2nd International Meeting
on Aortic Diseases
New insights into an old problem
September 30 & October 1-2 2010
Liège, Belgium

Anesthesiological considerations during thoracic aortic surgery

José Coddens
Dept. of Anesthesia &
Intensive Care Medicine

Onze Lieve Vrouw Ziekenhuis
Moorselbaan 164
9300 AALST
B E L G I U M

olv
Top in Zorg.

Thoracic Aortic Surgery = Challenge

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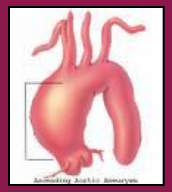
Blood loss

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

IARS ANESTHESIA & ANALGESIA
The Gold Standard in Anesthesiology

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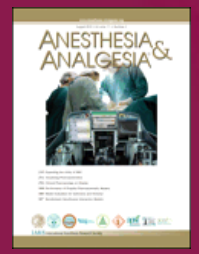
EDITORIAL:
Albert T. Cheung
An Evolving Role of Anesthesiologists in the Management of Thoracic Aortic Diseases

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:
A Report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines, American Association for Thoracic Surgery, American College of Radiology, American Stroke Association, Society of Cardiovascular Anesthesiologists, Society for Cardiovascular Angiography and Interventions, Society of Interventional Radiology, Society of Thoracic Surgeons, and Society for Vascular Medicine

Anesth Analg August 2010 111:279315

American Heart Association
Learn and Live

Circulation

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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

SIZE OF TREATMENT EFFECT →

ESTIMATE OF CERTAINTY (PRECISION) OF TREATMENT EFFECT	CLASS I *Benefit >>> Risk* Procedure/Treatment **SHOULD** be performed/ administered	CLASS IIa *Benefit >> Risk* *Additional studies with focused objectives needed* **IT IS REASONABLE** to perform procedure/administer treatment	CLASS IIb *Benefit ≥ Risk* *Additional studies with broad objectives needed; additional registry data would be helpful* Procedure/Treatment **MAY BE CONSIDERED**	CLASS III *Risk ≥ Benefit* Procedure/Treatment should **NOT** be performed/administered **SINCE IT IS NOT HELPFUL AND MAY BE HARMFUL**
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	■ Recommendation in favor of treatment or procedure being useful/effective ■ Some conflicting evidence from multiple randomized trials or meta-analyses	■ Recommendation's usefulness/efficacy less well established ■ Greater conflicting evidence from multiple randomized trials or meta-analyses	■ Recommendation that procedure or treatment is not useful/effective and may be harmful ■ 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	■ Recommendation in favor of treatment or procedure being useful/effective ■ Some conflicting evidence from single randomized trial or nonrandomized studies	■ Recommendation's usefulness/efficacy less well established ■ Greater conflicting evidence from single randomized trial or nonrandomized studies	■ Recommendation that procedure or treatment is not useful/effective and may be harmful ■ 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 expert opinion, case studies, or standard of care	■ Recommendation in favor of treatment or procedure being useful/effective ■ Only diverging expert opinion, case studies, or standard of care	■ Recommendation's usefulness/efficacy less well established ■ Only diverging expert opinion, case studies, or standard of care	■ Recommendation that procedure or treatment is not useful/effective and may be harmful ■ Only expert opinion, case studies, or standard of care
Suggested phrases for writing recommendations†	should is recommended is indicated is useful/effective/beneficial	is reasonable can be useful/effective/beneficial is probably recommended or indicated	may/might be considered 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

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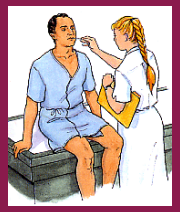
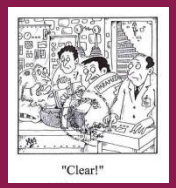


Preanaesthetic Assessment

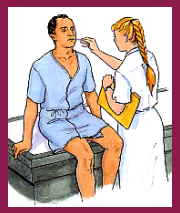
Preexisting or Associated Medical Conditions

Preoperative Medications

Anaesthetic Management



Postoperative Care & Complications



Preanaesthetic Assessment

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Urgency of the Operation:

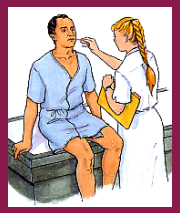
- Preop. Exam.
- Team spirit, Infrastructure, Protocols

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 IIa B

Single-Lung Ventilation for Thoracotomy

Potential for Bleeding

Taylored & Individualized Anesthetic Technique & Monitoring I C

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_vO_2

TEE IIa B

ACC/AHA/ASE 2003 Guideline Update for the Clinical Application of Echocardiography: summary article. A report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (ACC/AHA/ASE Committee to Update the 1997 Guidelines for the Clinical Application of Echocardiography).

Cheitlin MD, Armstrong WF, Aurigemma GP, Beller GA, Bierman FZ, Davis JL, Douglas PS, Faxon DP, Gillam LD, Kimball TR, Kussmaul WG, Pearlman AS, Philbrick JT, Rakowski H, Thys DM, Antman EM, Smith SC Jr, Alpert JS, Gregoratos G, Anderson JL, Hiratzka LF, Faxon DP, Hunt SA, Fuster V, Jacobs AK, Gibbons RJ, Russell RO; ACC; AHA; ASE.

Journal of the American Society of Echocardiography
Volume 16 Number 10

Cheitlin MD, Alpert JS, Armstrong WF, Aurigemma GP, Beller GA, Bierman FZ, Davidson TW, Davis JL, Douglas PS, Gillam LD, et al.

ACC/AHA guidelines for the clinical application of echocardiography.
A report of the American College of Cardiology American Heart Association Task Force on Practice Guidelines: Committee on Clinical Application of Echocardiography.

Circulation 1997 Mar 18;95(6):1686-744.

10th Christmas Echo

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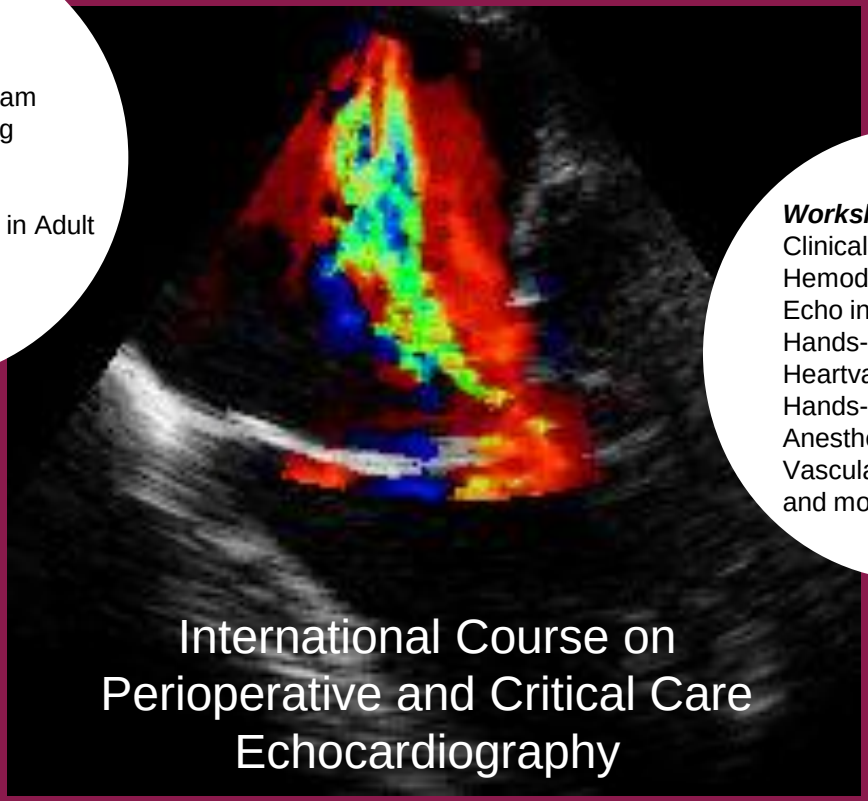
Test yourself!
Basic course
Pre-and post-course exam
Image regognitiontesting
Advanced course
Simulated exam for the European Accreditation in Adult Transesophageal Echocardiography



International Course on Perioperative and Critical Care Echocardiography

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

AORTIC DISEASE
J. CODDENS

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

Anaesthetic Pharmacology

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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.
Buylaert WA, Herregods LL, Mortier EP, Bogaert MG.
Department of Emergency Medicine,
University Hospital, Belgium.
Clin. Pharmacokinet. 1989 Jul;17(1):10-26

Dose requirements of infusions of cisatracurium or Rocuronium during hypothermic cardiopulmonary bypass.
Cammu G, Coddens J, Hendrickx 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 Temerature

Single-Lung Ventilation for Thoracotomy

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Double-Lumen Endobronchial Tube

Endobronchial Blocker

Fibroscope

Year	Left	Right
2003	329	36
2004	378	27
2005	351	38
2006	452	25
2007	439	20
2008	458	30
2009	504	30

Yearly DLT intubations OLV

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.
Can J Anaesth. 1993 Jul;40(7):681.

