Cardiovascular & Thoracic Research
What's New and Exciting?

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NO DISCLOSURES

Agenda

- Cardiac
  - Percutaneous Heart Valves (TAVI)
  - Sternotomy Closure with Rigid Fixation
  - Ventricular Assist Devices
  - Stem Cell Therapy

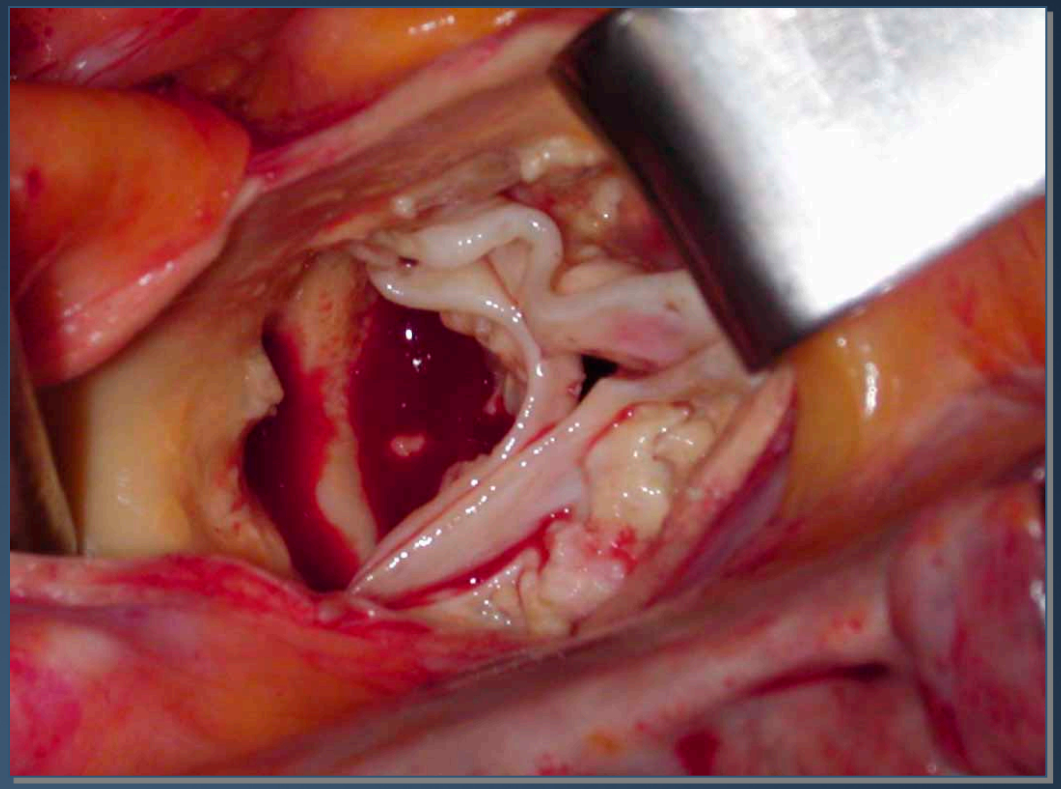
- Vascular
  - Critical Limb Ischemia with Stem Cells
  - Endovascular Stent Grafting (TAVAR, EVAR)

Percutaneous Aortic Valve Replacement
Current Status and Future Directions

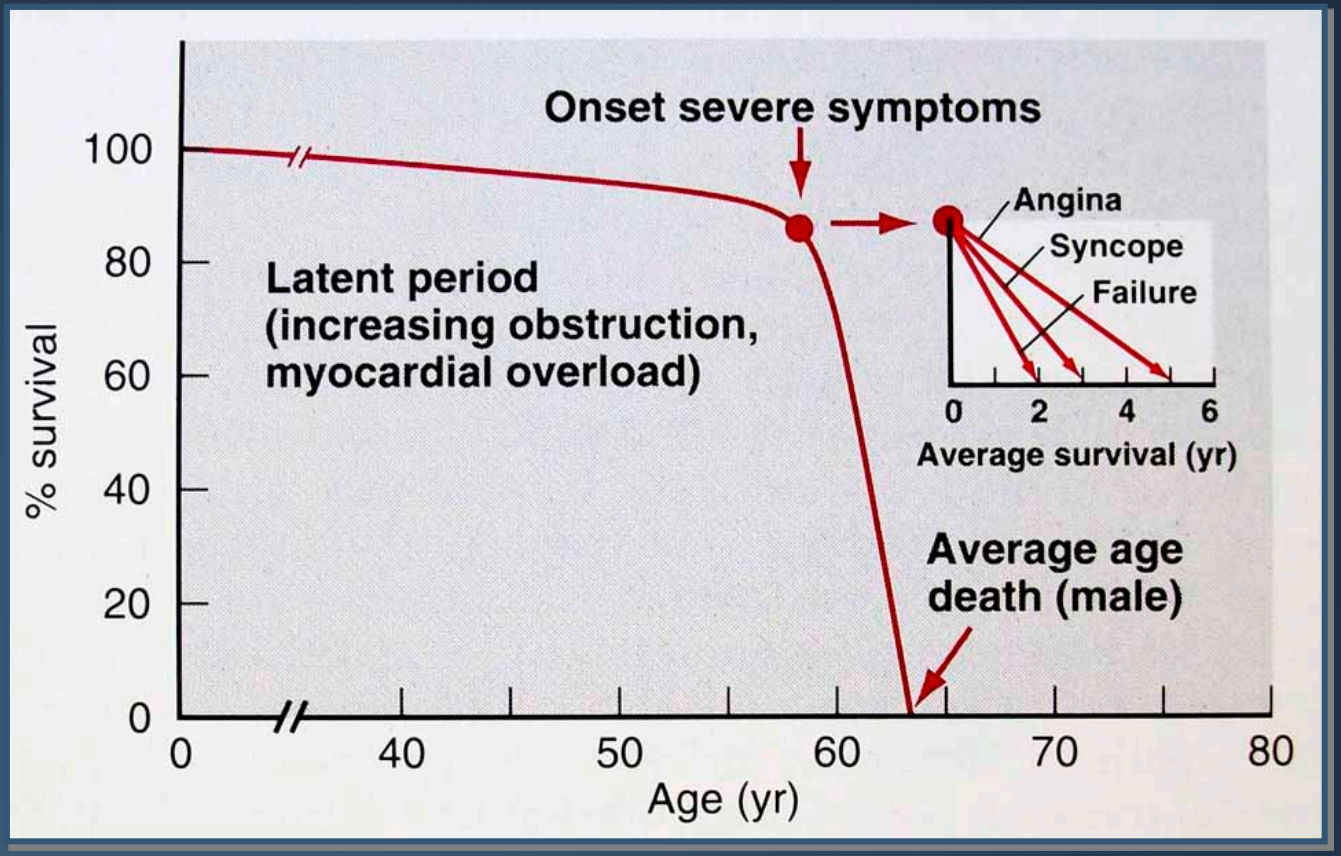
Aortic Stenosis------Disease of Aging

" It says here that you'd prefer someone with regular bowel movements..Does it matter if they're involuntary ? "

Tricuspid Aortic Valve



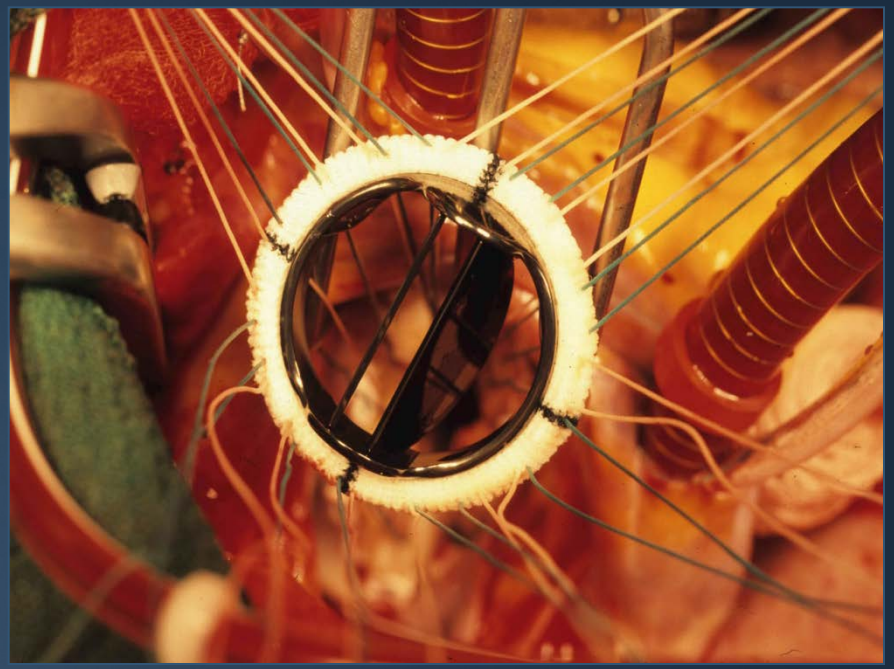
Importance of Symptoms



Cardiac Valve Selection

No coumadin *vs.* **Durability**

Edward's pericardial Magna® valve



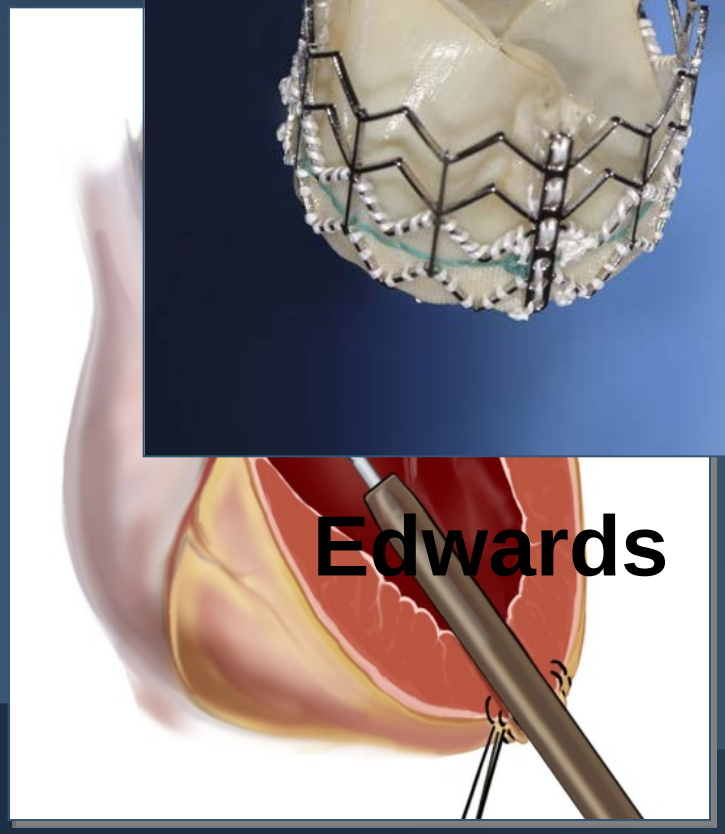
St. Jude Medical, Inc valve

"I don't think we're in Kansas anymore, Toto."

