Anesthesiological considerations during thoracic aortic surgery
Thoracic Aortic Surgery = Challenge

Blood loss

Interruption of Blood Flow

- Brain
- Spinal Cord
- Heart
- Kidneys
- Liver
- Intestine
- Limbs

Organ Protection
General Considerations

Thoracic Aortic Aneurysms
- Ascending Aortic & Arch Aneurysms
- Descending Thoracic/Thoracoabdominal Aortic Aneurysms

Aortic Dissection
- Type A
- Type B

Traumatic Aortic Injury

Aortic Atheromatous Disease

Aortic Coarctation

Penetrating Atherosclerotic Ulcus
EDITORIAL:
Albert T. Cheung
An Evolving Role of Anesthesiologists in the Management of Thoracic Aortic Diseases
Anesth Analg August 2010 111:259260

Special Article:
2010 ACCF/AHA/AATS/ACR/ASA/SCA/SCAI/SIR/STS/SVM Guidelines for The Diagnosis and Management of Patients with Thoracic Aortic Disease: Executive Summary:
Anesth Analg August 2010 111:279315
Applying Classification of Recommendations and Level of Evidence

Data available from clinical trials or registries about the usefulness/efficacy in different subpopulations, such as sex, age, history of diabetes, history of prior myocardial infarction, history of heart failure, and prior aspirin use.

### Table: Classification of Recommendations and Level of Evidence

<table>
<thead>
<tr>
<th>Class</th>
<th>Description</th>
<th>Treatment Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Class I</strong></td>
<td>Benefit &gt;&gt; Risk</td>
<td>Procedure/Treatment SHOULD be performed/administered</td>
</tr>
<tr>
<td><strong>Class IIa</strong></td>
<td>Benefit &gt;&gt; Risk Additional studies with focused objectives needed; additional registry data would be helpful</td>
<td>Procedure/Treatment MAY BE CONSIDERED</td>
</tr>
<tr>
<td><strong>Class IIb</strong></td>
<td>Benefit ≥ Risk Additional studies with broad objectives needed</td>
<td>Procedure/Treatment is useful/effective</td>
</tr>
<tr>
<td><strong>Class III</strong></td>
<td>Risk ≥ Benefit Procedure/Treatment is not useful/effective and may be harmful</td>
<td></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 expert opinion, 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
- may/might be considered
- is reasonable
- can be useful/effective/beneficial
- is probably recommended or indicated
- is useful/effective/beneficial
- may/might be reasonable
- usefulness/effectiveness is unknown/unclear/uncertain or not well established
- is not recommended
- is not indicated
- should not
- is not useful/effective/beneficial
- may be harmful

**Recommended**

**Reasonable**

**Might be reasonable**

**Not recommended**

---

**Writing Committee Members, et al. Circulation 2010;121:1544-1579**

**http://circ.ahajournals.org/cgi/content/full/121/13/1544**
General Considerations

Preanaesthetic Assessment

Preexisting or Associated Medical Conditions

Preoperative Medications

Anaesthetic Management

Postoperative Care & Complications
Preanaesthetic Assessment

Urgency of the Operation:

- Preop. Exam.
- Team spirit, Infrastructure, Protocols

Pathology & Extent of the Disease

Median Sternotomy vs. Thoracotomy vs. Stent

Mediastinal Mass Effect: **Intubation & TEE**

Airway Compression or Deviation
Preanaesthetic Assessment

Baseline Organ Function:
Renal: Fluid management Pharmacology

Cerebrovascular

Hepatic: Coagulation Pharmacology

Hematologic: Coagulation

Lung: COPD Con. Tiss. Disease

Atherosclerosis: Coronary/Peripheral Ischemia/Embolism
Preexisting or Associated Medical Conditions

Aortic Valve Disease
Cardiac Tamponade
Coronary Artery Stenosis
Cardiomyopathy
Cerebrovascular Disease
Pulmonary Disease
Renal Insufficiency
Esophageal Disease
Coagulopathy
Prior Cardiac Operations
Preoperative Medications