Potential for Bleeding

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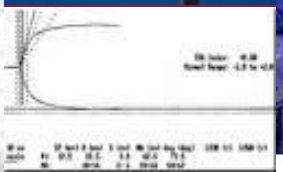
Large-bore intravenous access

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

n=8	AGE (Y)	L (cm)	BW(Kg)	ECC(min)	DH(min)	AoX(min)	CA(min)	PY%	CS(ml)	RBC(U)	FFP(U)	THR(U)
Min	42	169	82	121	17	0	0	9	200	0.0	0.0	0.0
Max	67	181	112	254	32	181	20	18	1450	7.0	4.0	2.0
Mean	54	176	92	184	27	102	4	13	638	1.1	0.5	0.3
Stdev	10	4	10	49	6	59	8	3	401	2.4	1.4	0.8

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 IIa C

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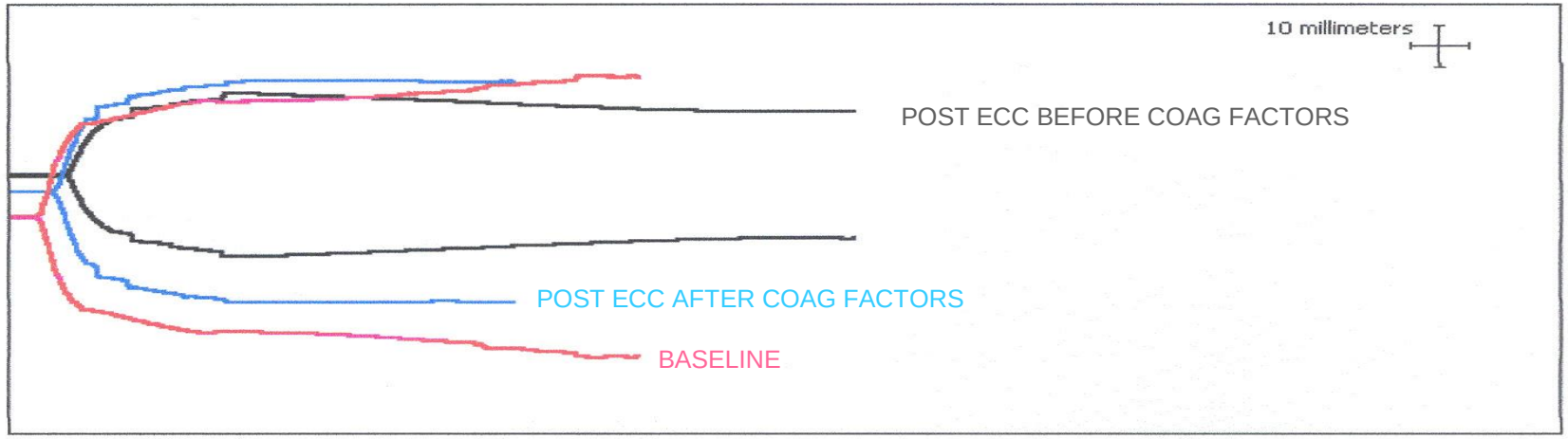
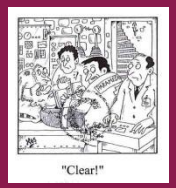


T. Gooris, T. Boghaert, L. Vermassen,
G. Vanvaerenbergh, R. Delahaye, B. Elsen
Dept. of Perfusion, O. L. V. Clinic,
Moorselbaan 164, 9300 AALST, BELGIUM


"Clear!"

Postoperative Care & Complications

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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

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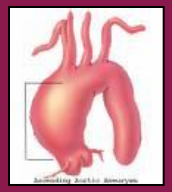


Thoracic Aortic Aneurysms

Ascending Aortic & Arch Aneurysms

Descending Thoracic/Thoracoabdominal Aortic Aneurysms

Aortic Dissection

Type A

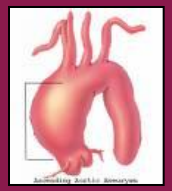
Type B

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.

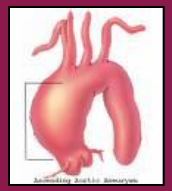
Tamponade

Hemothorax

Aorto-bronchial fistula

Aorto-esophageal fistula

TEE extremely valuable



Aortic Root & Proximal Ascending Aorta:

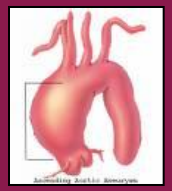
- Sternotomy
- Aortic Cannulation
- ECC

Distal Ascending Aorta & Arch:

- Sternotomy
- Femoral Cannulation
- ECC
- DHCA, ACP, RCP

Descending Aorta:

- Thoraco(phrenolaparo)tomy
- ECC +/-



Ascending & Aortic Arch Aneurysms

Mediastinal Mass Effect:

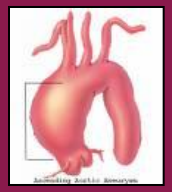
Pulmonary Artery
RVOT
Trachea
Left Mainstem Bronchus

Uni- or bilateral arterial catheters

Nasopharyngeal, tympanic & bladder T

DHCA

EEG, SEP, S_vO_2



Brainprotective Strategies IIb

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2 Mechanisms: Hypoperfusion
Embolism

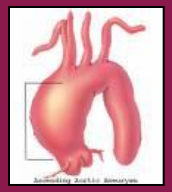
DHCA IIa B, Topical Cerebral Cooling

Retrograde Cerebral Perfusion IIa B

Selective Antegrade Cerebral Pefusion IIa B

Prevent Cerebral Hyperthermia during Rewarming IIIb

Pharmacologic Neuroprotection



DHCA:

Incomplete understanding

Autoregulation OK with α-stat

Q_{10} ~ 2.6

Most effective

EEG, S_vO_2

30 min safe at 11-14 C NP T

Topical cooling???

Duration ECC increased

Brain vulnarable during rewarming

Coagulopathy

Retrograde Cerebral Perfusion:

CVP < 25 mm Hg

10 Trendelenburg

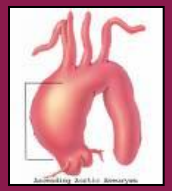
200 – 600 ml/min

Benefits not really proven

Maintenance of cerebral hypothermia

Delivery of substrate

Decreased risk of embolism

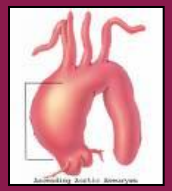


Selective Antegrade Cerebral Perfusion:

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

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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 SIDEBRANCHES & TEE

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Carotid aa LIMA Intercostal aa Mesenteric aa Renal aa (Spinal aa)

Orihasu K, Matsuura Y, Sueda T, Watari M, Okada K, Sugawara Y, Ishii O.
Aortic arch branches are no longer a blind zone for transesophageal echocardiography: a new eye for aortic surgeons.
J Thorac Cardiovasc Surg. 2000 Sep;120(3):466-72.

Kuroda M, Hamada H, Kawamoto M, Orihashi K, Sueda T, Yuge O.
Assessment of internal thoracic artery patency with transesophageal echocardiography during coronary artery bypass graft surgery.
J. Cardiothorac Vasc Anesth. 2009 Dec;23(6):822-7. Epub 2009 Jul 29.

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

Godet G, Couture P, Ionanidis G, Gosgnach M, Kieffer E, Viars P.
Another application of two-dimensional transesophageal echocardiography: spinal cord imaging. A preliminary report.
J Cardiothorac Vasc Anesth. 1994 Feb;8(1): 14-8.