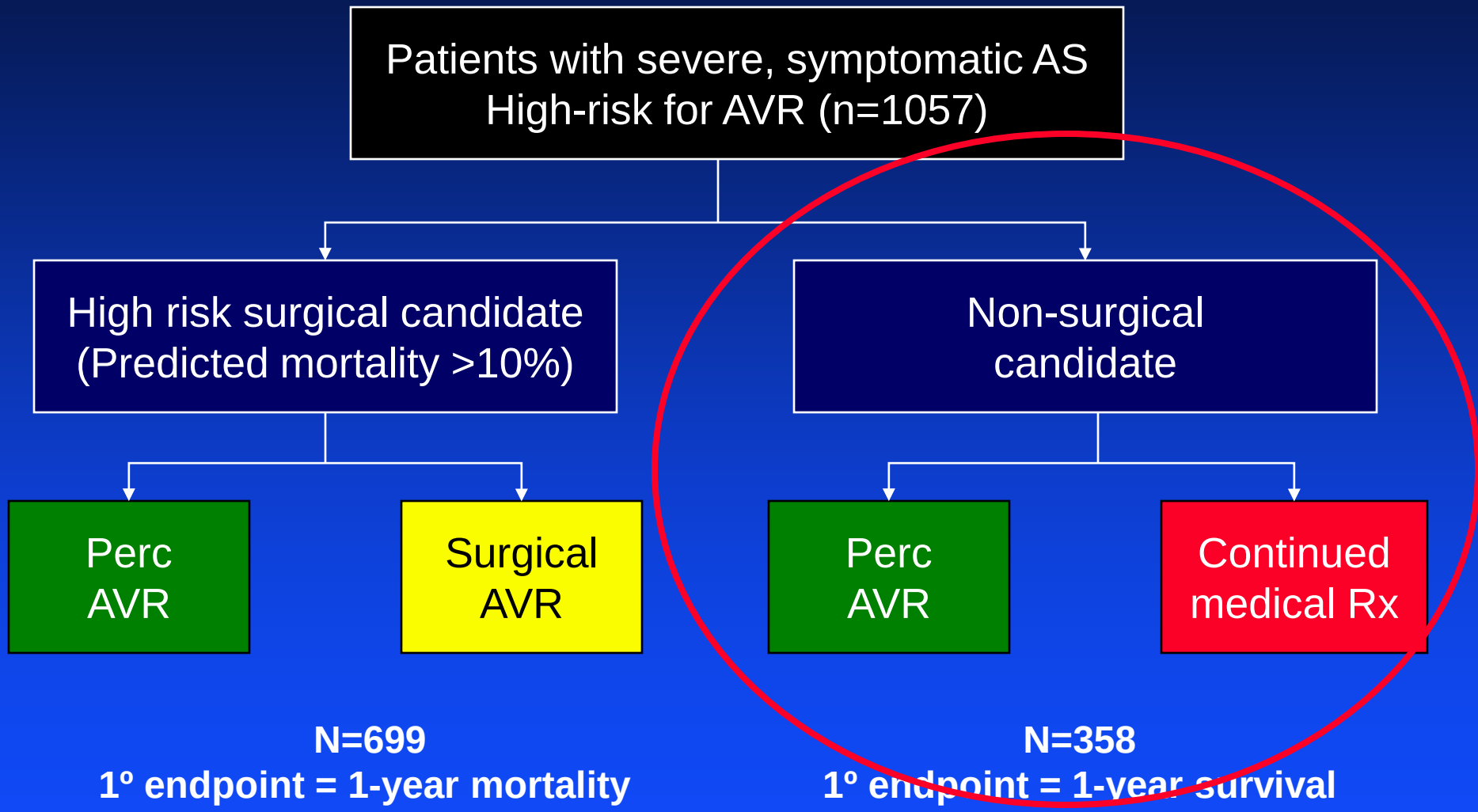
Percutaneous AVR

Antegrade Transapical

Retrograde Transfemoral



PARTNER Trial: Edwards Lifesciences

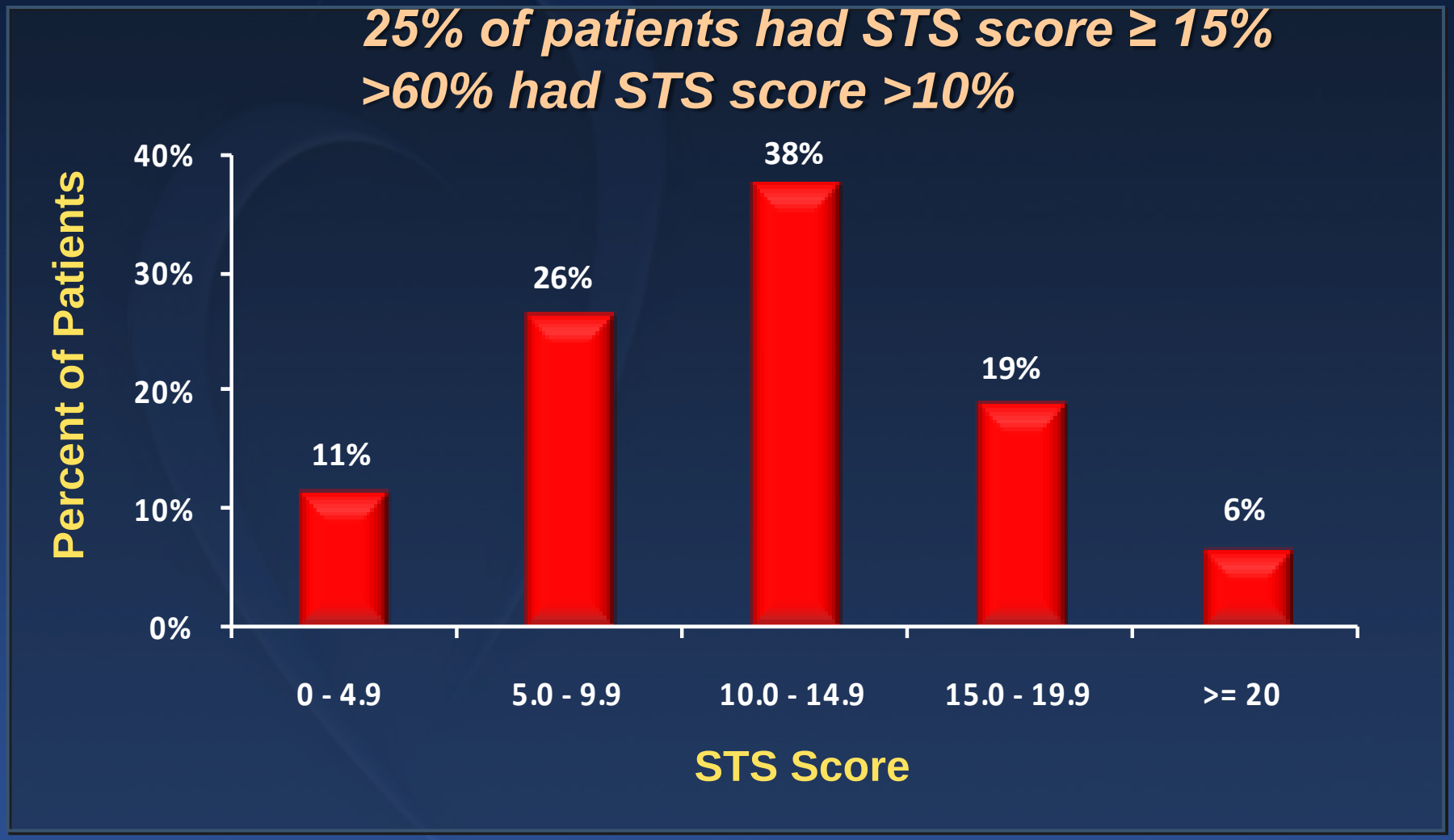


N=699
1º endpoint = 1-year mortality
Non-inferiority comparison

2º endpoint: death, MI, stroke

N=358
1º endpoint = 1-year survival
Superiority comparison

Distribution of STS Scores

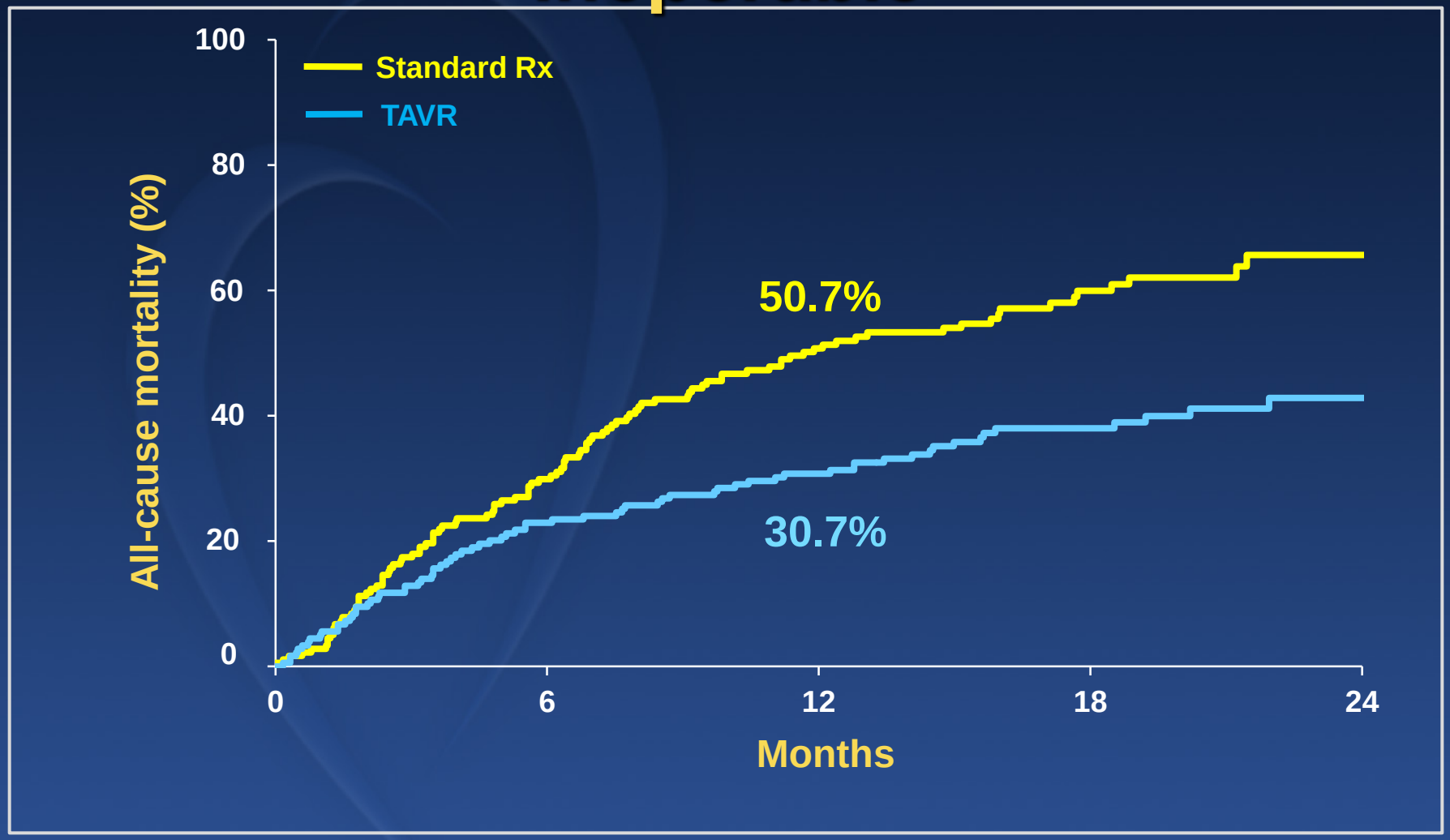


Patient Selection
Frailty Assessment

Additional demographics not accounted for in STS score

- Porcelain aorta
- Cirrhosis
- Chest wall radiation

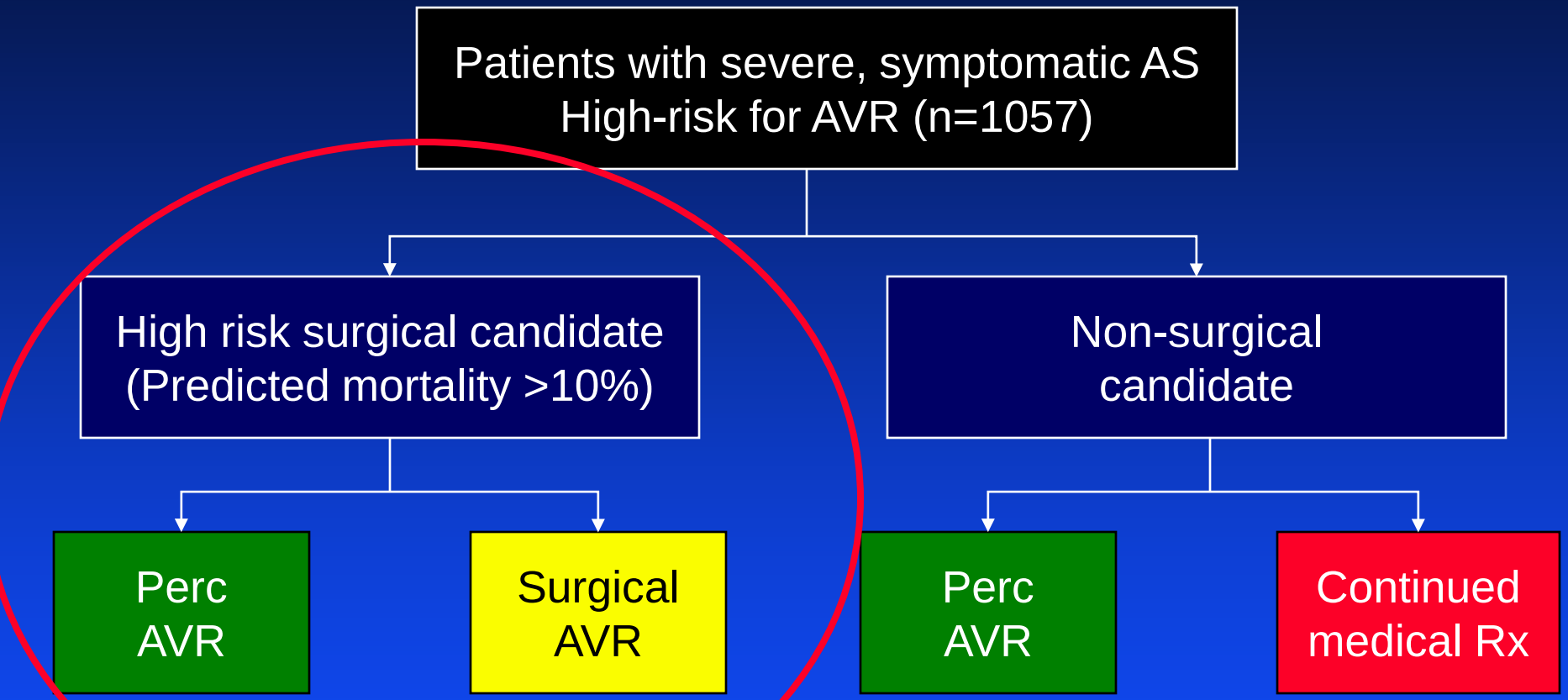
All Cause Mortality Inoperable



Clinical Outcomes at 30 Days & 1 Year

Outcome	30 Days n=179			1 Year n=179		
	TAVI	Standard Rx	P-value	TAVI	Standard Rx	P-value
Death						
All (%)	5.0	2.8	0.41	30.7	49.7	0.0004
Cardiovascular (%)	4.5	1.7	0.22	19.6	41.9	<.0001
Repeat hospitalization (%)	5.6	10.1	0.17	22.3	44.1	<.0001
Death (all) or repeat hosp (%)	10.6	12.3	0.74	42.5	70.4	<.0001
Stroke or TIA						
All (%)	6.7	1.7	0.03	10.6	4.5	0.04
TIA (%)	0	0	.	0.6	0	1.00
Minor stroke (%)	1.7	0.6	0.62	2.2	0.6	0.37
Major stroke (%)	5.0	1.1	0.06	7.8	3.9	0.18
Death (all) or major stroke (%)	8.4	3.9	0.12	33.0	50.3	0.001
Myocardial infarction						
All (%)	0	0	.	0.6	0.6	1.00
Peri-procedural (%	0	0	.	0	0	.

PARTNER Trial: Edwards Lifesciences

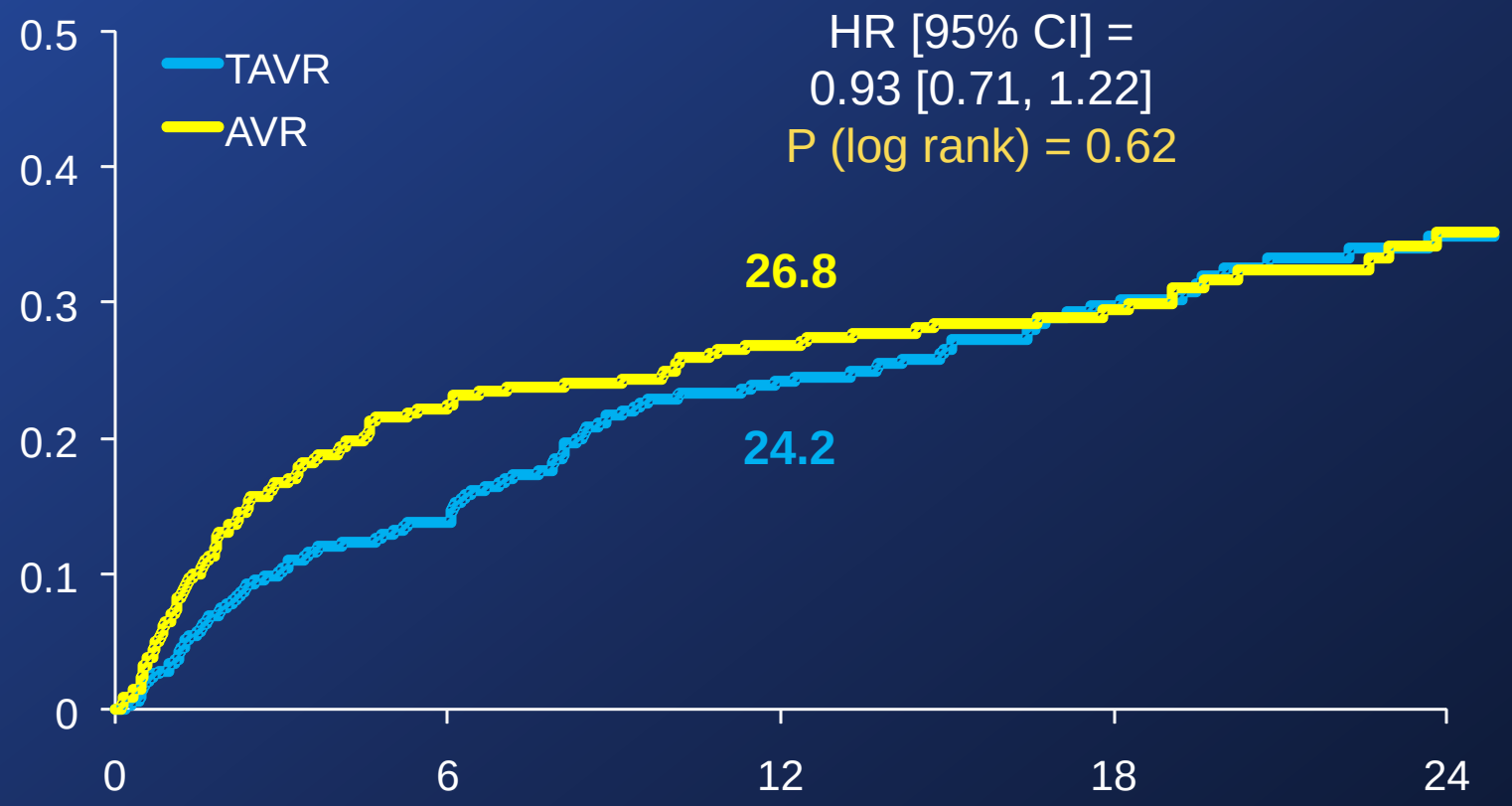


N=699
1º endpoint = 1-year mortality
Non-inferiority comparison

2º endpoint: death, MI, stroke

N=358
1º endpoint = 1-year survival
Superiority comparison

Primary Endpoint:
All-Cause Mortality at 1 Year



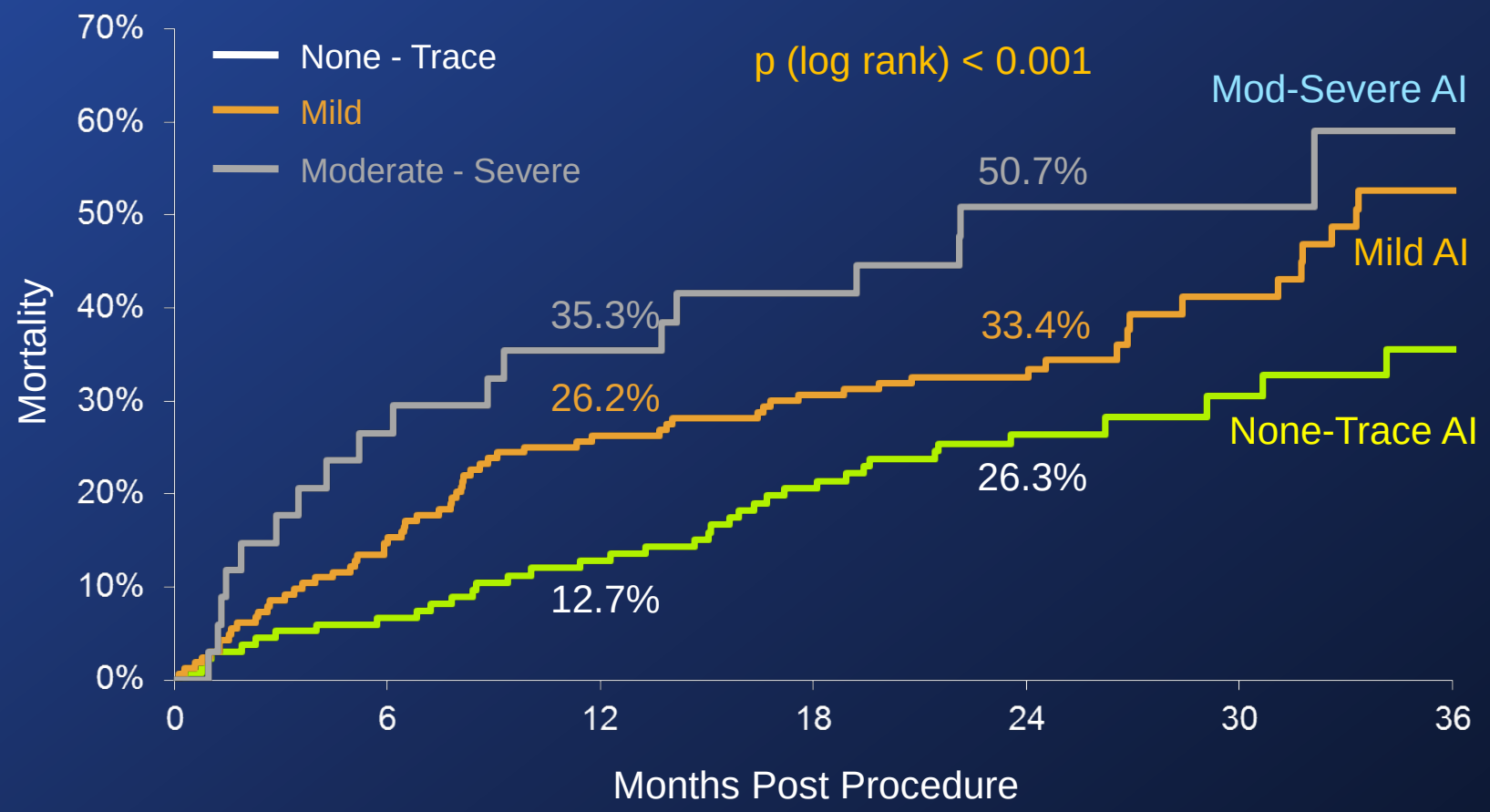
No. at Risk					
TAVR	348	298	260	147	67
AVR	351	252	236	139	65

Neurological Events at 30 Days and 1 Year
All Patients (N=699)

THE PARTNER TRIAL

Outcome	30 Days			1 Year		
	TAVR (N = 348)	AVR (N = 351)	p-value	TAVR (N = 348)	AVR (N = 351)	p-value
All Stroke or TIA – no. (%)	19 (5.5)	8 (2.4)	0.04	27 (8.3)	13 (4.3)	0.04
TIA – no. (%)	3 (0.9)	1 (0.3)	0.33	7 (2.3)	4 (1.5)	0.47
All Stroke – no. (%)	16 (4.6)	8 (2.4)	0.12	20 (6.0)	10 (3.2)	0.08
Major Stroke – no. (%)	13 (3.8)	7 (2.1)	0.20	17 (5.1)	8 (2.4)	0.07
Minor Stroke – no. (%)	3 (0.9)	1 (0.3)	0.34	3 (0.9)	2 (0.7)	0.84
Death/maj stroke – no. (%)	24 (6.9)	28 (8.2)	0.52	92 (26.5)	93 (28.0)	0.68

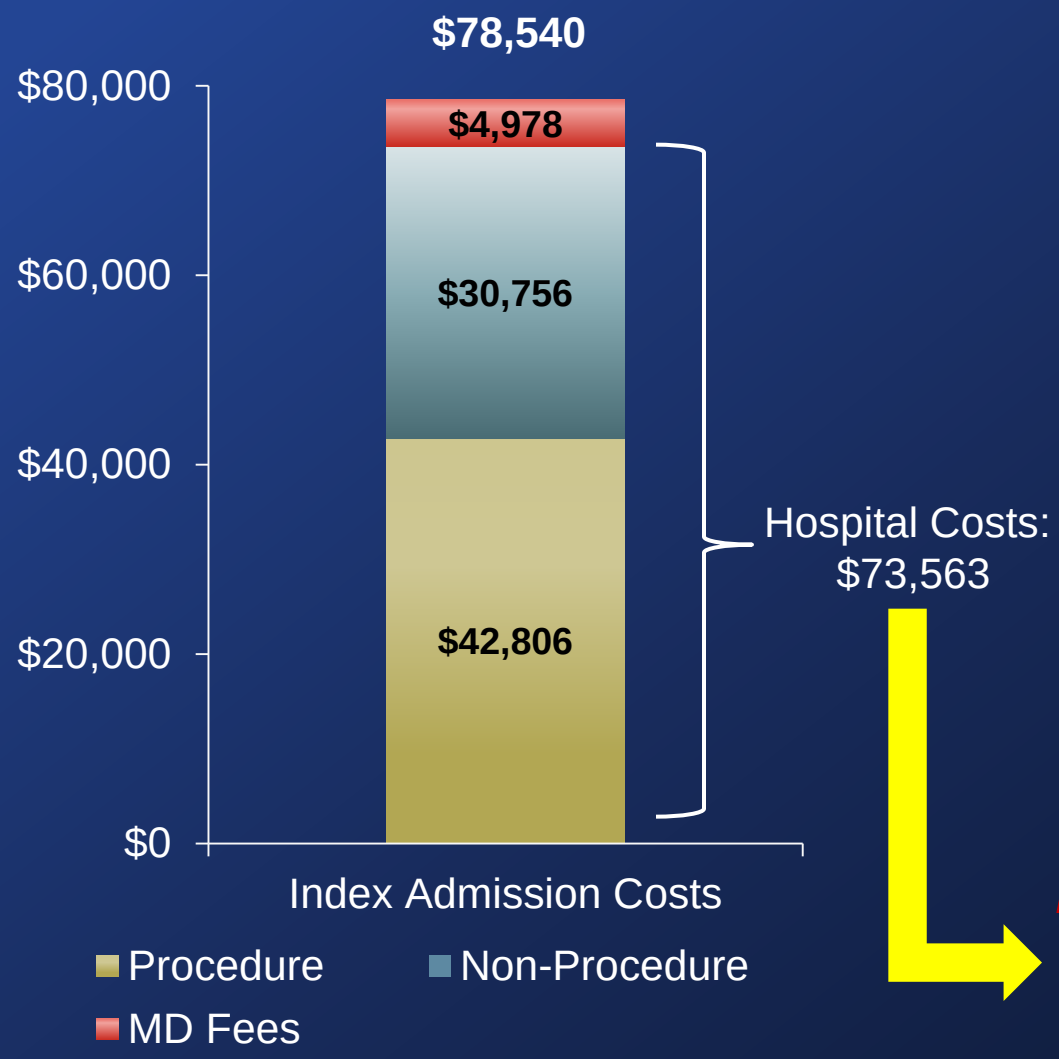
Aortic Insuffiency and Mortality
TAVR Patients



