Surgical Strategies for Aortic Root and Ascending Aorta Repair in Genetic Aortopathies

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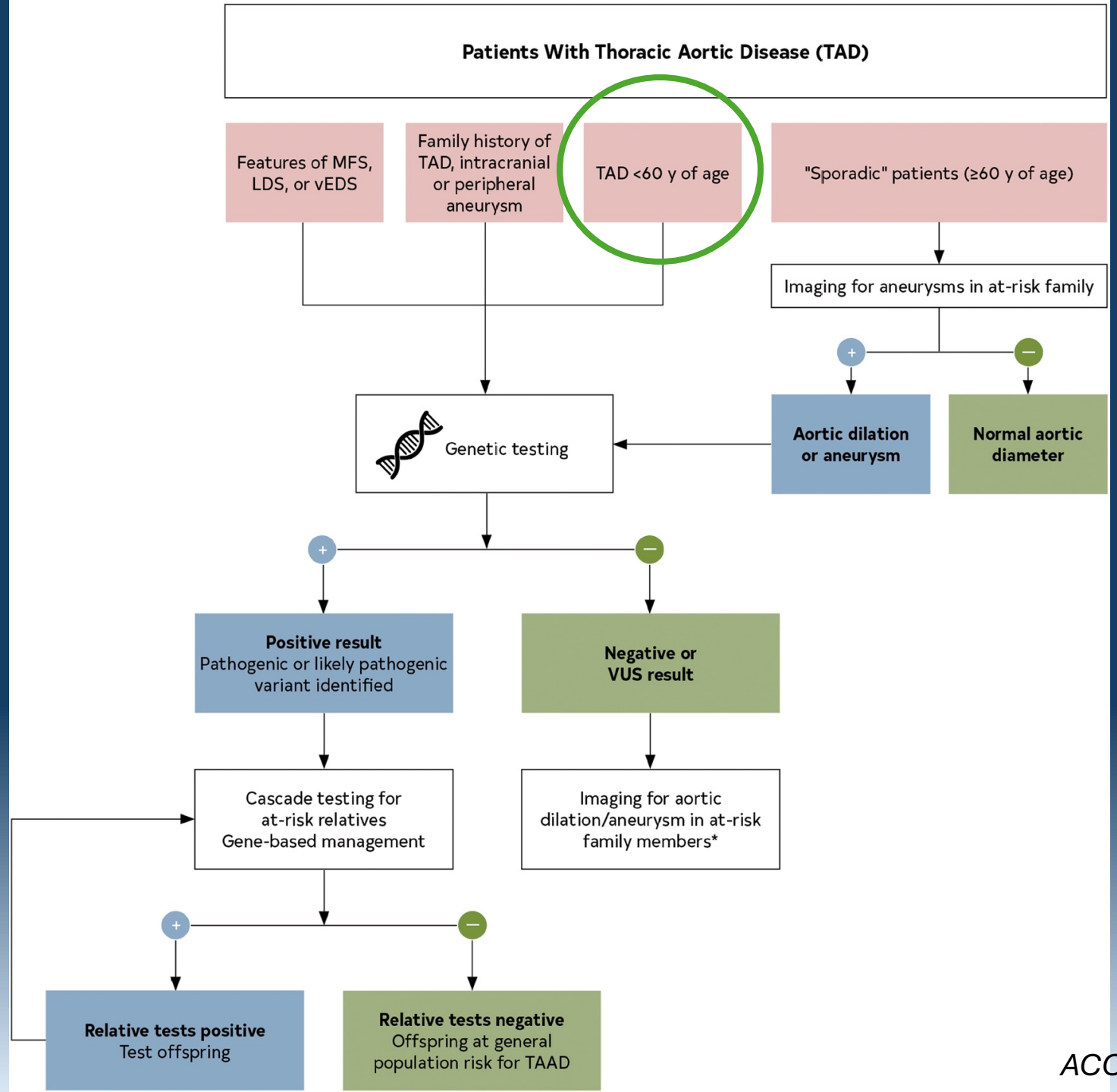
Some arch stuff …

VASCULAR GENETICS SYMPOSIUM

Disclosures

- Consultant: Gore
- NDA: Gore, Astra Zeneca



ACC/AHA 2022 Aortic Guidelines

Head

- Craniosynostosis
- Bifid uvula/cleft palate
- High, narrow palate
- Micrognathia
- Retrognathia

Chest/Abdomen

- Pectus deformity
- Pneumothorax
- Hernias (abdominal, inguinal, incisional, hiatal)
- Inflammatory bowel disease
- Food allergies
- Esophagitis
- Hollow organ rupture (eg. bowel, uterine, bladder rupture)

Hands/Fingers

- Arachnodactyly
- Contractures
- Acrogeria

Skin

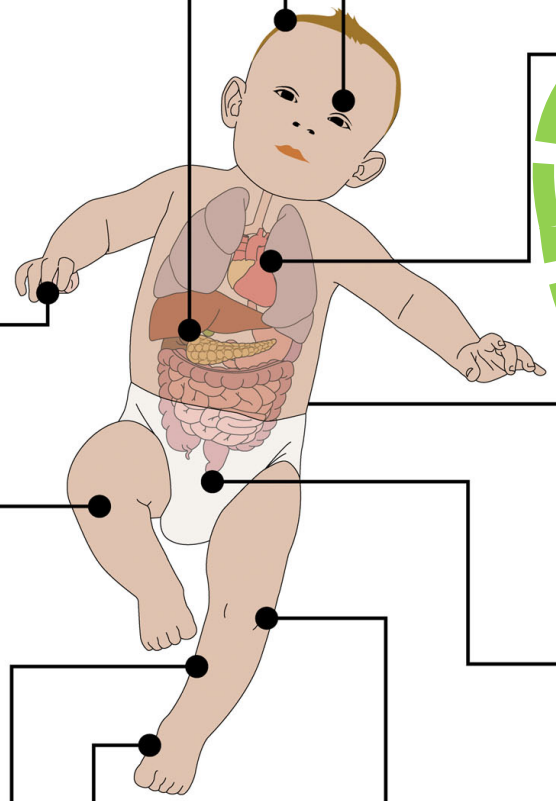
- Translucent skin
- Easy bruising
- Poor wound healing
- Atrophic scarring
- Striae
- Livedo reticularis
- Varicose veins before age 30

Muscle

- Tendon/muscle rupture

Feet/Toes

- Long toes
- Club foot
- Hammertoes
- Flat feet



Ocular

- Enophthalmos
- Myopia
- Retinal detachment
- Ectopia lentis
- Glaucoma
- Mydriasis
- Iris flocculi
- Dusky sclerae
- Cataract

Cardiovascular

- Aortic aneurysm/dissection
- Arterial aneurysm/dissection
- Arterial tortuosity
- Early occlusive disease
- Congenital heart disease
- Mitral/tricuspid valve prolapse
- Mitral annular disjunction
- Left ventricular dysfunction

Spine

- Scoliosis or spondylolisthesis
- Kyphosis
- Cervical spine malformations/instability
- Dural ectasia/Tarlov cyst

Pelvis

- Uterine prolapse
- Uterine rupture

Joints

- Hypermobility
- Joint dislocation/subluxation
- Congenital hip dysplasia
- Contractures
- Ankle valgus
- Protrusio acetabulae
- Reduced elbow extension

Dissection
Aneurysm
Tortuosity
Occlusive diease
Congenital Heart
Mitral
Tricuspid
Mitral annular disjunction
LV dysfunction

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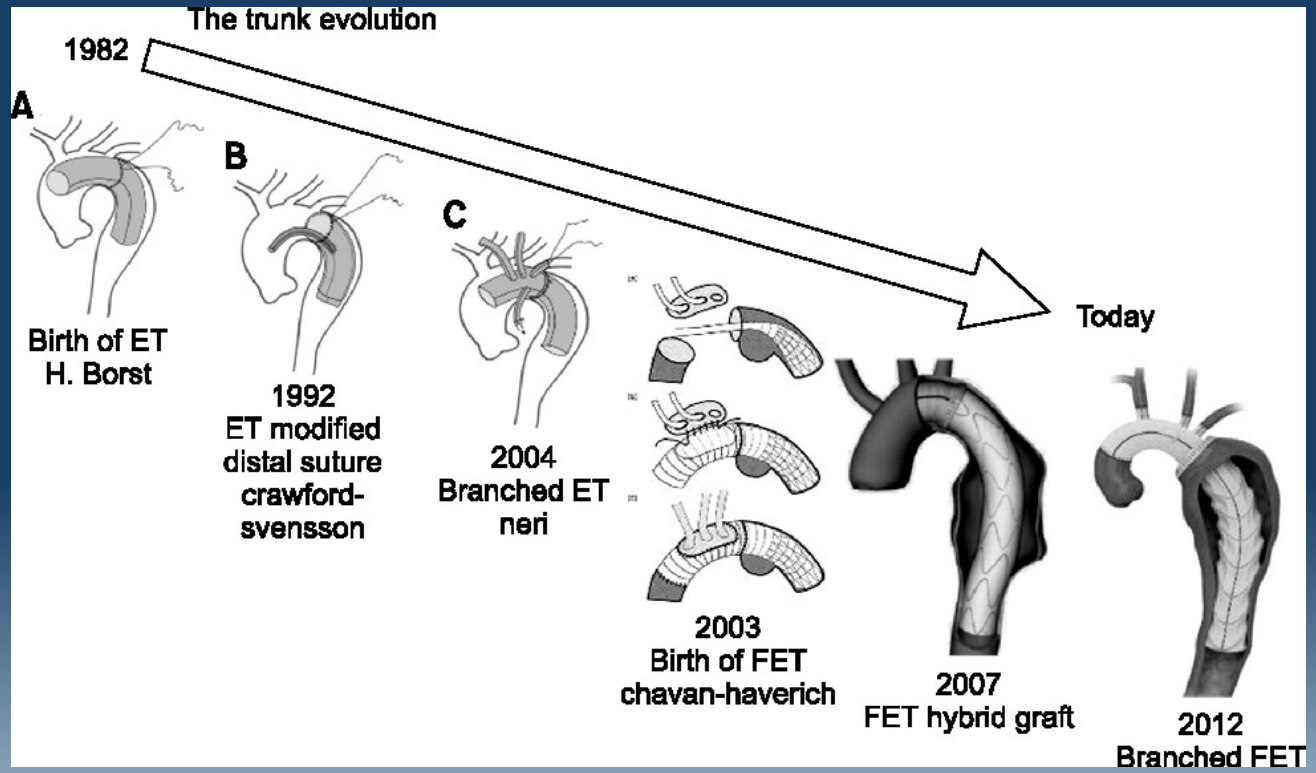
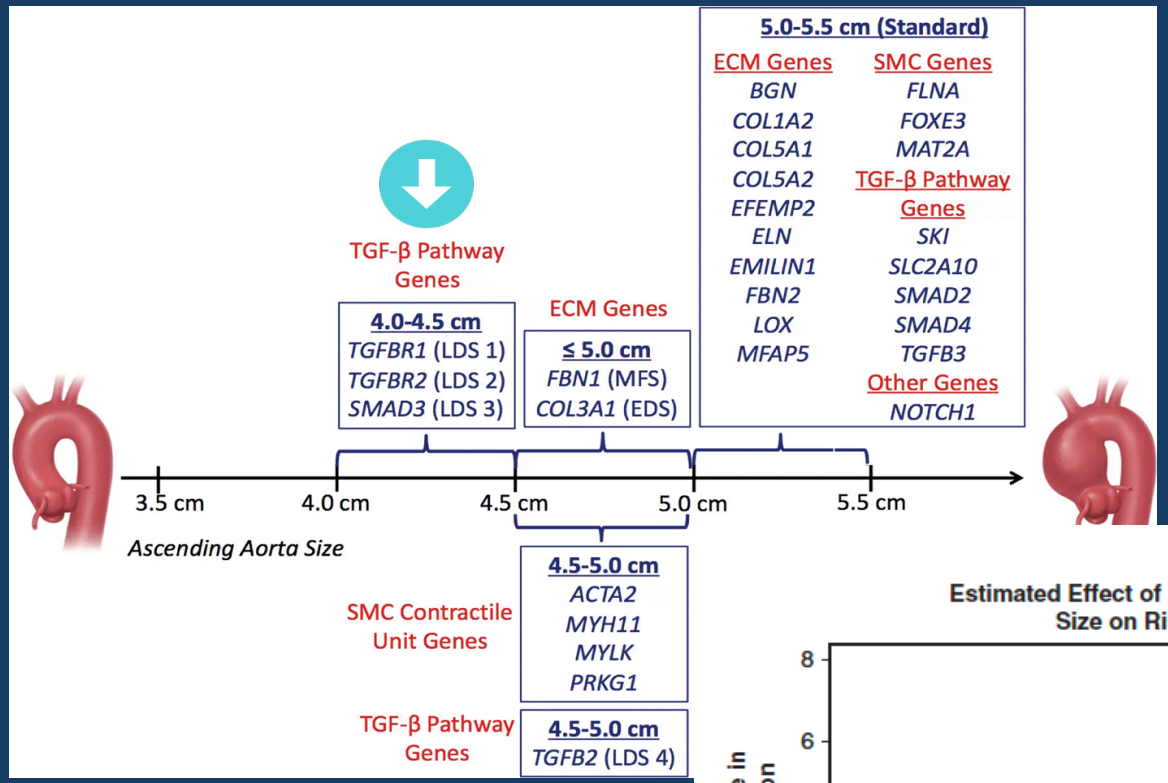
VASCULAR GENETICS SYMPOSIUM

