Aorta : Emergency to Surgery

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No disclosures.

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Thoracic Aortic Dissection and Aneurysms:

How can we save lives…
first it must be on our differential diagnosis….
and if you see something say something.

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Thoracic Aortic Dissection

- Thoracic Aortic Dissection is **highly lethal** - mortality rates of 27% even under optimal conditions
- Initial treatment in ED can be sub-optimal - **delay** in diagnosis or definitive treatment as patients have to undergo testing and often transfer to another facility
- **Low incidence** of disease - 3.5/100,000 population but expected to increase with our aging population
- **Difficult to diagnose** - classic presentations are not as common as we would like
- The work-up most often does not find a dissection when it is suspected - only 2.7% of CT scans are positive

Thoracic Aortic Dissection - Natural History

- 40% die immediately (~50% within 48 hours), mainly from rupture
- 2% per hour mortality (1-3% die in hour before surgery)
- End-organ malperfusion occurs in 16-30%, dramatically reduces survival
- Short term in-hospital and 30 day mortality: 3.4 - 25%

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Thoracic Aortic Dissection - Acute Complications

- Acute complications:
  - (contained) rupture, leakage, tamponade
  - Acute severe aortic regurgitation
  - Coronary disruption - MI
  - Cerebral malperfusion - CVA
  - Spinal infarct/paraplegia
  - Aortic rupture
  - Mesenteric/Renal/Limb ischemia
  - Pseudoaneurysm

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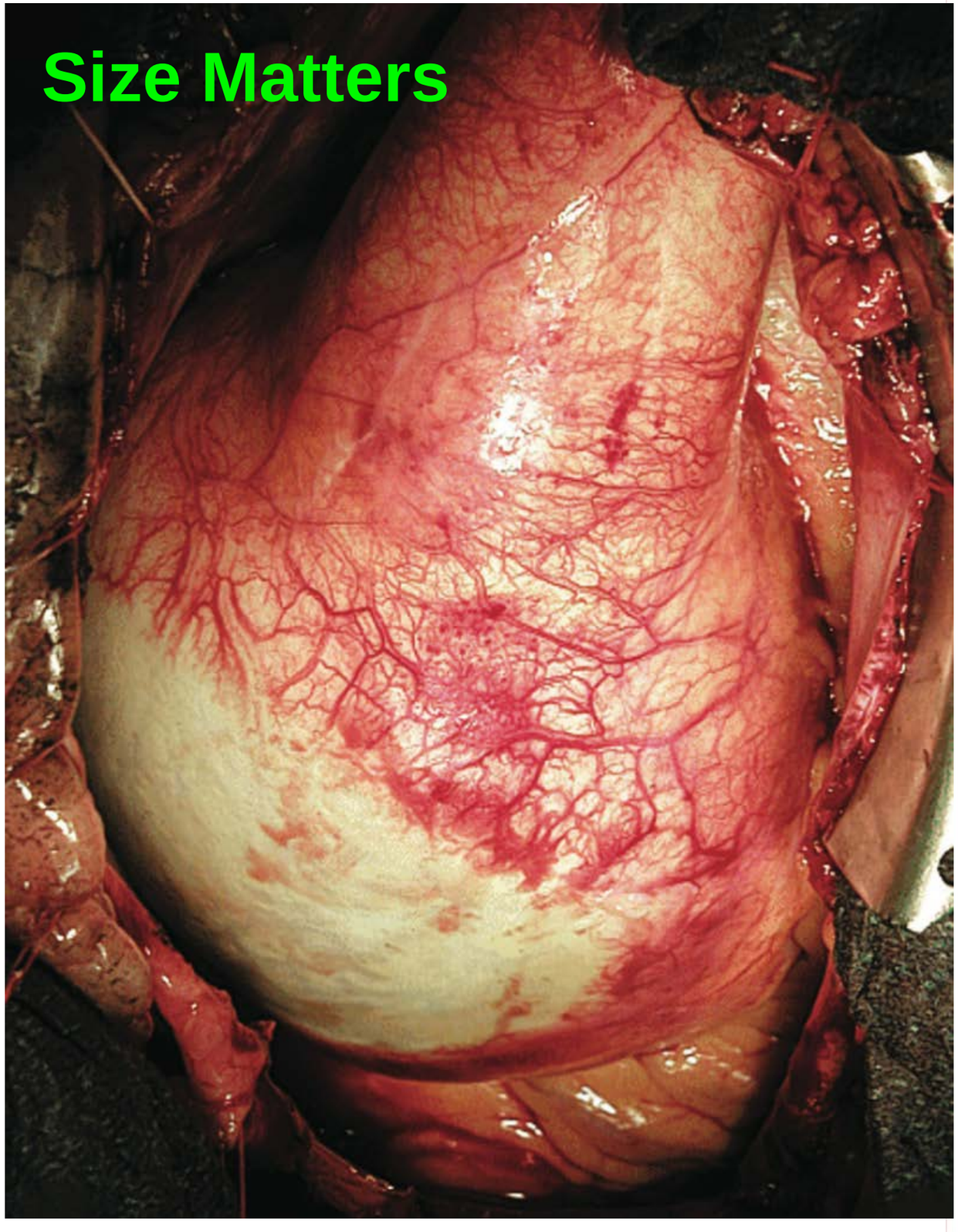
Thoracic Aortic Dissection