Numbers at Risk

None-Tr	**135**	**125**	**115**	**101**	**68**	**31**	**11**
Mild	**165**	**139**	**121**	**111**	**71**	**33**	**16**
Mod-Sev	**34**	**25**	**22**	**19**	**15**	**6**	**2**

TAVR Admission Costs



Mean (median) LOS (days)	
ICU	4.0 (2.0)
Non-ICU	6.1 (5.0)
Total	10.1 (7.0)
Post-Procedure	8.6 (6.0)

(N=175)

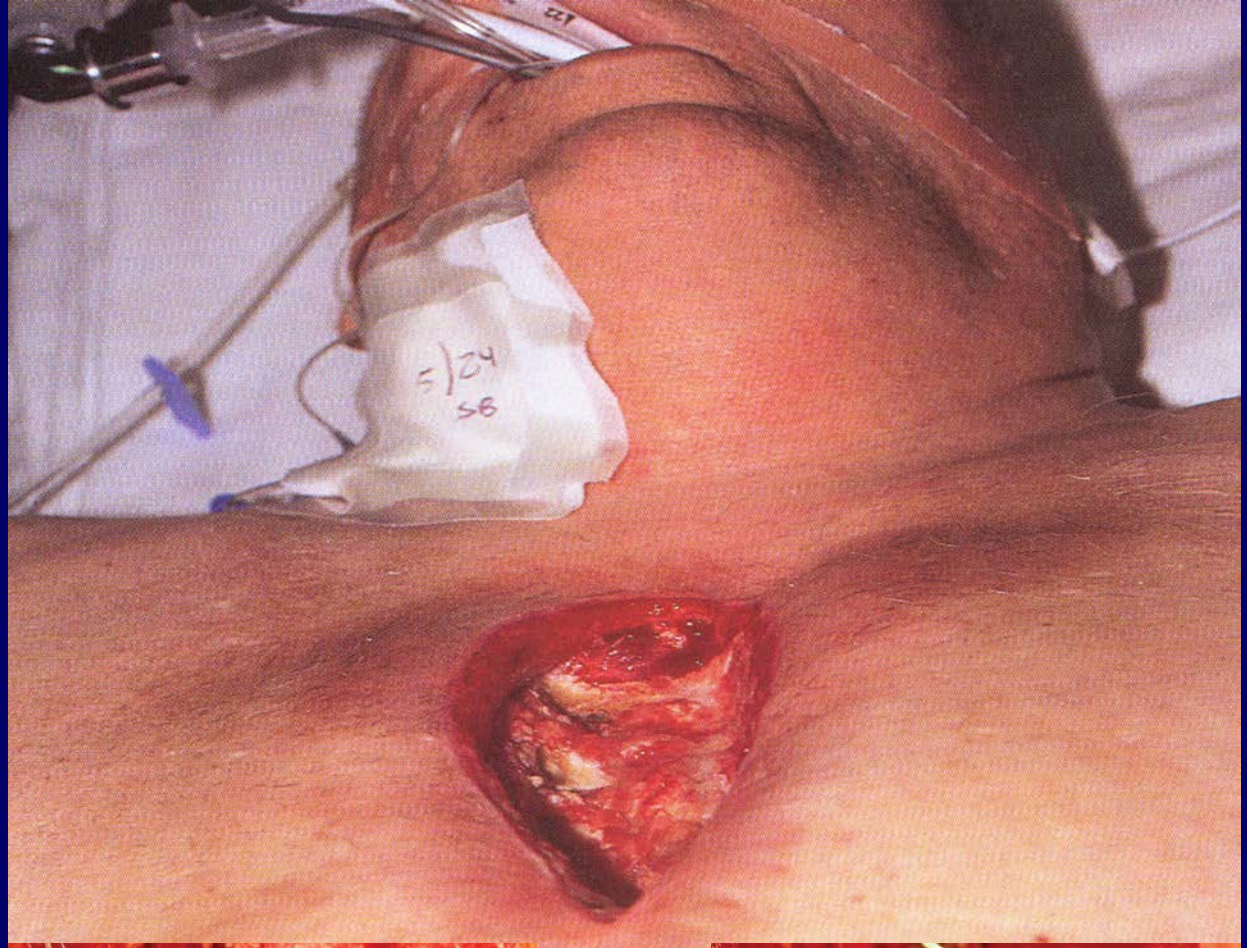
Hospital Reimbursement

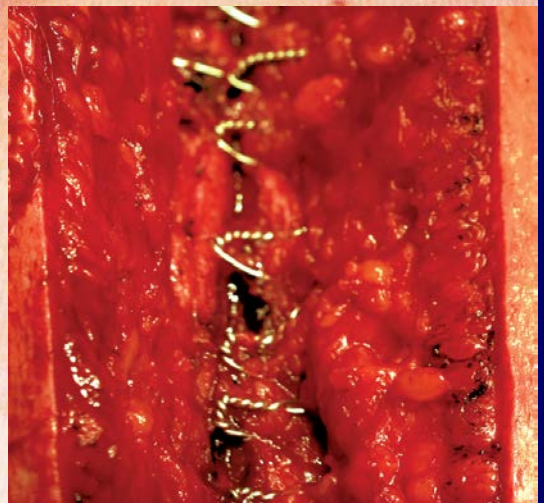
~ $56,000

TAVR: Next Steps

- Novel devices essential to overcome current procedural and technical hurdles
  - *Lower profile → smaller sheath size*
  - *Repositionable*
  - *Embolic protection*
  - *Reduced AI → essential for treating lower risk patients*
- Continued development of alternative access sites for patients with poor femoral access
  - *Subclavian/Axillary*
  - *Direct aortic*

Rigid Sternal Fixation





Rigid Fixation in Sternal Closure

- Rigid fixation used by all specialties
- Suture wires remain primary method of closure for cardiac surgeons
  - Low rate of perceived sternal wound complications
  - Low cost
  - Training

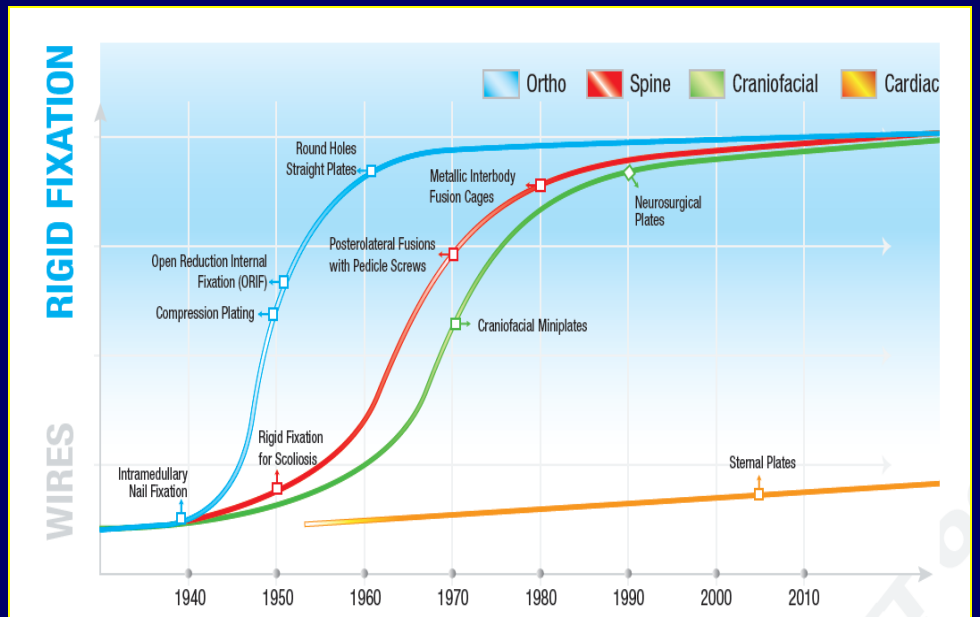
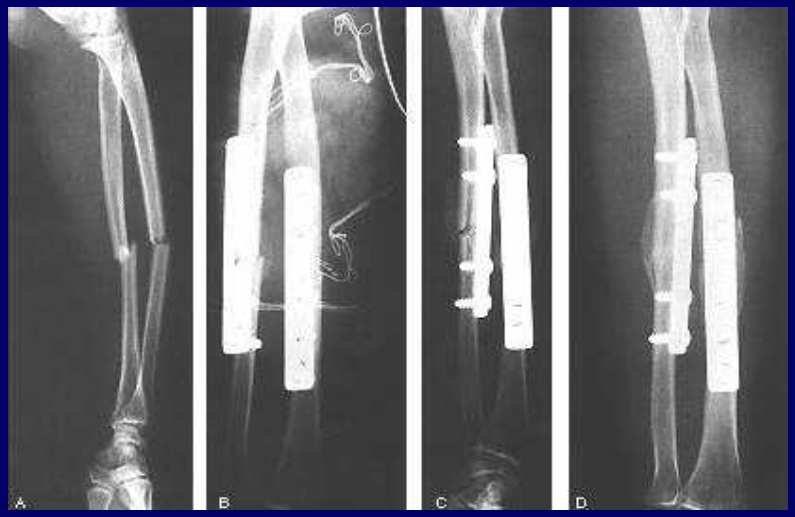


Figure 1. Timeline illustrating the adoption of rigid fixation in other specialties. Despite the adoption of rigid fixation techniques in nearly every other bone, and the numerous advances that have occurred in cardiac surgery over this period, wire closure remains the predominant method of sternal closure.

Rigid Fixation Supports Bone Healing

- Bone healing requires
  - Approximation
  - Compression
  - Rigid fixation

- Movement/bony separation can result in
  - Nonunion
  - Pain
  - Complications



Rigid Sternal Fixation

- Developed by cardiothoracic surgeons for primary sternal closure
  - Improved stability compared to wire closure
  - Less sternal separation
  - Improved bone healing
- Simple surgical technique
  - Approximate sternal halves
  - Rigidly fixate with plate/screw contructs

THE ANNALS OF THORACIC SURGERY

Sternal Closure With Rigid Plate Fixation Versus Wire Closure: A Randomized Controlled Multicenter Trial

Jaishankar Raman, MD, PhD, Sven Lehmann, MD, Kenton Zehr, MD, Brian J. De Guzman, MD, Lishan Aklog, MD, H. Edward Garrett, MD, Heber MacMahon, MB, BCh, Brian M. Hatcher, PhD, and Michael S. Wong, MD

Department of Cardiothoracic and Vascular Surgery, Rush University Medical Center, Chicago, Illinois; Department of Cardiac Surgery, University of Leipzig Heart Center, Leipzig, Germany; Division of Cardiothoracic Surgery, Scott and White Clinic, Temple, Texas; Department of Cardiovascular Surgery, St. Joseph's Hospital and Medical Center, Phoenix, Arizona; Cardiovascular Surgery Clinic, Memphis, Tennessee; Department of Radiology, University of Chicago Medical Center, Chicago, Illinois; Biomet Microfixation, Jacksonville, Florida; and Division of Plastic Surgery, University of California Davis Medical Center, Sacramento, California

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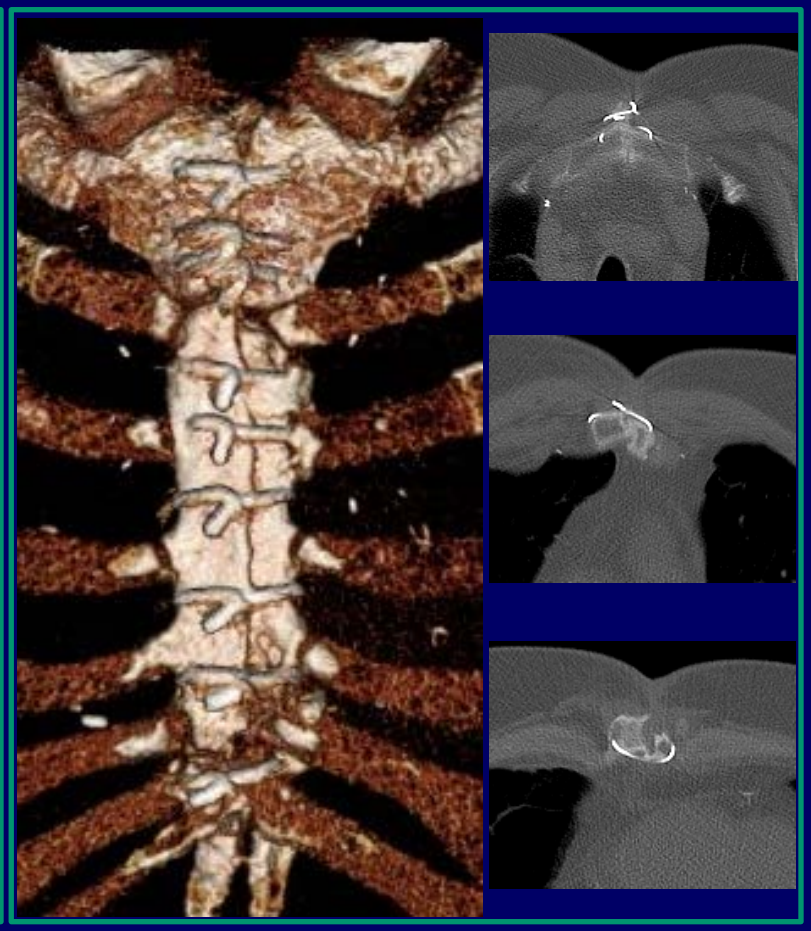
6 Month CT Scans

Mean Score: 4.0



Mean Score: 2.2

Raman et al. Sternal Closure with rigid plate fixation versus wire closure: A randomized controlled multi-center trial. *Annals Thor Surg* 2012; 94:1854-61.

Sternal Blu Clinical Study

Study Design	Prospective, randomized, controlled trial
Groups	Investigational: Sternal Blu Control: Wire Cerclage
Primary Endpoint	Bone healing via CT scans
Secondary Endpoints	Post op pain and narcotic usage, quality of life, RTW, 6 month costs, complications
Inclusion/Exclusion Criteria	Elective cardiac surgery patients excluding certain high risk patients
Surgical Technique	Midline sternotomy Variable plating and wiring configurations
Follow-up Schedule	Pre-op, POD 1 – Discharge, Discharge, 3 weeks, 6 weeks, 3 months, 6 months
Sites/Sample Size	236 patients (8-12 sites)

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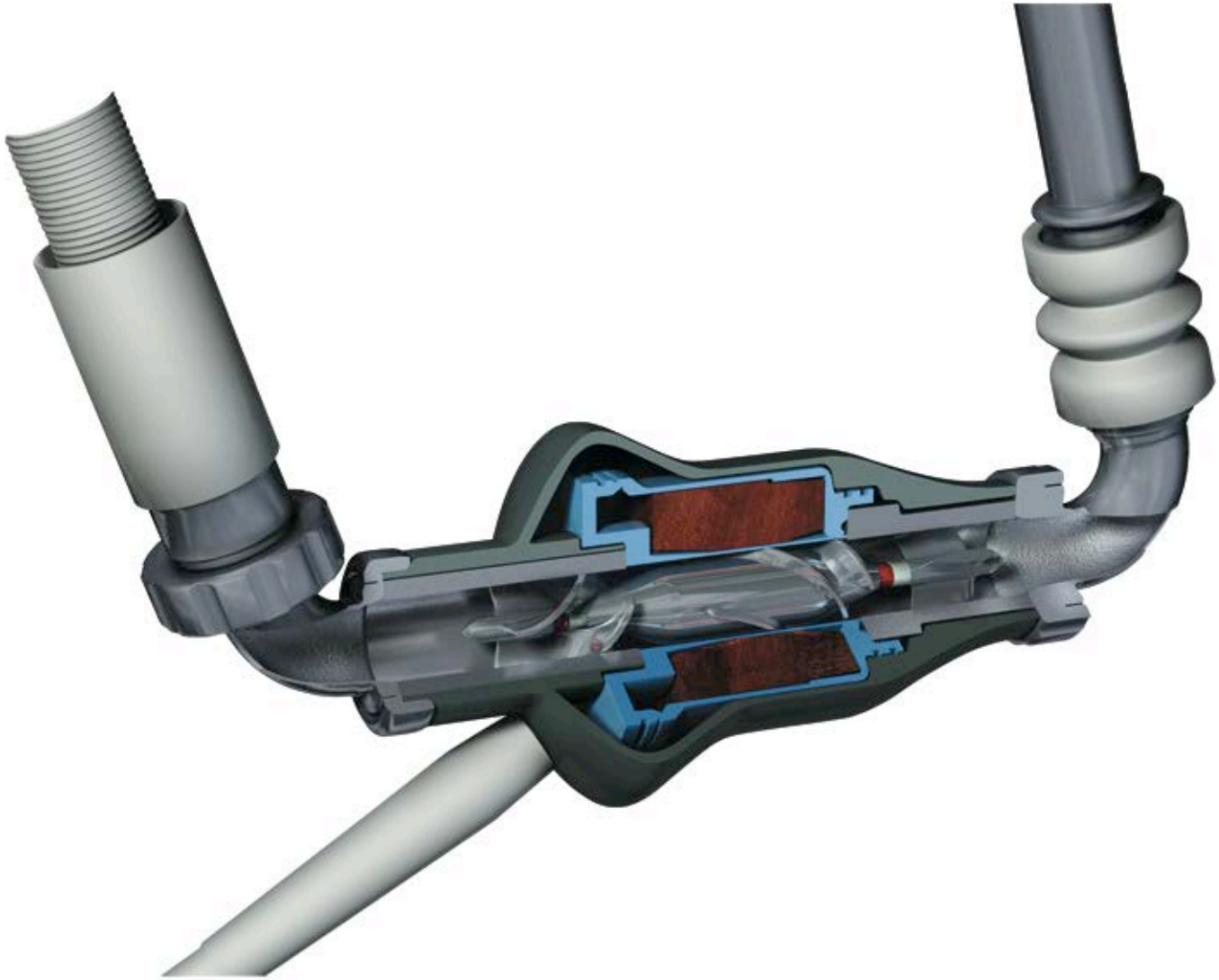
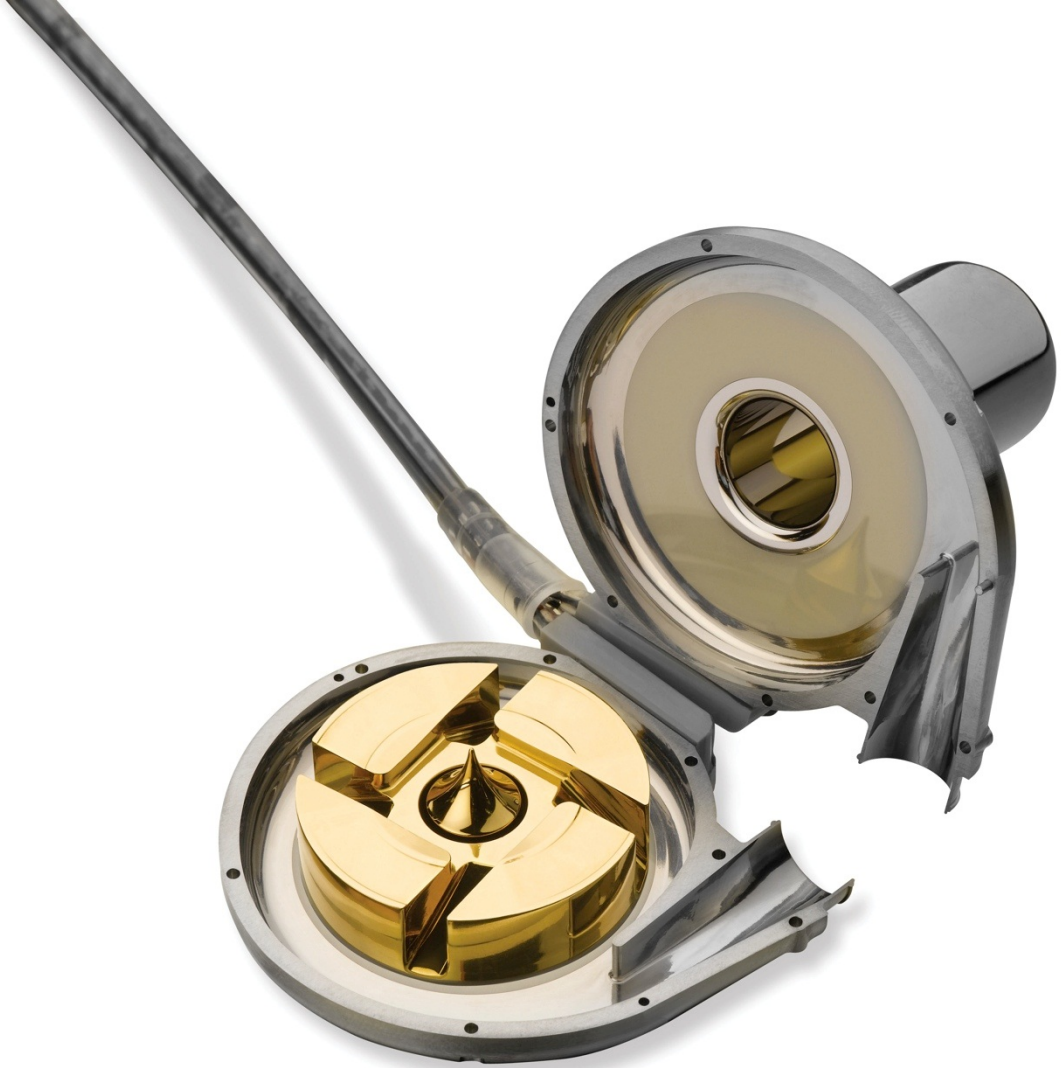
Saint Luke's
MID AMERICA HEART INSTITUTE