Medications to be continued:
- Cardiac
- Pulmonary
- Antiseizure

Medications to be discontinued:
- Anti-vit K
- Aspirin
- Platelet ADP receptor antagonists (clopidogrel, ticlopidine)
- Platelet GP IIb/IIIa inhibitors (abciximab, eptifibatide, tirofiban)

Tight glycemic control
Anaesthetic Management

Hemodynamic Monitoring

Anaesthetic Pharmacology

Neurophysiologic Monitoring

Single-Lung Ventilation for Thoracotomy

Potential for Bleeding

Preserve Normothermia

Antibiotic Prophylaxis
Hemodynamic Monitoring

Standard Monitoring +

Temperature (tymp., esoph., PA, urinary cath., nasoph.)

Proximal Aortic Pressure (left +/- right radial)

Distal Aortic Pressure

Central Venous Pressure

Pulmonary Artery Pressure, C.O. & S\textsubscript{vO\textsubscript{2}}

TEE IIa B


Journal of the American Society of Echocardiography
Volume 16 Number 10


10th Christmas Echo

Test yourself!
Basic course
Pre-and post-course exam
Image recognition testing
Advanced course
Simulated exam for the European Accreditation in Adult Transesophageal Echocardiography

Workshops
Clinical cases
Hemodynamics
Echo in the ICU
Hands-on TTE
Heartvalves Symposium
Hands-on Regional Anesthesia and Vascular Access and more!

International Course on Perioperative and Critical Care Echocardiography

Courtyard by Marriott Brussels
A joint initiative of the Belgian Society of Anaesthesia and Reanimation and the section Cardiac Anesthesia of the Dutch Society of Anesthesiology

AORTIC DISEASE J. CODDENS
Anaesthetic Pharmacology

Vasodilators/Vasoconstrictors
Inotropic agents/Beta blocking agents

Inhaled/I.V. Anesthetics/Locoregional
Preconditioning/Organ protection
Dose reduction during hypothermia
EEG/SSEP: Barbiturates
Propofol high bolus
MEP: NMB Agents

Antifibrinolytics: Aprotinin
ε-aminocaproïc acid
Tranexate
Stop during DHCA

Cardiopulmonary bypass and the pharmacokinetics of drugs. An update.
Buijsaert WA, Herregods LL, Mortier EP, Bogaert MG.
Department of Emergency Medicine, University Hospital, Belgium.

Dose requirements of infusions of cisatracurium or Rocuronium during hypothermic cardiopulmonary bypass.
Camu G, Ceddes J, Hendricks J, Deloof T.
Br J Anaesth. 2000 May;84(5):587-90
Neurophysiologic Monitoring

Electroencephalography (EEG)

Somatosensory Evoked Potentials (SSEPs)

Motor Evoked Potentials (MEPs)

Jugular Venous Oxygen Saturation

Lumbar CSF Pressure

Near Infrared Spectroscopy

Body Temperature
Reliability of auscultation in positioning of double-lumen endobronchial tubes.
Alliaume B, Coddens J, Deloof T.
Department of Anaesthesia and Intensive Care, Onze-Lieve-Vrouw Ziekenhuis, Aalst, Belgium.
Potential for Bleeding

Large-bore intravenous access

Blood Product Availability

Antifibrinolytic Therapy

Coagulation Monitoring
(Medtronic Femoral Arterial Cannula DLP, Grand Rapids, MI):
33 consecutive patients recalled
23 responders (1+, 9 non responders)
162 days postop (41 – 339)
No subj. complaints (cosm, tenderness…)
Some swelling & redness in recent cases
Duplex completely normal