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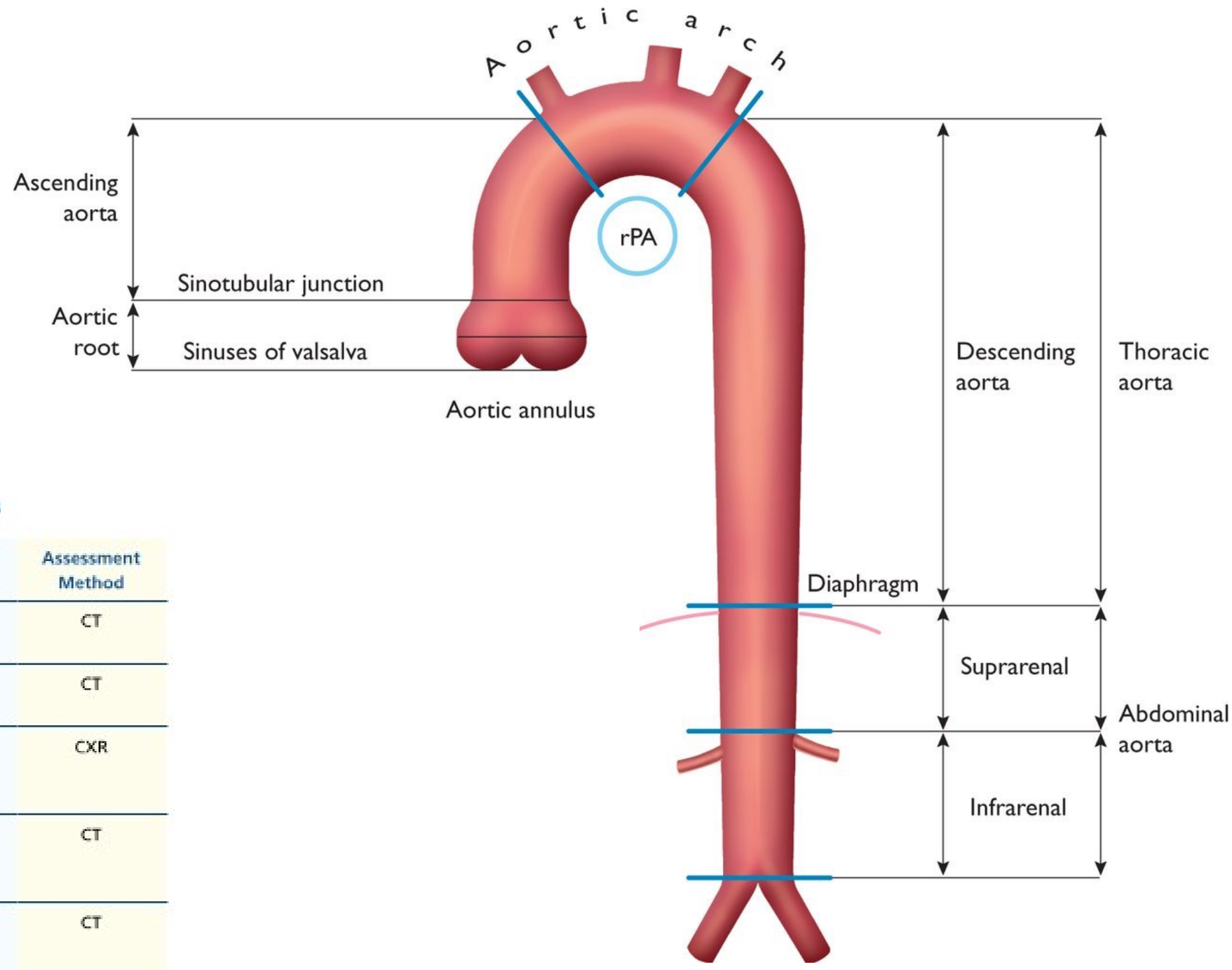