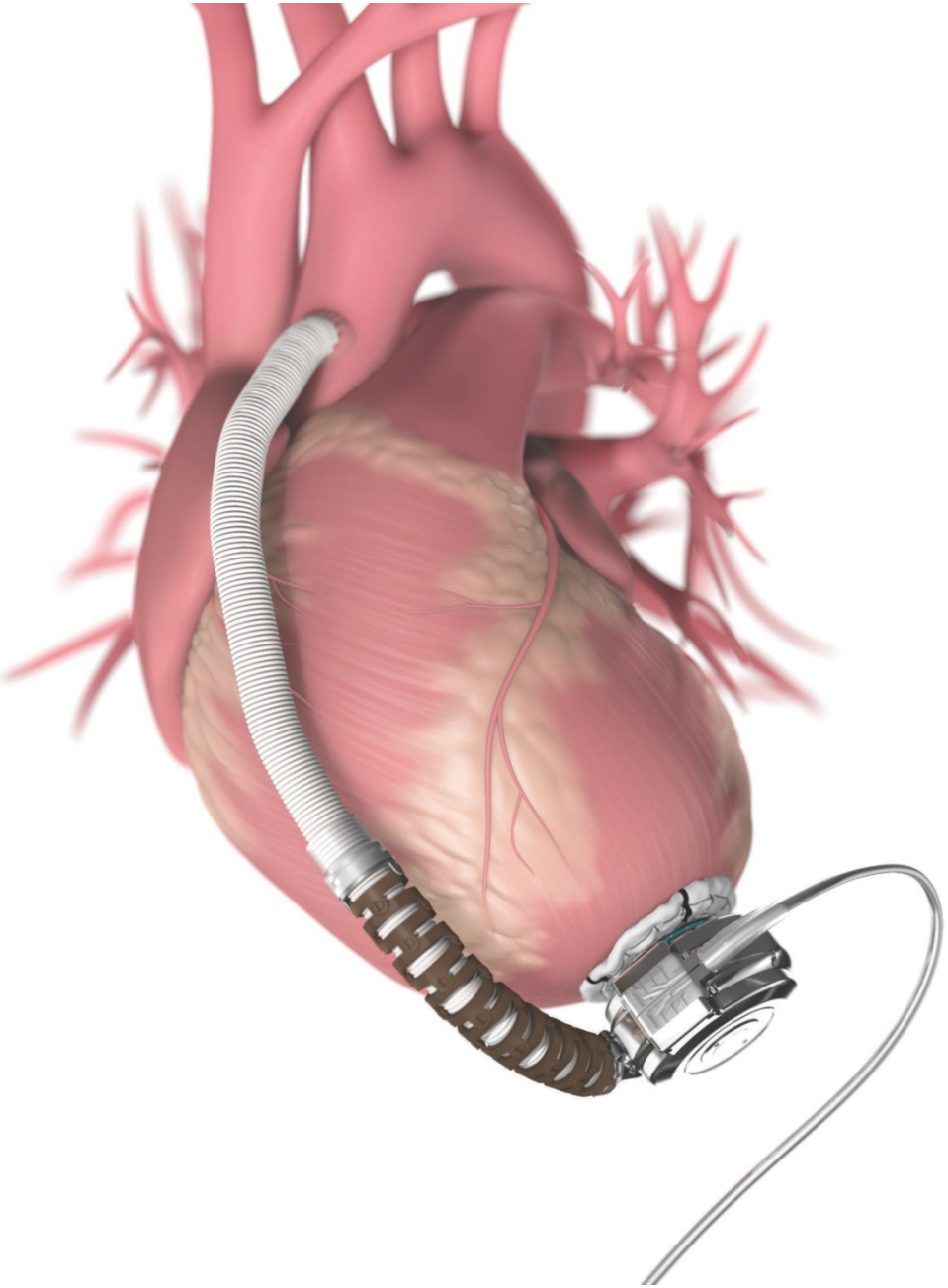
Mechanical Circulatory Support
Emerging Technologies


OLIVER


VAD
101103

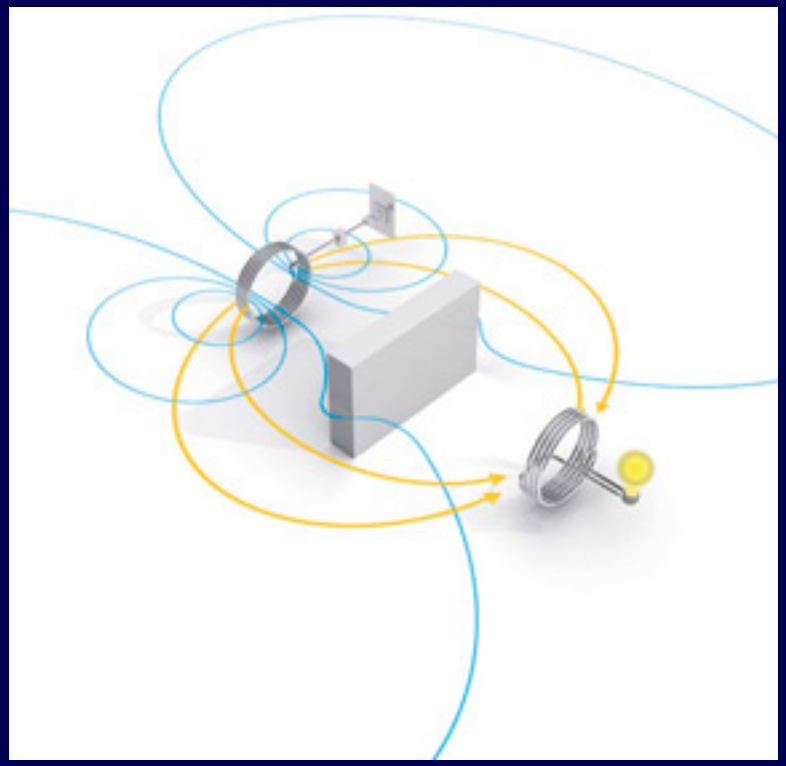




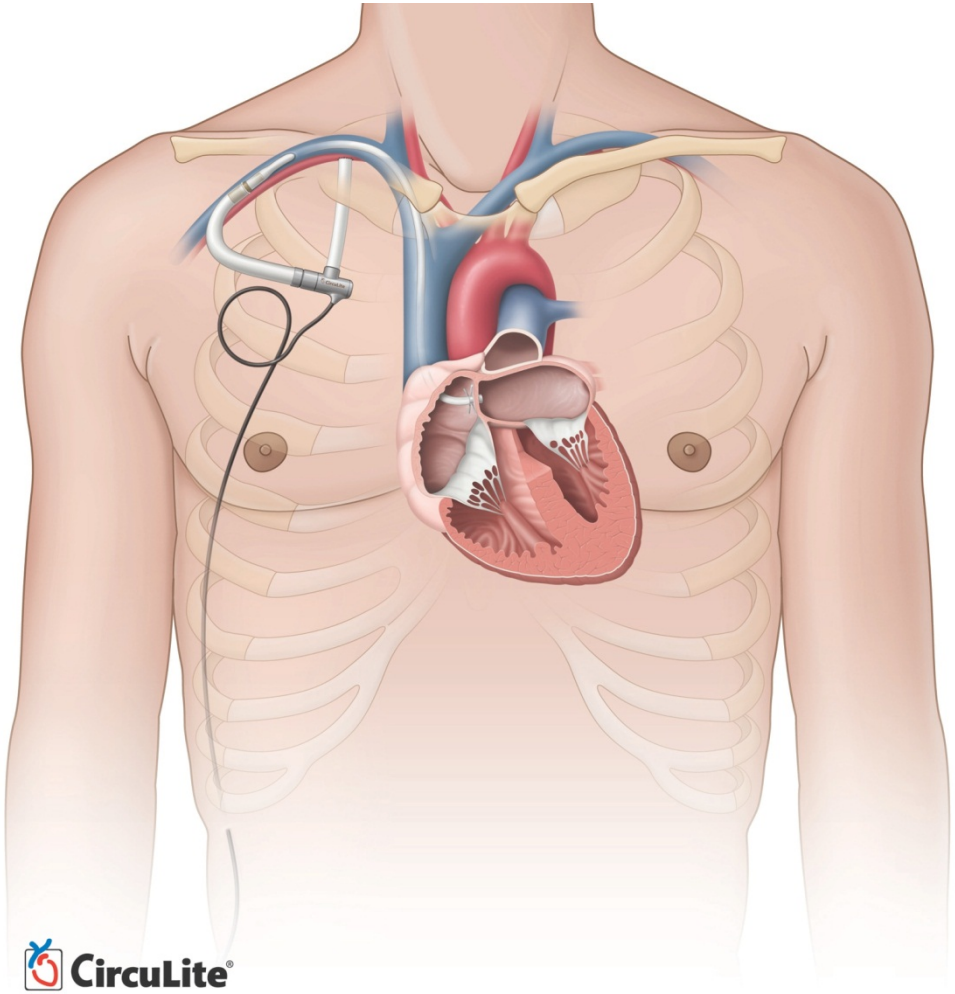


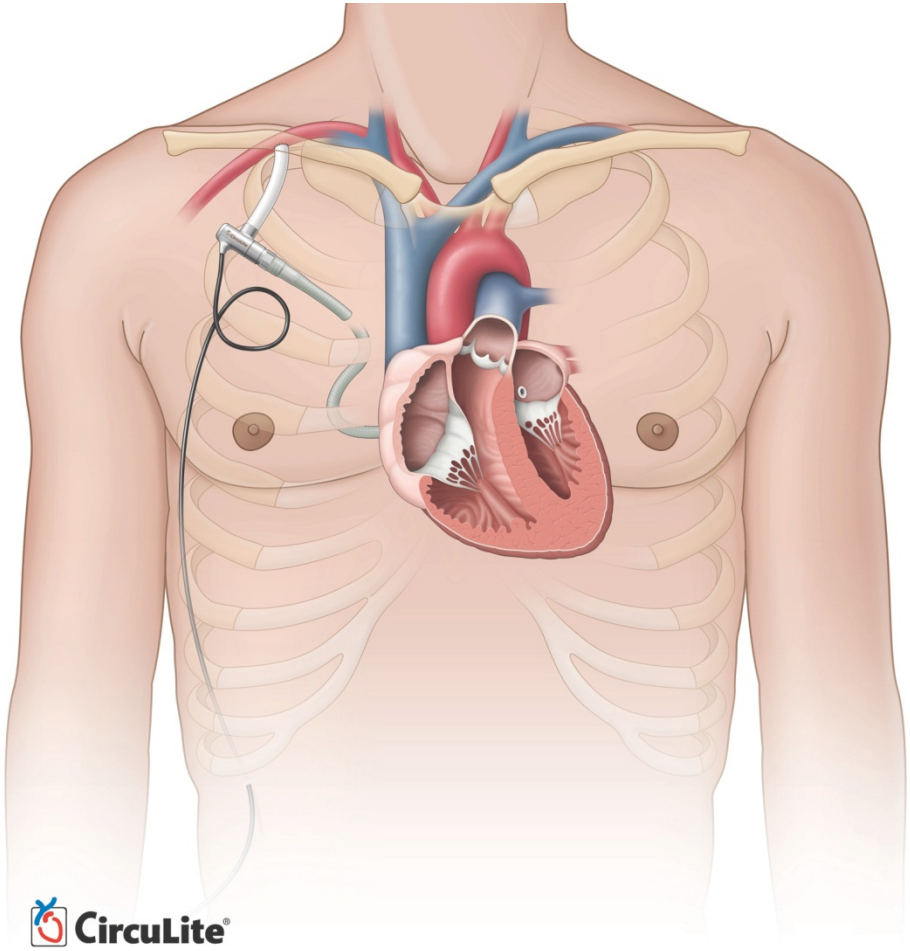
Future Directions

- Wireless Electricity, fully implantable systems- WITRICITY




CirculLite
AA
MN1500
LR6
1.5 VOLTS


CircuLite®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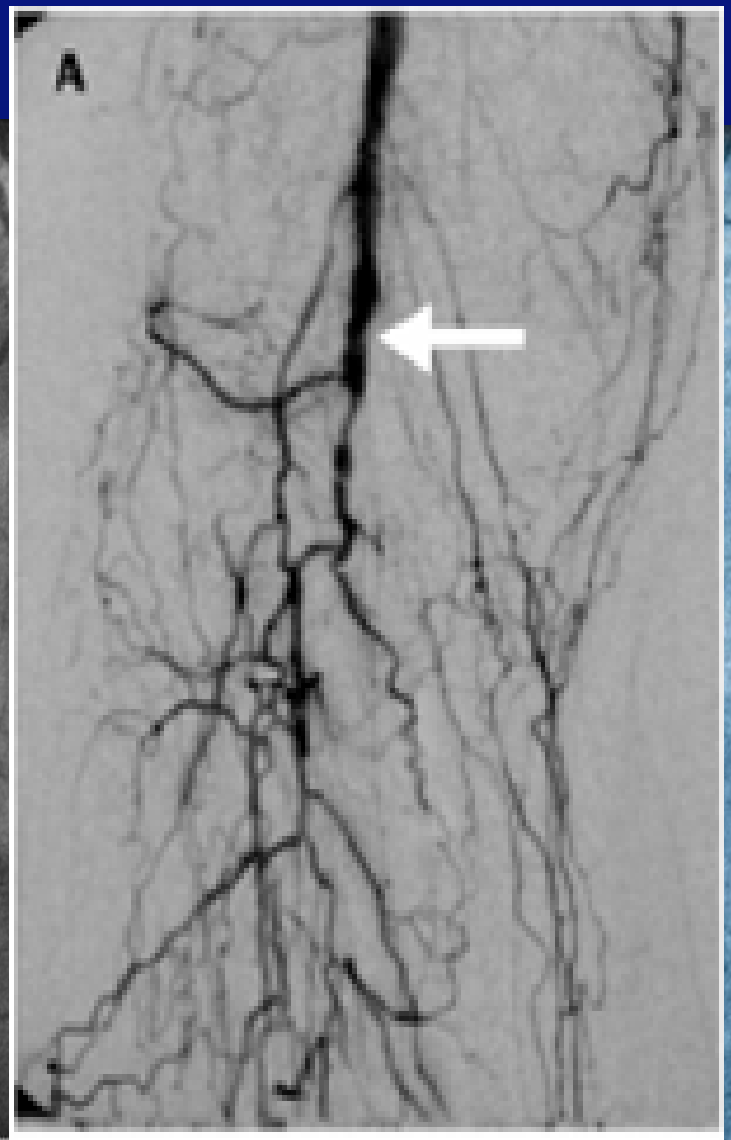
Diffuse Vascular Disease



Diffuse Coronary Artery Disease

Impact On Management Decisions

CCS Class IV patients managed medically have a mortality rate of 13%/year with a five year survival of only 35%.