Voci P, Tritapepe L, Testa G, Caretta Q.
Imaging of the anterior spinal artery by transesophageal color Doppler ultrasonography.
J Cardiothorac Vasc Anesth. 1999 Oct;13(5): 586-7.

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**

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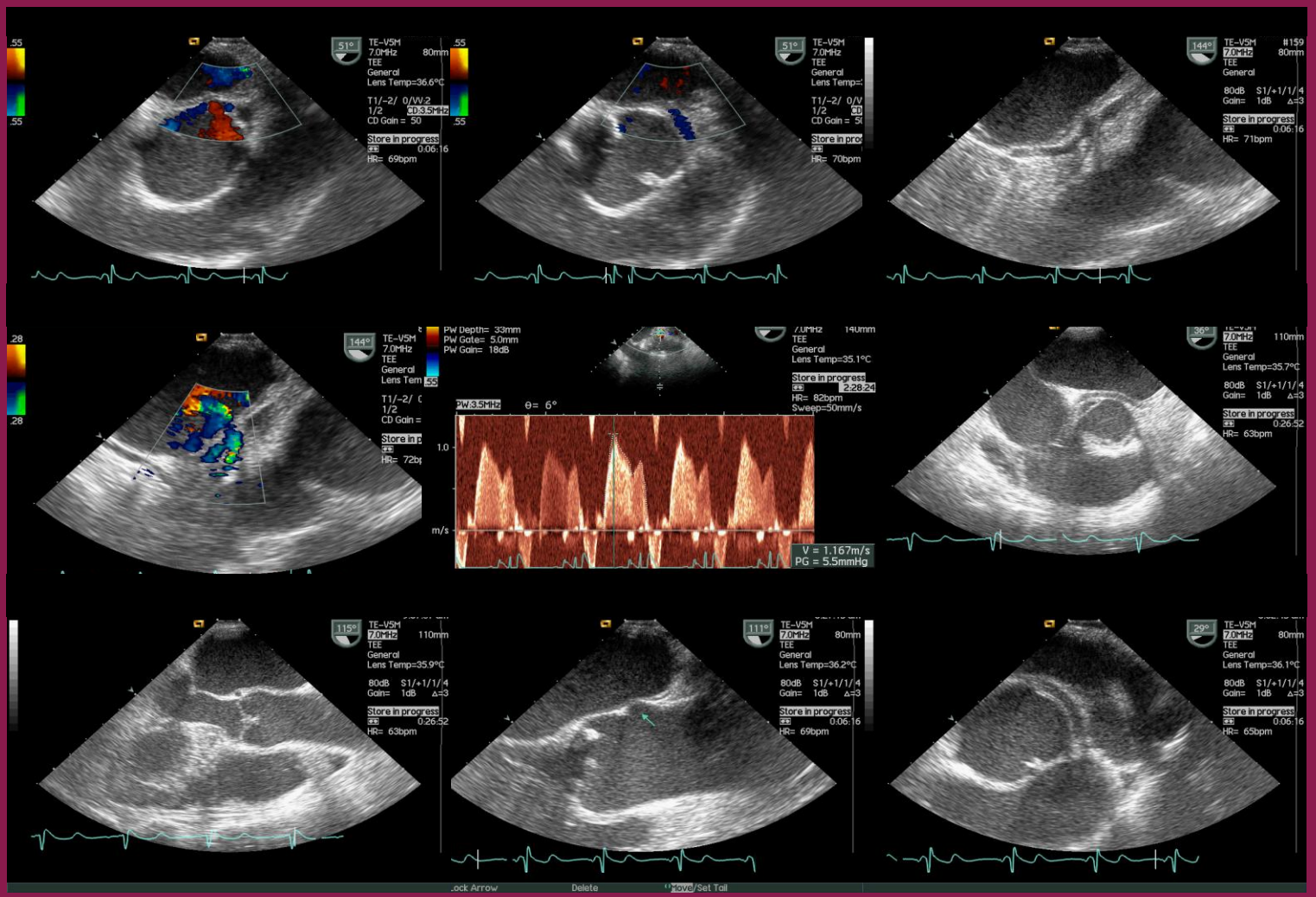
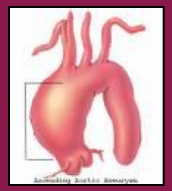




Surgical Techniques

Simple Aortic Cross-Clamp:

- Cross-Clamp Time
- Distal Ischemia
- Anhepatic Phase

Gott Shunt

Partial Left Heart Bypass:

- Distal Aortic Arch, Proximal Descending Aorta
- Protection of Spinal Cord & Mesenteric Organs

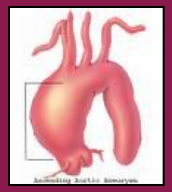
ECC & DHCA

Endovascular Stent Graft

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

Time (Minutes)	Paraplegia (Percentage)	Renal Failure (Percentage)
0–15	0	0
16–30	3.5	4.2
31–45	10.0	7.8
46–60	12.5	6.3
>60	25.0	0

Source: Modified from JJ Livesay, DA Cooley, RA Ventemiglia, et al. Surgical experience in descending thoracic aneurysmectomy with and without adjuncts to avoid ischemia. Ann Thorac Surg 1984;39:37.



Renal Protection Strategies:

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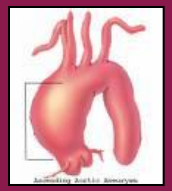
Preoperative hydration & intraoperative mannitol in open repair of the descending aorta IIb C

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 IIb B

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 heath 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

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VASCULAR SURGERY	2000	2001	2002	2003	2004	2005	2006	2007	2008
Nbr of interventions (# dcf's)	**679**	**688**	**681**	**637**	**563**	**603**	**644**	**537**	**654**
THORACIC AORTA SURGERY	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
Nbr of thoracic aorta interventions	**87**	**79**	**93**	**98**	**78**	**76**	**113**	**77**	**61**
ASCENDING AORTA - ARCH	**63**	**52**	**69**	**70**	**55**	**49**	**76**	**54**	**45**
ARR mechanical or bioprosthesis	*21*	*23*	*34*	*32*	*20*	*25*	*41*	*16*	*21*
ARR with homograft	*11*	*8*	*4*	*4*	*2*	*3*	*4*	*3*	*0*
ARR with native valve reimplantation (David)	*2*	*7*	*15*	*2*	*1*	*2*	*2*	*4*	*0*
AVR or AVP with graft	*2*	*2*	*9*	12	*8*	*6*	*10*	*13*	*7*
Graft and/or repair	*21*	*11*	*6*	19	*22*	*13*	*15*	*14*	*14*
Endoprosthesis (stentgraft)	6	*1*	*1*	*1*	*1*	*0*	*4*	*3*	*3*
Dilatation					*1*	*0*	*0*	*0*	*0*
OTHER								*1*	
DESCENDING AORTA	**14**	**18**	**13**	**13**	**15**	**17**	**22**	**19**	**15**
Graft and/or repair	*8*		*1*	*1*	*4*	*2*	*2*	*1*	*0*
Dilatation with stent					*1*	*0*	*0*	*0*	*0*