Table 3. Normal Adult Thoracic Aortic Diameters

Thoracic Aorta	Range of Reported Mean (cm)	Reported SD (cm)	Assessment Method
Root (female)	3.50 to 3.72	0.38	CT
Root (male)	3.63 to 3.91	0.38	CT
Ascending (female, male)	2.86	NA	CXR
Mid-descending (female)	2.45 to 2.64	0.31	CT
Mid-descending (male)	2.39 to 2.98	0.31	CT
Diaphragmatic (female)	2.40 to 2.44	0.32	CT
Diaphragmatic (male)	2.43 to 2.69	0.27 to 0.40	CT, arteriography

2010 ACCF/AHA/AATS/ ACR/ASA/SCA/SCAI/SIR/STS/SVM
Guidelines for the Diagnosis and Management of Patients With
Thoracic Aortic Disease

March 2010

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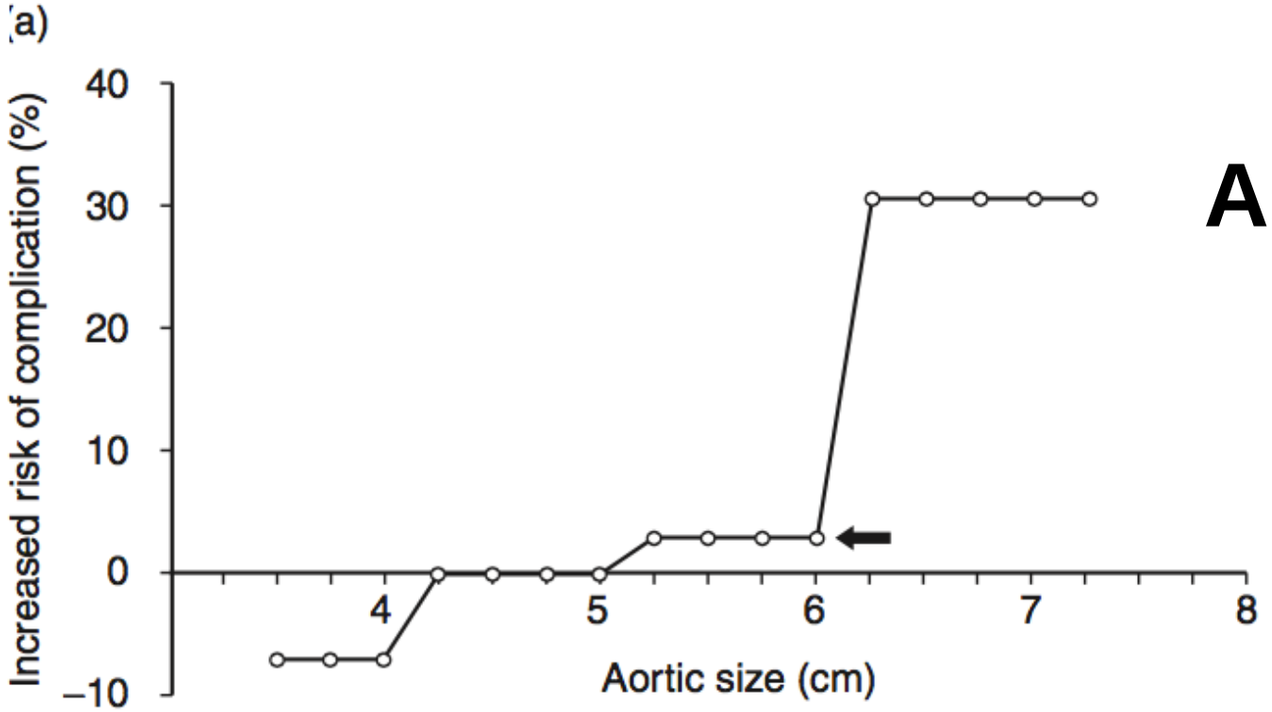
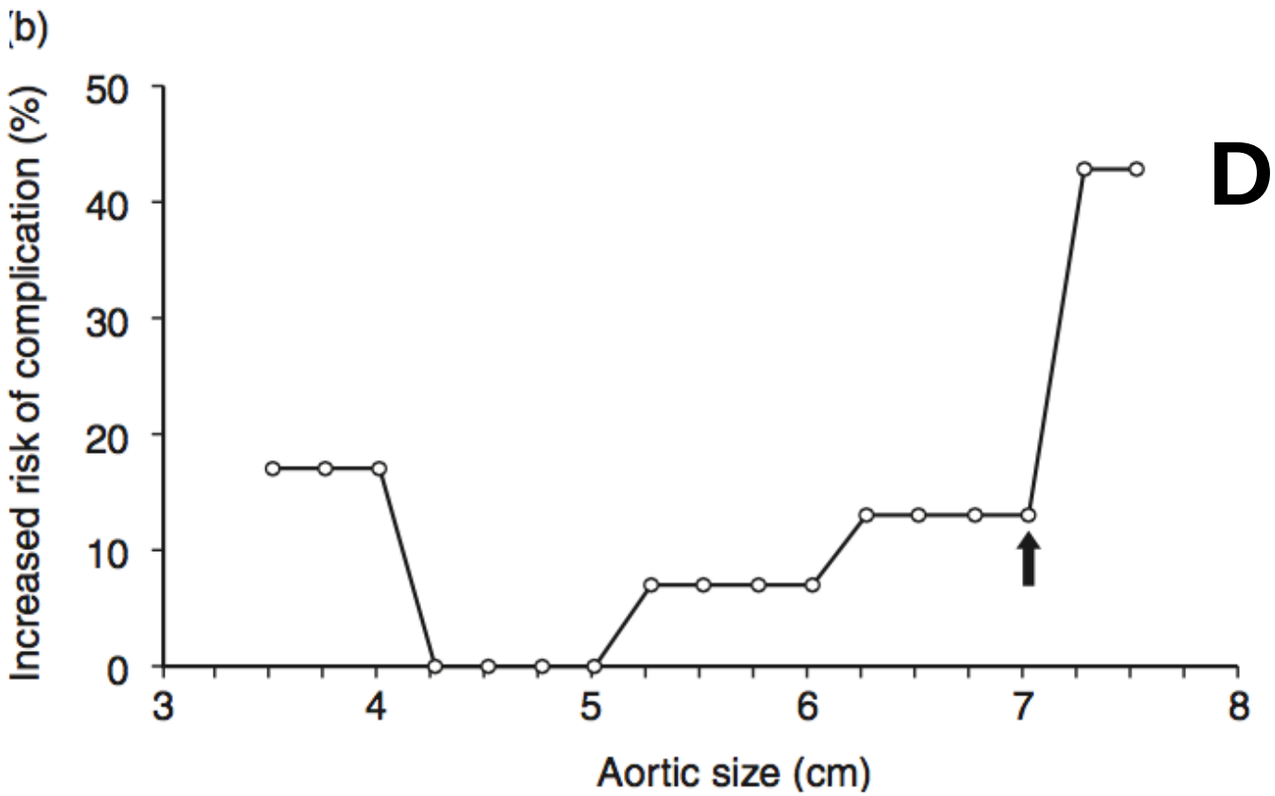
Lifetime Likelihood of Complications