Allen, et al. Ann Thorac Surg 2004

When quantified, diffuse CAD is a strong independent predictor of operative mortality

Graham, et al. JTCVS 1999

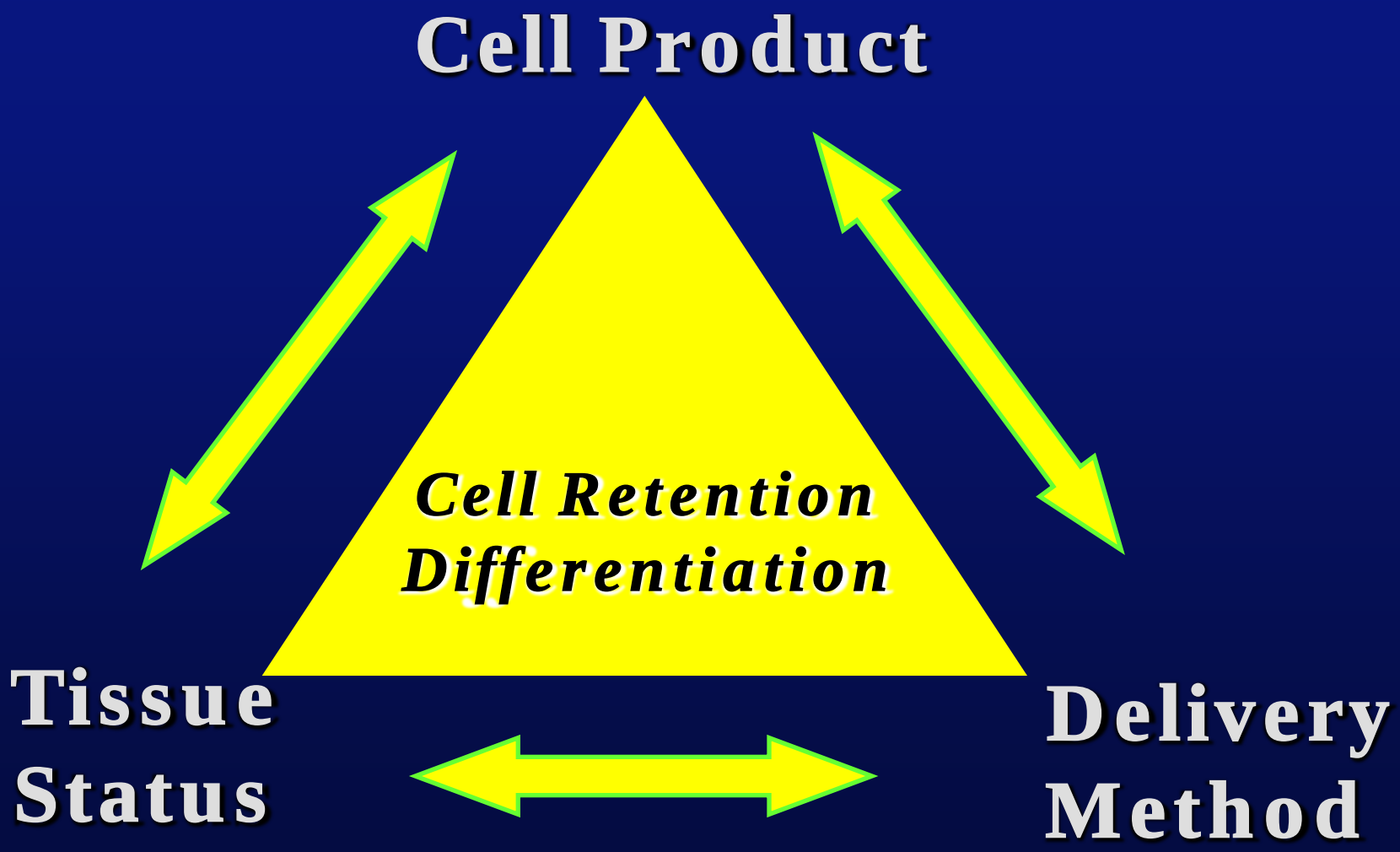
Incomplete revascularization due to diffuse CAD is an independent predictor of operative mortality

Osswald, et al. Eur J CT Surg 2001

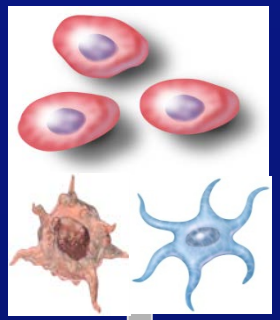
Demographically “Case-Matched” Patients

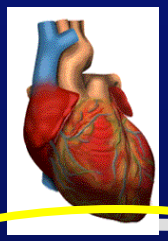
Same STS Predicted Risk

≠


Cell Product
Cell Retention
Differentiation
Tissue
Status
Delivery
Method

CARDIAC DISEASE
TREATMENT WITH AUTOLOGOUS BONE MARROW CELLS





Chronic Ischemia

Acute MI CHF

Paracrine Effect

Autocrine Effect

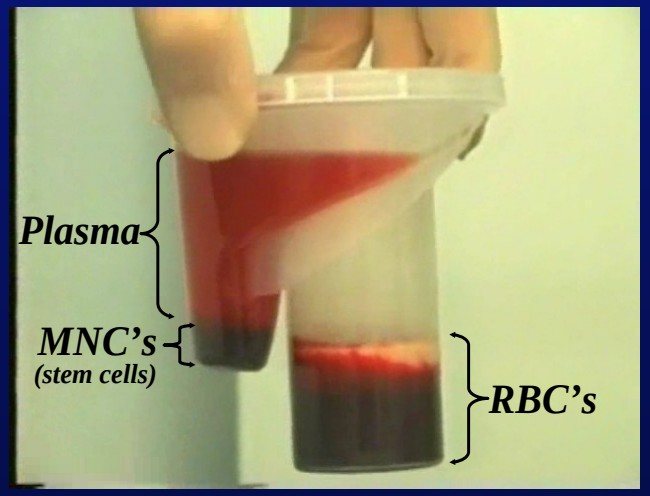
SAFE

Assmus NEJM 2006 *Patel JTCVS 2005* *Schachinger NEJM 2006*

BONE MARROW ASPIRATION CONCENTRATE: A RAPID, POINT OF CARE DEVICE FOR OBTAINING AUTOLOGOUS STEM CELLS FOR CELL-BASED THERAPIES

Keith B. Allen, MD[1]; Guillermo Reyes, MD[2]; A. Alegre, MD[2]; Beatriz Aguado, MD[2]; A. Michael Borkon, MD[1]; R. Scott Stuart, MD[1]; Emmanuel Daon, MD[1]; Alexander F. Pak, MD[1]; George L. Zorn, MD[1]; Juan Duarte, MD[2]
[1]Saint Luke's Mid America Heart Institute, Kansas City, MO, USA; [2]La Princesa University Hospital, Madrid, Spain

Cytotherapy (Suppl 1):2008 Vol 10:124



20cc Concentrated MNC's
3.2 billion MNC's
21 million CD34+
125,000 CD133+

120cc
Bone Marrow

15 minutes

Bone marrow laser revascularisation for treating refractory angina due to diffuse coronary heart disease☆

Guillermo Reyes [a,*], Keith B. Allen [b], Beatriz Aguado [c], Juan Duarte [a]

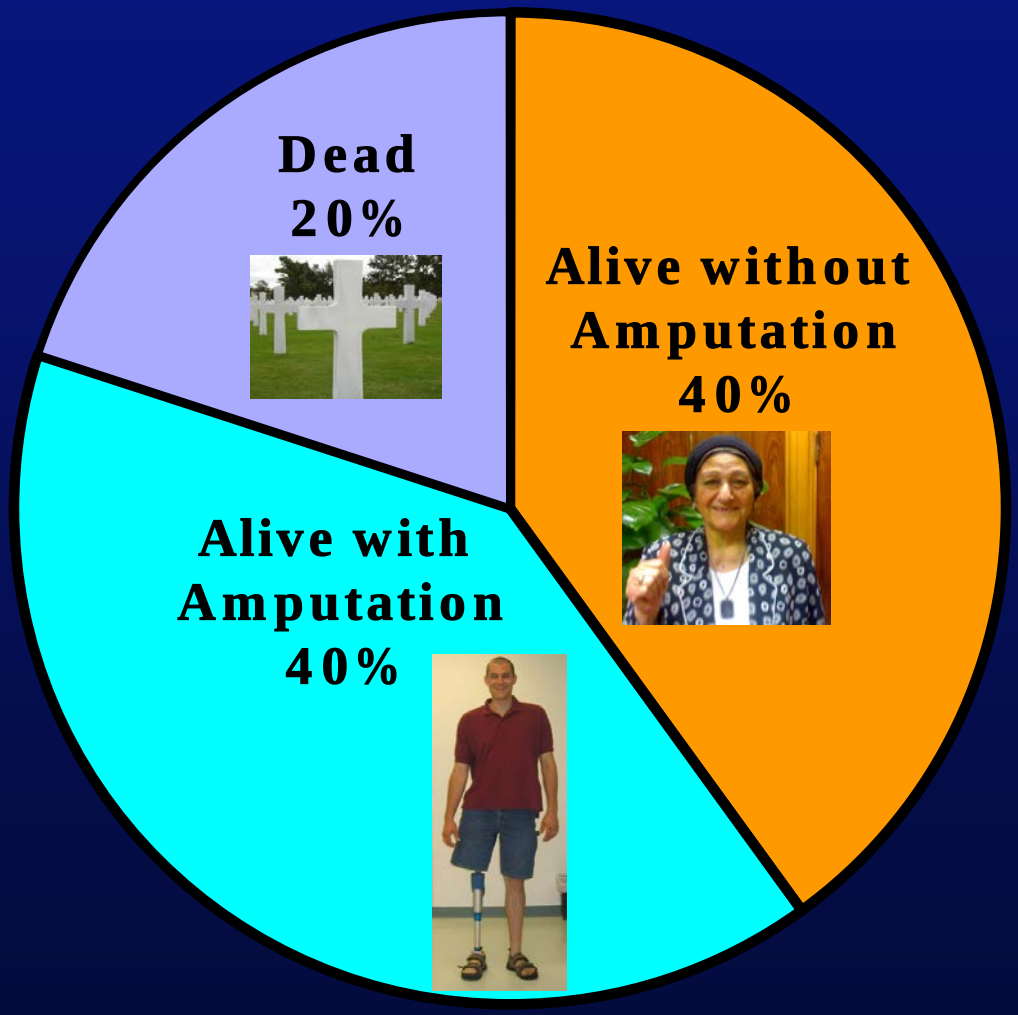
[a] Department of Cardiovascular Surgery, Hospital Universitario La Princesa, Madrid, Spain
[b] Department of Cardiothoracic Surgery, Mid America Heart Institute, St Luke's Hospital, Kansas City, MO, USA
[c] Department of Haematology, Hospital Universitario La Princesa, Madrid, Spain

European Journal of Cardio-thoracic Surgery 36 (2009) 192—194

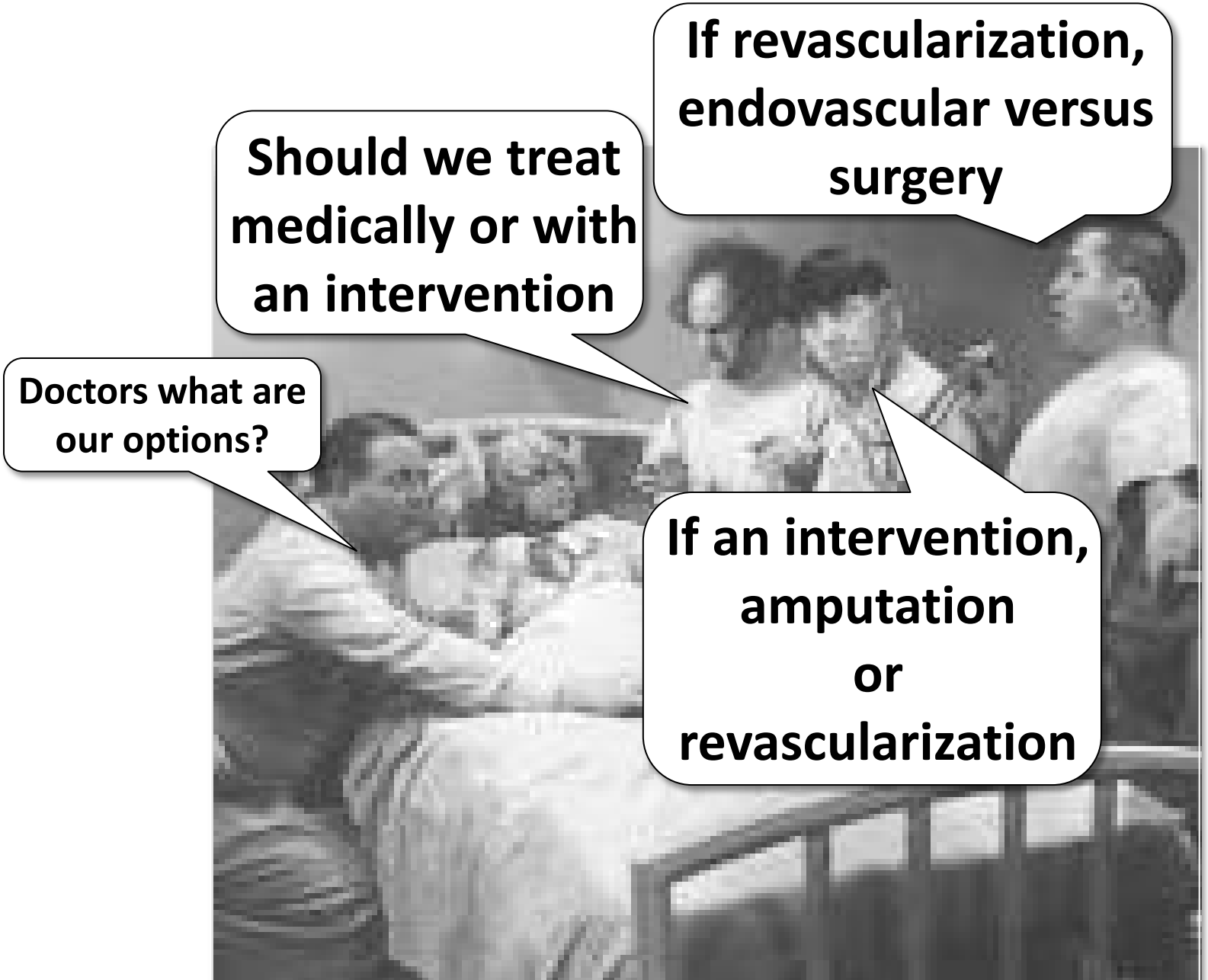
Critical Limb Ischemia: Defined

- Rest pain or nonhealing ulcers/gangrene
- Toe pressures <30mm Hg and/or Tcoms <30

Patient status 6mo after CLI diagnosis



CLI Decision Making Dilemmas



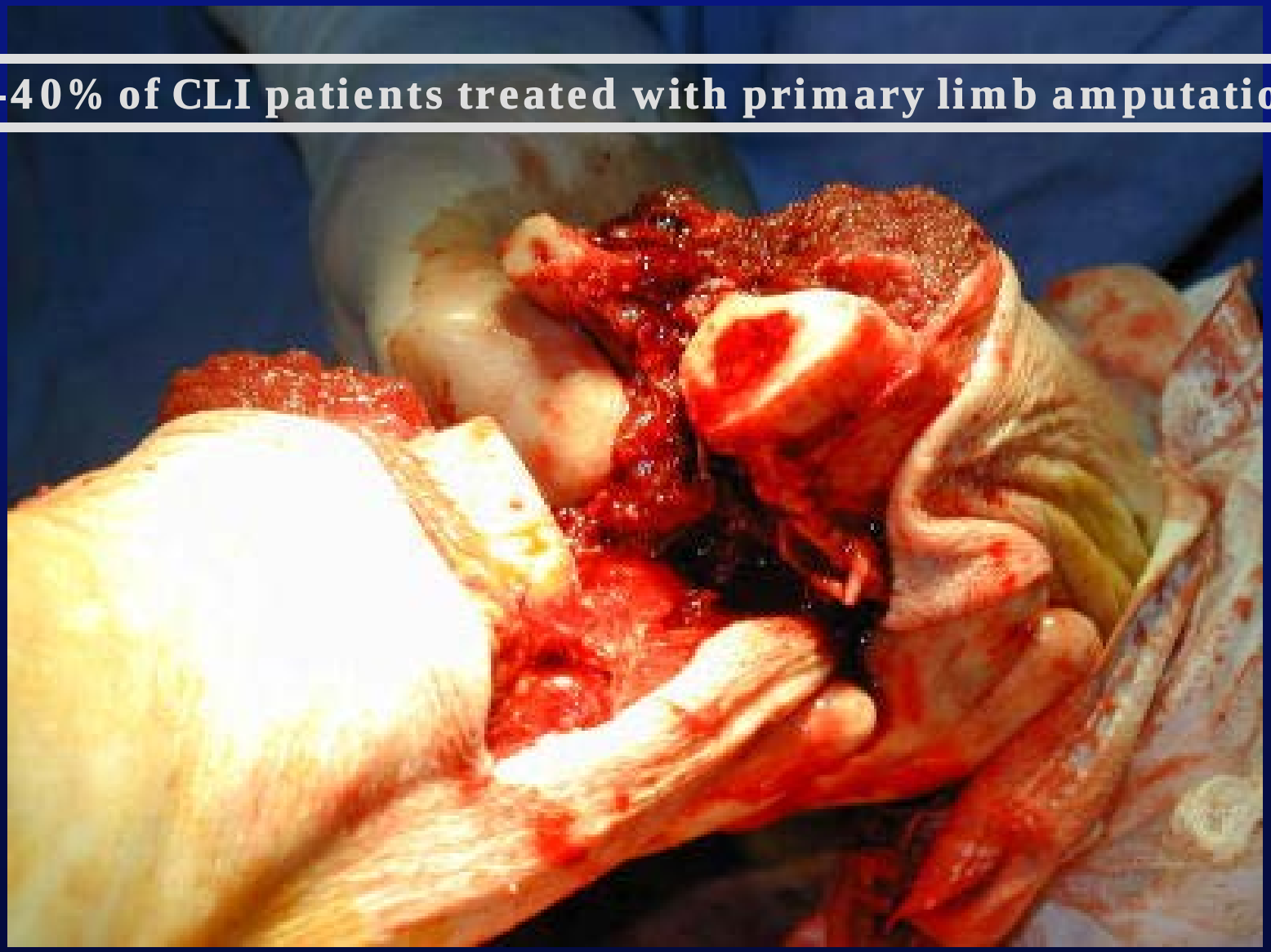
Critical Limb Ischemia Prognosis With Medical Therapy

- 25-40% of CLI patients progress to major limb amputation within 6 mo

- 25% die <1yr secondary cardiovascular complications

The Role for Primary Amputation In Patients With Critical Limb Ischemia

10-40% of CLI patients treated with primary limb amputation



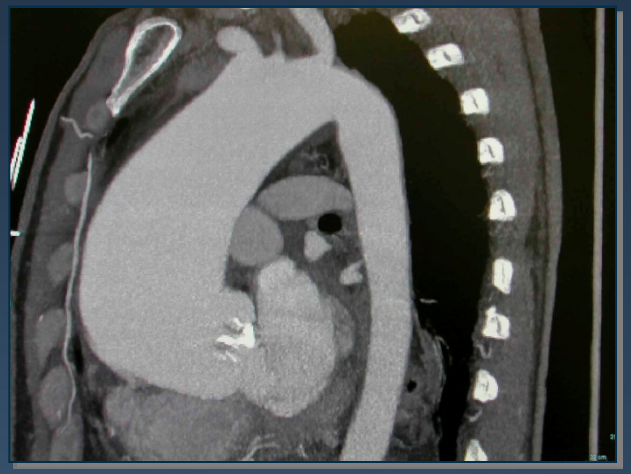
Stem Cell Therapy
Therapeutic Angiogenesis

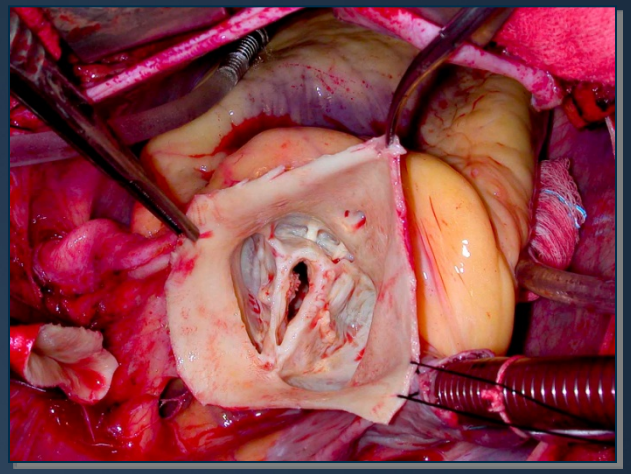
Autologous Bone Marrow Derived Stem Cells Use in Inoperable Critical Limb Ischemia