ICU stay (days) TAA open surgery survivors OLV Clinic 01/01/2000 to 01/01/2010

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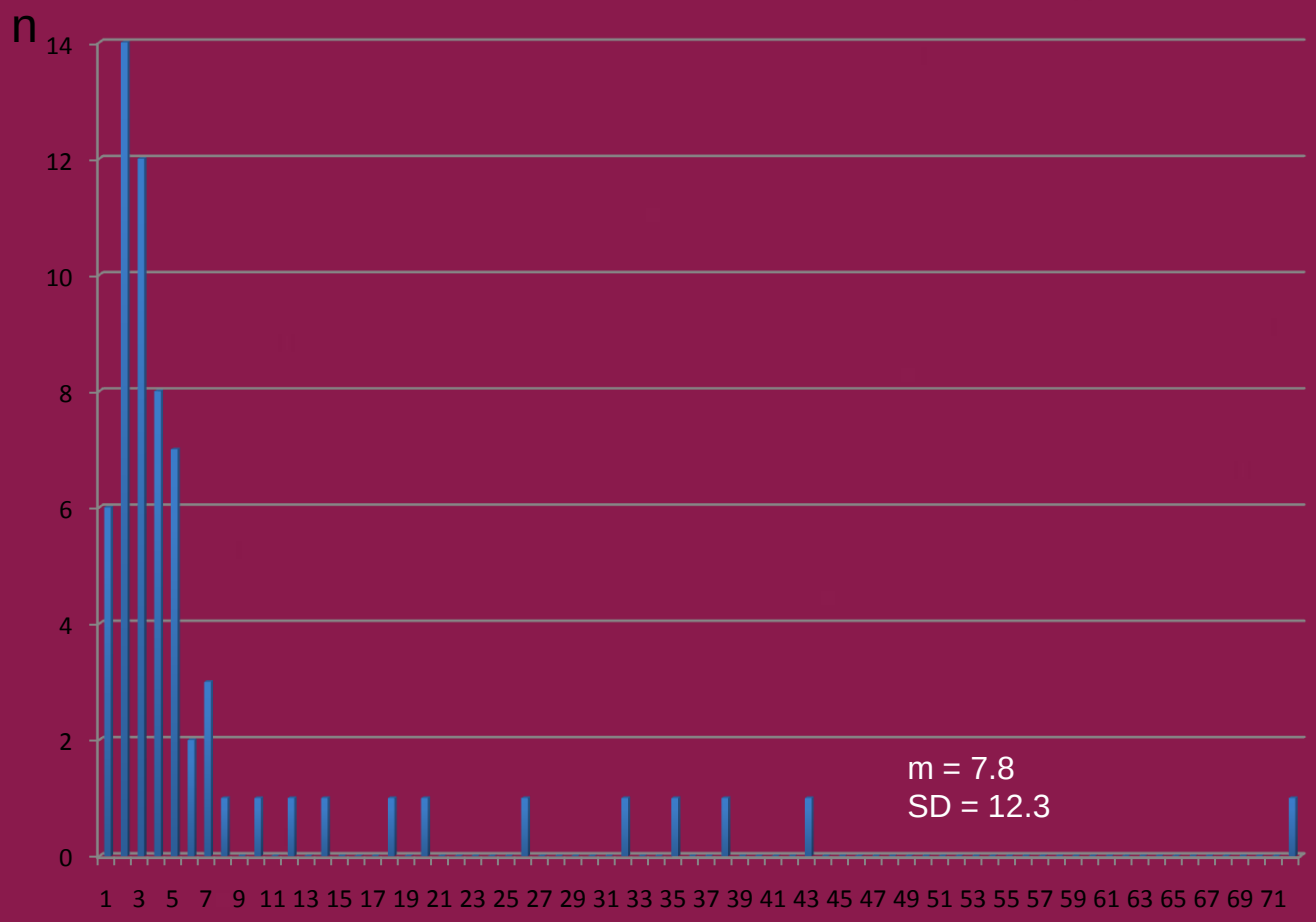
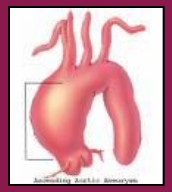
n = 85 Death = 21 Readmission = 5



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



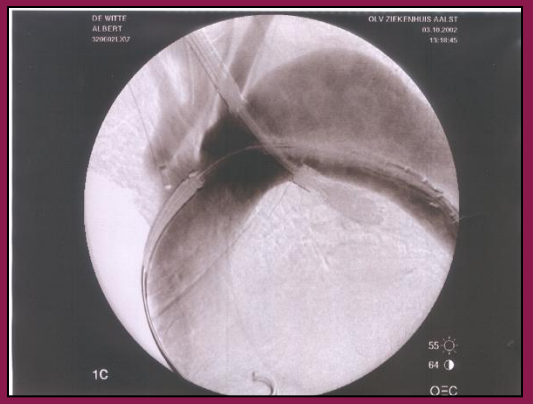
Endovascular Stent Graft

Advantages of TEE:

- **Non-invasive**
- **No use of contrast agents**
- **100% sensitivity & specificty to detect endoleaks**
  (Echocardiography-assisted surgery in transaortic endovascular stent grafting: Role of transesophageal echocardiography. Orihashi K, Matsuura Y, Sueda T, et al. J Thorac Cardiovasc Surg 120: 672-678, 2000)

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
J. Cardiothorac Vasc Anesth, Vol 16, No 2 (April), 2002: pp 218-233

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

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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.

ANESTHESIA & ANALGESIA

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:

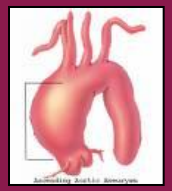
Detection of multiple entry sites
Detection of false lumen slow flow after stent implantation
Detection of incomplete stent apposition
Visualisation of guide wire postion over the entire length

TEE superior to INVUS & ANGIO:

Detection of endoleaks

Circulation
Journal of the American Heart Association
American Heart Association
Learn and Live

olv Top in Zorg.



Endo-Leak: 3 Types

I Attachment site leak

- –A Proximal leak
- –B Distal leak
- –C Iliac occluder (seen with repair AAA)

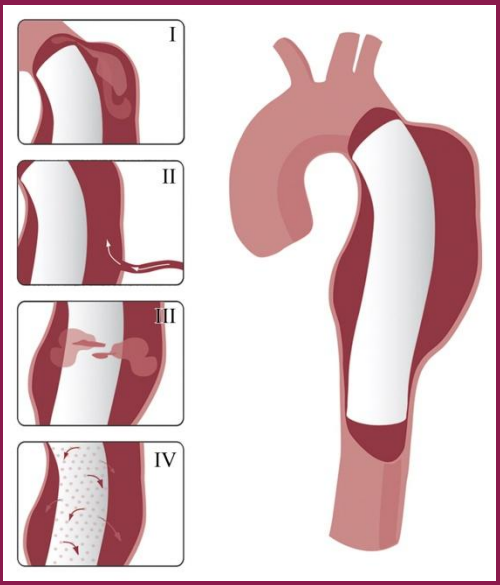
II Branch leaks

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

III Graft defect

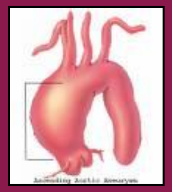
- –A Midgraft hole
- –B Junctional leak or graft disconnection
- –Other mechanism, e.g. failure from suture holes

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 III C

Right Radial Artery Catheter (prox. pressure)

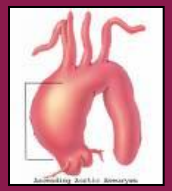
Femoral Artery Catheter (distal pressure)

CVP, PAP, CO, SVO2

SSEP, MEP

Postoperative pain management

Prevention of Postoperative Paraplegia



Postoperative Paraplegia

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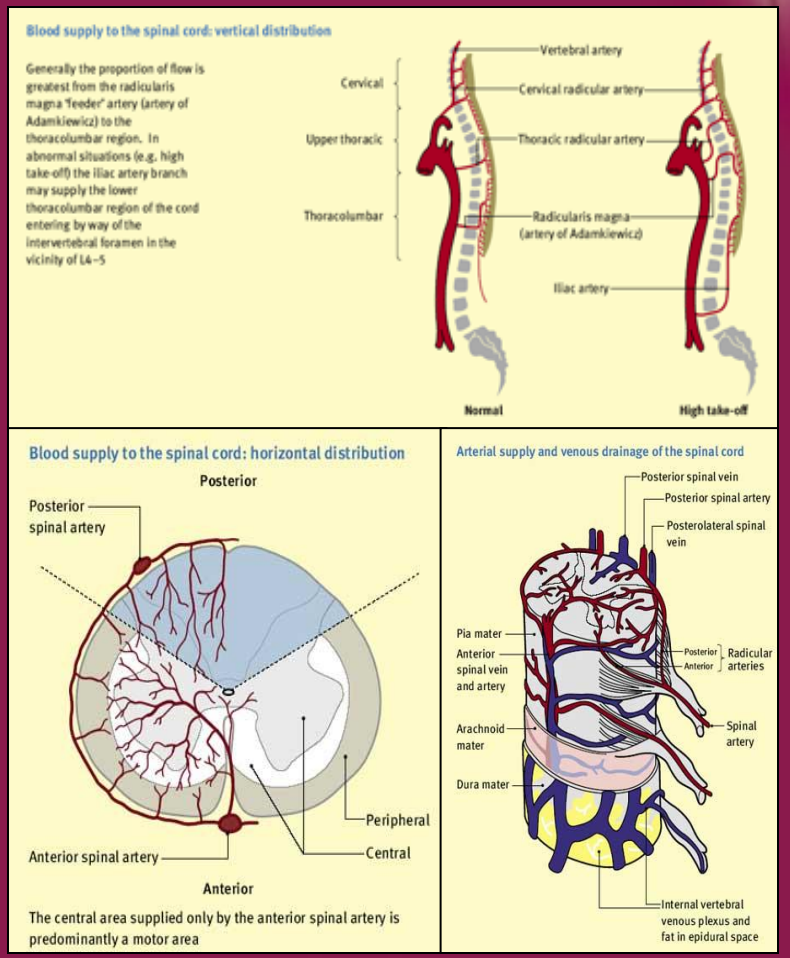
Risk Factors:

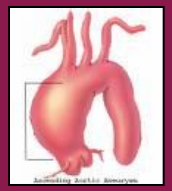
- Aneurysm Extent
- Hypotension or Cardiogenic Shock
- Emergency Operation
- Aortic Rupture
- Presence of Dissection
- Duration of Cross Clamp
- Sacrifice of Intercostal or Segmental Arteries
- Prior Thoracic or Abdominal Aneurysm Repair
- Prior Repair of Type A Dissection
- Occlusive Peripheral Vascular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

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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 arteies
- 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

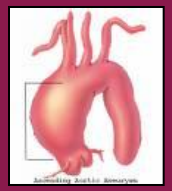
- SSEP's, MEP's

Postoperative Neurologic Evaluation for Early Detection of Delayed-onset Paraplegia

- Serial neurologic examinations

Pharmacological Neuroprotection IIb B

- Glucocorticoïd, Barbiturates, $MgSO_4$, Mannitol, Naloxone, Lidocaïne, Intrathecal papaverine



Lumbar CSF Drainage: Prevention & Treatment

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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 normalneurologic exam & coagulation

Complications:
Epidural hematoma
Intradural hematoma
Catheter fracture
Meningitis
Intracranial hypotension
Lumbar puncture headache

Journal of
Cardiothoracic and
Vascular Anesthesia

PRO AND CON

Paul G. Barash, MD
Section Editor

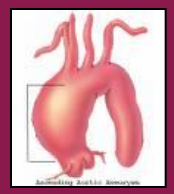
Pro: Cerebrospinal Fluid Drainage Protects the Spinal Cord During Thoracoabdominal Aortic Reconstruction Surgery

Sherif Afifi, MD, FCCM

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

Lee Wallace, MD

Journal of Cardiothoracic and Vascular Anesthesia, Vol 16, No 5 (October), 2002: pp 650-652



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

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Cochrane Library Document http://www.update-software.com/CLI...(SPINAL+and+(CORD+and+PROTECTION))

The Cochrane Library

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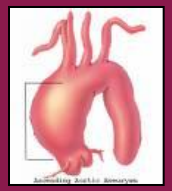
History

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

Ling E, Arellano R. Systematic overview of the evidence supporting the use of cerebrospinal fluid drainage in thoracoabdominal aneurysm surgery for prevention of paraplegia. *Anesthesiology*2000, 93(4), 1115-1122.

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

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

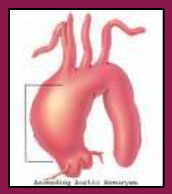
Loss of segmental arteries
Hypotension
Ischemic sympathetic dysfunction

➔Decreased CSF Perfusion Pressure

Combined with CSF drainage

Norepinephrine
Phenylephrine
Epinephrine
Vasopressin
MAP > 80 – 100 mm Hg

Documented effectiveness



Intraoperative Neurophysiologic Monitoring

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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 interferenc

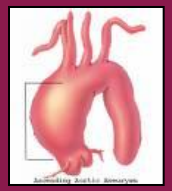
Comparison of lower to upper extremity

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 postion 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

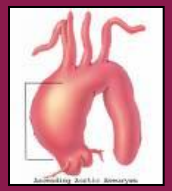
Mg++SO4-

Ca++ channel antagonists

Papaverine

Naloxone

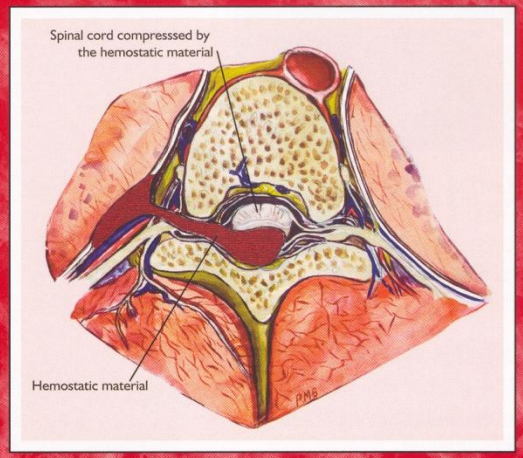
No evidence of efficacy



Postoperative Pain Management

Vol 20, No 5 October 2006

Journal of
Cardiothoracic and
Vascular Anesthesia



Special Articles

- REGIONAL ANESTHESIA AND THORACIC SURGERY
- ORGAN TRANSPLANTATION AND BYPASS TECHNIQUES
- RECOMBINANT FACTOR VIIa

Full-Text: www.JCVAonline.com
Submit Manuscript: http://ees.elsevier.com/jcva

Elsevier

Regional techniques are not recommended in patients at risk for epidural hematoma formation III C

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Incidence of epidural haematoma and neurological injury in cardiovascular patients with epidural analgesia/anaesthesia: systematic review and meta-analysis.
Ruppen W. Derry S. McQuay HJ, Moore RA
BMC Anesthesiol. 2006 Sep 12;6:10.

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

Intrathecal and epidural anesthesia and analgesia for cardiac surgery.

Chaney MA.

Anesth Analg 2006;102:45–64.

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

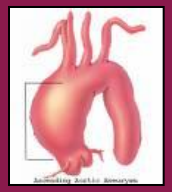
[Letters to the Editor]

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.

Cardiac surgery versus thoracic/thoracoabdominal aortic surgery: spinal cord ischemia.

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

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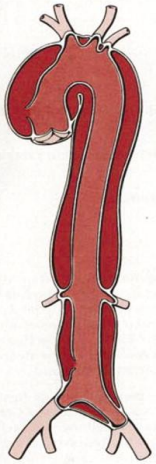
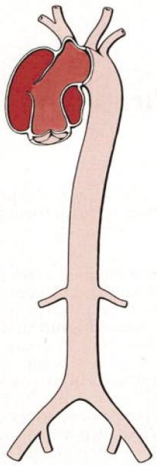
De Bakey Type I	Type II	Type III
		
Stanford	**Type A**	**Type B**

De Bakey

Type I	Originates in the ascending aorta, propagates at least to the aortic arch and often beyond it distally
Type II	Originates in and is confined to the ascending aorta
Type III	Originates in the descending aorta and extends distally down the aorta or, rarely, retrograde into the aortic arch and ascending aorta

Stanford

Type A	All dissections involving the ascending aorta, regardless of the site of origin
Type B	All dissections not involving the ascending aorta

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

olv Top in Zorg.

