, P = 0.001). Multiple regression analysis showed that statin use was independently associated with intraoperative insulin sensitivity (β = −0.16, P = 0.03).

CONCLUSIONS—Preoperative use of lipophilic statins is associated with increased insulin resistance during cardiac surgery in nondiabetic, dyslipidemic patients.
Two meta-analyses including 100,000 participants concluded that long-term statin intake increases the risk of new-onset diabetes


In the JUPITER study (Justification for the Use of Statins in Prevention: an Intervention Trial Evaluating Rosuvastatin), which enrolled 17,802 non-diabetic adults, rosuvastatin intake 1.9 years increased the incidence of diabetes by 20%.

4.10.2. Pulmonary Artery Catheterization

Class I

1. Placement of a pulmonary artery catheter is indicated, preferably before the induction of anesthesia or surgical incision, in patients in cardiogenic shock undergoing CABG. (Level of Evidence: C)

Class IIa

1. Placement of a pulmonary artery catheter can be useful in the intraoperative or early postoperative period in patients with acute hemodynamic instability.\(^\text{311-316}\) (Level of Evidence: B)

Class IIb

1. Placement of a pulmonary artery catheter may be reasonable in clinically stable patients undergoing CABG after consideration of baseline patient risk, the planned surgical procedure, and the practice setting.\(^\text{311-316}\) (Level of Evidence: B)
5.5. Renal Dysfunction

Class IIb

1. In patients with preoperative renal dysfunction (creatinine clearance <60 mL/min), off-pump CABG may be reasonable to reduce the risk of acute kidney injury.388-392 (Level of Evidence: B)

2. In patients with preexisting renal dysfunction undergoing on-pump CABG, maintenance of a perioperative hematocrit greater than 19% and mean arterial pressure greater than 60 mm Hg may be reasonable. (Level of Evidence: C)

3. In patients with preexisting renal dysfunction, a delay of surgery after coronary angiography may be reasonable until the effect of radiographic contrast material on renal function is assessed.393-395 (Level of Evidence: B)

4. The effectiveness of pharmacological agents to provide renal protection during cardiac surgery is uncertain.396-418 (Level of Evidence: B)
současná kardioanestezie:

nárůst tzv. mini-invazivních výkonů:
- TAVI ev. transapikální -
- spolupráce multidisciplinární - chirurg, invazivní kardiolog
- pacient nadále v péči týmu kardioanesteziologů a intenzivistů
TAVI - vyšetřovací program

- TTE + TEE (EF LK, anatomie chlopně a kalcifikací, rozměry anulu)
- CT oblouku aorty, CT pánevních tepen
- Anestesiologické konzilium
- Invazivní vyšetření (kompletní hemodynamika, p-tlaky, gradient, plocha Ao ústí, koronarografie, angiografie bulbu, angiografie pánevních tepen)
- Vyloučení fokální zdrojů infekce (FOKUSY)
Thorakoskopické výkony

anestezolog:

- kanylace VJI l.dx pro MO,
- selektivní intubace
- TEE
- selektivní ventilace
riziko krvácení:
riziko krvácení:
Update on Blood Conservation for Cardiac Surgery

Bhanu P. Nalla, MBBS, FRCA,* John Freedman, MD, FRCPC,† Gregory M.T. Hare, MD, PhD, FRCPC,**‡ and C. David Mazer, MD, FRCPC*‡

Balancing the Risk of Anemia and Its Treatment

<table>
<thead>
<tr>
<th>Definite Tissue Hypoxia</th>
<th>Hypoxic Cell Response Anemic Organ Dysfunction</th>
<th>No Tissue Hypoxia</th>
</tr>
</thead>
<tbody>
<tr>
<td>30 g·L⁻¹</td>
<td>50 g·L⁻¹</td>
<td>100 g·L⁻¹</td>
</tr>
</tbody>
</table>