Ascending Aorta



Descending Aorta

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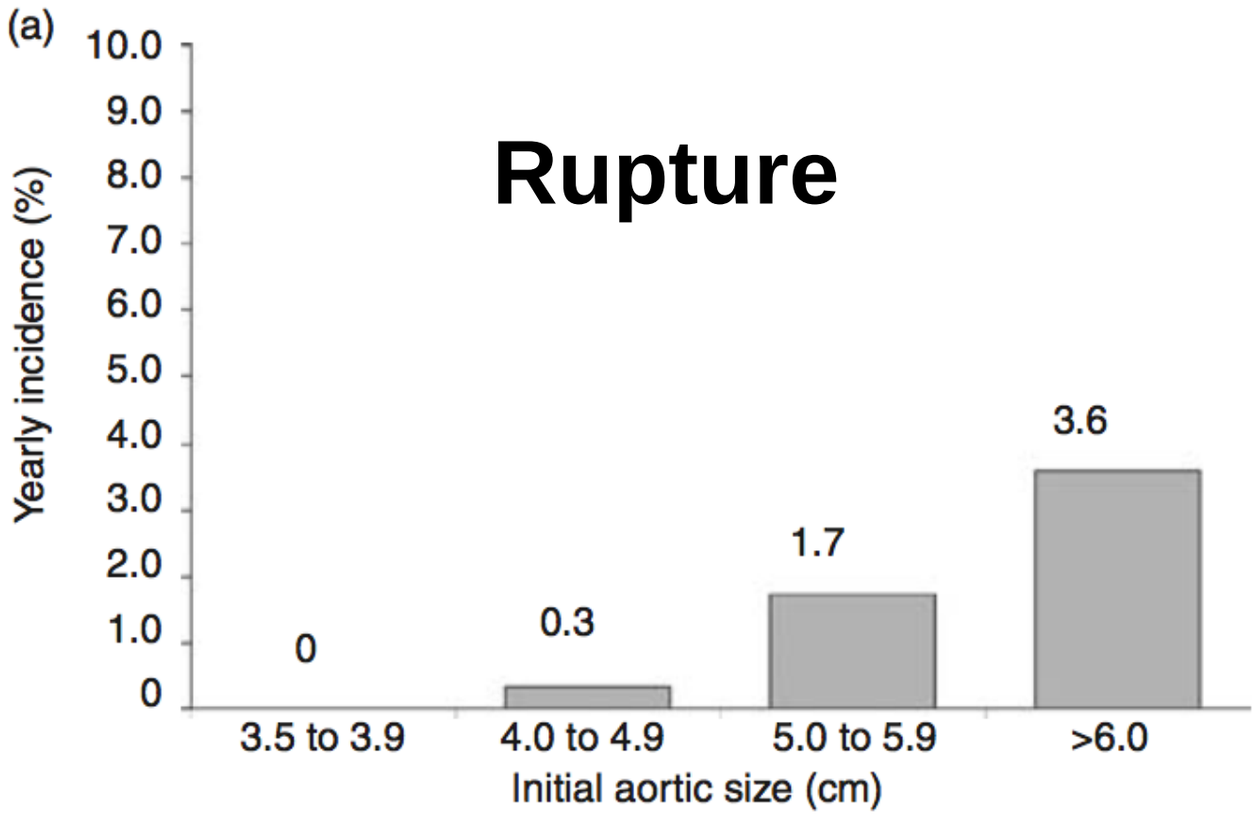
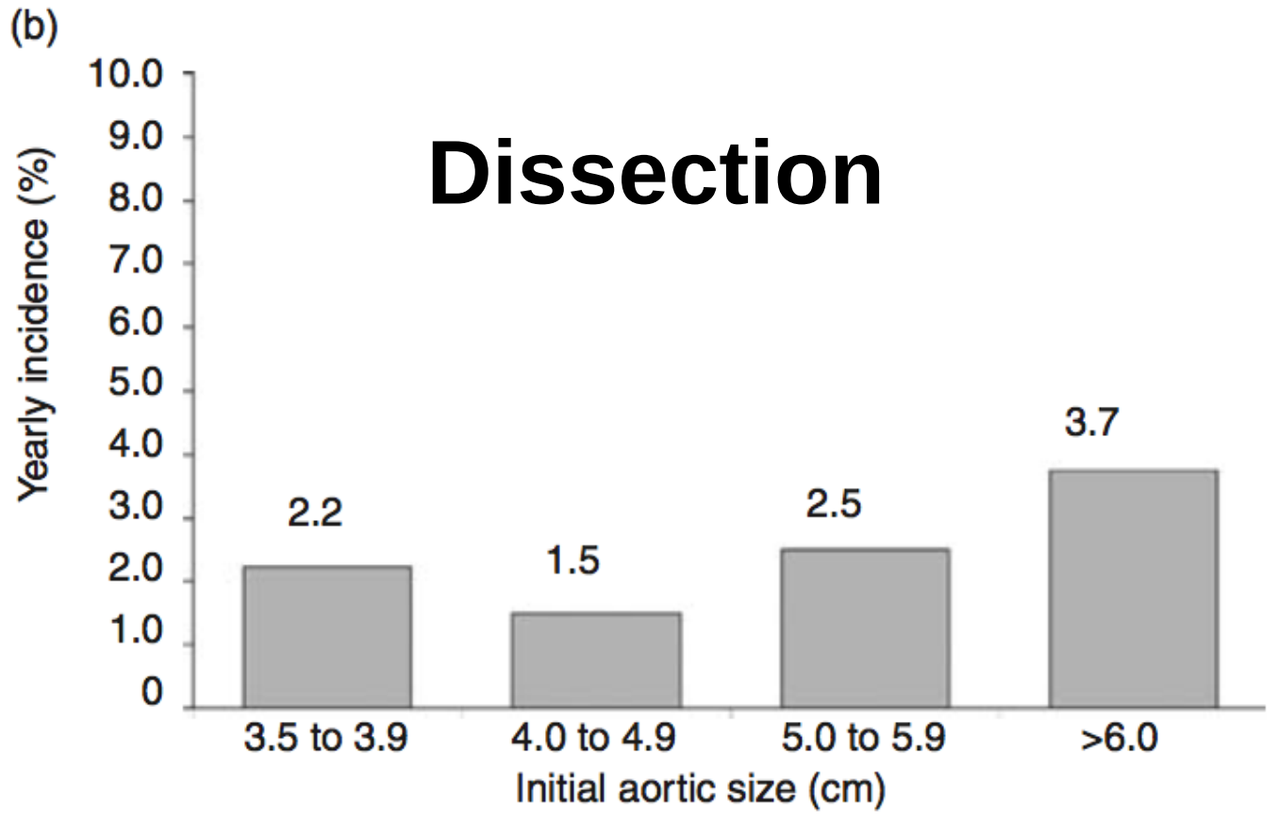
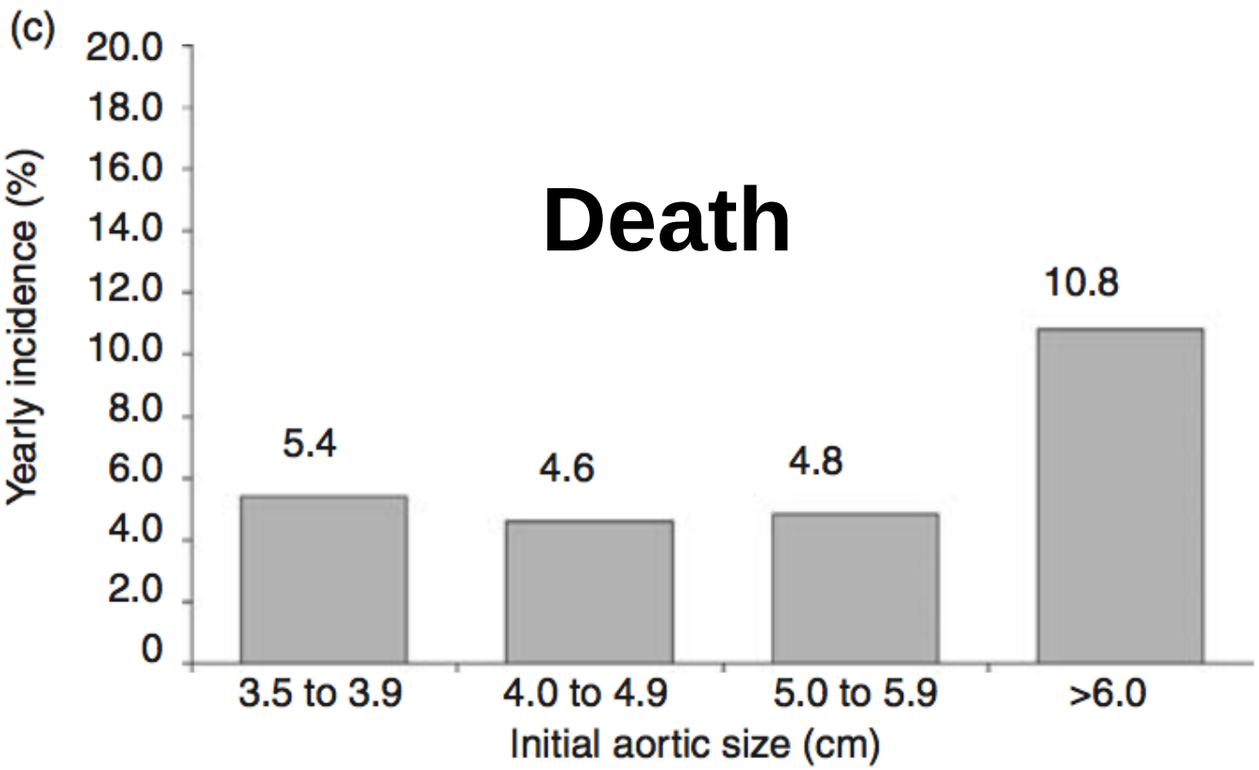