Predisposing Factors for Aortic Dissection:

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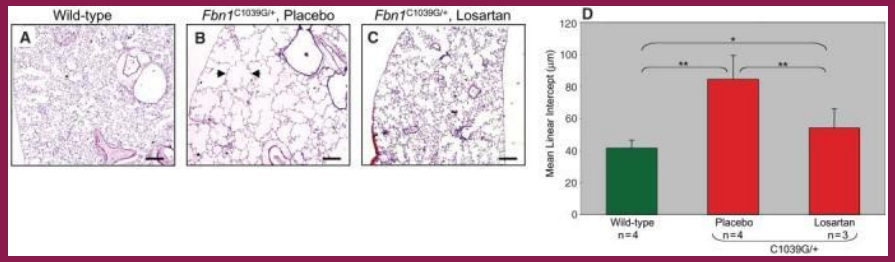
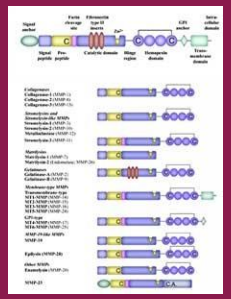
Hypertension
Cystic Media Degeneration
Atherosclerosis

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

Pregnancy
Crack Cocaïne Abuse
Arteritis
Aortic Trauma/Iatrogenic

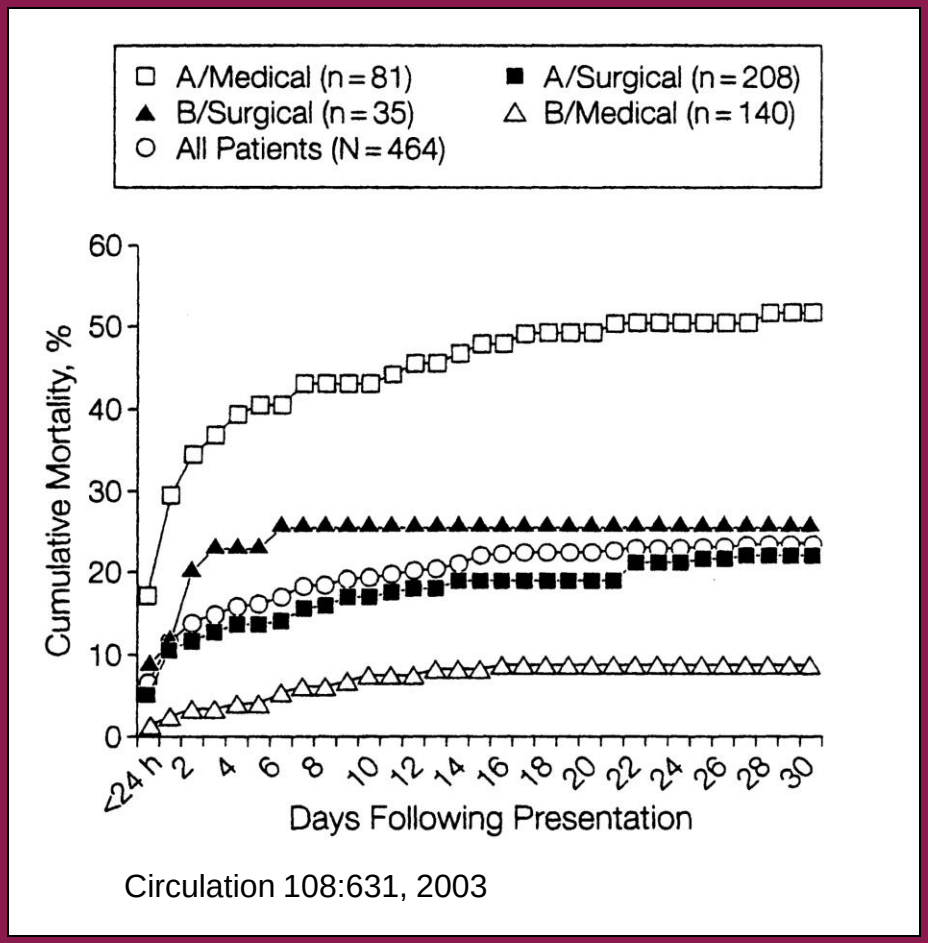


Habashi JP, Judge DP, Holm TM, Cohn RD, Loeys BL, Cooper TK, Myers L, Klein EC, Liu G, Calvi C, Podowski M, Neptune ER, Halushka MK, Bedja D, Gabrielson K, Rifkin DB, Carta L, Ramirez F, Huso DL, Dietz HC.Related Articles.
Losartan, an AT1 antagonist, prevents aortic aneurysm in a mouse model of Marfan syndrome.
Science. 2006 Apr 7;312(5770):117-21.



MMP Inhibition in Abdominal Aortic Aneurysms: Rationale for a Prospective Randomized Clinical Trial
ROBERT W. THOMPSON[1,*], B. TIMOTHY BAXTER[2]
Annals of the New York Academy of Sciences
Volume 878, pages 159–178, June 1999

Type A versus Type B



Circulation 108:631, 2003

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ORIGINAL ARTICLE

Volume 328:1-9 January 7, 1993 Number 1 Next ▸

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

Advantage	Aortography	CT	MRI	TEE
Readily available	Fairly	Quite	Fairly	Very
Rapid	Fairly	Quite	Fairly	Very
Performed at patient's bedside	No	No	No	Yes
Noninvasive	No	Yes	Yes	Yes
Does not use intravenous contrast agent	No	No	Yes	Yes
Cost	High	Reasonable	Moderate	Reasonable

*TEE denotes transesophageal echocardiography.

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REVIEW ARTICLE

MEDICAL PROGRESS

◂ Previous Volume 328:35-43 January 7, 1993 Number 1 Next ▸

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

Variable	Aortography	CT	MRI	TEE
Sensitivity	++	++	+++	+++
Specificity	+++	+++	+++	++/+++
Site of intimal tear	++	+	+++	++
Presence of thrombus	+++	++	+++	+
Presence of aortic insufficiency	+++	−	+	+++
Pericardial effusion	−	++	+++	+++
Branch-vessel involvement	+++	+	++	+
Coronary-artery involvement	++	−	−	++

*TEE denotes transesophageal echocardiography, +++ denotes excellent results, ++ good results, + fair results, and − not detected.

Anesthetic Management

2nd International Meeting
on Aortic Diseases
New insights into an old problem
September 30 & October 1-2 2010
Liège, Belgium