Hemoglobin Concentration

Organ Injury ↔ Dysfunction ↔ Function

Update on Blood Conservation for Cardiac Surgery

Bhanu P. Nalla, MBBS, FRCA,* John Freedman, MD, FRCPC,† Gregory M.T. Hare, MD, PhD, FRCPC,**‡ and C. David Mazer, MD, FRCPC*‡

Table 2. Comparison of TRUST and TRACK Scoring Systems for Prediction of Blood Transfusion Requirements

<table>
<thead>
<tr>
<th>Variable</th>
<th>TRUST86 Score</th>
<th>Variable</th>
<th>TRACK88 Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preoperative Hb &lt;135 g/L</td>
<td>1</td>
<td>Age &gt;67 y</td>
<td>6</td>
</tr>
<tr>
<td>Weight &lt;77 kg</td>
<td>1</td>
<td>Weight &lt;60 kg (women) or &lt;85 kg (men)</td>
<td>2</td>
</tr>
<tr>
<td>Female sex</td>
<td>1</td>
<td>Female sex</td>
<td>4</td>
</tr>
<tr>
<td>Age &gt;65 y</td>
<td>1</td>
<td>Complex surgery</td>
<td>7</td>
</tr>
<tr>
<td>Nonelective surgery</td>
<td>1</td>
<td>Preoperative Hct &lt;40%</td>
<td>1-13 maximum</td>
</tr>
<tr>
<td>Serum creatinine &gt;120 μmol/L</td>
<td>1</td>
<td>Maximum score</td>
<td>32</td>
</tr>
<tr>
<td>Previous cardiac surgery</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nonisolated surgery</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Score</td>
<td></td>
<td>Probability of Transfusion (%)</td>
<td></td>
</tr>
<tr>
<td>0 = baseline risk</td>
<td>0-19</td>
<td>Probability of Transfusion Calculated</td>
<td></td>
</tr>
<tr>
<td>1 = low risk</td>
<td>20-39</td>
<td>from Nomogram</td>
<td></td>
</tr>
<tr>
<td>2 = intermediate risk</td>
<td>40-59</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 = high risk</td>
<td>60-79</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 = very high risk</td>
<td>80-100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Abbreviations: Hb, hemoglobin; Hct, hematocrit; TRACK, Transfusion Risk and Clinical Knowledge; TRUST, Transfusion Risk Understanding Scoring Tool.


<table>
<thead>
<tr>
<th>Timing</th>
<th>Indicated (I)</th>
<th>Reasonable (IIa)</th>
<th>Not Unreasonable (IIb)</th>
<th>Not Indicated/Harmful (III)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preoperative</td>
<td>Preoperative Hct and platelet count</td>
<td>D/C aspirin in low-risk patients</td>
<td>D/C potent antiplatelet/antithrombotic drugs (except unfractionated heparin)</td>
<td>Preoperative screening of intrinsic coagulation system</td>
</tr>
<tr>
<td></td>
<td>for risk prediction</td>
<td></td>
<td></td>
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<tr>
<td>Multimodal,</td>
<td>Multimodal, multidisciplinary</td>
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<tr>
<td></td>
<td>approach</td>
<td></td>
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<tr>
<td></td>
<td>D/C platelet P2Y12 receptor inhibitors ≥3 days preop</td>
<td>PAD (up to 2 U)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intraoperative</td>
<td>Lysine analog antifibrinolytics</td>
<td>Transfusion trigger 6 g/dL</td>
<td>DDAVP for specific responsive platelet dysfunction</td>
<td>Transfusion if Hb &gt;10 g/dL</td>
</tr>
<tr>
<td></td>
<td>Routine RBC saving</td>
<td>Non-RBC blood product transfusion based on clinical bleeding and/or POC tests</td>
<td>Trial of therapeutic PEEP</td>
<td>Aprotinin</td>
</tr>
<tr>
<td></td>
<td></td>
<td>OPCAB surgery</td>
<td>Centrifugal pumps</td>
<td>Routine DDAVP</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Decreased/alternatives to blood sampling</td>
<td>Recombinant factor VIIa for intractable nonsurgical bleeding</td>
<td>Dipyridamole</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Leukodepleted RBCs</td>
<td>Open venous reservoirs</td>
<td>Leukocyte filters</td>
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<tr>
<td></td>
<td></td>
<td>Plasma for serious bleeding with coagulation factor deficiencies</td>
<td>Higher heparin levels for long CPB</td>
<td></td>
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<tr>
<td></td>
<td>Antithrombin III concentrate for heparin resistance before CPB</td>
<td></td>
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<tr>
<td>TEVAR for descending aortic pathology</td>
<td>PCC for urgent reversal of warfarin</td>
<td>Protamine titration or empiric low-dose regimens</td>
<td></td>
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<tr>
<td>Minicircuits</td>
<td>Topical antifibrinolytics</td>
<td>Heparin-coated circuits</td>
<td></td>
<td></td>
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<tr>
<td>Modified ultrafiltration</td>
<td>Platelet/plasmapheresis</td>
<td>Low CPB prime or retrograde autologous priming</td>
<td></td>
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<tr>
<td></td>
<td>TQM program</td>
<td>Intraoperative cell saving</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Pump salvage with centrifugation</td>
<td>Topical hemostatic agents</td>
<td></td>
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</tr>
</tbody>
</table>