J. Haenen, J. Coddens, E. Kerschot

<table>
<thead>
<tr>
<th>n=8</th>
<th>AGE (Y)</th>
<th>L (cm)</th>
<th>BW(Kg)</th>
<th>ECC(min)</th>
<th>DH(min)</th>
<th>AoX(min)</th>
<th>CA(min)</th>
<th>PY%</th>
<th>CS(ml)</th>
<th>RBC(U)</th>
<th>FFP(U)</th>
<th>THR(U)</th>
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<tbody>
<tr>
<td>Min</td>
<td>42</td>
<td>169</td>
<td>82</td>
<td>121</td>
<td>17</td>
<td>0</td>
<td>0</td>
<td>9</td>
<td>200</td>
<td>0.0</td>
<td>0.0</td>
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<tr>
<td>Max</td>
<td>67</td>
<td>181</td>
<td>112</td>
<td>254</td>
<td>32</td>
<td>181</td>
<td>20</td>
<td>18</td>
<td>1450</td>
<td>7.0</td>
<td>4.0</td>
<td>2.0</td>
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<tr>
<td>Mean</td>
<td>54</td>
<td>176</td>
<td>92</td>
<td>184</td>
<td>27</td>
<td>102</td>
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<td>Stdev</td>
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<td>49</td>
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<td>3</td>
<td>401</td>
<td>2.4</td>
<td>1.4</td>
<td>0.8</td>
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</tbody>
</table>

T. Gooris, T. Boghaert, L. Vermassen, G. Vanvaerenbergh, R. Delahaye, B. Elsen
Dept. of Perfusion, O. L. V. Clinic, Moorselbaan 164, 9300 AALST, BELGIUM
An algorithmic approach to transfusion, antifibrinolytic and anticoagulation management is reasonable.
Hypothermia
Hypotension
Hypertension
Bleeding
Spinal Cord Ischemia
Stroke
Renal Insufficiency
Respiratory Insufficiency
Phrenic Nerve Injury
Diaphragmatic Dysfunction
Recurrent Laryngeal Nerve Injury
Pain Management
General Considerations

Thoracic Aortic Aneurysms
  Ascending Aortic & Arch Aneurysms
  Descending Thoracic/Thoracoabdominal Aortic Aneurysms

Aortic Dissection
  Type A
  Type B

Traumatic Aortic Injury

Aortic Atheromatous Disease

Aortic Coarctation

Penetrating Atherosclerotic Ulcus
Thoracic Aortic Aneurysms

Associated Lesions:
Aortic Root & Ascending Aorta: Bicuspid AV Aortic Regurgitation

Annuloaortic ectasia
Mass effect: recurrens nerve
left atelectasis
superior vena cava syndrome
dysphagia
dyspnoe

Embolism: stroke, mesenteric, renal, limb.
Tamponade
Hemothorax
Aorto-bronchial fistula
Aorto-esophageal fistula

TEE extremely valuable
Aortic Root & Proximal Ascending Aorta:
  Sternotomy
  Aortic Cannulation
  ECC

Distal Ascending Aorta & Arch:
  Sternotomy
  Femoral Cannulation
  ECC
  DHCA, ACP, RCP

Descending Aorta:
  Thoraco(phrenolaparo)tomy
  ECC +/-
Ascending & Aortic Arch Aneurysms

**Mediastinal Mass Effect:**
- Pulmonary Artery
- RVOT
- Trachea
- Left Mainstem Bronchus

Uni- or bilateral arterial catheters

Nasopharyngeal, tympanic & bladder T

DHCA

EEG, SEP, $S_vO_2$
Brainprotective Strategies Ib

2 Mechanisms:
- Hypoperfusion
- Embolism

DHCA Ila B, Topical Cerebral Cooling

Retrograde Cerebral Perfusion Ila B

Selective Antegrade Cerebral Pefusion Ila B

Prevent Cerebral Hyperthermia during Rewarming IIIb

Pharmacologic Neuroprotection
DHCA:

Incomplete understanding
Autoregulation OK with $\alpha$-stat
$Q_{10} \sim 2.6$
**Most effective**
EEG, $S_vO_2$
30 min safe at 11-14 °C NP T
Topical cooling???
Duration ECC increased
Brain vulnerable during rewarming
Coagulopathy

Retrograde Cerebral Perfusion:

CVP < 25 mm Hg
10° Trendelenburg
200 – 600 ml/min
**Benefits not really proven**
Maintenance of cerebral hypothermia
Delivery of substrate
Decreased risk of embolism
Selective Antegrade Cerebral Perfusion:

Oxygenated blood 10-14 °C
250-1000 ml/min
50-80 mm Hg
Effectiveness supported by case series
Transcranial Doppler
Near Infrared Spectroscopy

Pharmacologic Neuroprotection:

No Proof
Barbiturates
Volatile Anaesthetics
Glucocorticoïds
Mg^{++}SO_{4} 1-2 g IV
Lidocaïne 200 mg IV
Mannitol 25 g IV
Descending Thoracic & Thoracoabdominal Aortic Aneurysms

Atherosclerosis:
- Peripheral
- Cerebral
- Renal
- Coronary

COPD

Embolism:
- Mesenteric
- Renal
- Lower Limb

Temporary Interruption of Blood Flow
Thoracoabdominal Incision
Diaphragm division
Phrenic & Recurrent Nerve
Esophagus
Aortic arch branches are no longer a blind zone for transesophageal echocardiography: a new eye for aortic surgeons.

Assessment of internal thoracic artery patency with transesophageal echocardiography during coronary artery bypass graft surgery.

Susan Garwood, MBChB, Elizabeth Davis, RDCS, Stephen N. Harris, MD
Intraoperative transesophageal ultrasonography can measure renal blood flow
J Cardiothorac Vasc Anesth. Feb 2001; vol 15, nr 1


Voci P, Tritapepe L, Testa G, Caretta Q.
Imaging of the anterior spinal artery by transesophageal color Doppler ultrasonography.
Intraoperative Severity Assessment of Coronary Artery Stenosis in Patients at Risk: The Role of Transesophageal Echocardiography

Thomas Theunissen, MD,* Jose Coddens, MD,* Luc Foubert, MD, PhD*, Guy Cammu, MD, PhD*, Ivan Degrieck, MD†, and Thierry Deloof, MD*

Departments of *Anesthesia and Intensive Care Medicine and †Thoracic and Cardiovascular Surgery, OLV-Ziekenhuis, Aalst, Belgium Anesth Analg; 102(2): 366-8
Surgical Techniques

Simple Aortic Cross-Clamp:
Cross-Clamp Time
Distal Ischemia
Anhepatic Phase

Table 8-3. Incidence of Paraplegia and Renal Failure Related to Cross Clamp Time

<table>
<thead>
<tr>
<th>Time (Minutes)</th>
<th>Paraplegia (Percentage)</th>
<th>Renal Failure (Percentage)</th>
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<tbody>
<tr>
<td>0–15</td>
<td>0</td>
<td>0</td>
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<tr>
<td>16–30</td>
<td>3.5</td>
<td>4.2</td>
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<tr>
<td>31–45</td>
<td>10.0</td>
<td>7.8</td>
</tr>
<tr>
<td>46–60</td>
<td>12.5</td>
<td>6.3</td>
</tr>
<tr>
<td>&gt;60</td>
<td>25.0</td>
<td>0</td>
</tr>
</tbody>
</table>


Gott Shunt

Partial Left Heart Bypass:
Distal Aortic Arch, Proximal Descending Aorta
Protection of Spinal Cord & Mesenteric Organs

ECC & DHCA

Endovascular Stent Graft
Renal Protection Strategies:

Preoperative hydration & intraoperative mannitol in open repair of the descending aorta IIb C

Cold cristalloid or blood perfusion of renal arteries (‘nephroplegia’) IIb B

Furosemide, mannitol or dopamine should not be given solely III C

Urine flow = monitor of renal perfusion
Advantages & Disadvantages of Distal Perfusion Techniques

Potential advantages:
- Control of proximal hypertension
- Decrease LV afterload
- Less hemodynamic Δ with clamping/unclamping
- Decrease duration mesenteric ischemia
- Decrease risk of paraplegia
- Ability to control T with heat exchanger
- Vascular access for volume expansion
- Ability to use extracorporeal oxygenation
- Capability to selectively perfuse mesenteric organs
- Maintain lower extremity SSEP’s & MEP’s

Potential disadvantages:
- Greater level of anticoagulation
- Risk of vascular injury at cannulation site
- Risk of thromboembolic events
- Perfusionist
- Proximal & distal pressure & flow monitoring required
- Technical complexity
OLV: open procedures versus endovascular approach