Acute Dissection = Emergency

Type A ➔ Surgery
Type B ➔ Medical/Surgical

Endovascular approach

Type A ~ Ascending AA + DHCA
Type B ~ TAAA

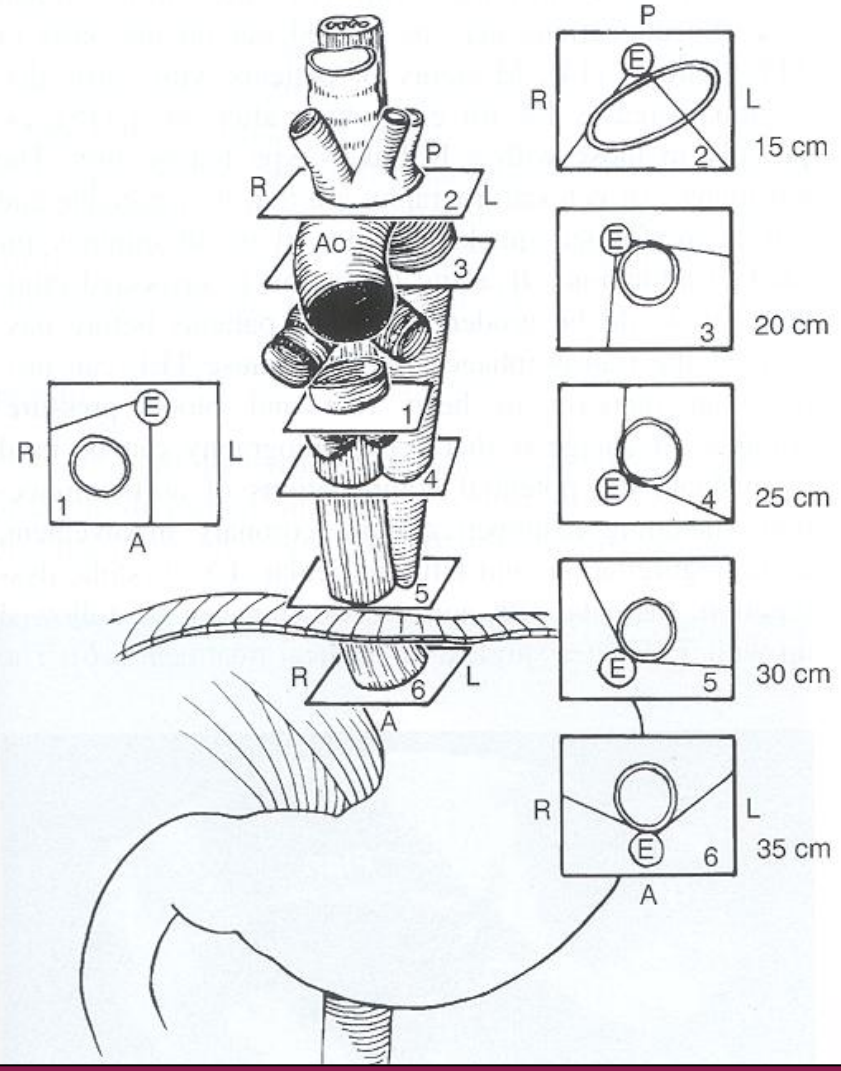
TEE

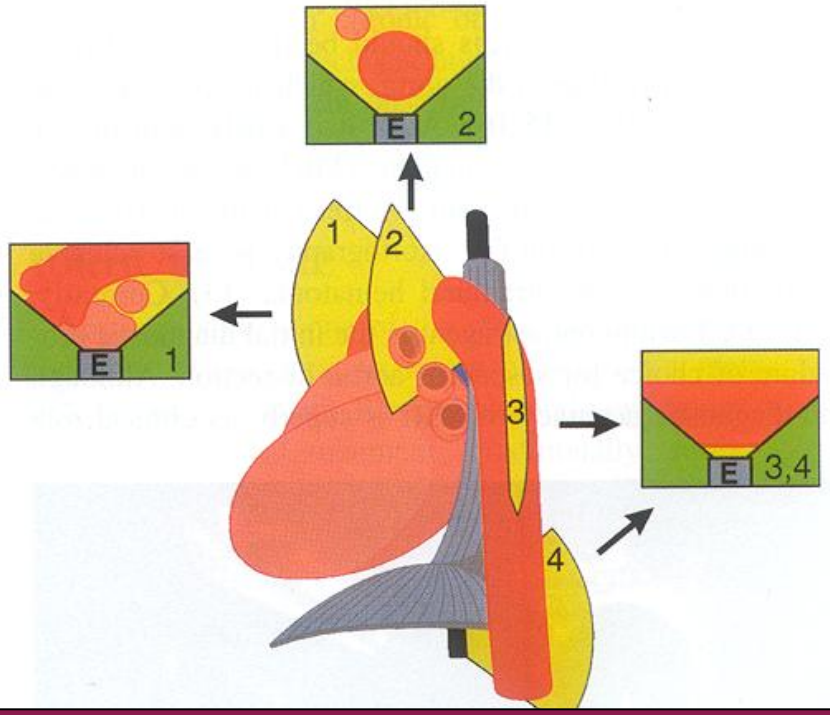
CLINICAL MANUAL
AND REVIEW OF
TRANSESOPHAGEAL
ECHOCARDIOGRAPHY

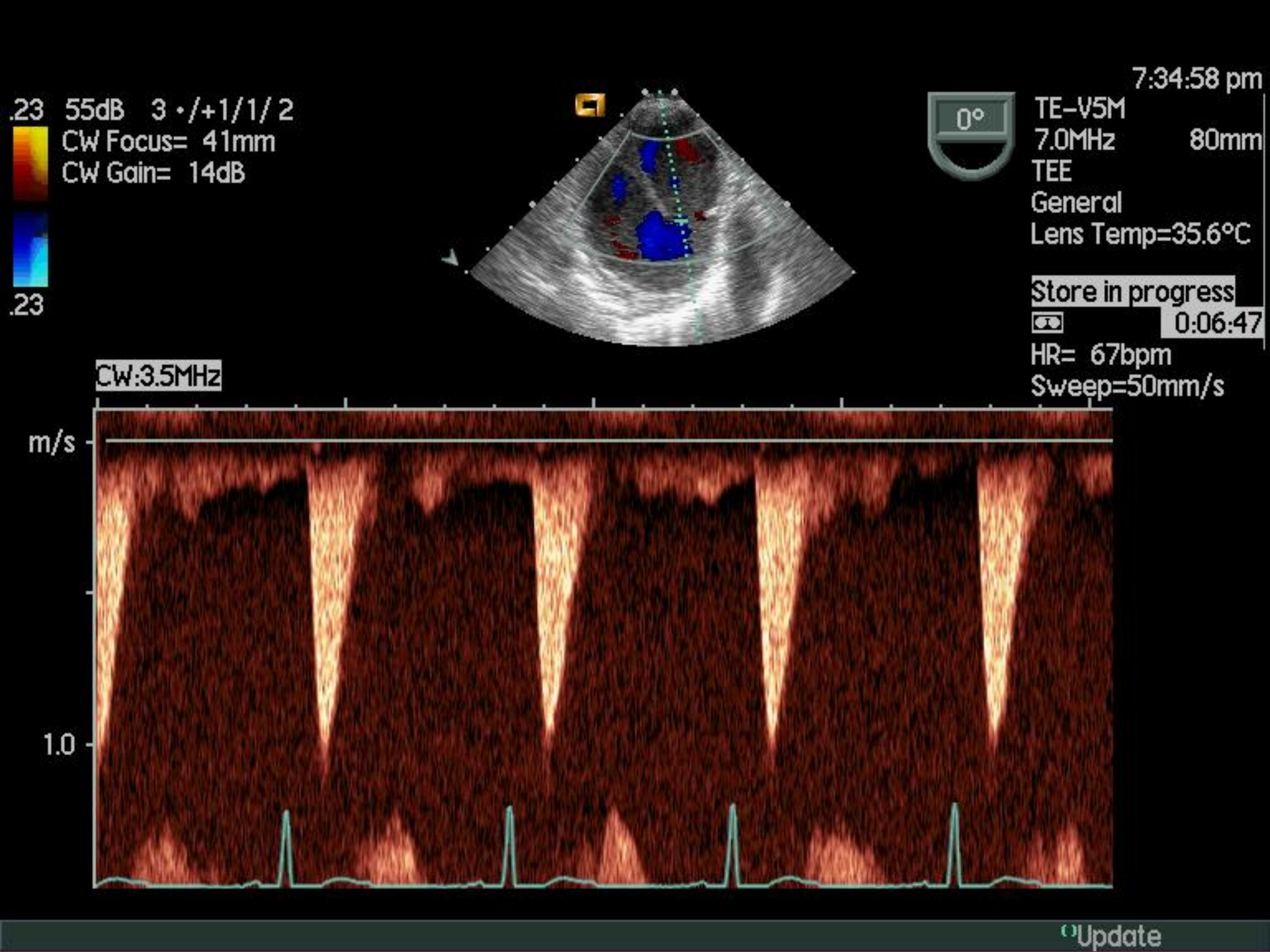
Diseases of the Aorta 11

Jose Coddens

JOSEPH P. MATHEW
CHAKIB M. AYOUB



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General
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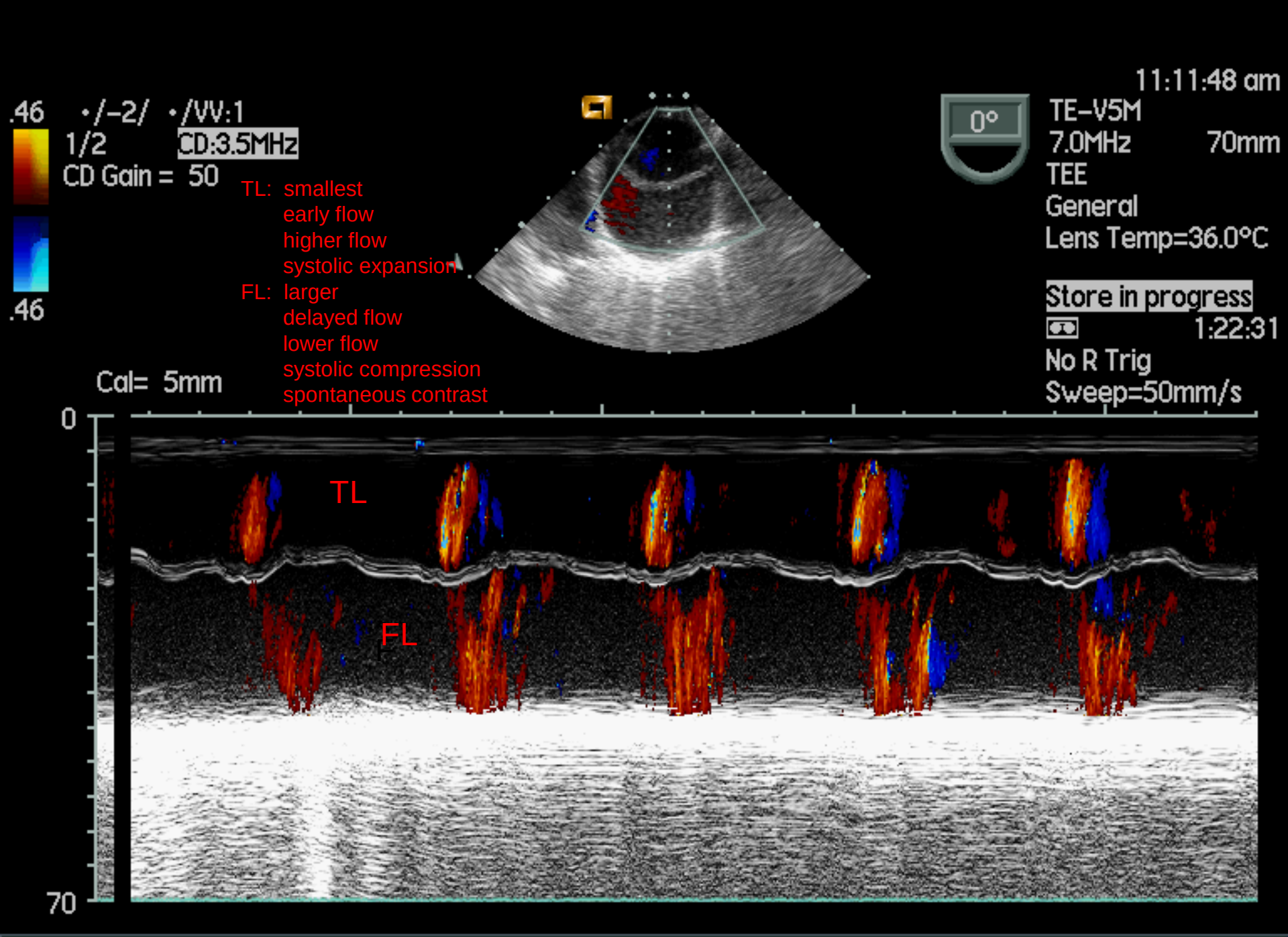
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TL: smallest
early flow
higher flow
systolic expansion
FL: larger
delayed flow
lower flow
systolic compression
spontaneous contrast
0°
TE-V5M
7.0MHz 70mm
TEE
General
Lens Temp=36.0°C
Store in progress
1:22:31
No R Trig
Sweep=50mm/s
Cal= 5mm
0
TL
FL
70

Retrograde type A dissection: No entry tear in Ascending Aorta

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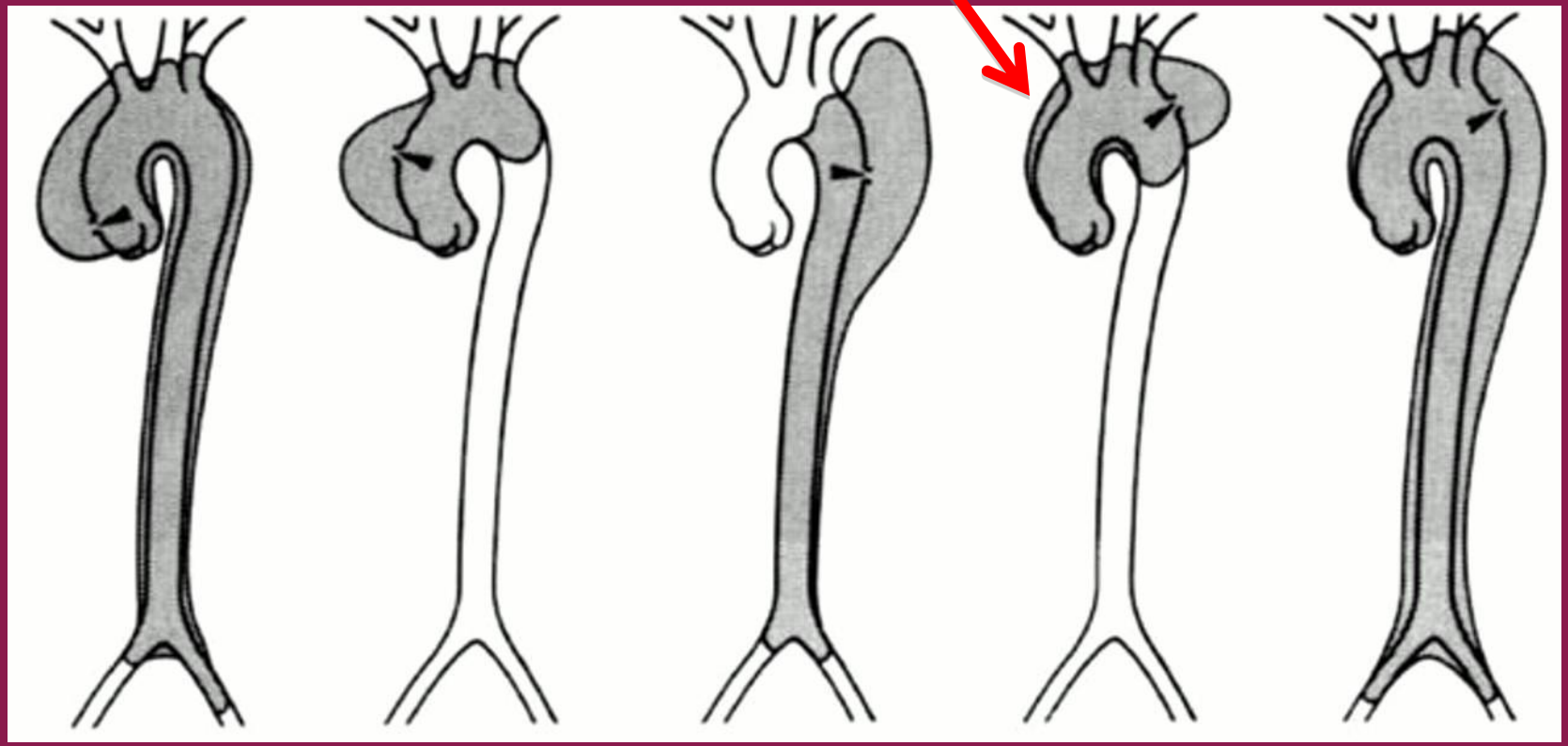


Left Ventricular Diastolic Dysfunction in Chronic Aortic Type B Dissection