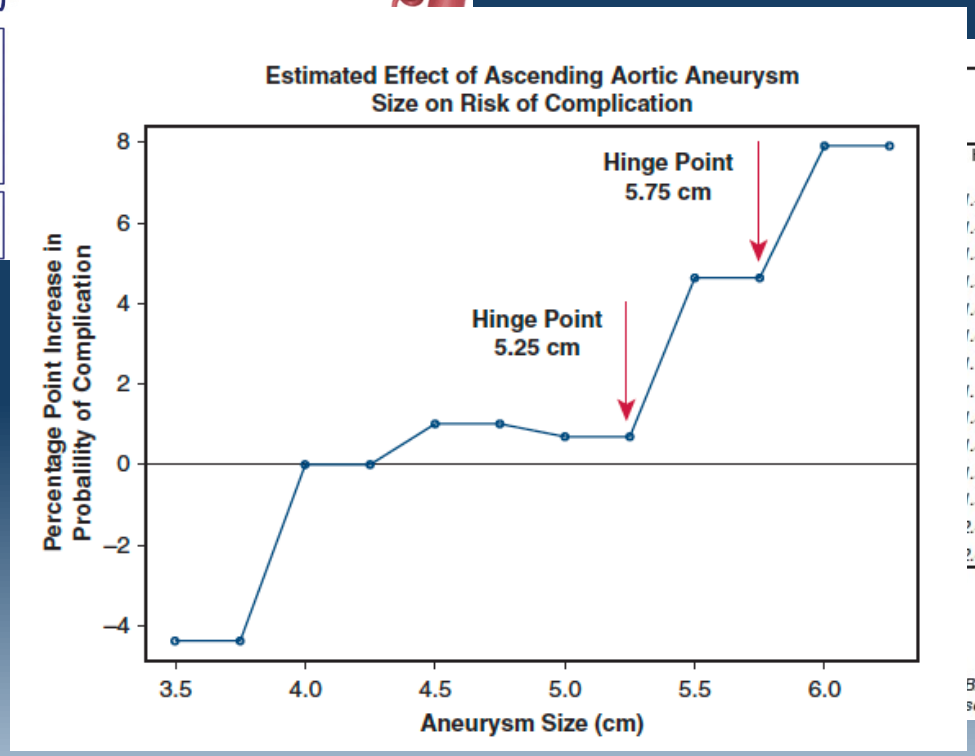
Outcomes — centers of excellence

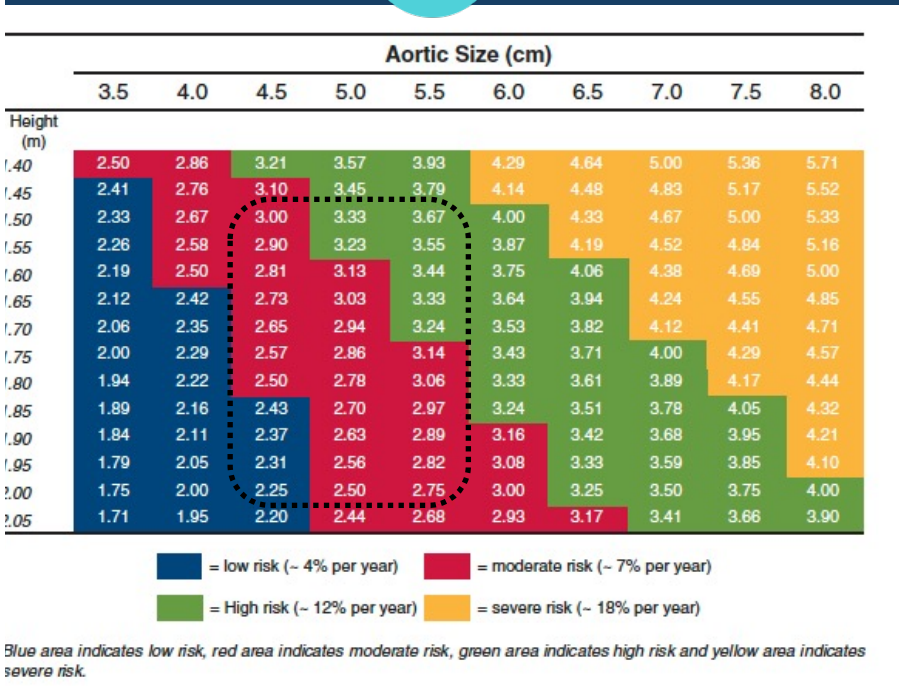
- Early mortality 5-18%
- Stroke 5-14%
- Spinal cord injury 5%
- 5 year survival ~80%



When to operate ?

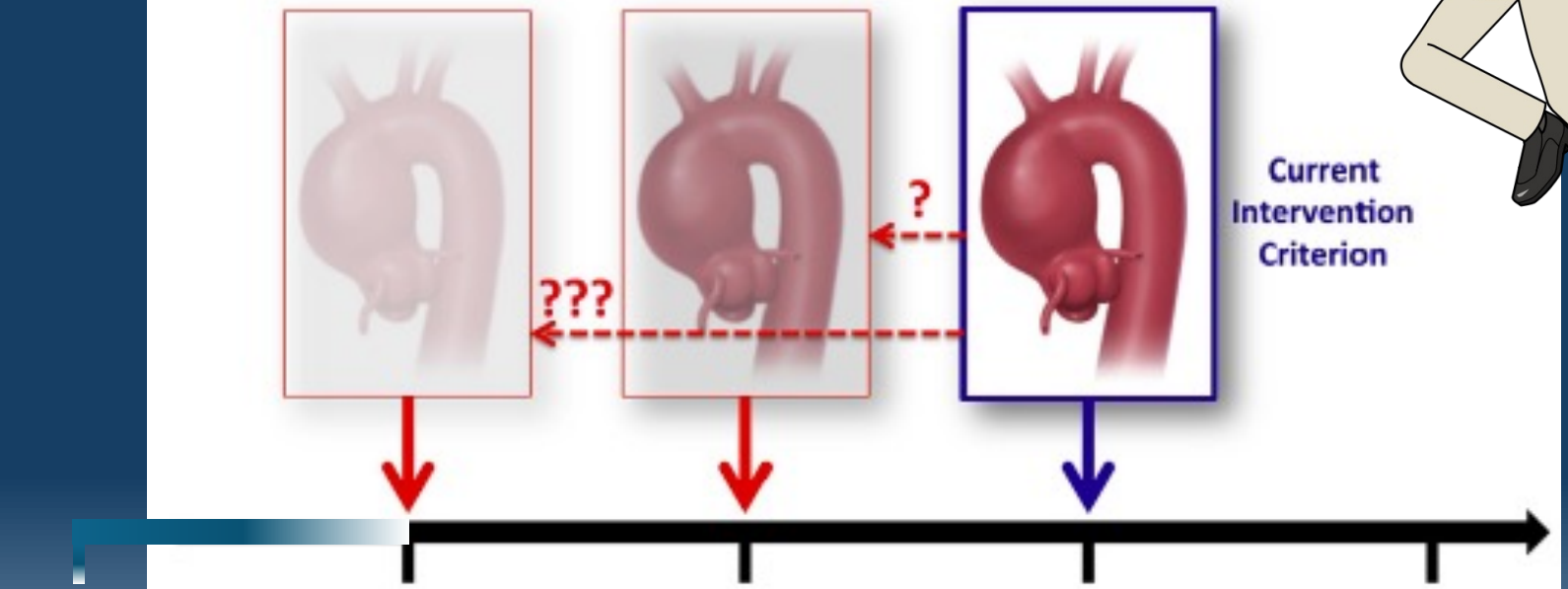






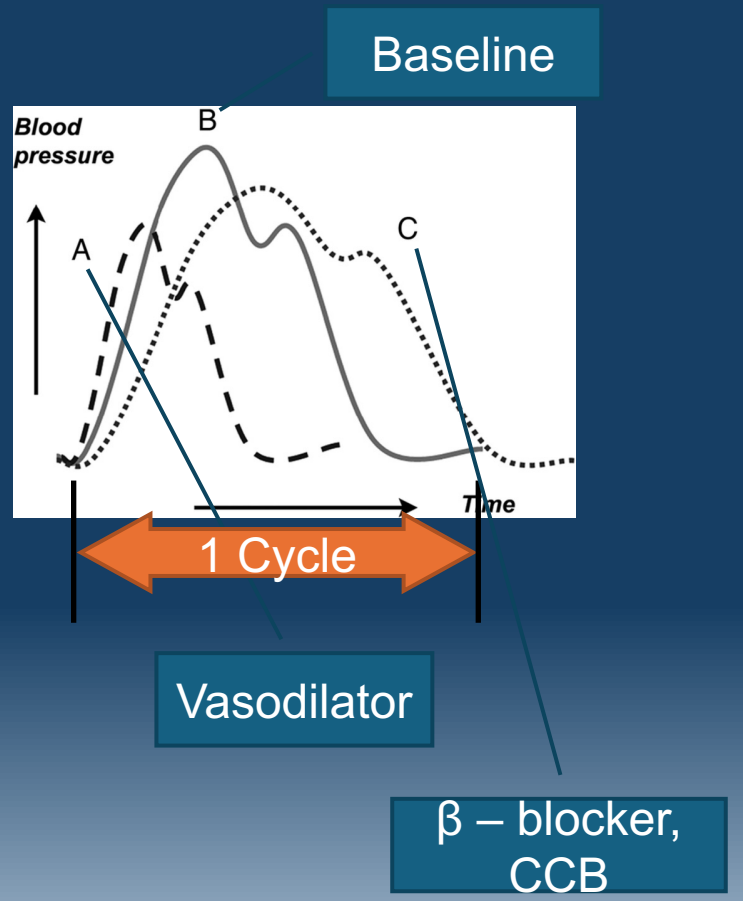
Baseline 4.00 – 4.25 cm

Time for a Left-ward Shift in Ascending Aortic Guidelines?



Current Management

- Anti-impulse therapy
- Open surgery
- Endovascular surgery
- Hybrid surgery
- Surveillance therapy
- Palliative therapy



Preoperative

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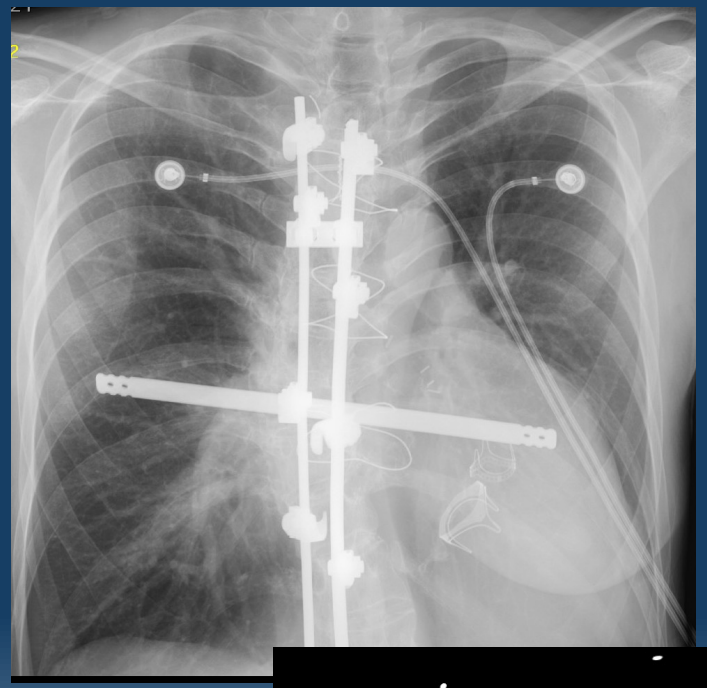
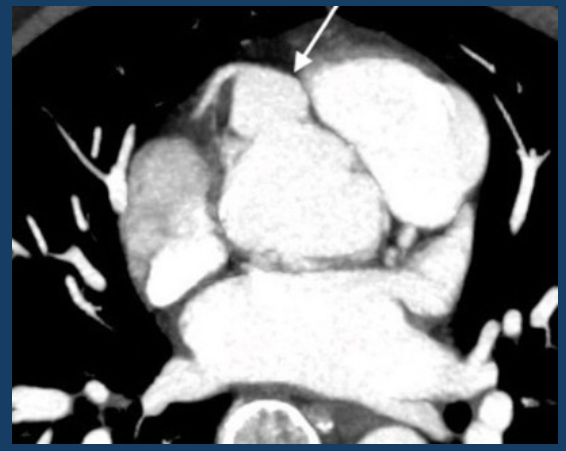
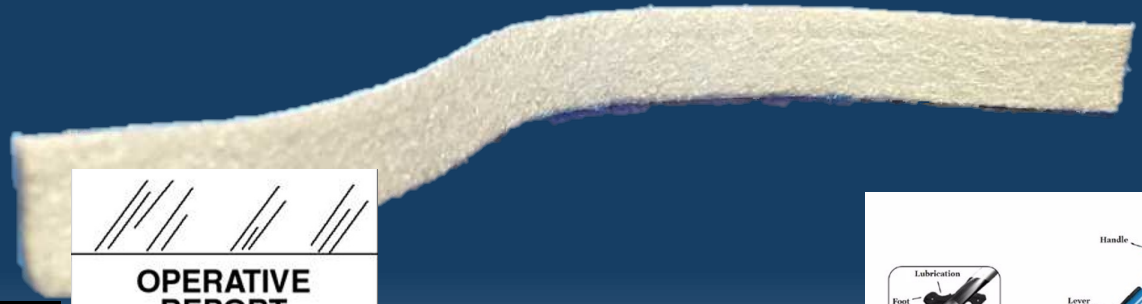
VASCULAR GENETICS SYMPOSIUM

Preoperative



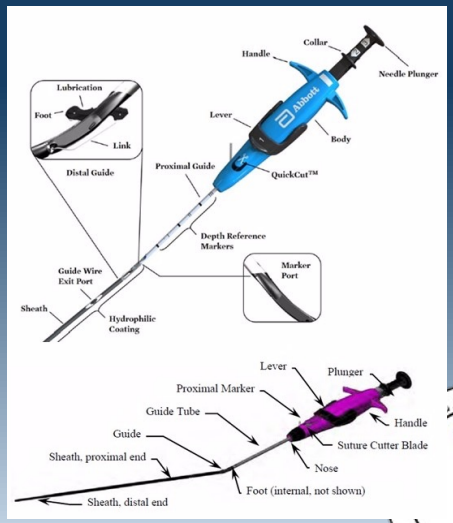




OPERATIVE REPORT

OPERATIVE REPORT

SVC – IVC
LV Vent – PA - LAA
Aorta – Innominate
Axillary – Carotid
LV Apex



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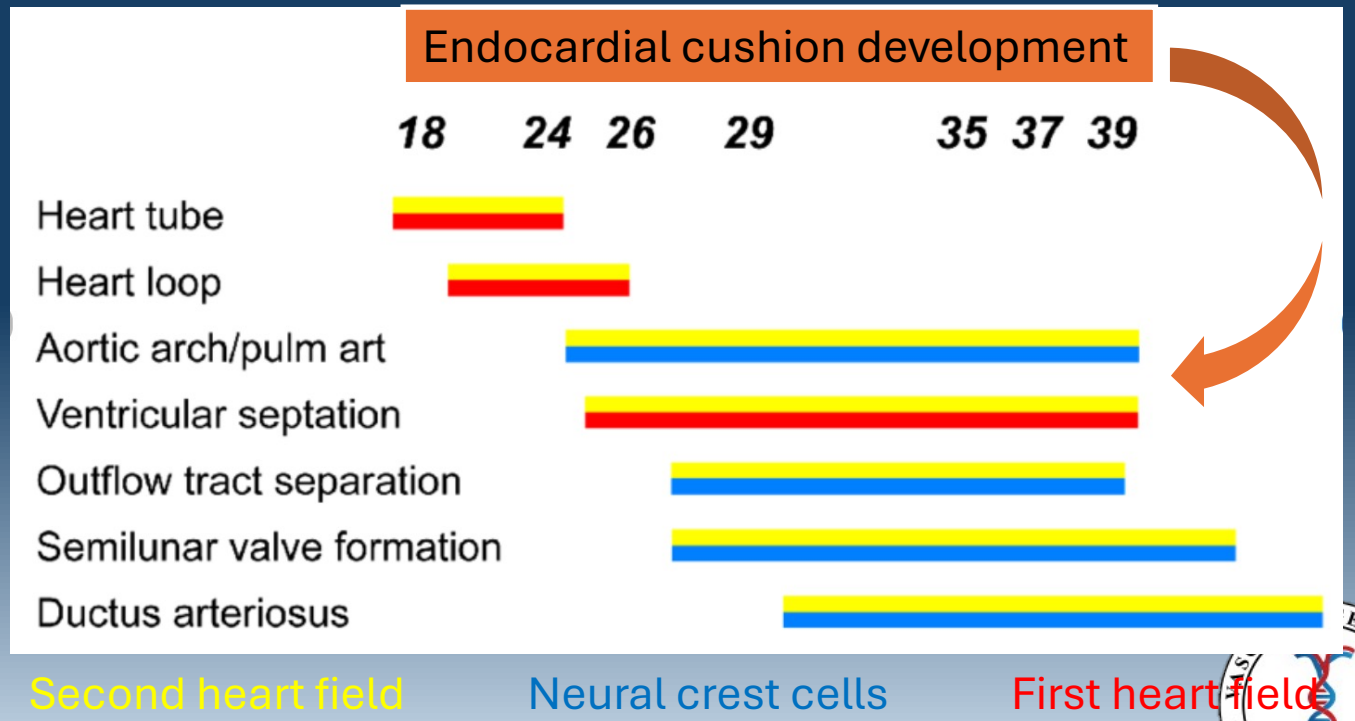
SYMPOSIUM