<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>Nbr of interventions (# dcf’s)</td>
<td>679</td>
<td>688</td>
<td>681</td>
<td>637</td>
<td>563</td>
<td>603</td>
<td>644</td>
<td>537</td>
<td>654</td>
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<tr>
<td>Nbr of thoracic aorta interventions</td>
<td>87</td>
<td>79</td>
<td>93</td>
<td>98</td>
<td>78</td>
<td>76</td>
<td>113</td>
<td>77</td>
<td>61</td>
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<tr>
<td>ASCENDING AORTA - ARCH</td>
<td>63</td>
<td>52</td>
<td>69</td>
<td>70</td>
<td>55</td>
<td>49</td>
<td>76</td>
<td>54</td>
<td>45</td>
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<tr>
<td>ARR mechanical or bioprosthesis</td>
<td>21</td>
<td>23</td>
<td>34</td>
<td>32</td>
<td>20</td>
<td>25</td>
<td>41</td>
<td>16</td>
<td>21</td>
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<tr>
<td>ARR with homograft</td>
<td>11</td>
<td>8</td>
<td>4</td>
<td>4</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>0</td>
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<tr>
<td>ARR with native valve reimplantation (David)</td>
<td>2</td>
<td>7</td>
<td>15</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>0</td>
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<tr>
<td>AVR or AVP with graft</td>
<td>2</td>
<td>2</td>
<td>9</td>
<td>12</td>
<td>8</td>
<td>6</td>
<td>10</td>
<td>13</td>
<td>7</td>
</tr>
<tr>
<td>Graft and/or repair</td>
<td>21</td>
<td>11</td>
<td>6</td>
<td>19</td>
<td>22</td>
<td>13</td>
<td>15</td>
<td>14</td>
<td>14</td>
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<tr>
<td>Endoprosthesis (stentgraft)</td>
<td>6</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>4</td>
<td>3</td>
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<tr>
<td>Dilatation</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
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<table>
<thead>
<tr>
<th>DESCENDING AORTA</th>
<th>14</th>
<th>18</th>
<th>13</th>
<th>13</th>
<th>15</th>
<th>17</th>
<th>22</th>
<th>19</th>
<th>15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Graft and/or repair</td>
<td>8</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Dilatation with stent</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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</table>
ICU stay (days) TAA open surgery survivors
OLV Clinic 01/01/2000 to 01/01/2010
n = 85  Death = 21  Readmission = 5

Dept. of Cardiothoracic & Vascular Surgery
OLV Clinic Aalst
H. Vanermen, F. Wellens, R. De Geest,
I. De Grieck, F. Van Praet, F. Casselman,
K. Dossche, I. De Blier, Y. Vermeulen
Advantages of TEE:

- Non-invasive
- No use of contrast agents
- 100% sensitivity & specificity to detect endoleaks


Disadvantages of TEE:

- Requires general anesthesia
- Distal ascending aorta & aortic arch difficult to visualise
- TEE probe interferes with fluoroscopy

Endovascular Aortic Repair
Ronald A. Kahn, MD, and David M. Moskowitz, MD
The Importance of Intraoperative Transesophageal Echocardiography in Endovascular Repair of Thoracic Aortic Aneurysms
Madhav Swaminathan, MD*, Catherine K. Lineberger, MD*, Richard L. McCann, MD†, and Joseph P. Mathew, MD*
Anesth Analg 2003;97:1566–72

We found TEE to be a valuable intraoperative tool for
1) identifying aortic pathology,
2) confirming that the guidewire is in the true lumen,
3) aiding stent graft positioning, and
4) Supplementing angiography for detecting endoleaks.