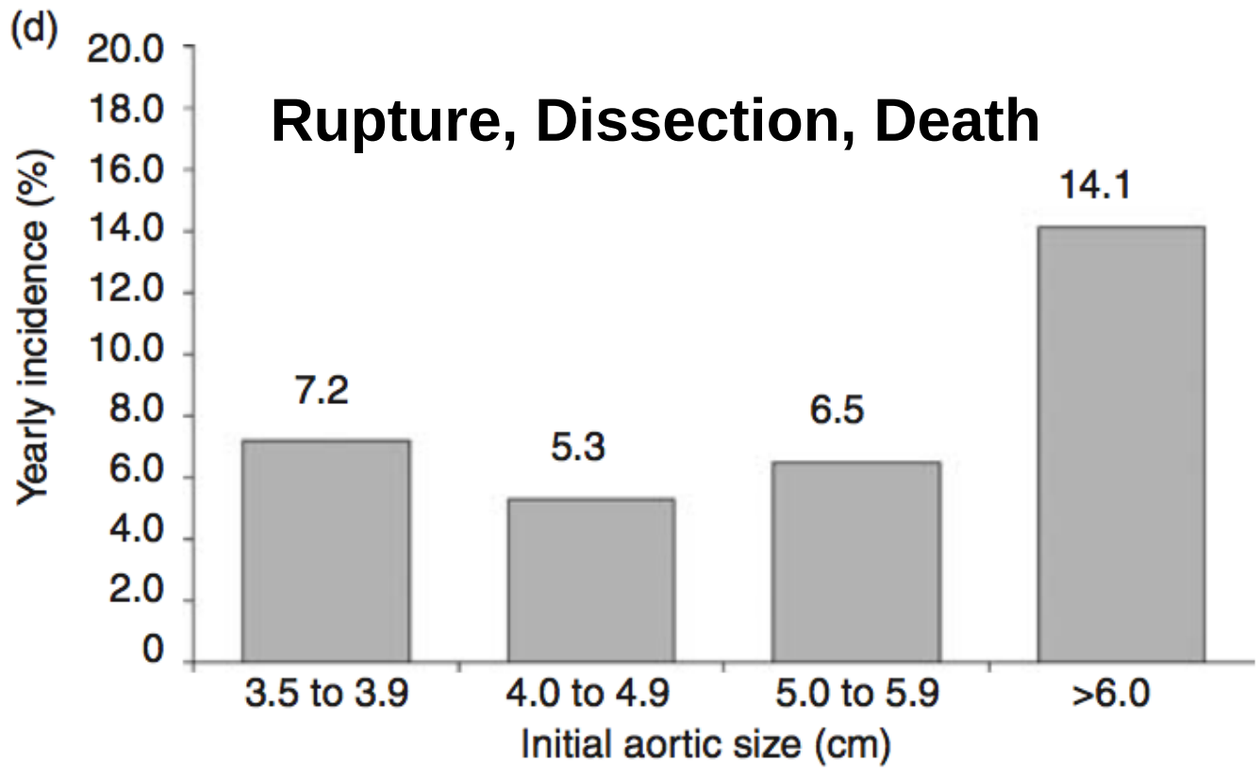
Yearly Event Rates at Different Diameters