Key considerations

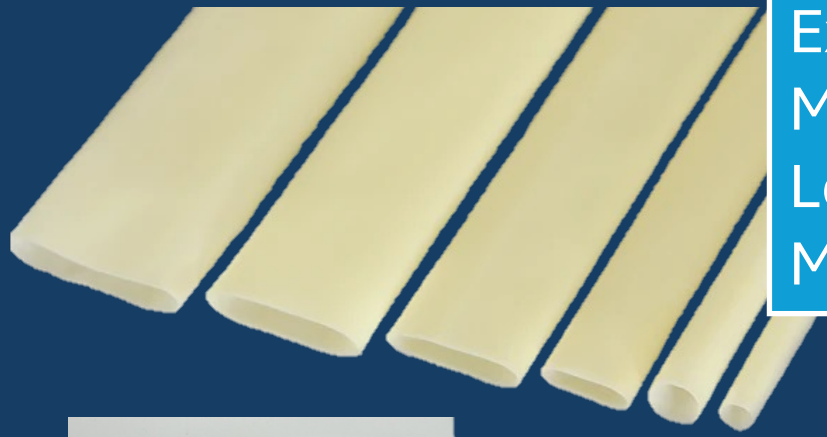
- Coronary plan – Cabrol / Hemi Cabrol
- Aortic valve – preserve / replace
- Mitral valve
- Tricuspid valve

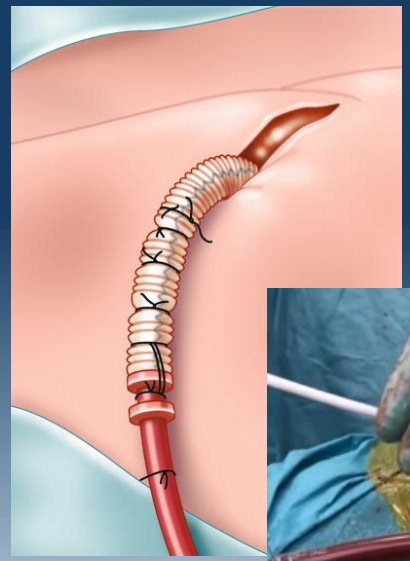
- Ventricle performance



Operative

Expose more than you need
Minimize topical hemostatic agents
Leave chest open
Manage the room – team





- KCentra
- FEIBA
- RiaSTAP
- FFP on CPB
- Platelets
- Cryo
- Warm to 36.6 deg

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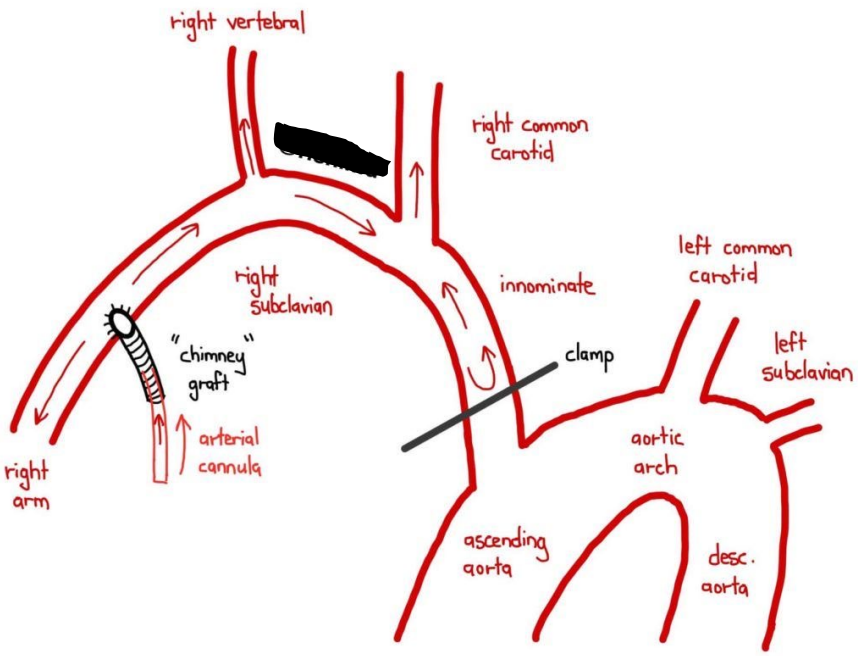
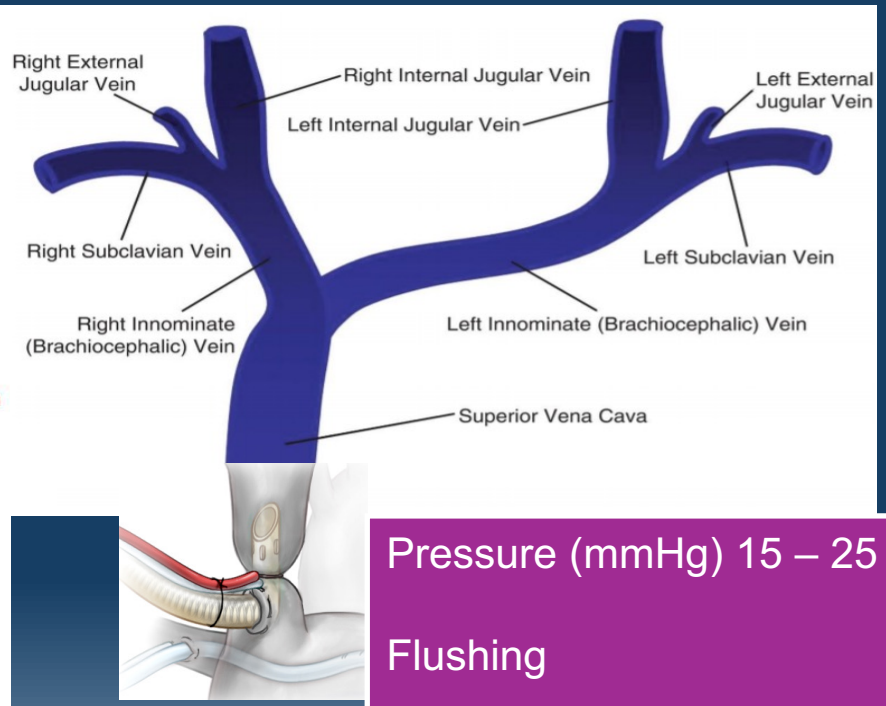
VASCULAR GENETICS SYMPOSIUM

Arch considerations





	Temperature (°C)		
	20-24	24-28	28-32
Flow (mL/kg/min)	8-10	10-12	12-15
Pressure (mmHg)	40-50	50-70	70-80
pH management		Alpha stat	
Hematocrit (%)		20-30	