How to Guide Stent-Graft Implantation in Type B Aortic Dissection?: Comparison of Angiography, Transesophageal Echocardiography, and Intravascular Ultrasound
Dietmar H. Koschyk, Christoph A. Nienaber, Malgorzata Knap, Thomas Hofmann, Yskert V. Kodolitsch, Valeria Skriabina, Mohammed Ismail, Olaf Franzen, Tim C. Rehders, Christoph Dieckmann, Gunnar Lund, Hermann Reichenspurner and Thomas Meinertz
Circulation 2005;112;260-264

TEE & IVUS superior to ANGIO:
Detection of multiple entry sites
Detection of false lumen slow flow after stent implantation
Detection of incomplete stent apposition
Visualisation of guide wire position over the entire length

TEE superior to INVUS & ANGIO:
Detection of endoleaks
Endo-Leak: 3 Types

I Attachment site leak
   –A Proximal leak
   –B Distal leak
   –C Iliac occluder (seen with repair AAA)

II Branch leaks
   –A simple to-and-fro from branch vessel to sac
   –B Complex flow

III Graft defect
   –A Midgraft hole
   –B Junctional leak or graft disconnection
   –Other mechanism, e.g. failure from suture holes

IV Graft wall porosity

Pseudoleak
movement of unclotted blood in aneurysmal sac or false lumen
Anaesthetic Management

Selective Lung Ventilation:
  Double Lumen Endobronchial Tube
  Endobronchial Blocker
  To be exchanged at end procedure

Right Radial Artery Catheter (prox. pressure)

Femoral Artery Catheter (distal pressure)

CVP, PAP, CO, SVO2

SSEP, MEP

Postoperative pain management

Prevention of Postoperative Paraplegia
Postoperative Paraplegia

Risk Factors:

- Aneurysm Extent
- Hypotension or Cardiogenic Shock
- Emergency Operation
- Aortic Rupture
- Presence of Dissection
- Duration of Cross Clamp
- Sacrifice of Intercostal or Segmental Arteries
- Prior Thoracic or Abdominal Aneurysm Repair
- Prior Repair of Type A Dissection
- Occlusive Peripheral Vascular Disease
- Anemia

Anatomy of Blood Supply

Immediate-onset vs Delayed-onset:
Preventive vs Therapeutic Interventions
Strategies to Decrease the Risk of Intraoperative Spinal Cord Ischemia

Minimize Aortic Cross-Clamp Time

- Distal Aortic Perfusion IIb B
- Gott Shunt
- Partial LV Bypass
- Partial CPB

Deliberate Hypothermia

- Mild to moderate systemic hypothermia (32-35°C) IIa B
- DHCA (14-18°C)
- Selective spinal cord hypothermia (epidural cooling 25°C) IIb B

Increase Spinal Cord Perfusion Pressure

- Re-implantation of critical intercostal & segmental arteries
- Lumbar CSF drainage (CSF pressure < 10mm Hg) I B
- Arterial pressure augmentation (MAP > 85 mm Hg) IIa B

Monitoring of Lower Extremity Neurophysiologic Function IIb B

- SSEP’s, MEP’s

Postoperative Neurologic Evaluation for Early Detection of Delayed-onset Paraplegia

- Serial neurologic examinations

Pharmacological Neuroprotection IIb B

- Glucocorticoïd, Barbiturates, MgSO₄, Mannitol, Naloxone, Lidocaïne, Intrathecal papaverine
Lumbar CSC Perfusion Pressure = MAP – Lumbar CSF Pressure

Aortic X Clamp
Reperfusion
Increased CVP
Spinal Edema

⇒ Increased CSF Pressure

CSF Drainage
⇒ Decreased CSF Pressure

14 G Tuohy needle L3-L4, closed system
Silicon elastomer ventriculostomy catheter 10-15 cm
Continuous monitoring: $P_{CSF} < 10$ mm Hg
Inserted before surgery
Drainage for 24 h
Left capped for 24 h
Removed after 48 h if normal neurologic exam & coagulation

**Complications:**
- Epidural hematoma
- Intradural hematoma
- Catheter fracture
- Meningitis
- Intracranial hypotension
- Lumbar puncture headache
Pro: Cerebrospinal Fluid Drainage Protects the Spinal Cord During Thoracoabdominal Aortic Reconstruction Surgery