**ANH/IAD**
- **MUF (pediatrics)**
- **Plasma in massive transfusion**
- **RBC salvage using centrifugation**
- **Microplegia**
- **Vacuum-assisted drainage**
- **Biocompatible CPB circuits**
- **Postoperative cell saving**
- **Direct reinfusion of shed blood from chest tubes**
- **Prophylactic PEEP**
- **Transfusion if Hb >10 g/dL**

**Abbreviations:** ANH, acute normovolemic hemodilution; CPB, cardiopulmonary bypass; D/C, discontinue; DDAVP, desmopressin; EPO, erythropoietin; Hb, hemoglobin; Hct, hematocrit; IAD, intraoperative autologous donation; MUF, modified ultrafiltration; OPCAB, off-pump coronary artery bypass grafting; PAD, preoperative autologous donation; PCC, prothrombin complex concentrate; PEEP, positive end-expiratory pressure; POC, point of care; RBC, red blood cell; STS/SCA, Society of Thoracic Surgeons/Society of Cardiovascular Anesthesiologists; TEVAR, thoracic endovascular aortic repair; TQM, total quality management.
The easier, the better: Age, creatinine, ejection fraction score for operative mortality risk stratification in a series of 29,659 patients undergoing elective cardiac surgery

Marco Ranucci, MD, a Serenella Castelvecchio, MD, a Massimiliano Conte, MD, b Gianluigi Megliola, MD, b Giuseppe Speziale, MD, c Flavio Fiore, MD, c Fabio Guarracino, MD, d Sabino Scolletta, MD, e Ricardo Martinez Escobar, MD, f Mauro Falco, MD, f Elena Bignami, MD, f, h and Giovanni Landoni, MD b

Conclusions: The age, creatinine, ejection fraction score provides an accuracy level comparable to that of the European System for Cardiac Operative Risk Evaluation, with far superior clinical performance. (J Thorac Cardiovasc Surg 2011;142:581-6)
definice high risc patient

\[ \text{ACEF score} = \text{Age (years)} + 1 \quad (\text{if serum creatinine} \geq 2 \text{mg/dL}) \]

\[ \text{EF (\%)} \]

\[ \text{mg/dL} \times 88 = \text{umol/l} \]
FIGURE 2. Predicted versus observed operative mortality rates for deciles of risk distribution. *ACEF*, Age, creatinine, ejection fraction; *CI*, confidence interval; *ES*, European System for Cardiac Operative Risk Evaluation.
“OK, the old one’s in my right hand, the donor’s in my left. Right?”