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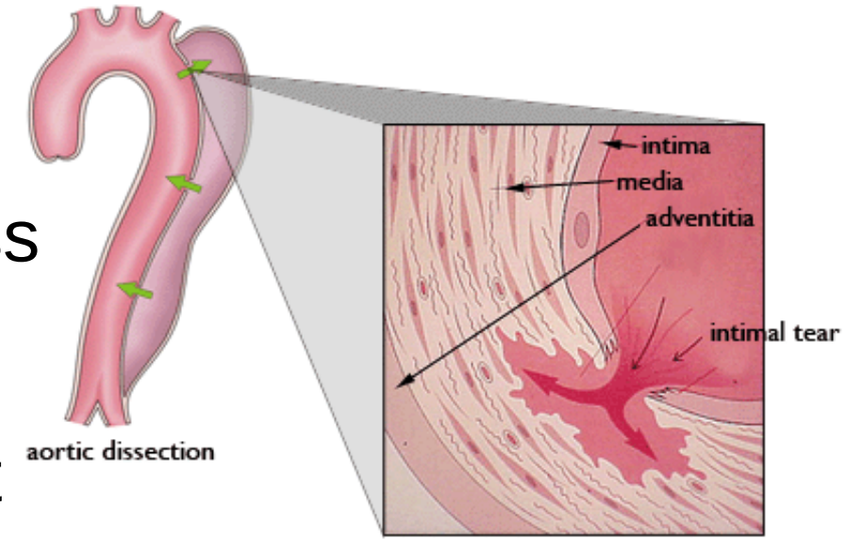
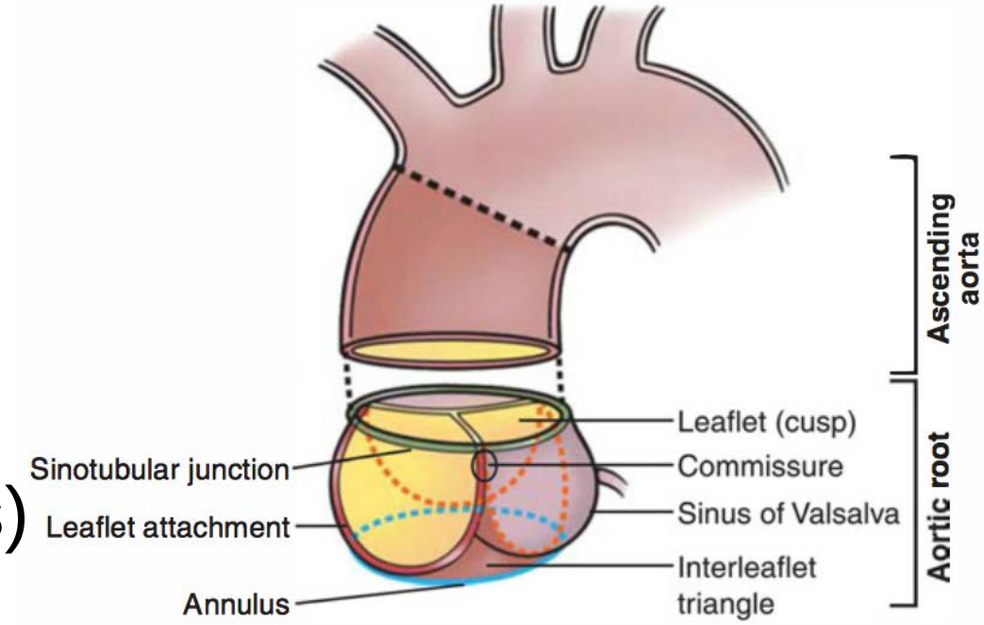
Etiology of Ascending Aorta and Aortic Arch Aneurysm