Sherif Afifi, MD, FCCM

Con: Cerebrospinal Fluid Drainage Does Not Protect the Spinal Cord During Thoracoabdominal Aortic Reconstruction Surgery

Lee Wallace, MD

Case reports & 2 studies attest treatment efficacy
1 Meta-analysis failed to prove preventive benefit*
1 RCT (n=150) showed 80% preventive risk reduction

Systematic overview of the evidence supporting the use of cerebrospinal fluid drainage in thoracoabdominal aneurysm surgery for prevention of paraplegia


Cerebrospinal fluid drainage reduces paraplegia after thoracoabdominal aortic aneurysm repair: Results of a randomized clinical trial

Joseph S. Coselli, MD, Scott A. LeMaire, MD, Cüneyt Köksoy, MD, Zachary C. Schmittling, MD, and Patrick E. Curling, MD, Houston, Tex
Arterial Pressure Augmentation: Preventive & Therapeutic

Lumbar CSC Perfusion Pressure = MAP – Lumbar CSF Pressure > 70 mm Hg

Loss of segmental arteries
Hypotension
Ischemic sympathetic dysfunction  \( \rightarrow \) Decreased CSF Perfusion Pressure

Combined with CSF drainage

Norepinephrine
Phenylephrine
Epinephrine
Vasopressin
MAP > 80 – 100 mm Hg

Documented effectiveness
Intraoperative Neurophysiologic Monitoring

**SSEP:**
- **Stimulation:** Peripheral nerves
- **Recording:** Peripheral nerves, Spinal cord, Brainstem, Thalamus, Cerebral cortex
- **Anaesthesia:** Balanced IV (narcotic, NMBA, BZDP, propofol, < 0.5 MAC volatile)

**MEP:**
- **Stimulation:** Scalp
- **Recording:** Anterior tibialis muscle
- **Anaesthesia:** TIVA, no NMBA

**Interference:**
- Anesthetic agents
- Hypothermia
- Electrical interference

**Comparison of lower to upper extremity**
Spinal cord ischemia: decrease/disappearance of EP

**CONTROVERSIAL:**
- SSEP only posterior part of spinal cord
- False positives
- **Corrective measures:**
  - Increase proximal perfusion pressure
  - Increase distal perfusion pressure
  - Increase distal aortic flow rate
  - Change position of proximal or distal clamp
  - Reattachment of additional arteries
Selective Spinal Cord Cooling
Cumbersome
Limited clinical experience (a few centers)

Pharmacologic Protection of the Spinal Cord
Glucocorticoïds
Thiopental
Mannitol
Mg++SO4-
Ca++ channel antagonists
Papaverine
Naloxone

No evidence of efficacy
Postoperative Pain Management
Regional techniques are not recommended in patients at risk for epidural hematoma formation.


N=14105: 8 transient neurologic deficit
4918 card surg: estimated risk = 1/1700
5026 vasc surg: estimated risk = 1/1700


Risk of Hematoma After Epidural Anesthesia and Analgesia for Cardiac Surgery. Ho, Anthony M.-H. MS, MD, FRCPC, FCCP; Li, Peggy T. Y. MB, ChB; Karmakar, Manoj K. MD, FRCA [Letters to the Editor]

Neuraxial blockade and hematoma in cardiac surgery: estimating the risk of a rare adverse event that has not (yet) occurred. Ho AM, Chung DC, Joynt GM. Chest. 2000 Feb;117(2):551-5.
General Considerations

Thoracic Aortic Aneurysms
  Ascending Aortic & Arch Aneurysms
  Descending Thoracic/Thoracoabdominal Aortic Aneurysms

Aortic Dissection
  Type A
  Type B

Traumatic Aortic Injury

Aortic Atheromatous Disease

Aortic Coarctation

Penetrating Atherosclerotic Ulcus
Aortic Dissection

Mechanisms of Disease

Chronic dissection can dilate
Aneurysm can dissect

Intimal tear without IMH
IMH without intimal tear
Rupture of vasavasorum
Ulcerating plaque