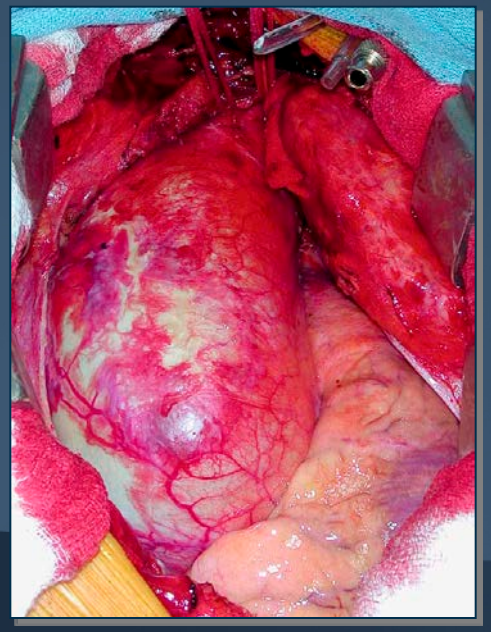
Before | **After (24 wks)**

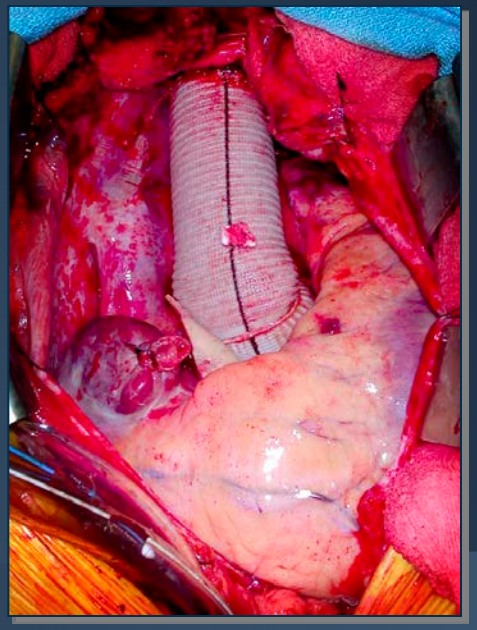
Endovascular Options for Aortic Pathology

Ascending-Arch Aneurysm







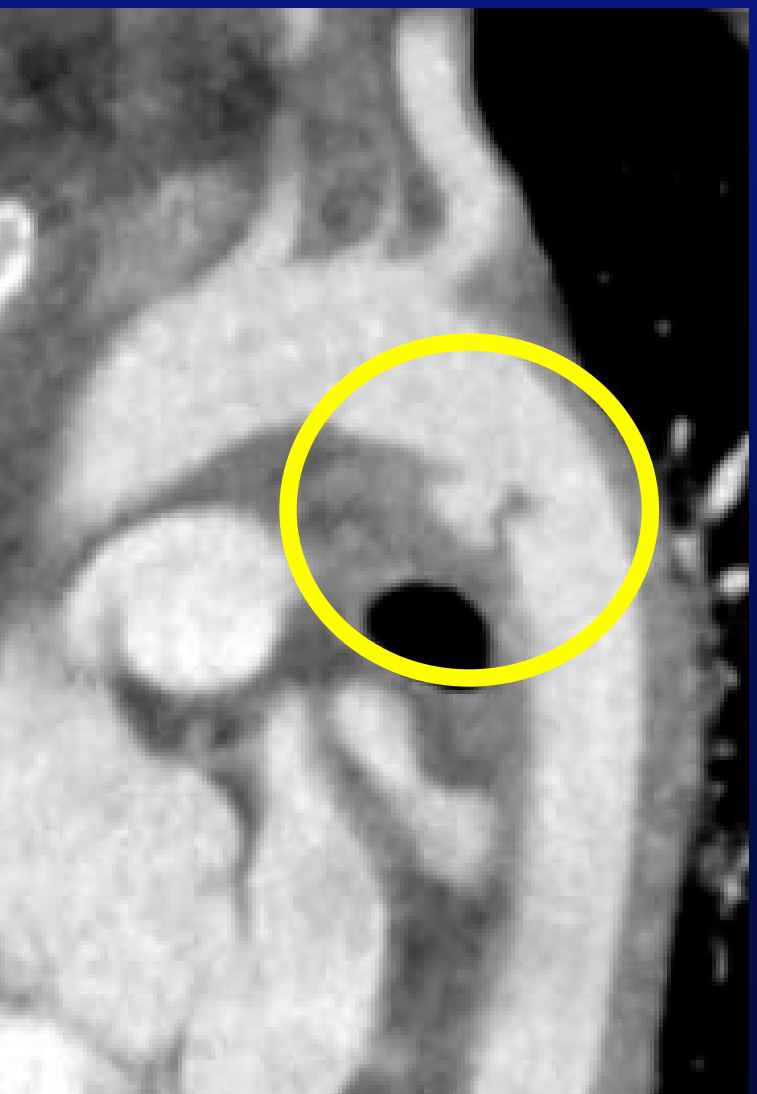


Endovascular Options

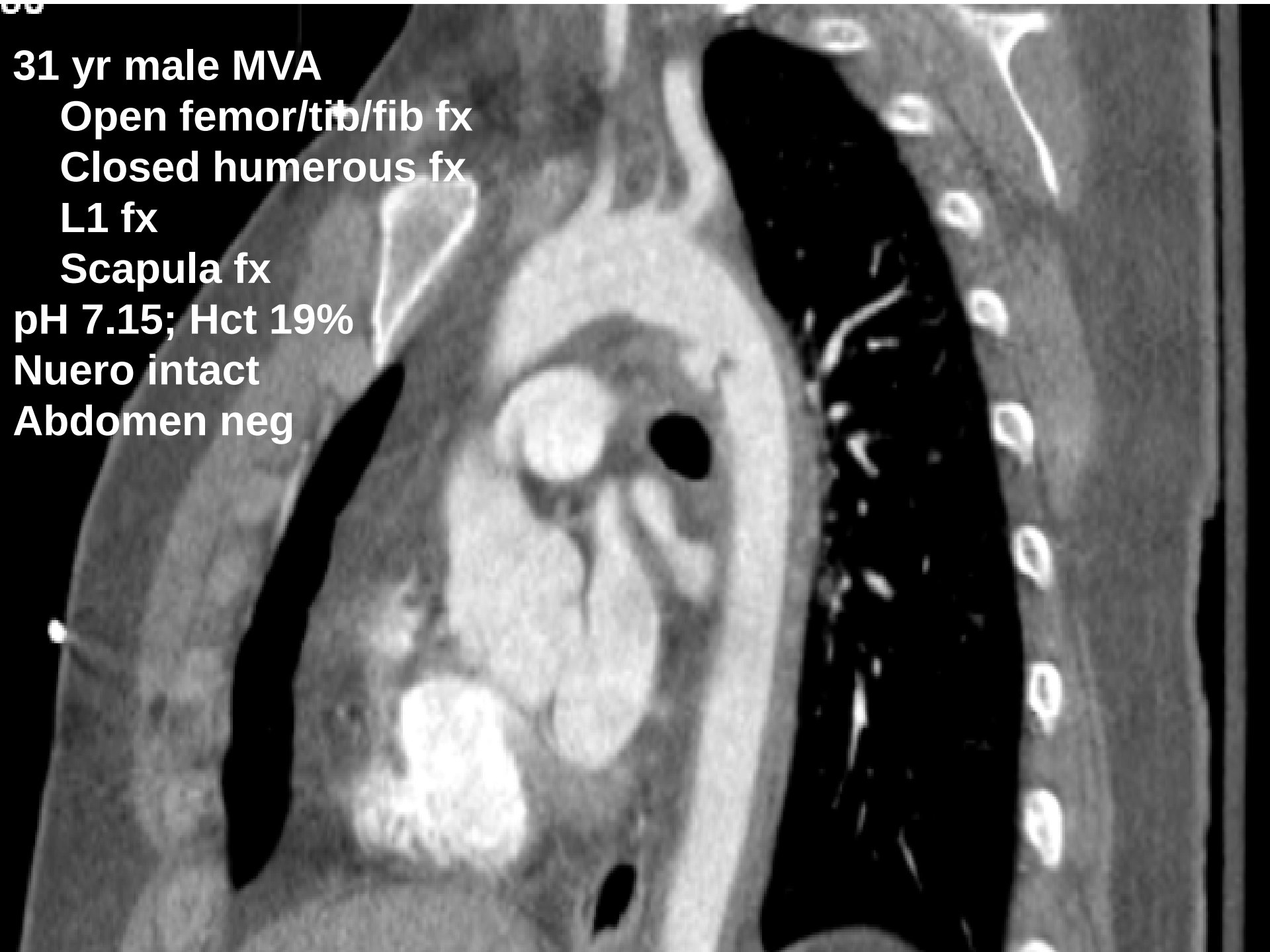
- Traumatic Aortic Tears
- Coarctation
- Dissections
- Penetrating Ulcers
- Abdominal Aortic Aneurysms
- Hybrid Cases

Traumatic Aortic Disruption

Allen KB, Borkon AM, Laster S, Aggarwal S. Innovations 2012;7(2):105



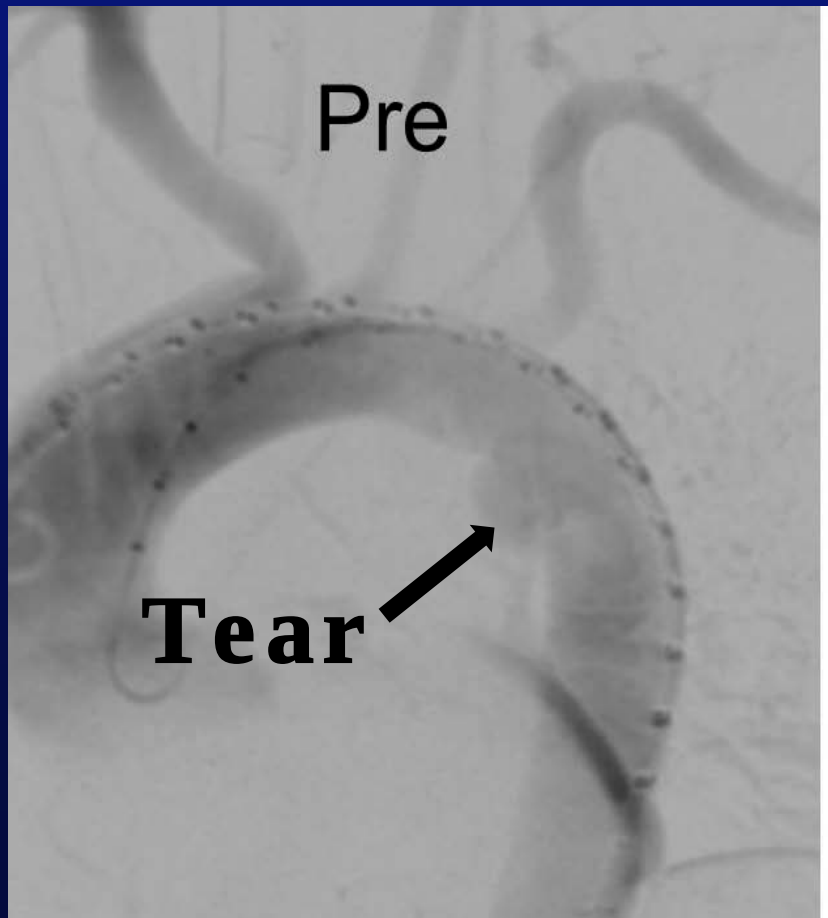
- Recently approved FDA grafts for traumatic tears (CTAG)have less shortcomings, however, post treat-ment issues remain concerns
- However, stent grafts approved to treat aneurysmal disease have disadvantages including size mis-match in y uma patients and lengt te coverage racic aorta increas al cord ischer

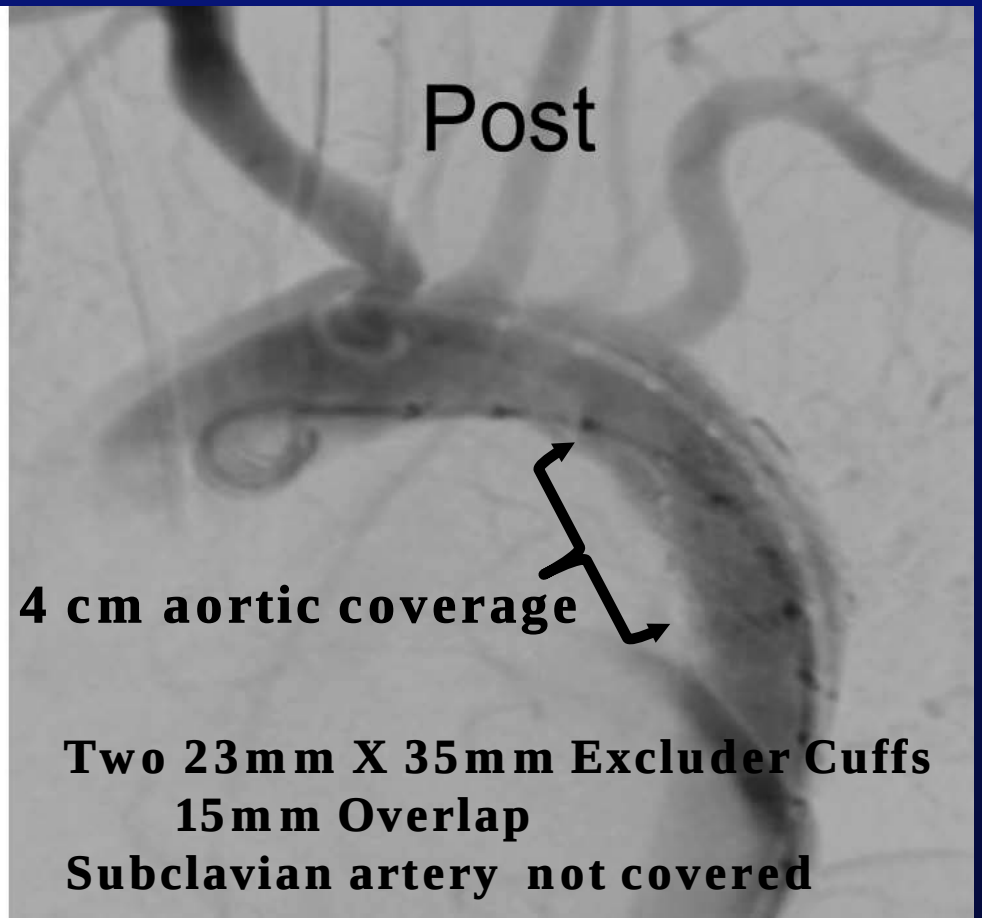

31 yr male MVA
Open femor/tib/fib fx
Closed humerous fx
L1 fx
Scapula fx
pH 7.15; Hct 19%
Nuero intact
Abdomen neg

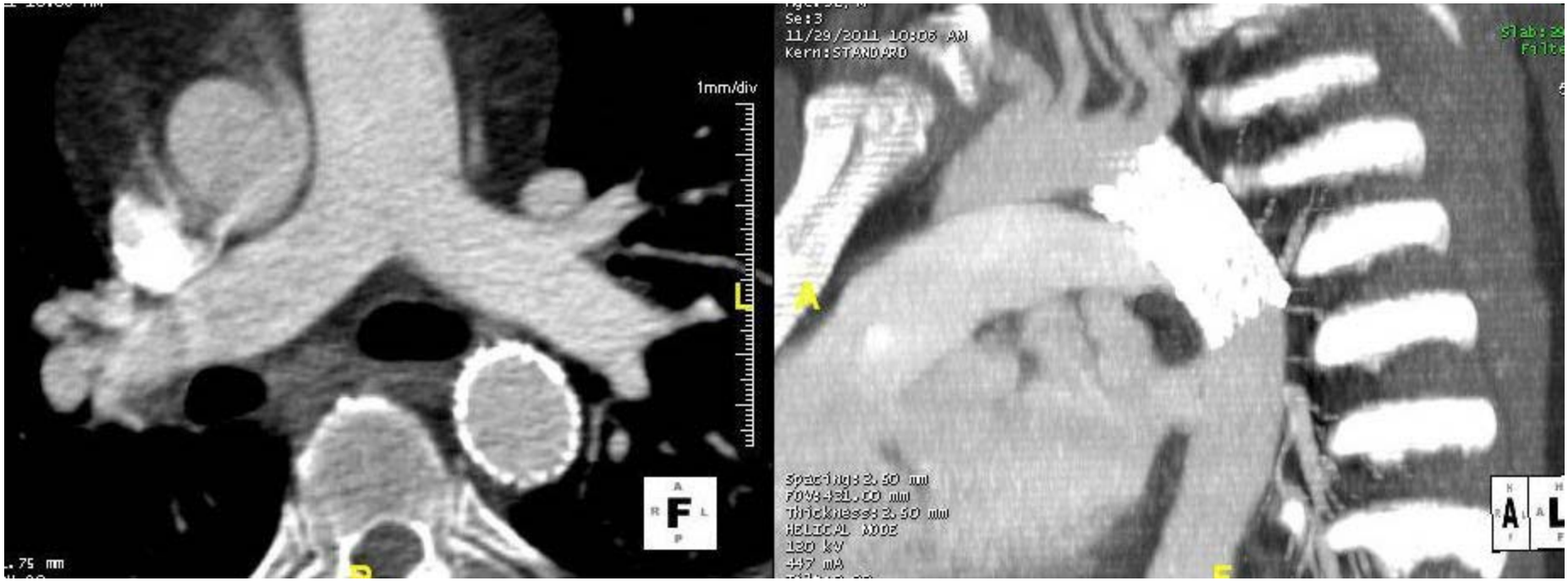
Technique

Allen KB, Borkon AM, Laster S, Aggarwal S. Innovations 2012;7(2):105.