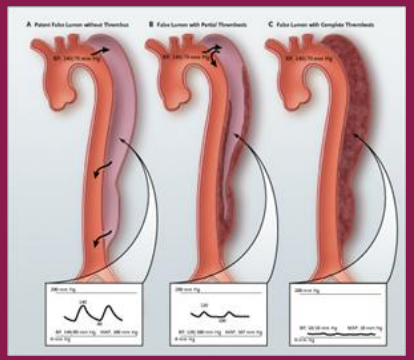
The Annals of Thoracic Surgery Volume 83, Issue 4
April 2007, Pages 1356-1360

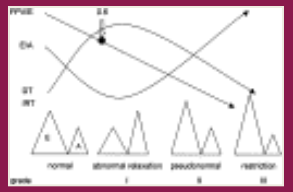
Yasushige Shingu MD[a], , , Norihiko Shiiya MD, PhD[a], Taisei Mikami MD, PhD[b], Kenji Matsuzaki MD[a], Takashi Kunihara MD, PhD[a] and Yoshiro Matsui MD, PhD[a]

Group I = double barreled with narrow TL
Group II = thrombosed FL

Transmitral Flow Properties and Diastolic Dysfunction Grade

Case	E/A	DT (ms)	IRT (ms)	FPV (cm/s)	FPV/E	Grade
Group I						
1	0.89	230	80	—	—	I
2	0.84	240	90	—	—	I
3	1.58	225	105	30	0.35	II
4	1.56	192	75	50	0.46	II
5	0.71	242	86	—	—	I
6	1.00	225	100	40	0.44	II
7	1.58	225	100	36	0.56	II
Group II						
1	0.48	220	115	—	—	I
2	0.79	—	78	—	—	I
3	0.70	235	125	—	—	I
4	0.51	305	70	—	—	I
5	0.91	250	—	—	—	I





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:

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Extracorporeal technologies

Neuroprotective strategies

Transfusion & coagulation

One-lung ventilation

TEE

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