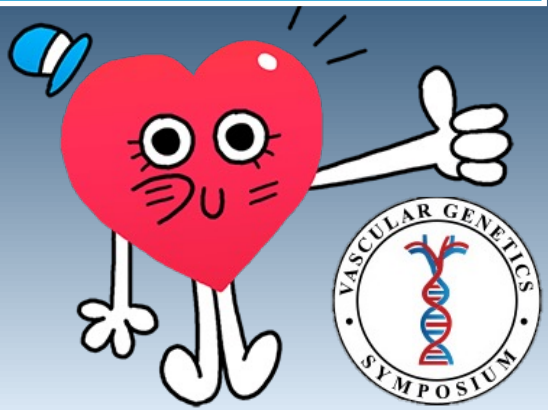
Pressure (mmHg) 15 – 25 mmHg

Flushing

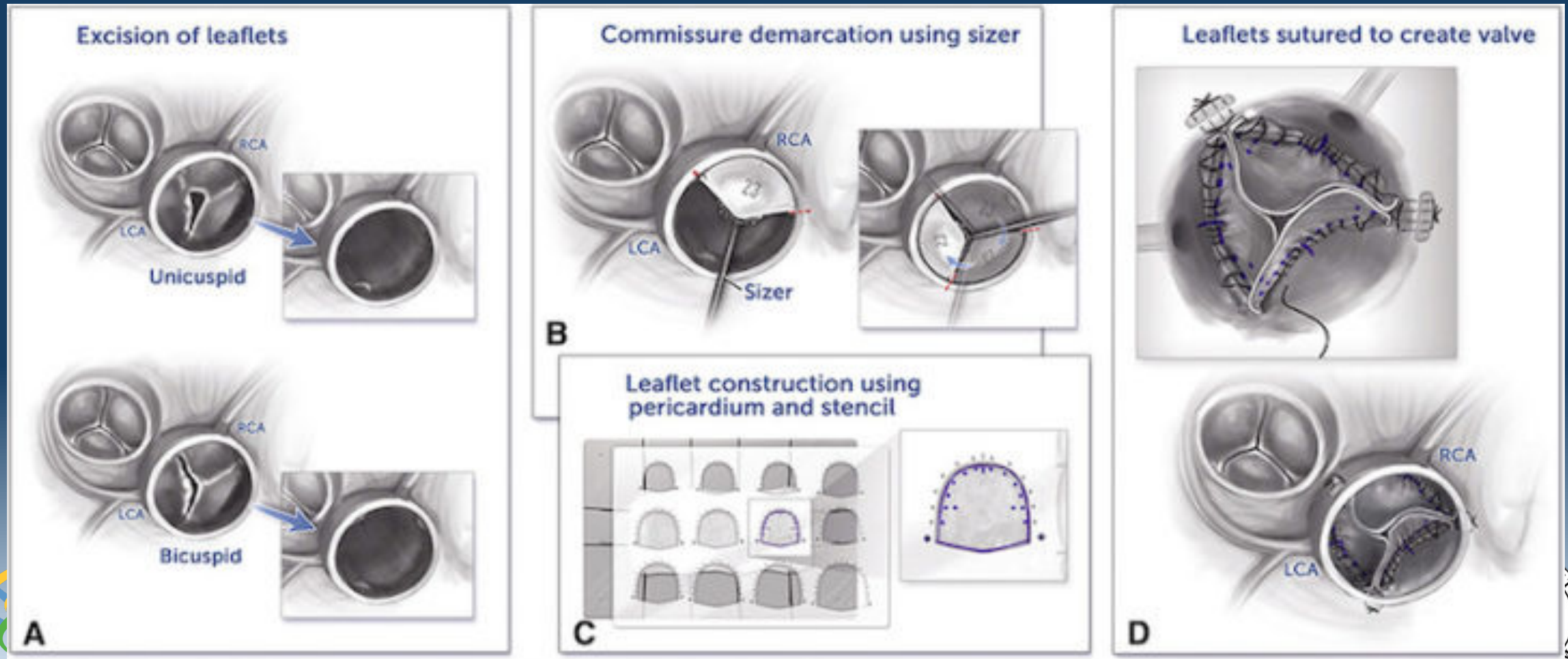
Adjunct to DHCA

SACP
DACP
RCP
SACP + RCP washout
DACP + RCP washout

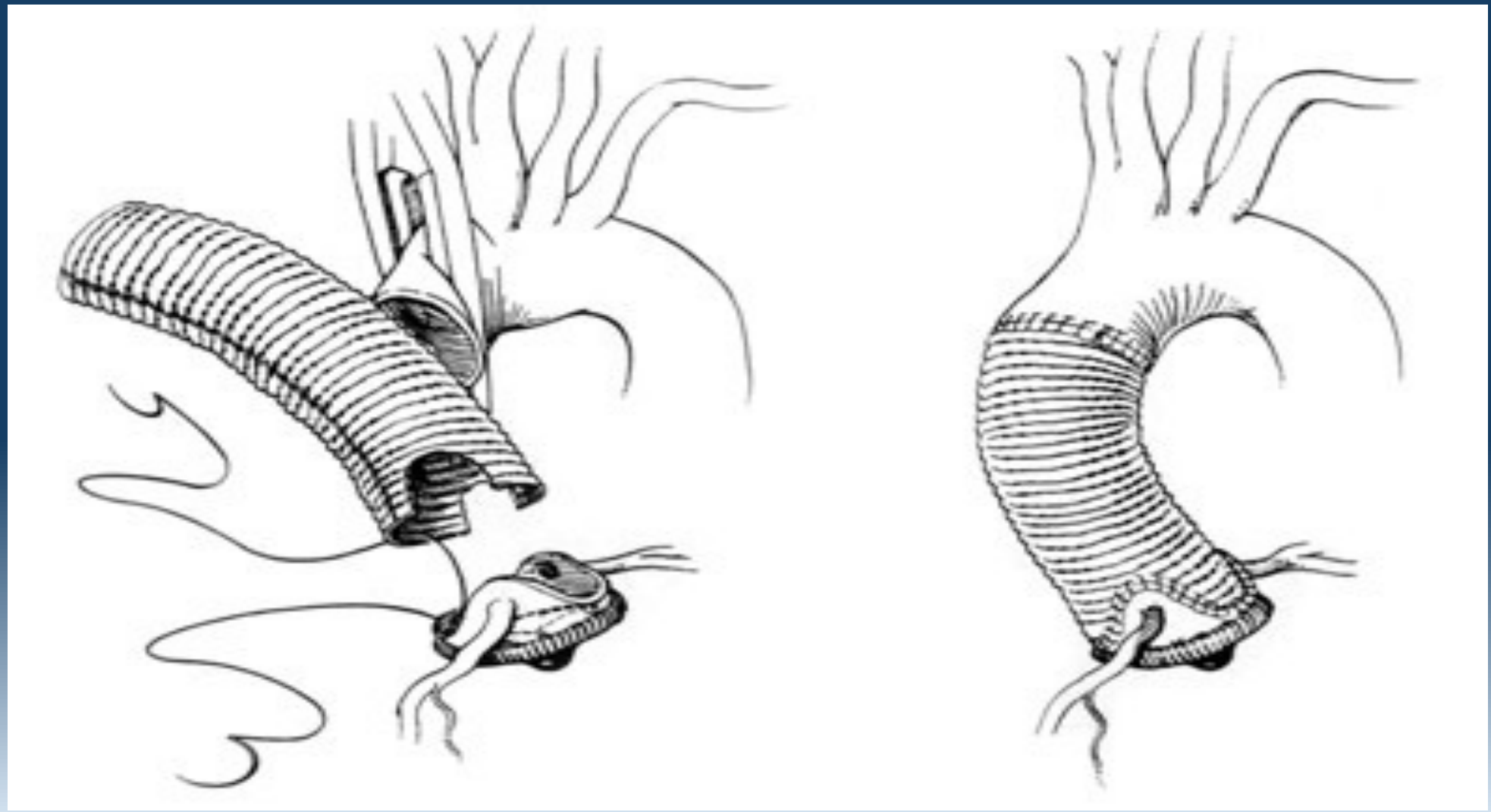
Alpha STAT
pH STAT



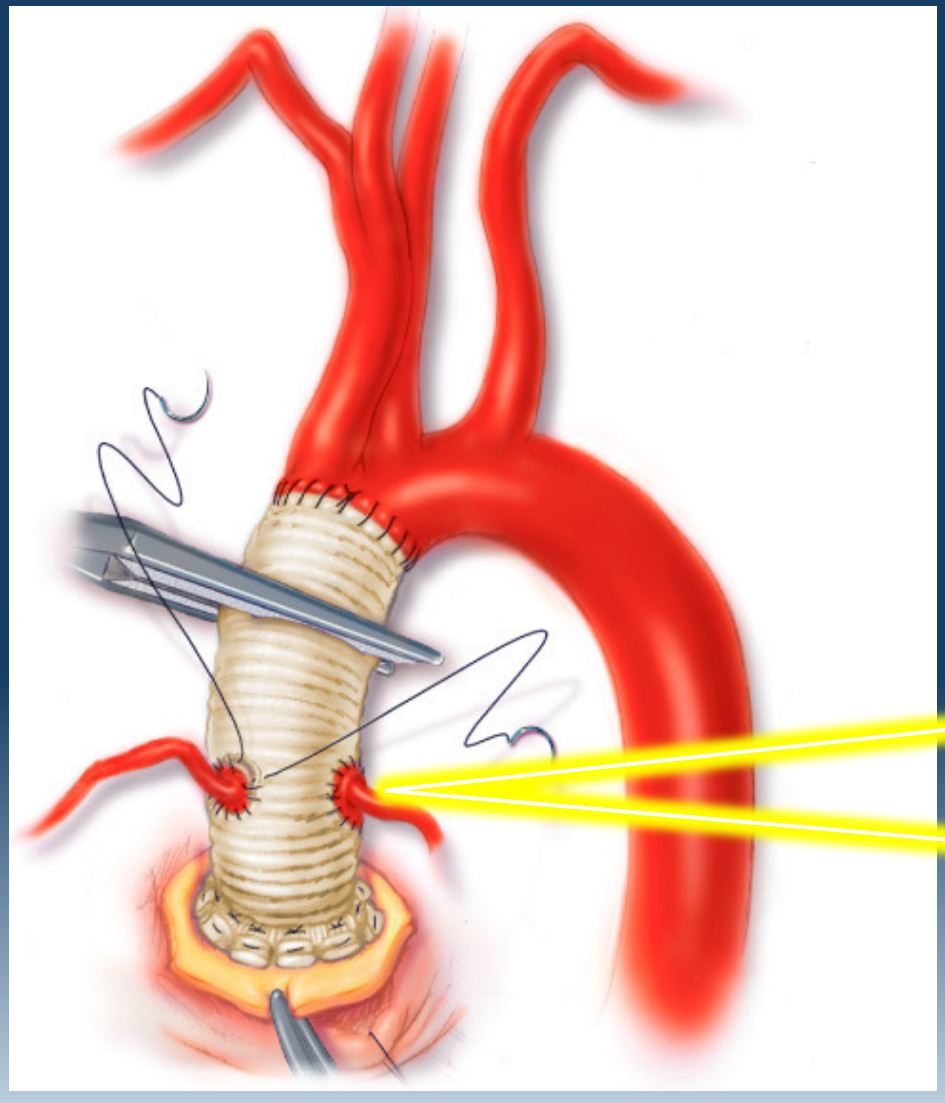
Ozaki procedure

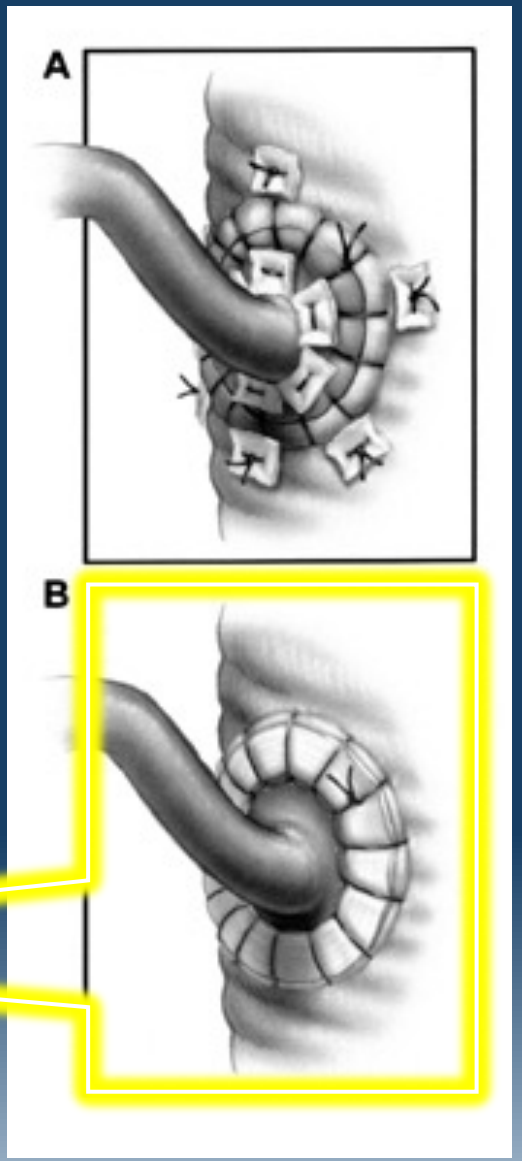


Wheat Procedure

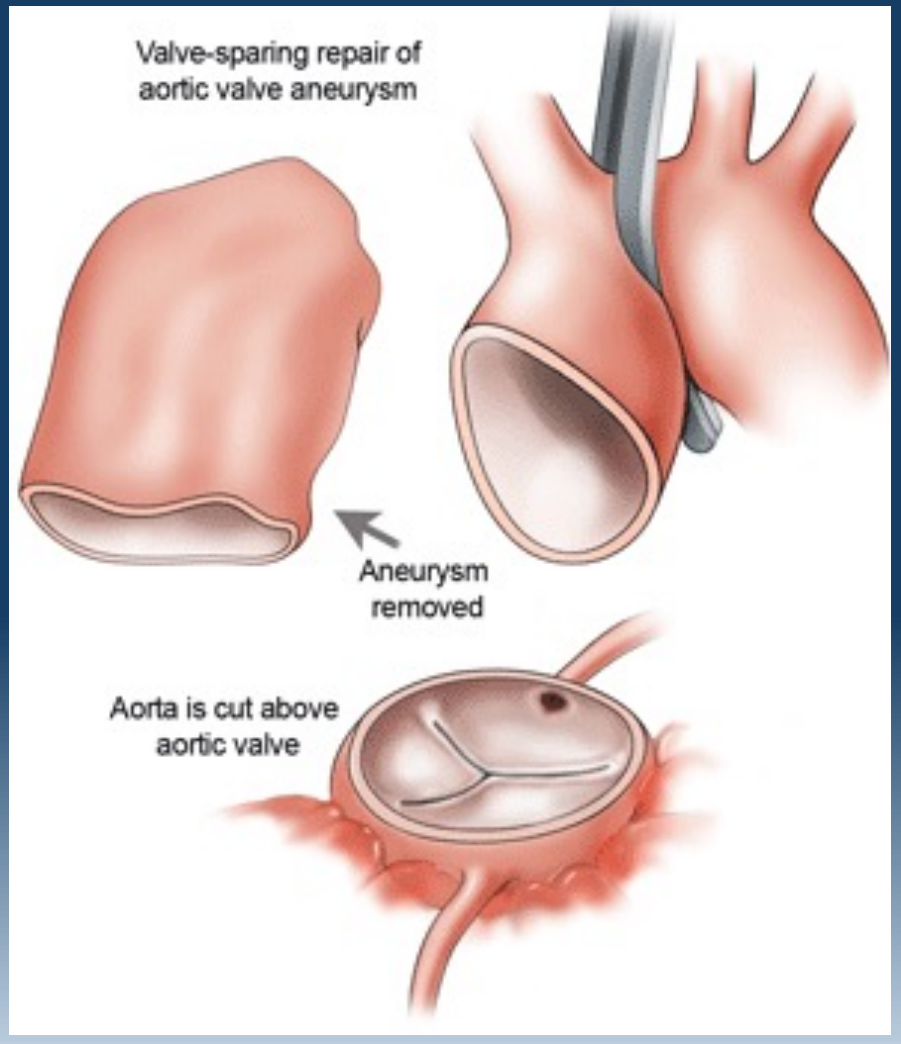


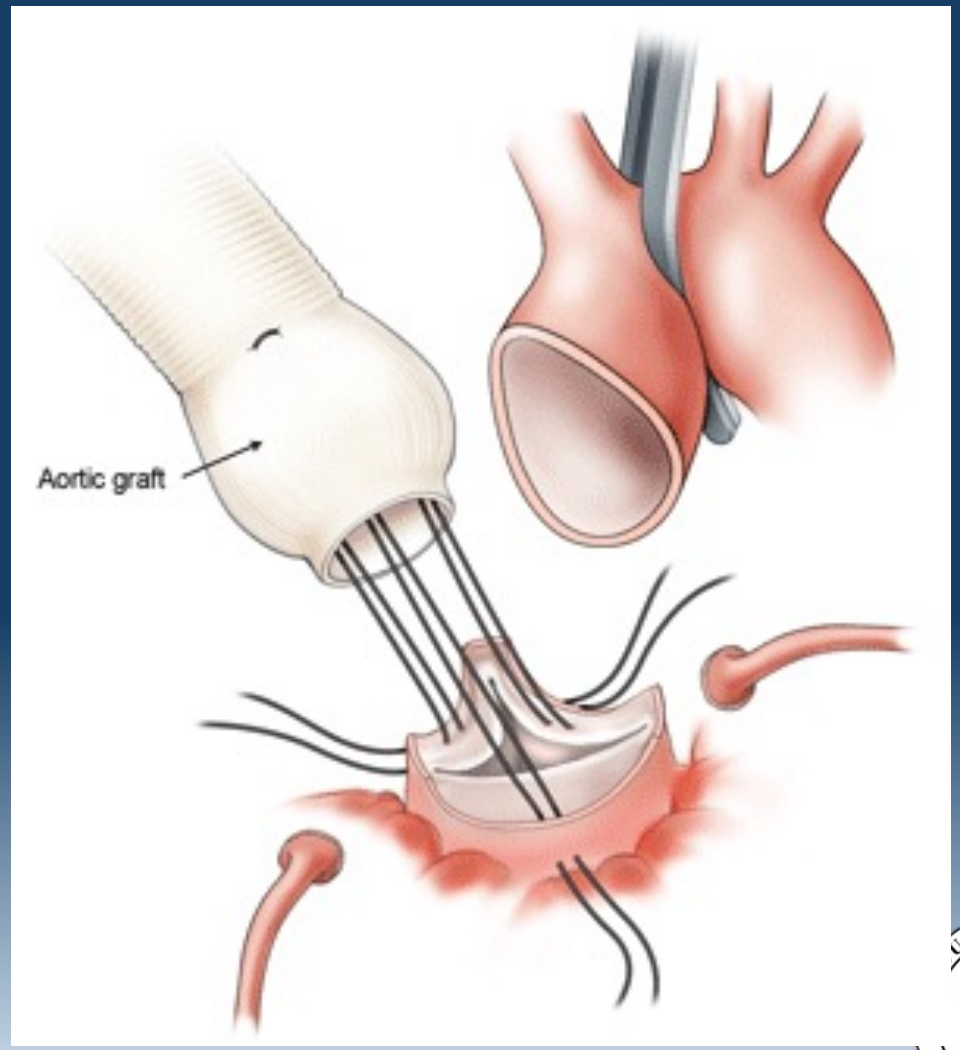
Bentall Procedure



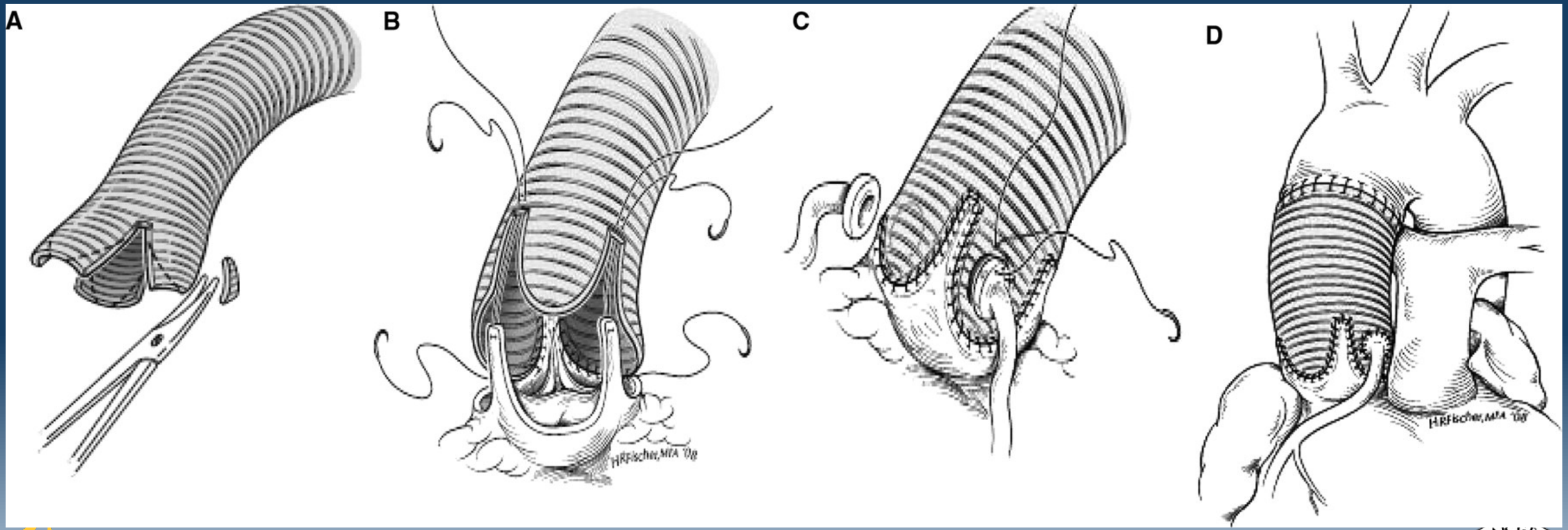


Aortic Root Reconstruction (David)