Stacked Excluder (Gore) AAA short cuffs

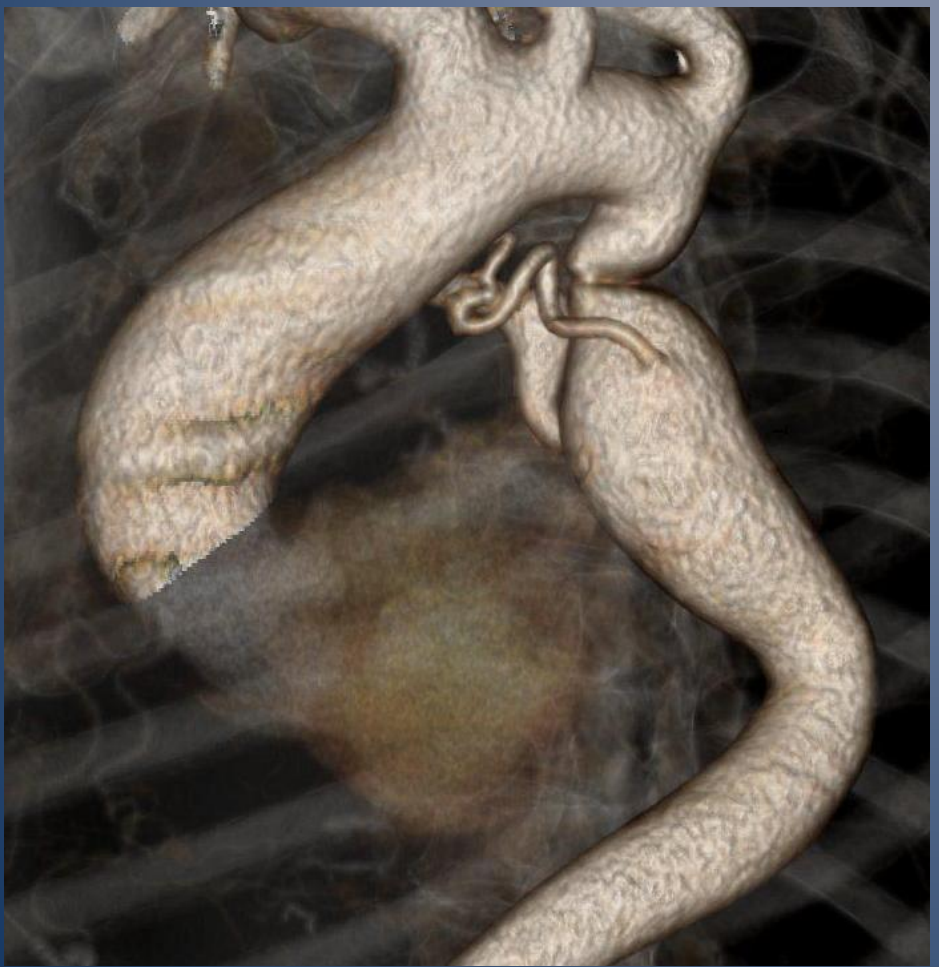


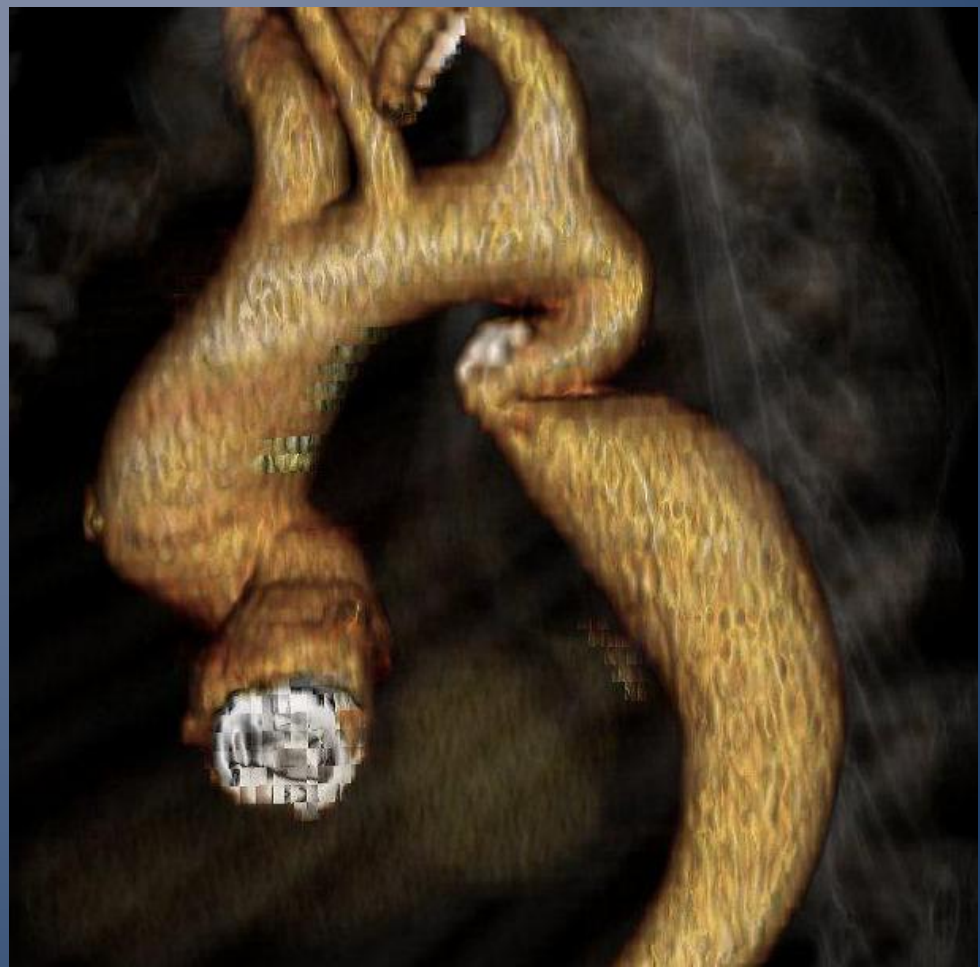



1mm/div
L
A
R
F
L
P
Se:3
11/29/2011 10:06 AM
Kern:STANDARD
A
Spacing:2.50 mm
FOV:431.00 mm
Thickness:2.50 mm
HELICAL MODE
120 kV
447 mA
A
L

Primary Coarctation of the Aorta in Older Patients

Presented at New York Aortic Symposium, April 2012

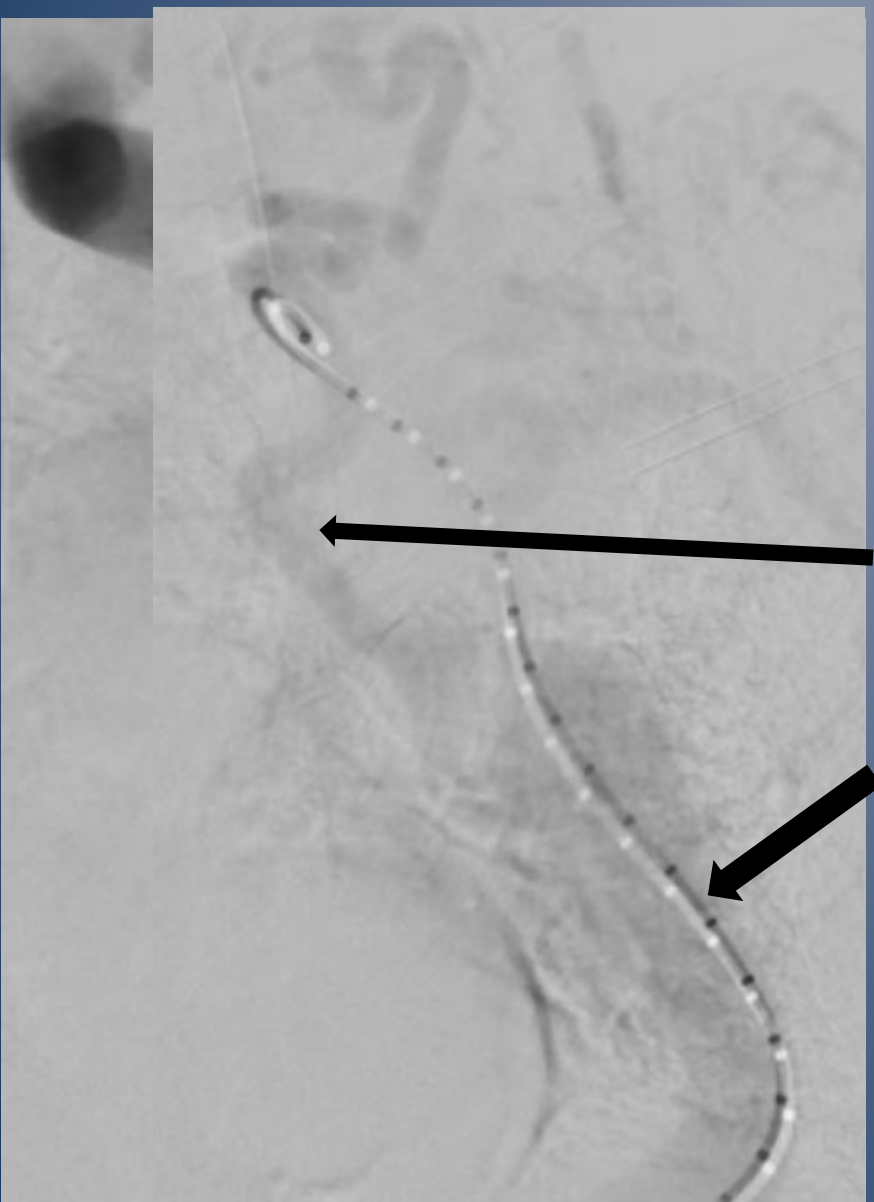




71 YEAR OLD FEMALE

- Mod vascular dementia with prior right posterior infarct.
- Carotid dopplers suggested right vertebral steel syndrome.
- CT demonstrated coarctation with large right thyrocervical artery providing distal aortic collaterals and creating the right vertebral steel.

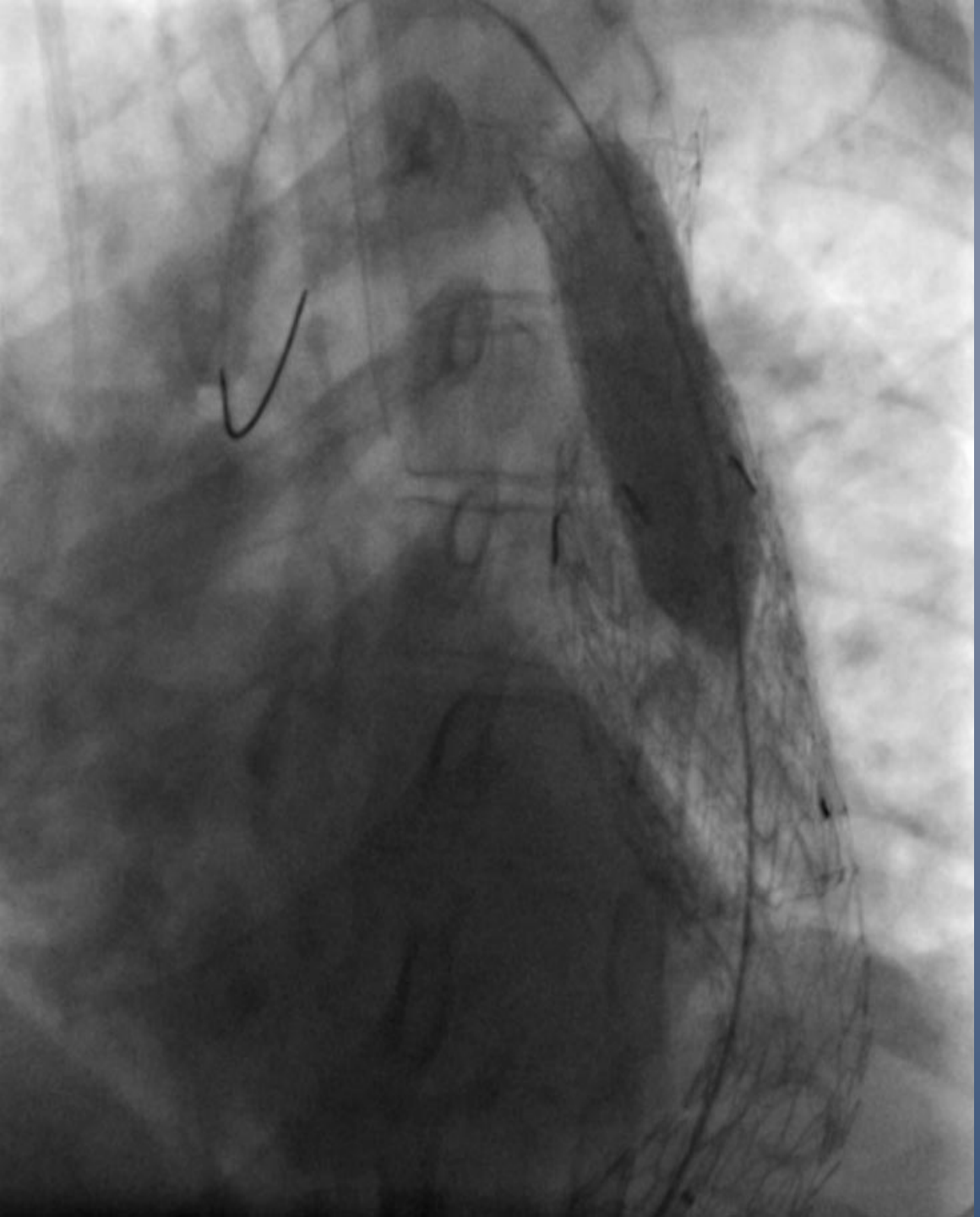
PROCEDURE DETAILS



- Femoral cutdown
- Initial angiogram with catheter obstructing coarctation lumen

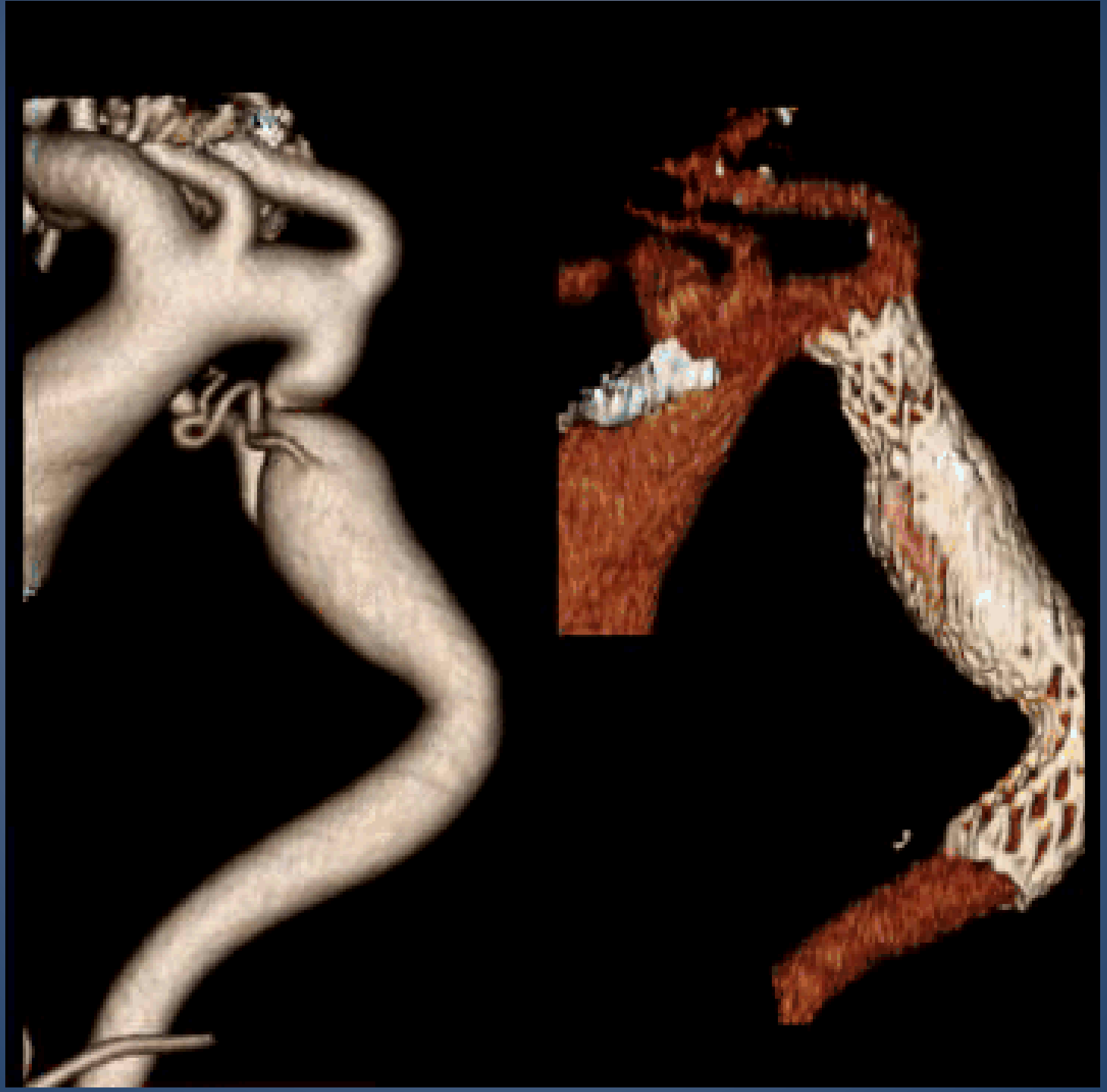
Delayed images demonstrate large collateral from thyrocervical artery filling distal aorta

Gore Excluder AAA cuff (32mm x 4.5cm) deployed below coarctation to seal potential endoleak from thyrocervical collateral



- *Gore C-TAG (28mm x 15 cm)*
- *Post deployment balloon dilation*
- *Prior deployment balloon dilation*
- *Adenosine utilized during deployment*