Genotype + environment = phenotype
Aortic segments
Dilatation = growth

Iatrogenic

Aortic Dissection: New Frontiers in Diagnosis and Management.
Christoph A. Nienaber, MD; Kim Eagle, MD.
Circulation 2003 108: 628 - 635
Predisposing Factors for Aortic Dissection:

Hypertension
Cystic Media Degeneration
Atherosclerosis

Marfan’s Syndrome
Ehlers-Danlos Syndrome
Annuloaortic Ectasia
Bicuspid Aortic Valve
Aortic Coarctation
Familial Aortic Dissection

Pregnancy
Crack Cocaïne Abuse
Arteritis
Aortic Trauma/Iatrogenic

Losartan, an AT1 antagonist, prevents aortic aneurysm in a mouse model of Marfan syndrome.

MMP Inhibition in Abdominal Aortic Aneurysms: Rationale for a Prospective Randomized Clinical Trial
ROBERT W. THOMPSON1, B. TIMOTHY BAXTER2
Annals of the New York Academy of Sciences
Volume 878, pages 159–178, June 1999
Type A versus Type B

The Diagnosis of Thoracic Aortic Dissection by Noninvasive Imaging Procedures
Christoph A. Nienaber, Yskert von Kodolitsch, Volkmar Nicolas, Volker Siglow, Angela Piepho, Carsten Brockhoff, Dietmar H. Koschyk, and Rolf P. Spielmann

Diagnostic Imaging in the Evaluation of Suspected Aortic Dissection -- Old Standards and New Directions
Joaquin E. Cigarroa, Eric M. Isselbacher, Roman W. DeSanctis, and Kim A. Eagle

<table>
<thead>
<tr>
<th>ADVANTAGE</th>
<th>AORTOGRAPHY</th>
<th>CT</th>
<th>MRI</th>
<th>TEE</th>
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<tbody>
<tr>
<td>Readily available</td>
<td>Fairly</td>
<td>Quite</td>
<td>Fairly</td>
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<td>Rapid</td>
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<td>Noninvasive</td>
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<td>Does not use intravenous</td>
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<td>Contrast agent</td>
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<table>
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<tr>
<td>Sensitivity</td>
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<td>++</td>
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<td>++</td>
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<tr>
<td>Specificity</td>
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<td>+++</td>
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<td>Site of intimal tear</td>
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<td>Presence of thrombus</td>
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<td>Presence of aortic insufficiency</td>
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<tr>
<td>Coronary-artery involvement</td>
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<td>-</td>
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*TEE denotes transesophageal echocardiography.
**+++** denotes excellent results, **++** good results, **+** fair results, and **-** not detected.
Anesthetic Management

Acute Dissection = Emergency

Type A ➔ Surgery
Type B ➔ Medical/Surgical

Endovascular approach

Type A ~ Ascending AA + DHCA
Type B ~ TAAA

TEE
TL: smallest early flow higher flow systolic expansion
FL: larger delayed flow lower flow systolic compression spontaneous contrast
Retrograde type A dissection:
No entry tear in Ascending Aorta
# Left Ventricular Diastolic Dysfunction in Chronic Aortic Type B Dissection

*The Annals of Thoracic Surgery Volume 83, Issue 4*  
April 2007, Pages 1356-1360

Yasushige Shingu MD, Norihiko Shiiya MD, PhD, Taisei Mikami MD, PhD, Kenji Matsuzaki MD, Takashi Kunihara MD, PhD and Yoshiro Matsui MD, PhD

<table>
<thead>
<tr>
<th>Transmirtal Flow Properties and Diastolic Dysfunction Grade</th>
<th>Group I = double barreled with narrow TL</th>
<th>Group II = thrombosed FL</th>
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<td><strong>Case</strong></td>
<td><strong>E/A</strong></td>
<td><strong>DT (ms)</strong></td>
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DT = deceleration time; E/A = ratio of early to late peak velocities; FPV = flow propagation velocity; FPV/E = ratio of flow propagation velocity and transmitral E wave velocity. IRT = isovolumic relaxation time.
Expertise in:

Hemodynamics

Extracorporeal technologies

Neuroprotective strategies

Transfusion & coagulation

One-lung ventilation

TEE