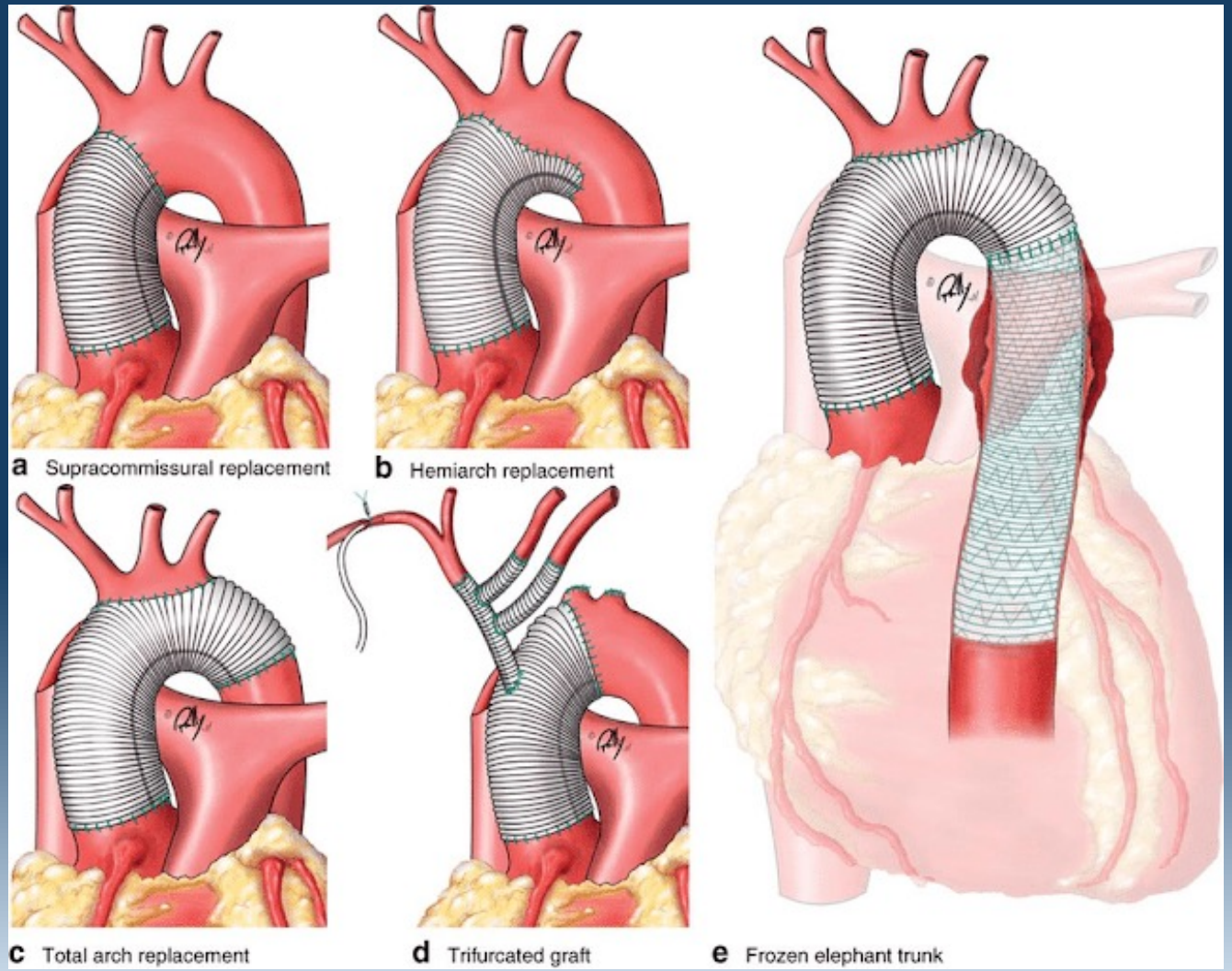


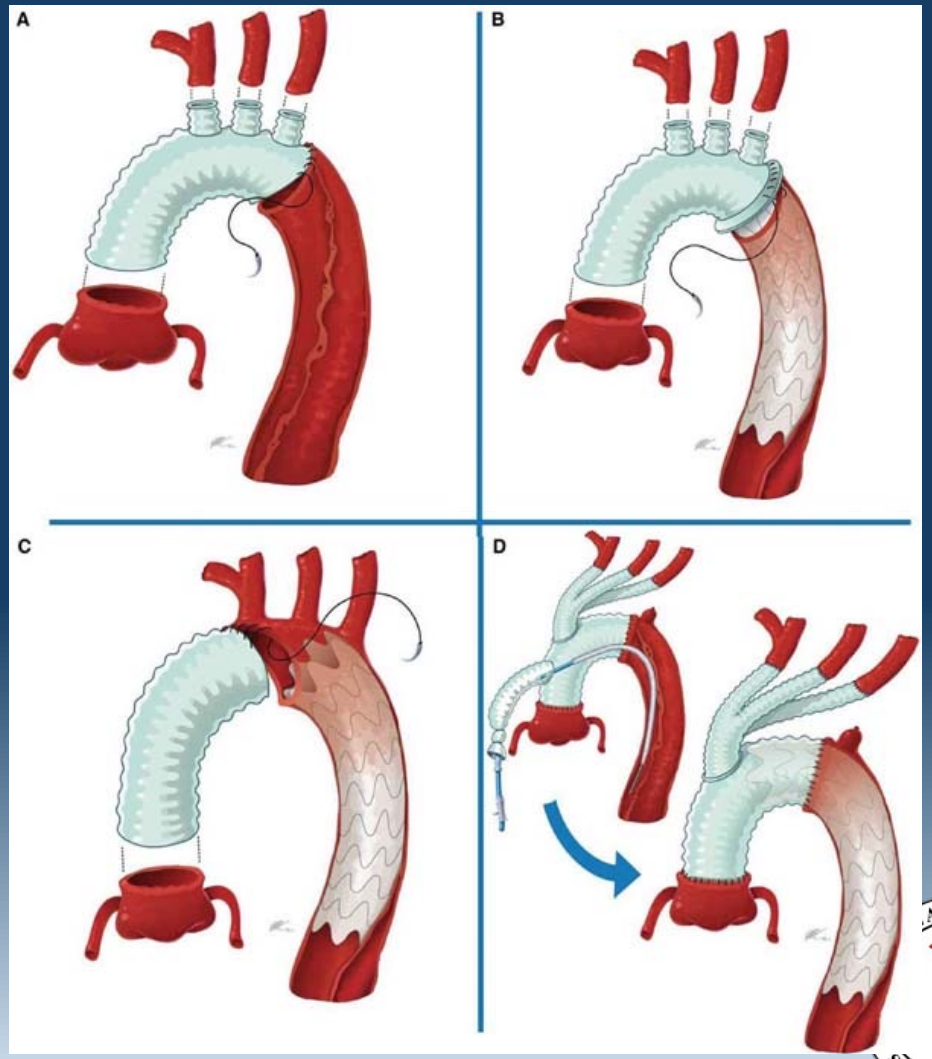


Aortic Remodeling (Yacoub)

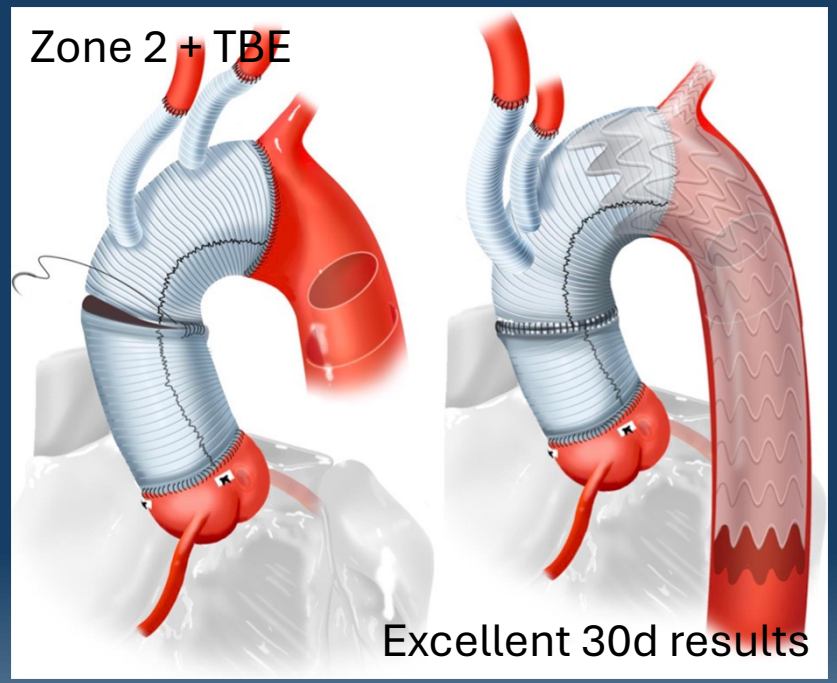


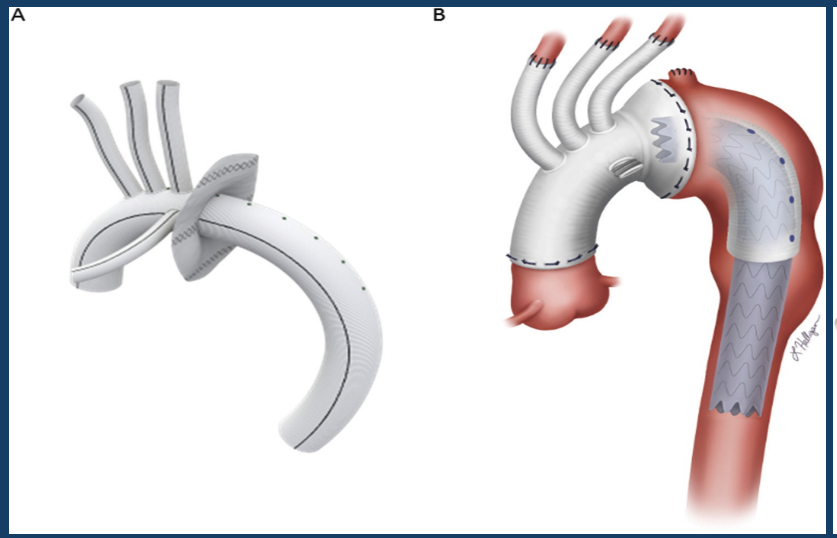
“ Arch operation “



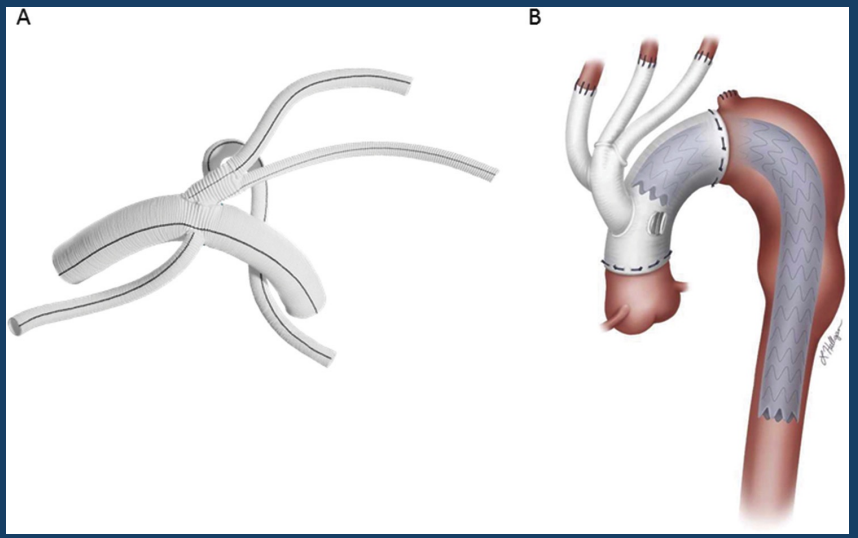


Excellent option …





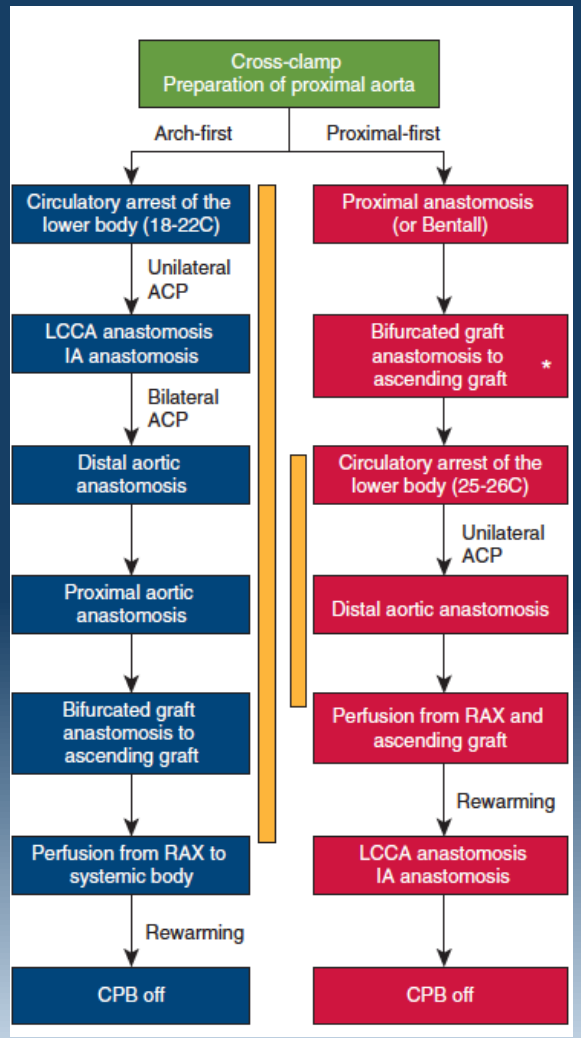
30d mortality 6%
Permanent paraplegia 3%
5y survival 63%



5y Aorta specific survival 94%
5y freedom reintervention 78%

Ann Cardiothorac Surg 2018;7(3):351-356
Ann Thorac Surg 2018;106:1136-42

Total Arch … Arch First vs. Proximal First



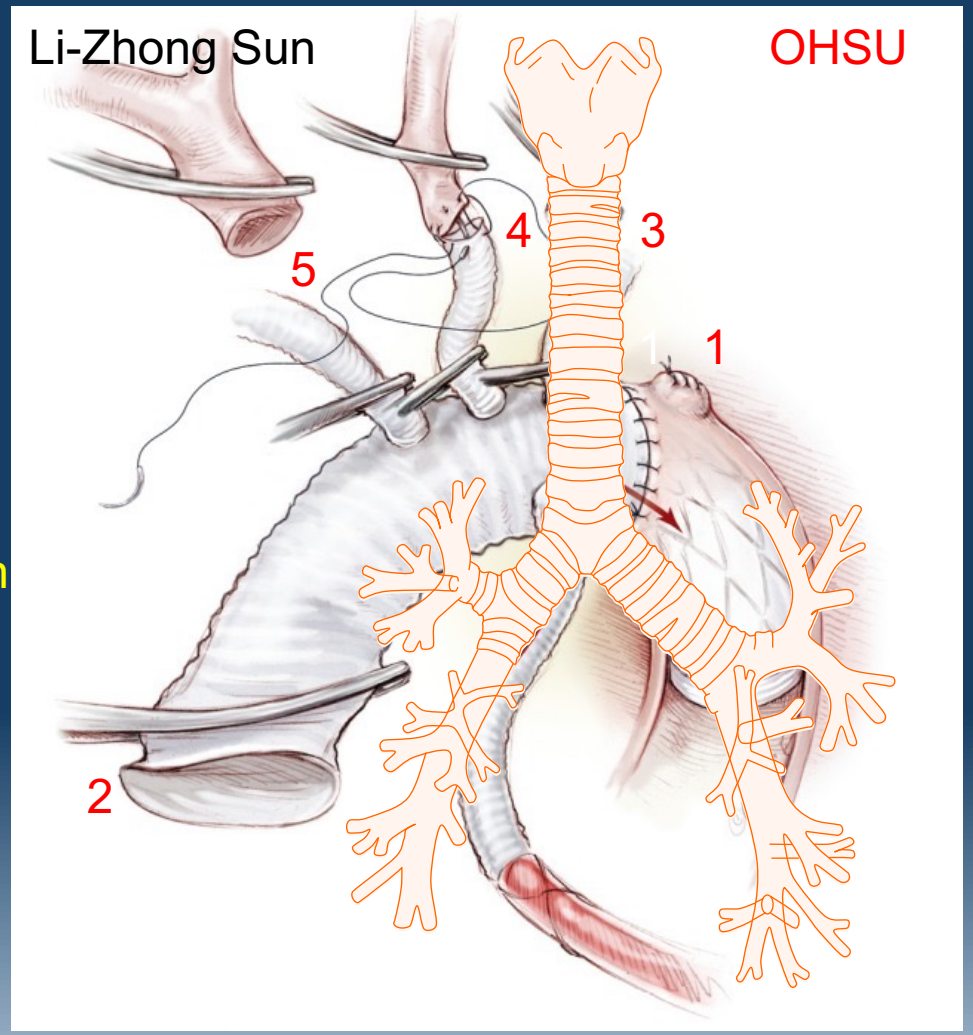
- Proximal first is more efficient
- Proximal first is more teachable