- Completion Angiogram without endoleak
- Gradient across coarctation ***zero***

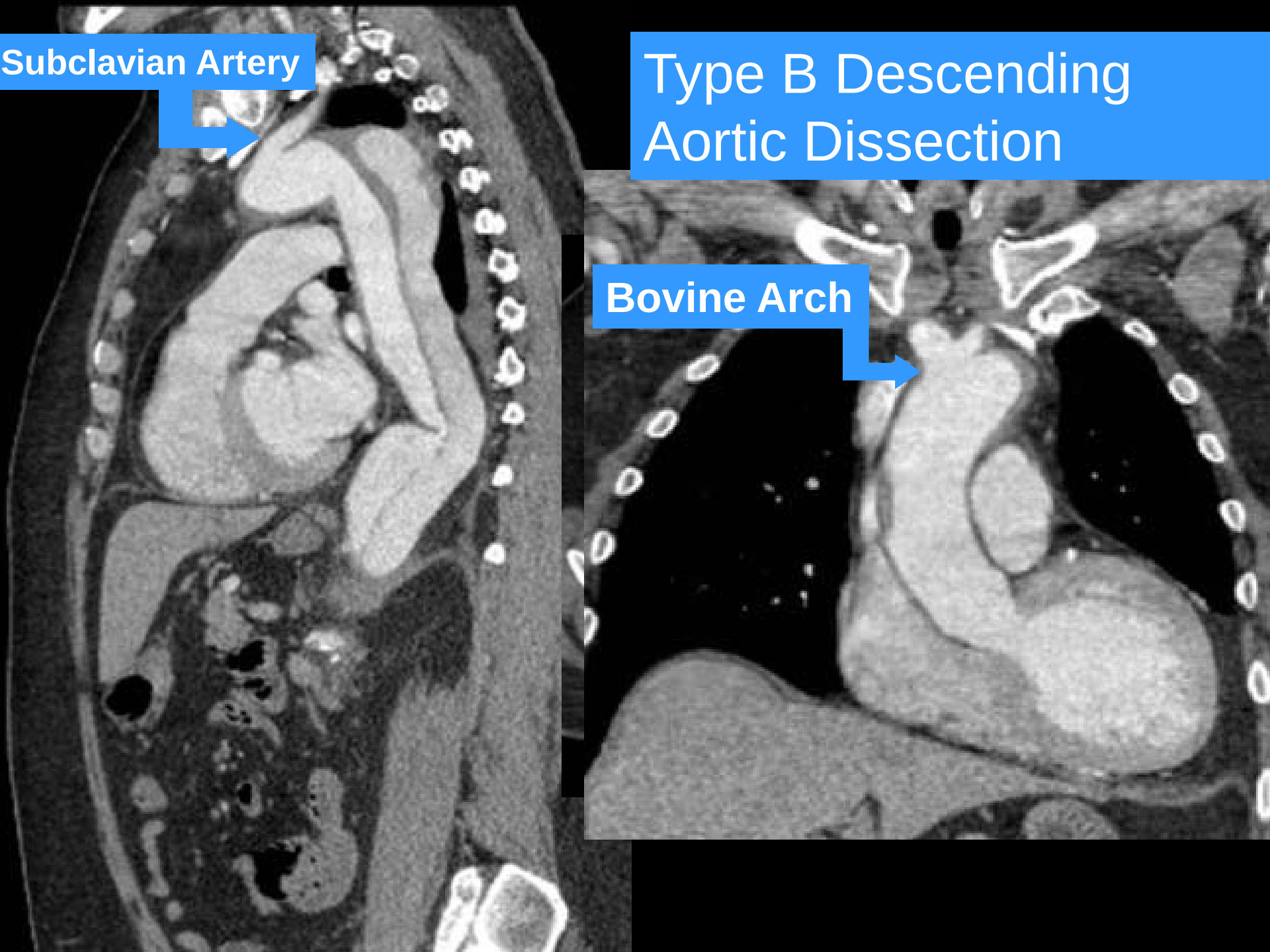


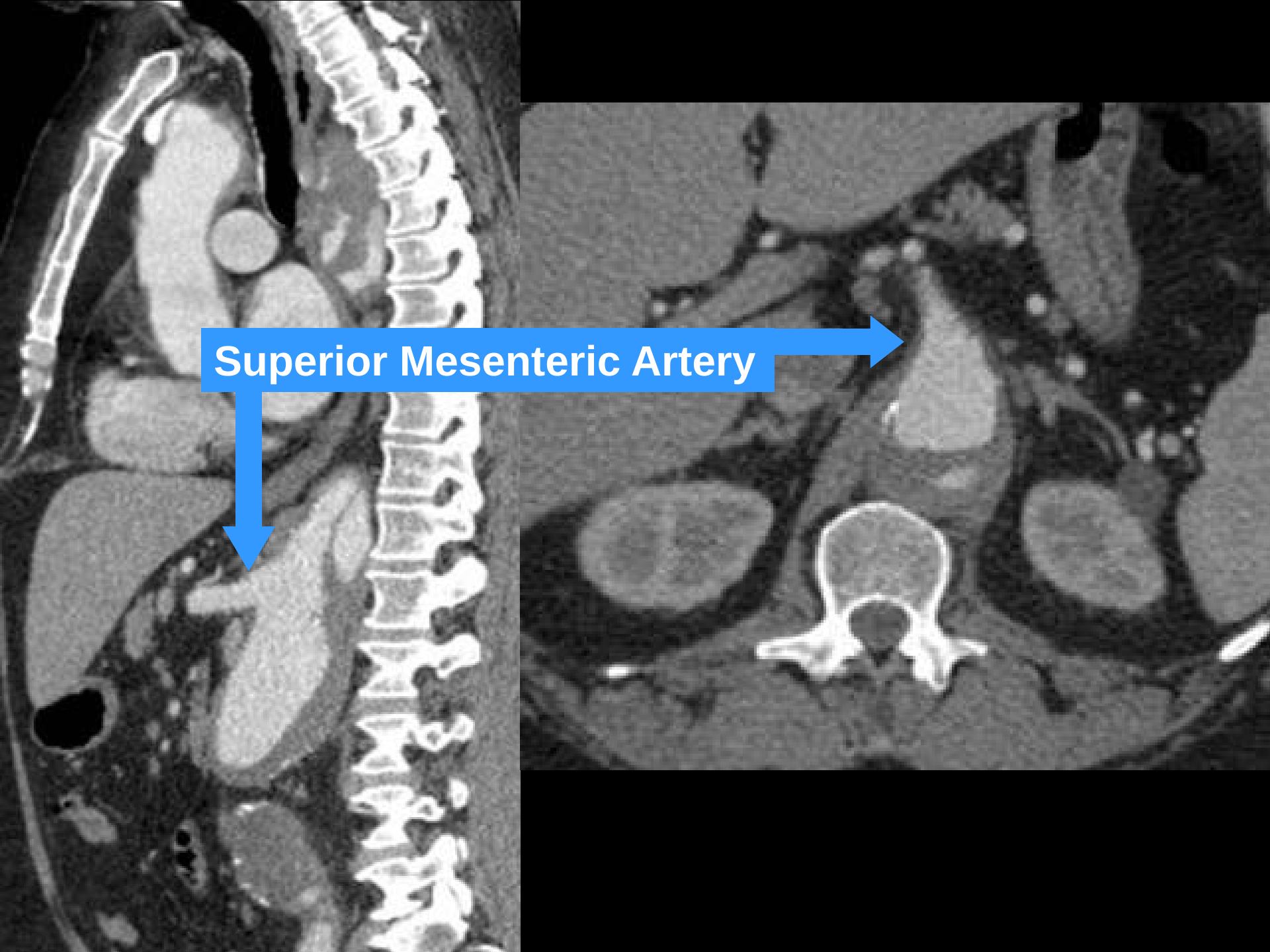
Dissections

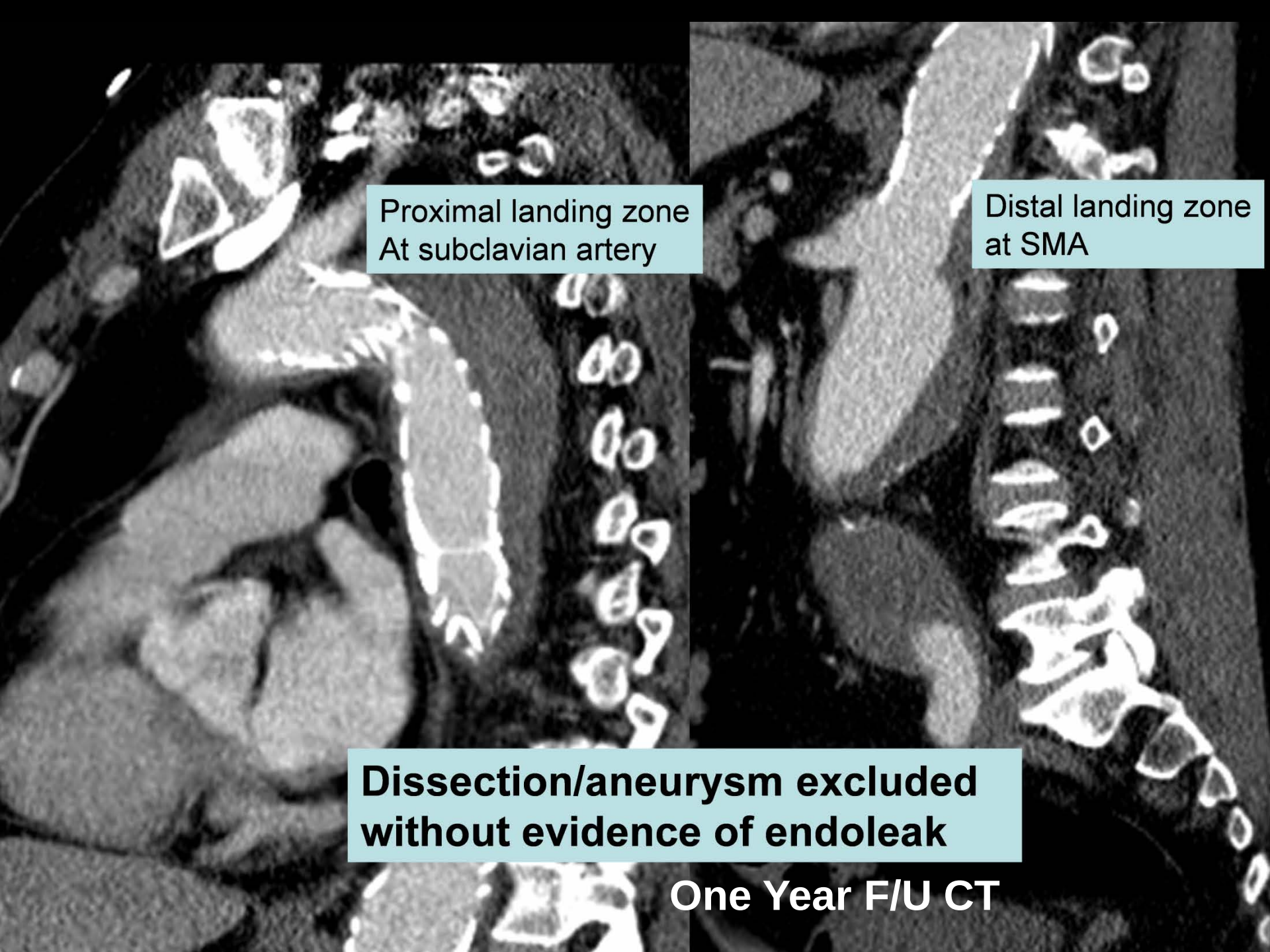
- 62 hypertensive WM with uncomplicated Type B dissection initially managed medically at VA.

- Represents to VA with chest pain and 4cm aneurismal expansion of thoracic dissection.

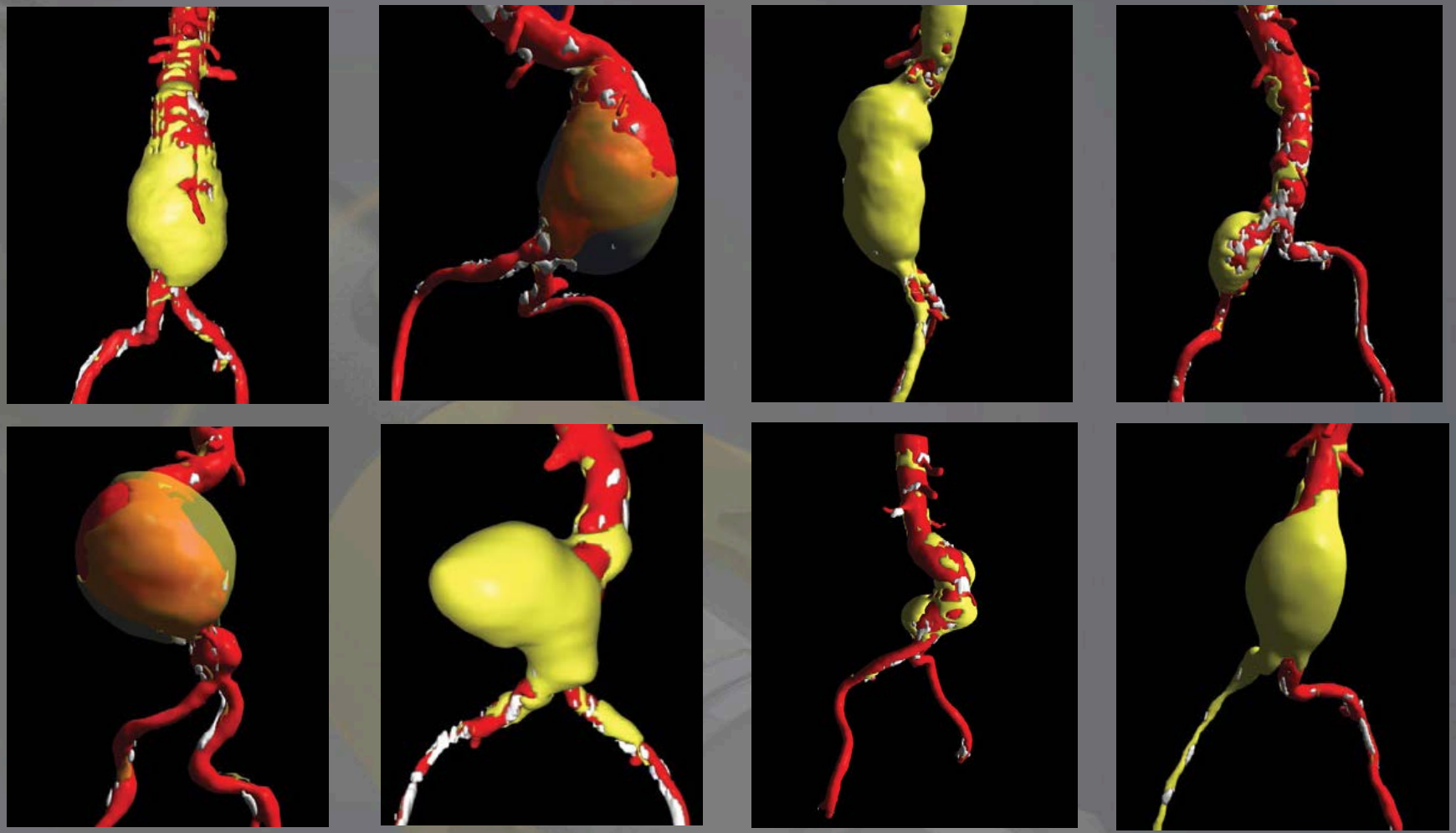
Type B Descending Aortic Dissection



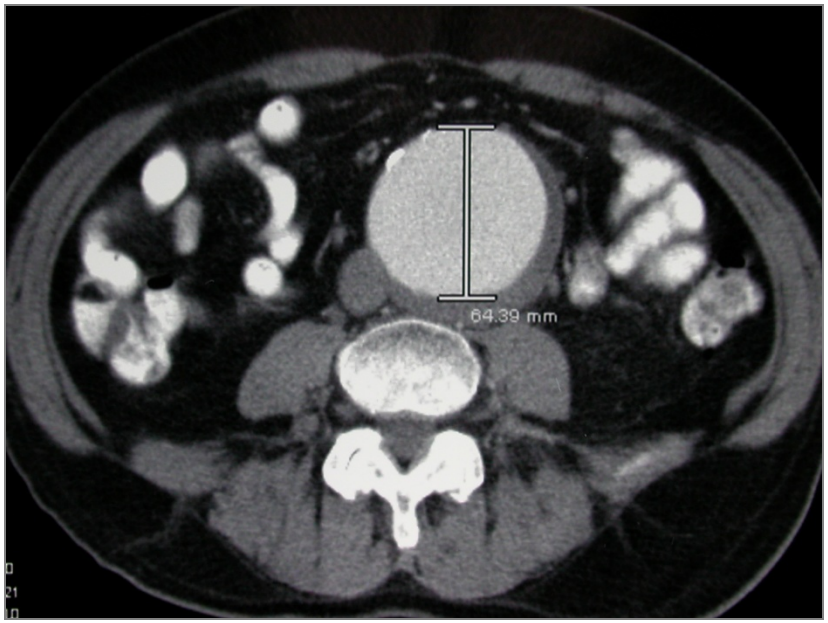

Superior Mesenteric Artery

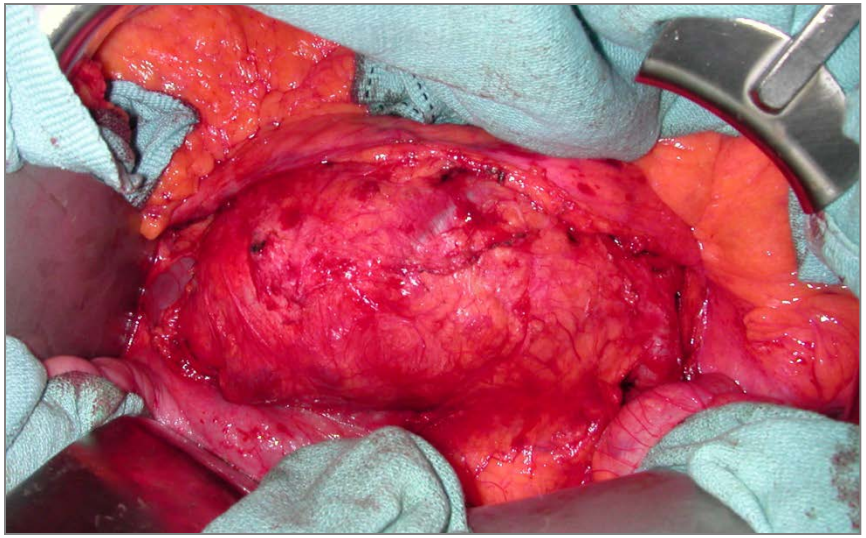

Proximal landing zone
At subclavian artery
Distal landing zone
at SMA
Dissection/aneurysm excluded
without evidence of endoleak
One Year F/U CT

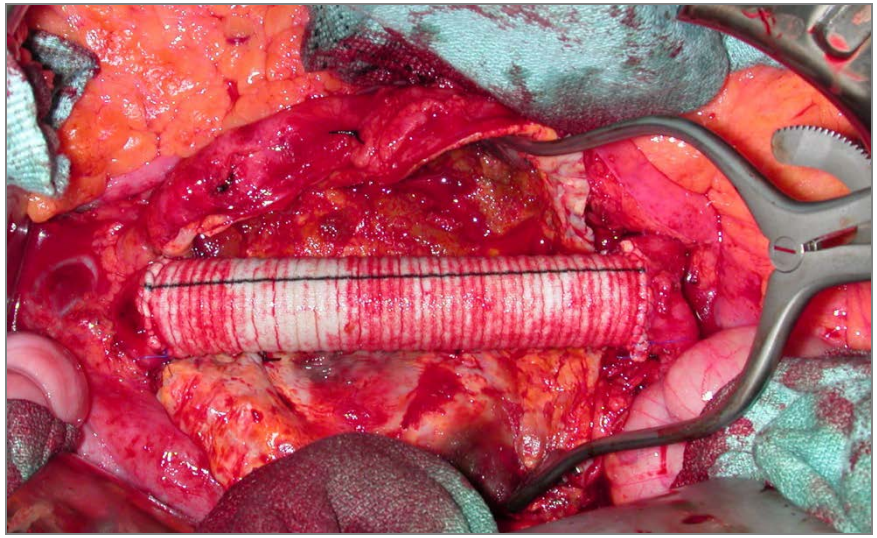
AAA



Abdominal Aortic Aneurysm
Open Repair





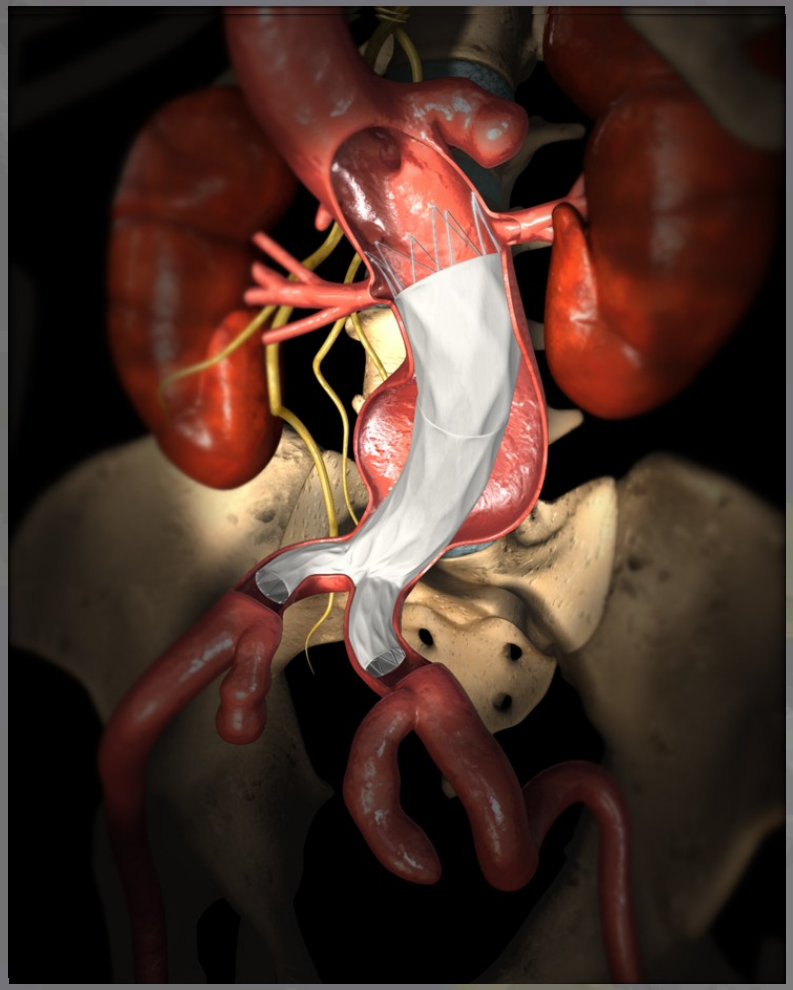


Fixation

Non anatomic

Anatomic

AFX Endovascular AAA System Deployment Procedure



- Deploy Unibody on Aortic Bifurcation
- Implant Proximal Extension just Below Renal Arteries

Iliac Aneurysm

Before

After

VENTANA GRAFT

Branched Graft Technology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