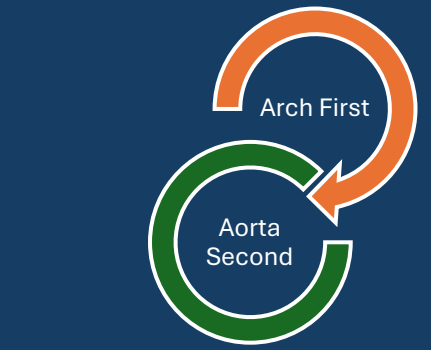
- Shorter lower-body ischemic time
- Warmer core temperature
- Shorter CPB
- Less blood product use

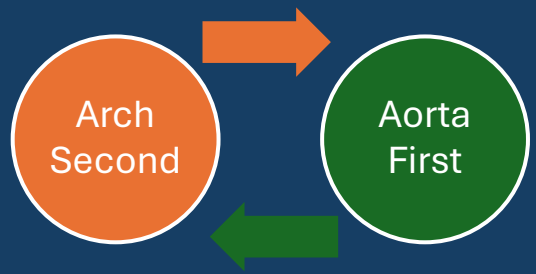
OHSU method more efficient

CPB lower, transfusion lower, mortality similar

JTCVS Techniques 2023;21:7-17







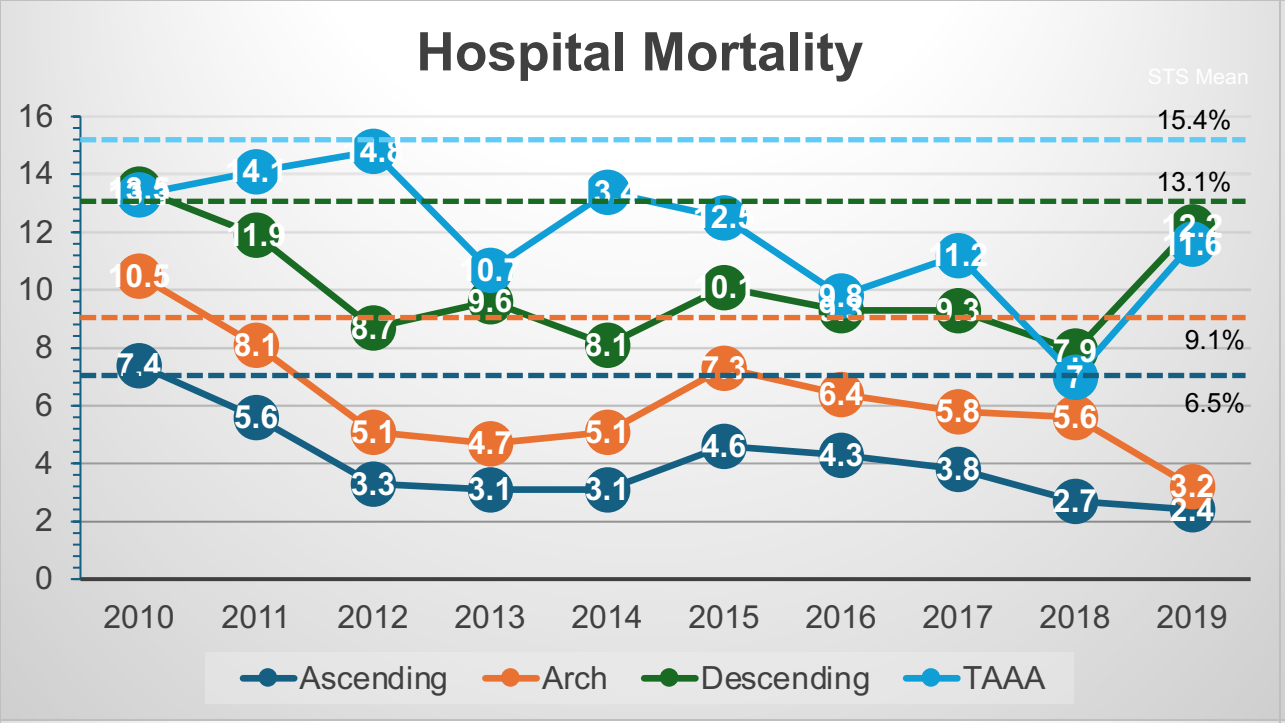
Proximalization

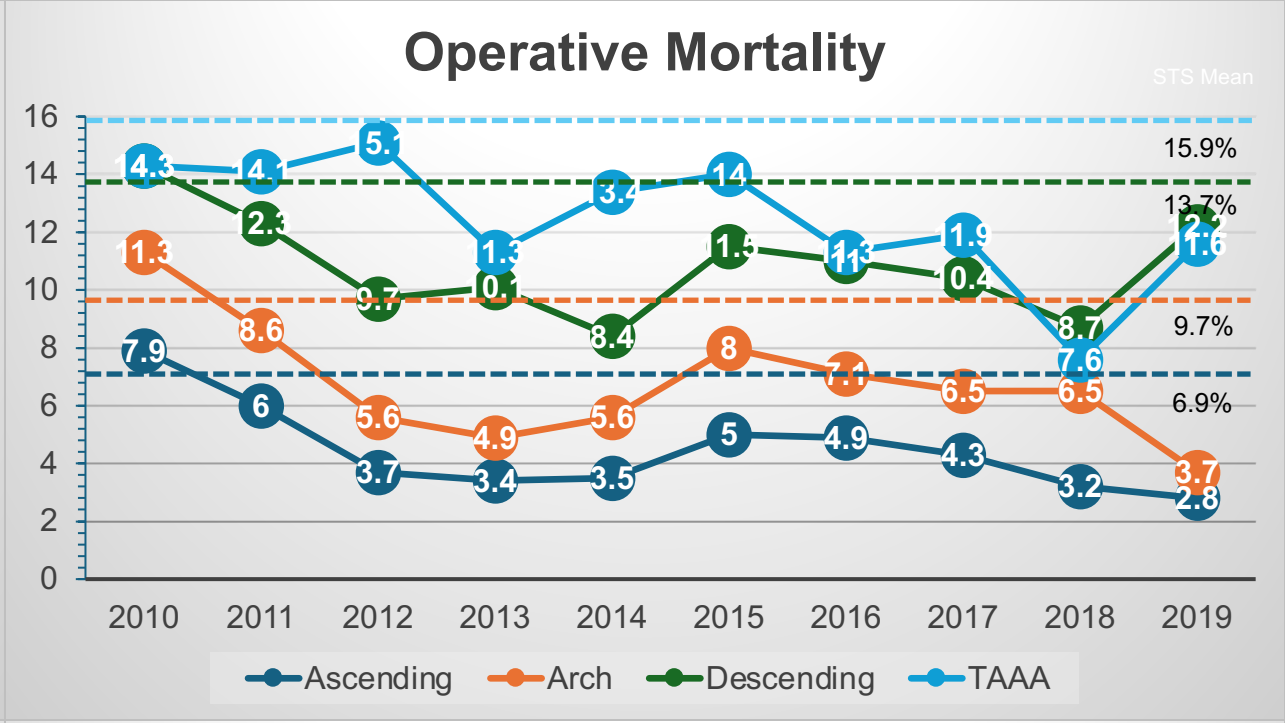
Recurrent nerve injury

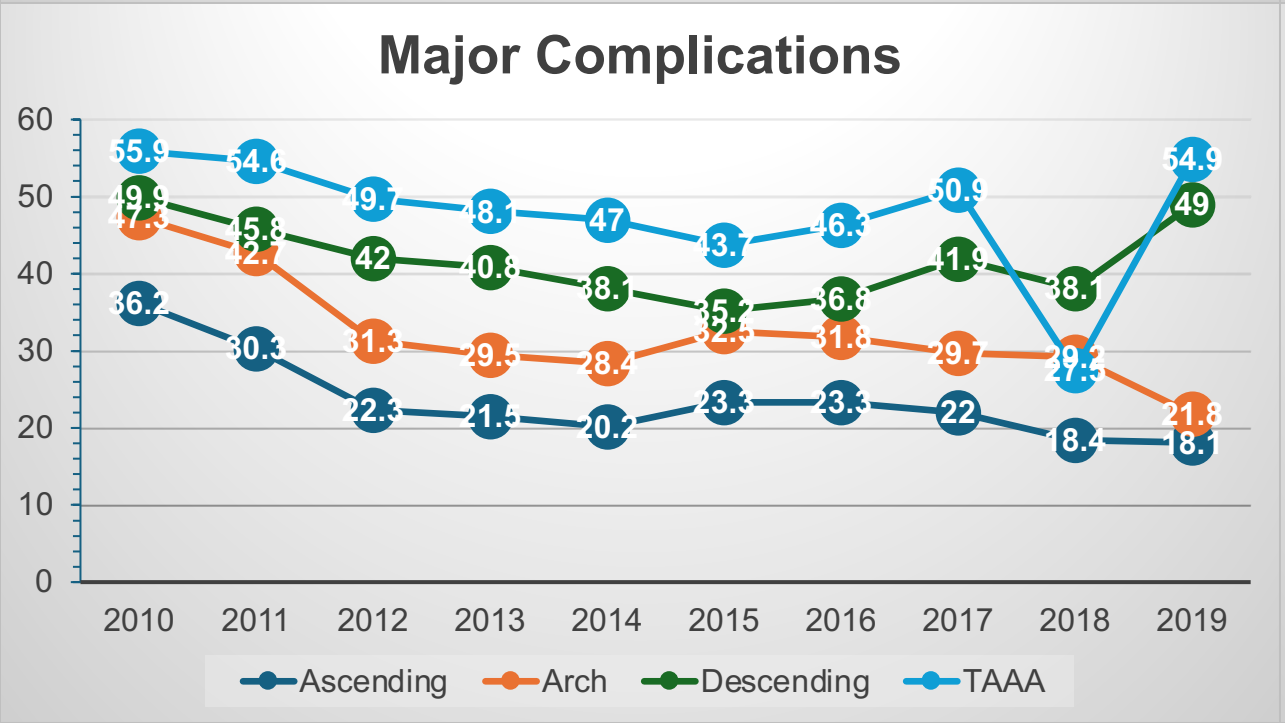
Hemostasis

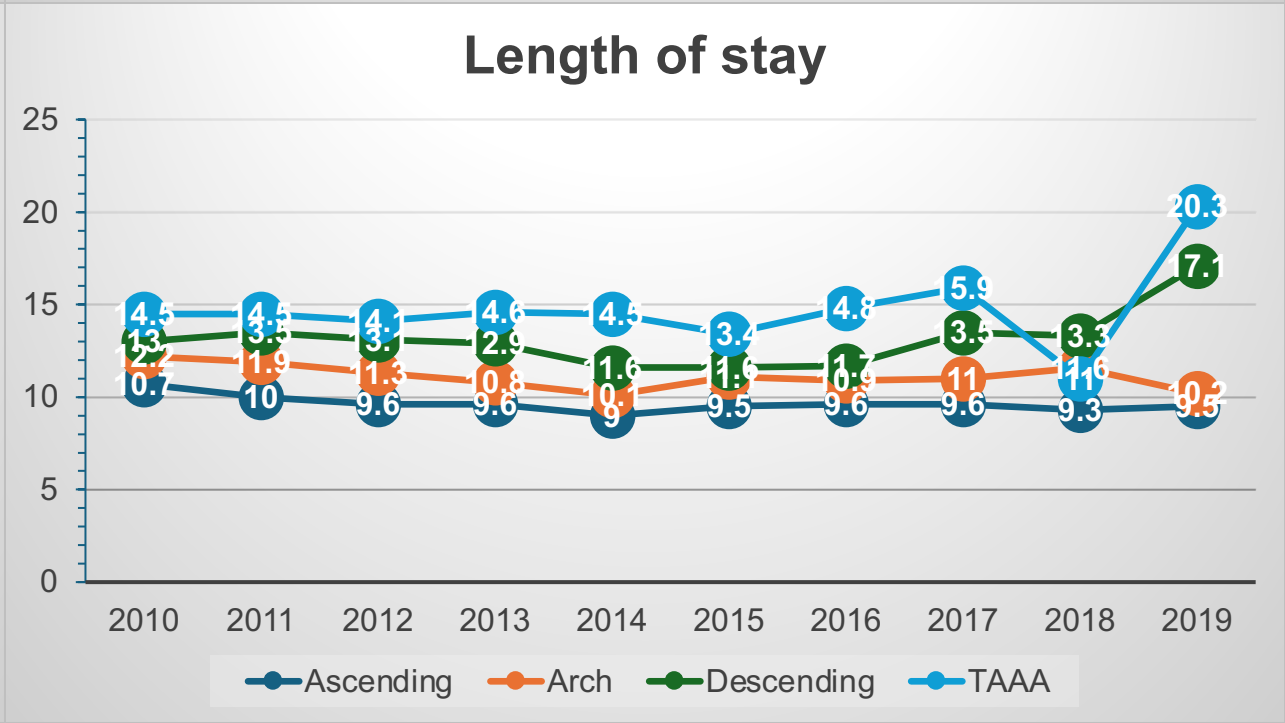
Staging

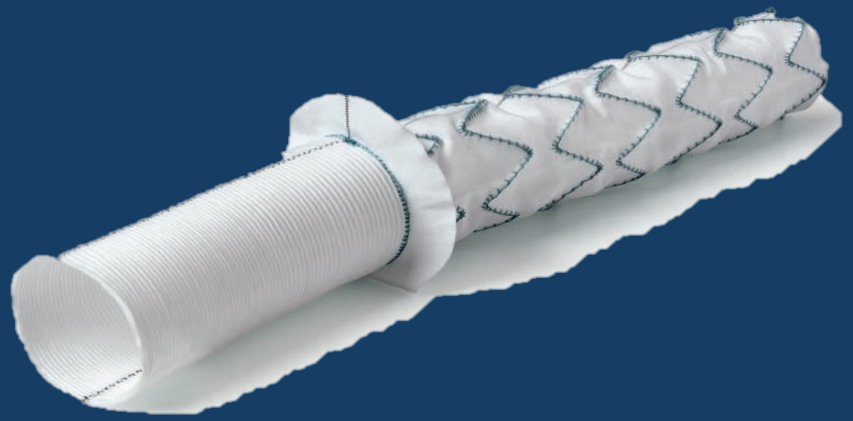
Sun and Zheng et al., Circulation 2011
Ma and Sun et al., Ann Cardiothorac Surg 2013

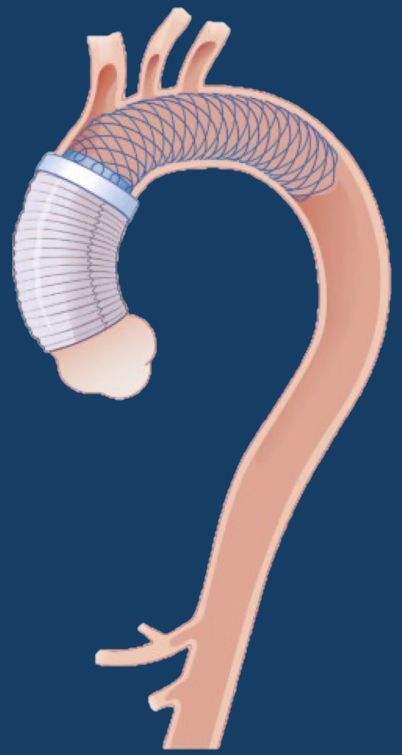

Hospital Mortality
STS Mean
15.4%
13.1%
9.1%
6.5%
2010 2011 2012 2013 2014 2015 2016 2017 2018 2019
Ascending
Arch
Descending
TAAA

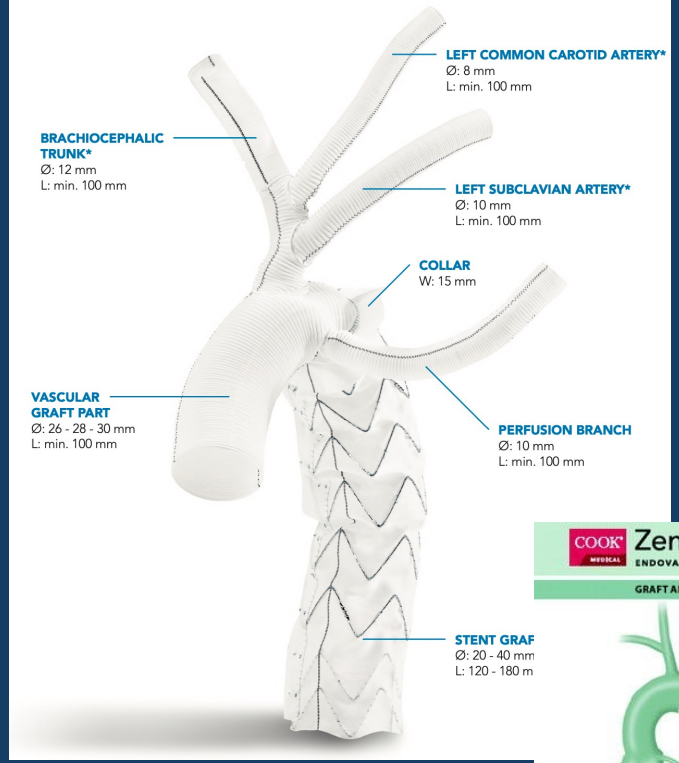

Operative Mortality
STS Mean
15.9%
13.7%
9.7%
6.9%
2010 2011 2012 2013 2014 2015 2016 2017 2018 2019
Ascending
Arch
Descending
TAAA

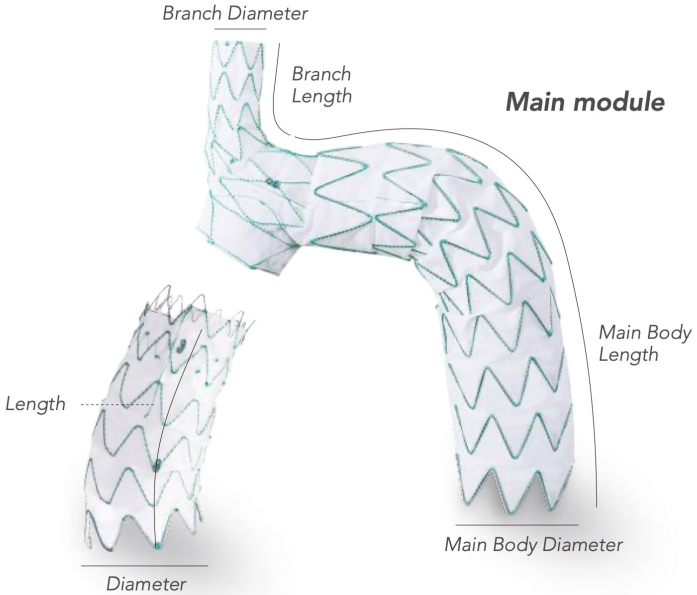

Major Complications
2010 2011 2012 2013 2014 2015 2016 2017 2018 2019
Ascending
Arch
Descending
TAAA

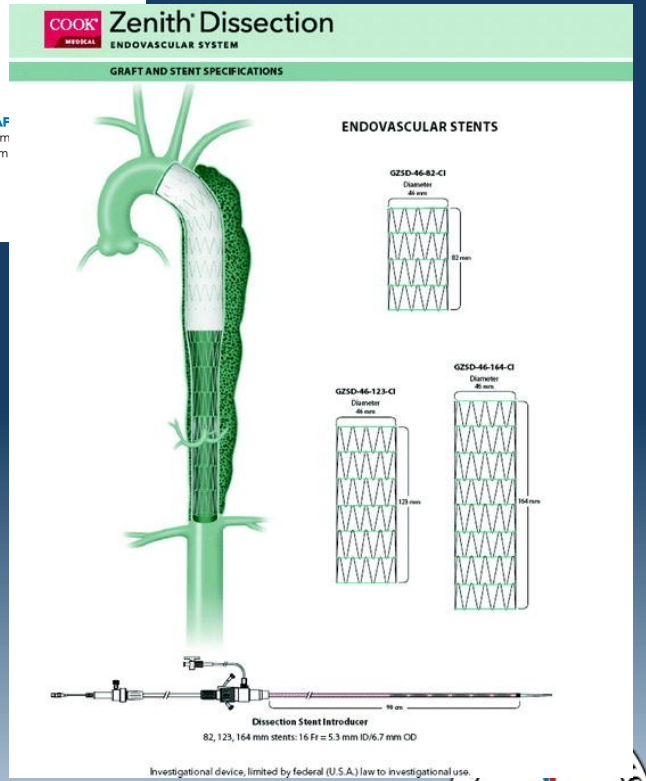

Length of stay
2010 2011 2012 2013 2014 2015 2016 2017 2018 2019
Ascending
Arch
Descending
TAAA






LEFT COMMON CAROTID ARTERY*
Ø: 8 mm
L: min. 100 mm
BRACHIOCEPHALIC TRUNK*
Ø: 12 mm
L: min. 100 mm
LEFT SUBCLAVIAN ARTERY*
Ø: 10 mm
L: min. 100 mm
COLLAR
W: 15 mm
VASCULAR GRAFT PART
Ø: 26 - 28 - 30 mm
L: min. 100 mm
PERFUSION BRANCH
Ø: 10 mm
L: min. 100 mm
STENT GRAF
Ø: 20 - 40 mm
L: 120 - 180 m


Branch Diameter
Branch Length
Main module
Main Body Length
Length
Main Body Diameter
Diameter
Ascending module


COOK
Zenith Dissection
ENDOVASCULAR SYSTEM
GRAFT AND STENT SPECIFICATIONS
ENDOVASCULAR STENTS
GZSD-46-82-CI
GZSD-46-123-CI
GZSD-46-164-CI
Dissection Stent Introducer
82, 123, 164 mm stents: 16 Fr = 5.3 mm ID/6.7 mm OD
Investigational device, limited by federal (U.S.A.) law to investigational use.

Zone 2-3

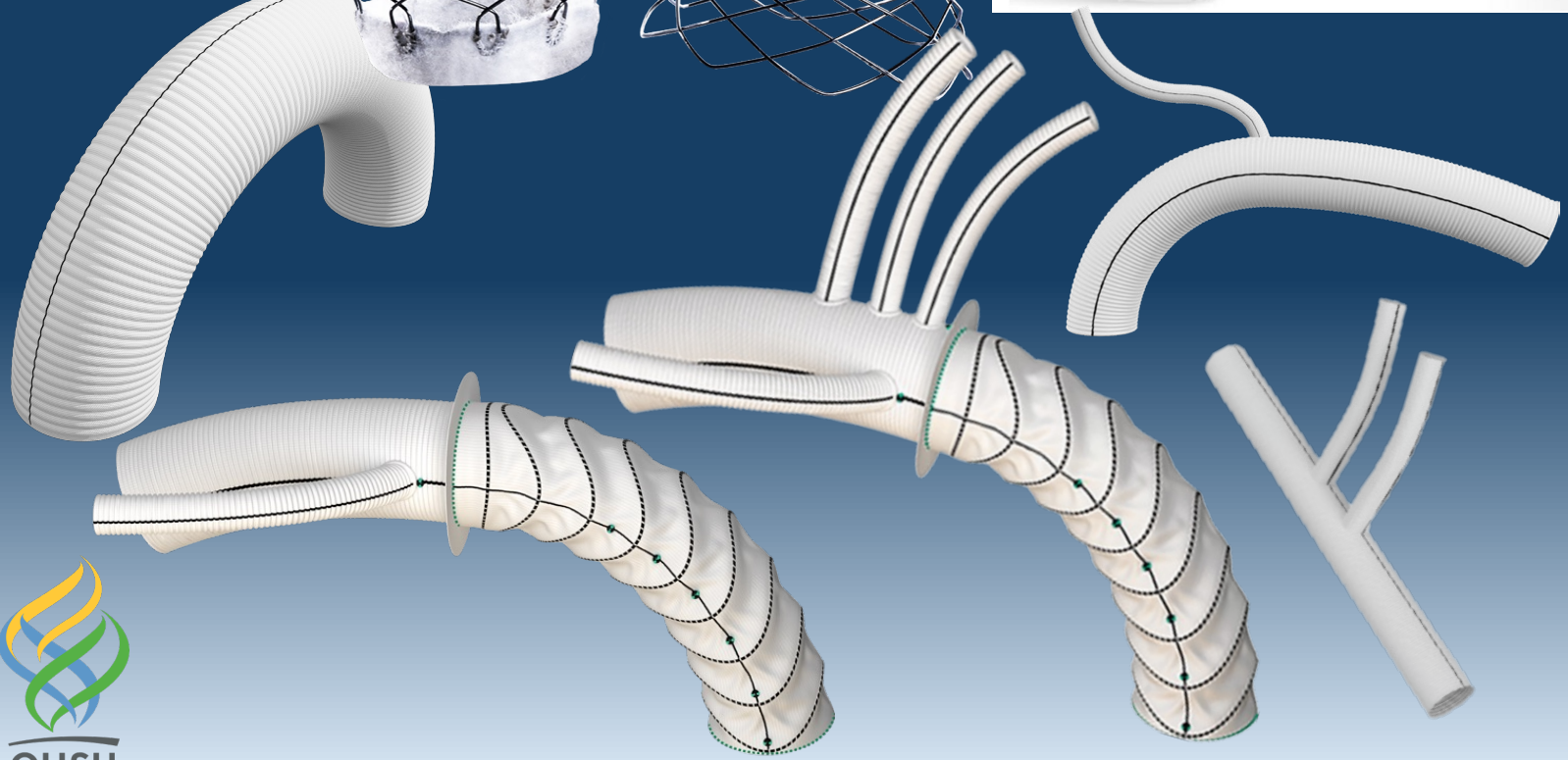
En bloc (island) technique

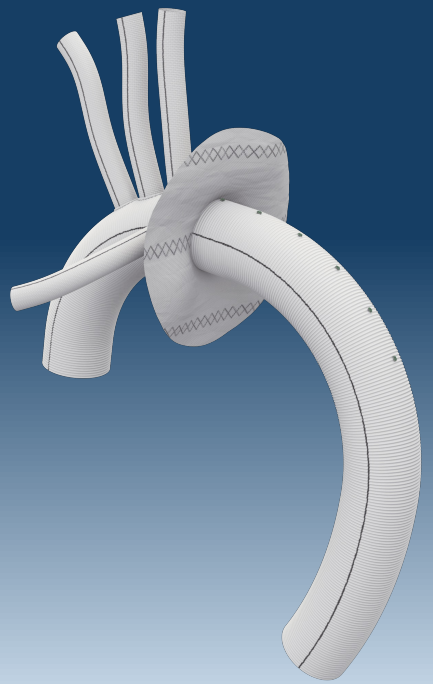
Zone 1-2-3

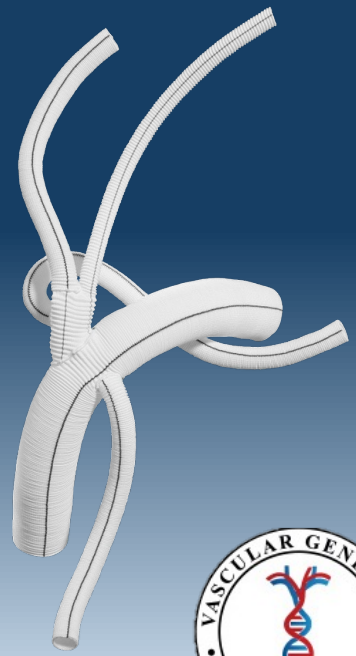
Single vessel anastomosis

Zone 0-1

Single vessel anastomosis







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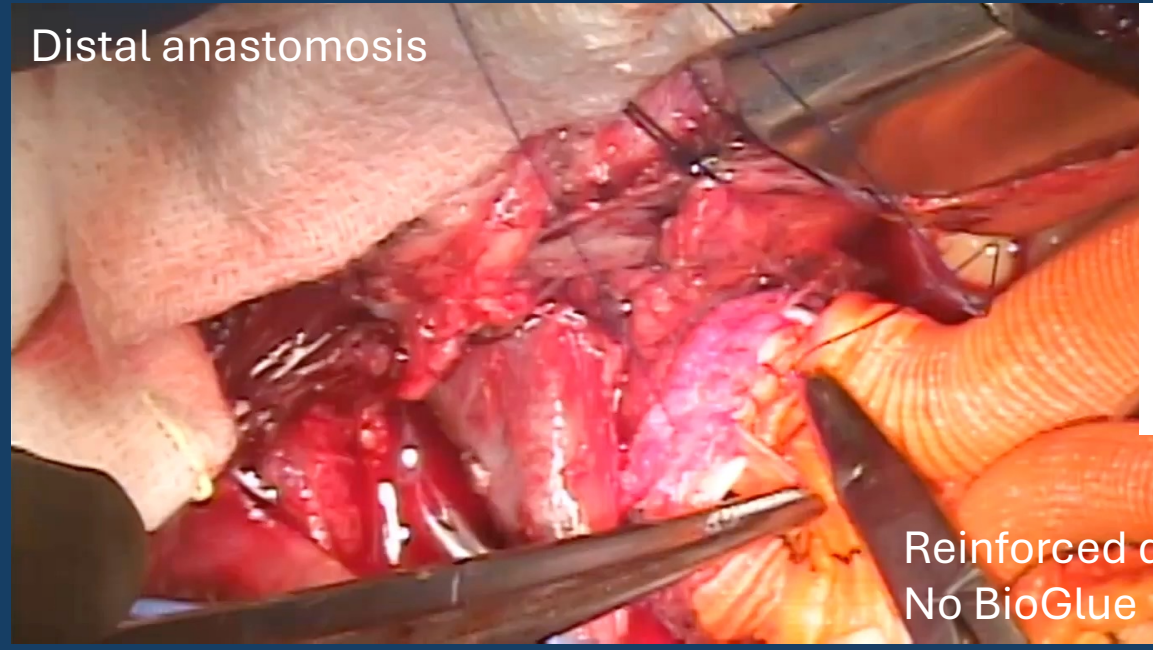
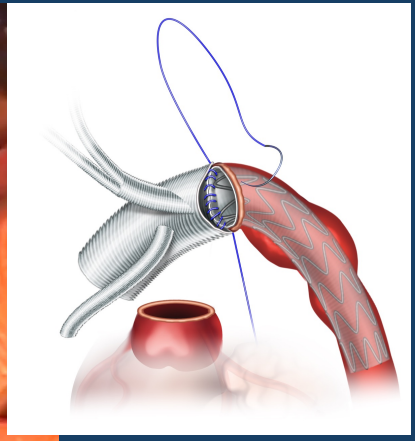
VASCULAR GENETICS SYMPOSIUM

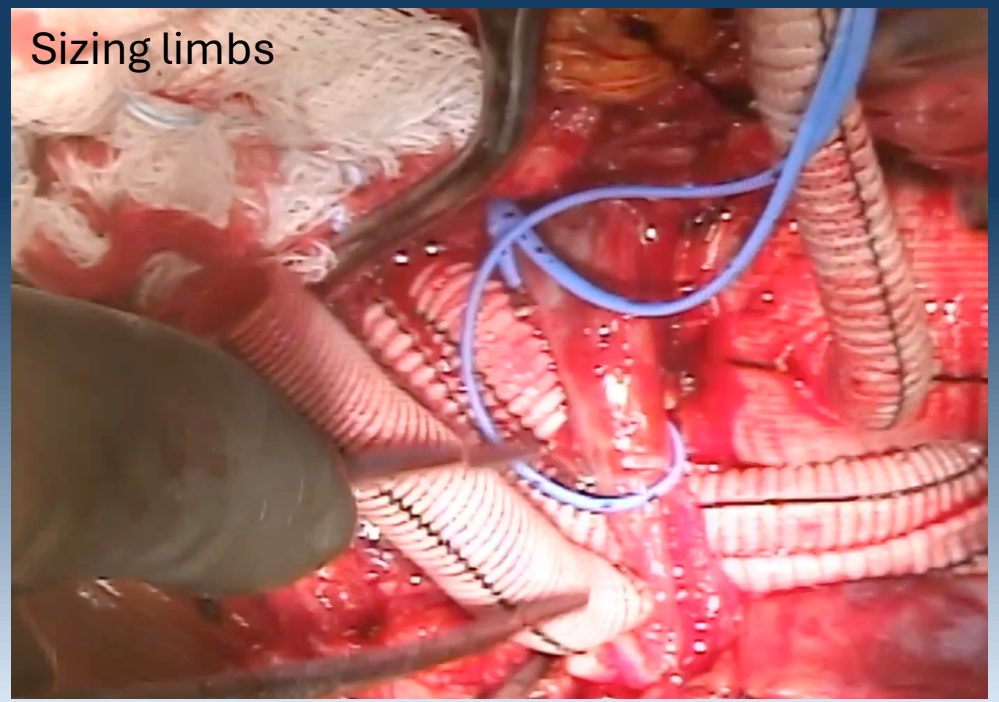
Exposure



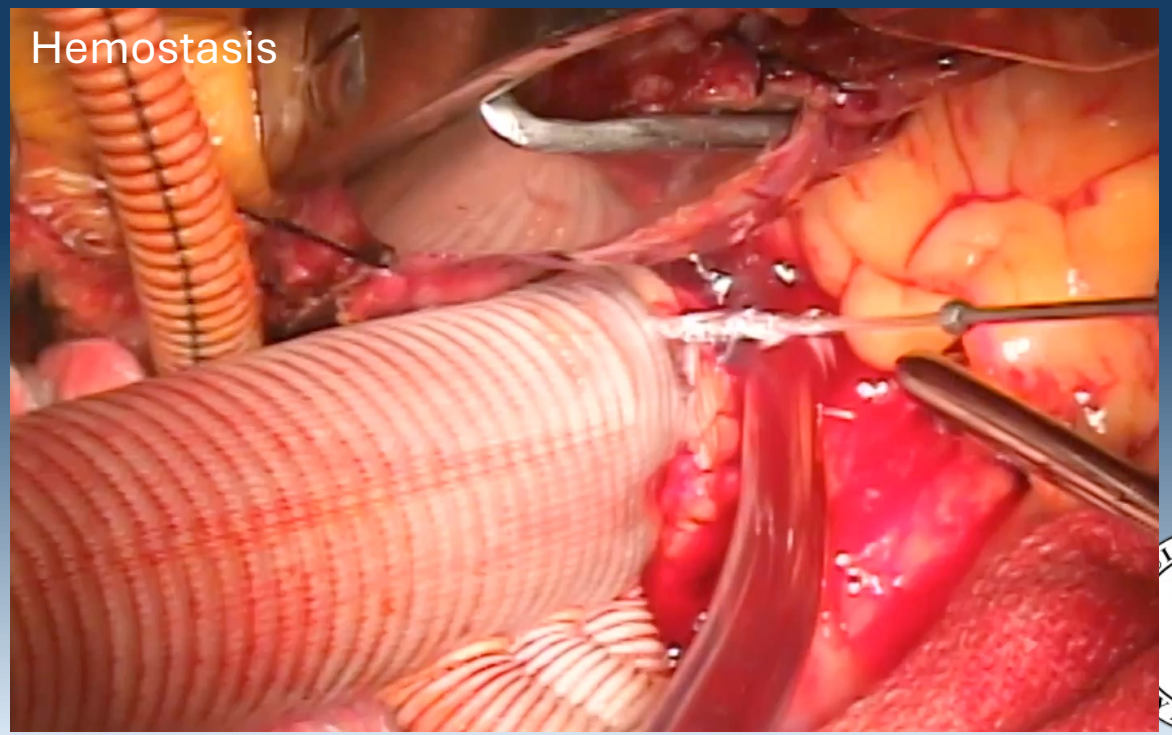
Distal anastomosis



Reinforced distal anastomosis
No BioGlue



Sizing limbs



Hemostasis

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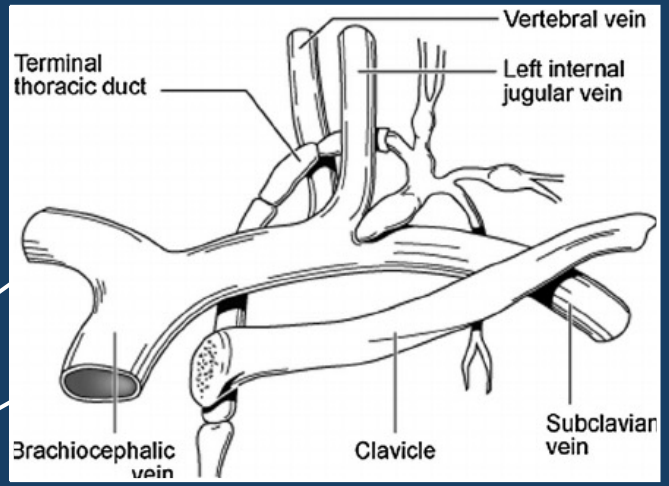
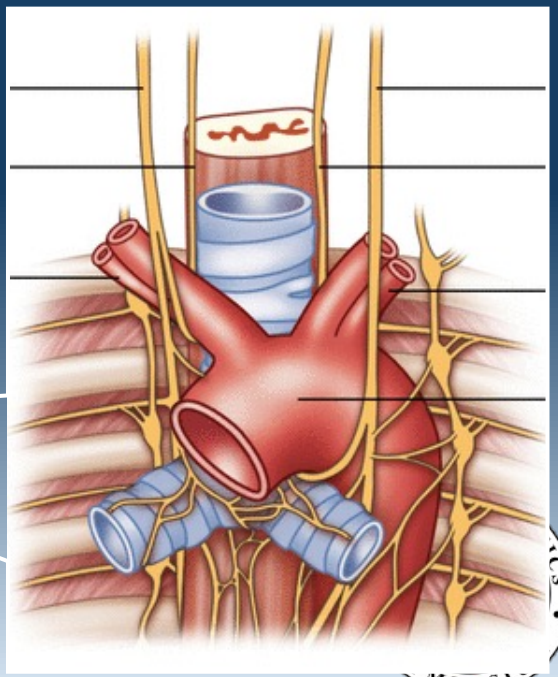
Key complications

- Bleeding (output, SVR)
- Tamponade (CI, Resuscitation)
- Myocardial Dysfunction (echo)
- Residual dissection (Pulses, Waveforms)
- Renal failure (GFR, Cr)
- Visceral ischemia (LFTs, Lactate, Hypoglycemia)
- Chyle leak (fluid character)
- Vocal cord paresis/paralysis (SpO_2, LRN, aspiration)
- Lower extremity paralysis (exam)





Postoperative

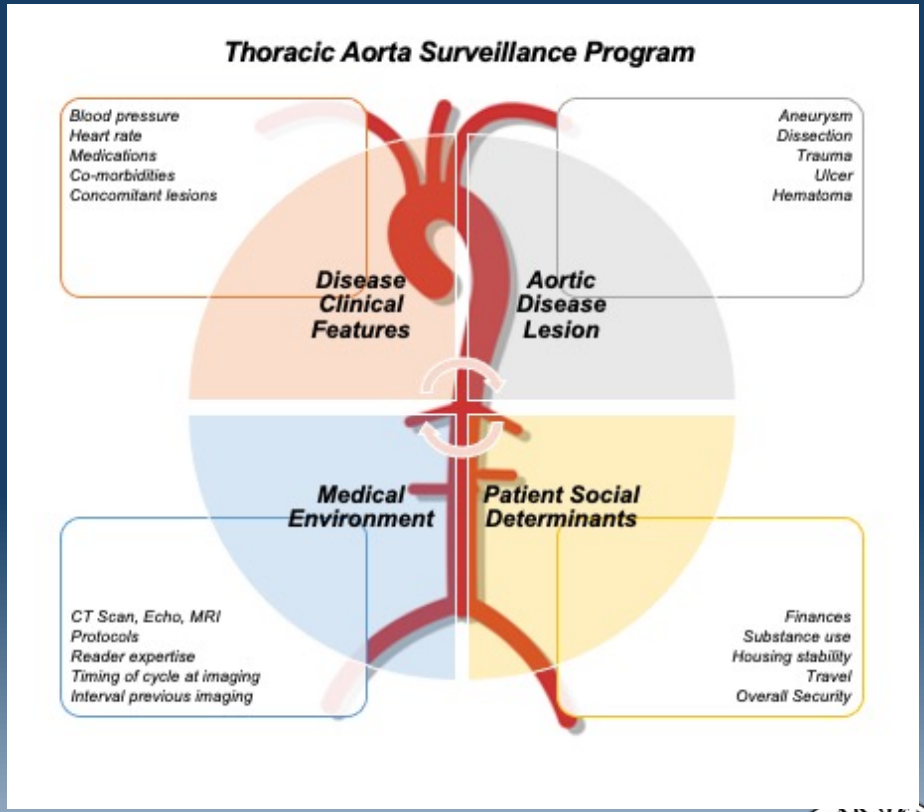
- Venous capacitance – big issue, need to be mindful
- Volume management – don’t over do it
- Need for CRRT/Dialysis – start early
- Vasoactive agents versus volume resuscitation – use more
- Trach - early
- Feeding tubes – place early
- Dependent decubitus ulcers - manage with early mobilization

Aortic Surveillance Program

- Every dissection, aneurysm seen
- 1 month, 3 months, 6 months, 12 months
- CTA – Echo

- Impulse Control and Blood pressure
- Vit C, Zinc, multi-vitamins, ASA

- Multi-disciplinary planning



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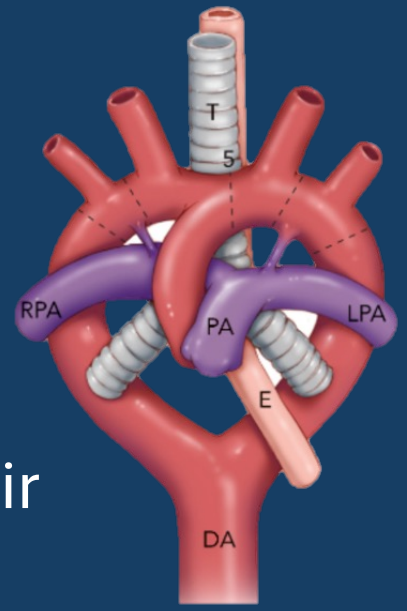
Bottom line



- Gated CTA Chest – Imaging is key !
- Stress echo and transthoracic echo give different data
- <60yo – needs genetic testing
- >4.5cm … needs aggressive consideration for follow up / repair
- Use frailty as a metric of repair extent
- Cardiac and Vascular surgery are one “ Aortic Team ”
- Be creative and definitive in repairs
- Follow patients for life
  - Annually for 5y
  - Every 2y (5y – 10y)
  - Every 3y (15y – 20y)
  - Every 5y (till death)

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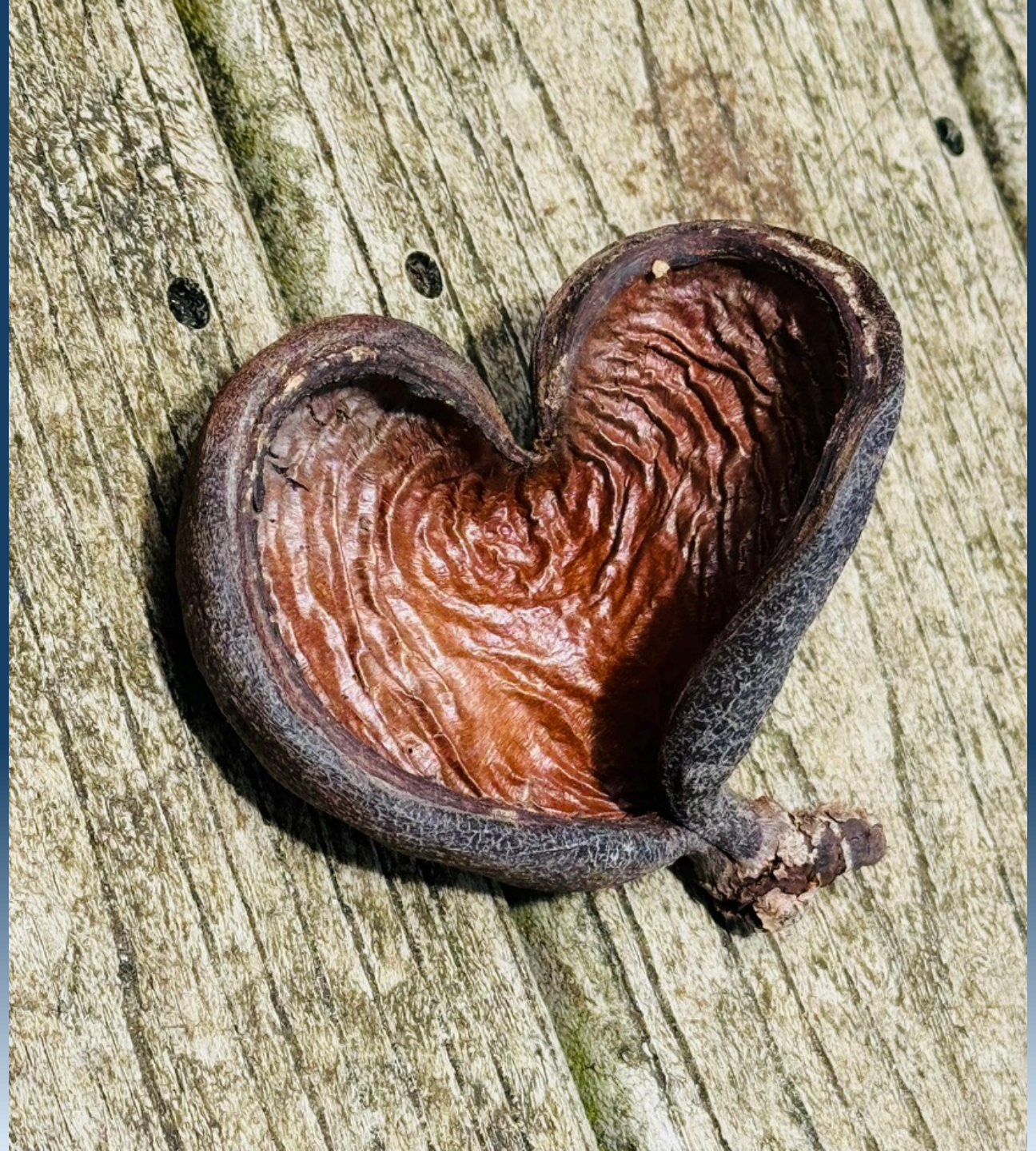

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VASCULAR GENETICS SYMPOSIUM