- Degenerative changes in the elastic media
- Loss of elastic fibers and smooth muscle loss causes aneurysmal changes
- Annulo-aortic ectasia
  - Marfan's Syndrome (85% have aortic root dilatation)
  - Ehlers-Danlos syndrome - disorder in collagen synthesis
  - Loeys-Dietz syndrome
- Atherosclerosis
- Aortic valve malformation
  - Congenital Bicuspid or Unicuspid
- Infection - mycotic aneurysm (ie. syphillis)
- Arteritis - Takayasu arteritis, Kawasaki disease





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Risk Factors for Development of Thoracic Aortic Dissection

Conditions Associated With Increased Aortic Wall Stress
Hypertension, particularly if uncontrolled
Pheochromocytoma
Cocaine or other stimulant use
Weight lifting or other Valsalva maneuver
Trauma
Deceleration or torsional injury (eg, motor vehicle crash, fall)
Coarctation of the aorta

Conditions Associated With Aortic Media Abnormalities

Genetic

- Marfan syndrome
- Ehlers-Danlos syndrome, vascular form
- Bicuspid aortic valve (including prior aortic valve replacement)
- Turner syndrome
- Loeys-Dietz syndrome
- Familial thoracic aortic aneurysm and dissection syndrome

Inflammatory vasculitides

- Takayasu arteritis
- Giant cell arteritis
- Behçet arteritis

Other

- Pregnancy
- Polycystic kidney disease
- Chronic corticosteroid or immunosuppression agent administration
- Infections involving the aortic wall either from bacteremia or extension of adjacent infection

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Classification of Thoracic Aortic Dissection

- Time course: Acute vs. Chronic
- Anatomical: Ascending, descending or both
- Stanford:
  - Type A: Involving the ascending aorta (with or without descending aortic involvement)
  - Type B: Involving only the descending aorta
- De Bakey:
  - I: Ascending and Descending aorta
  - II: Ascending Aorta only
  - III: Descending Aorta only

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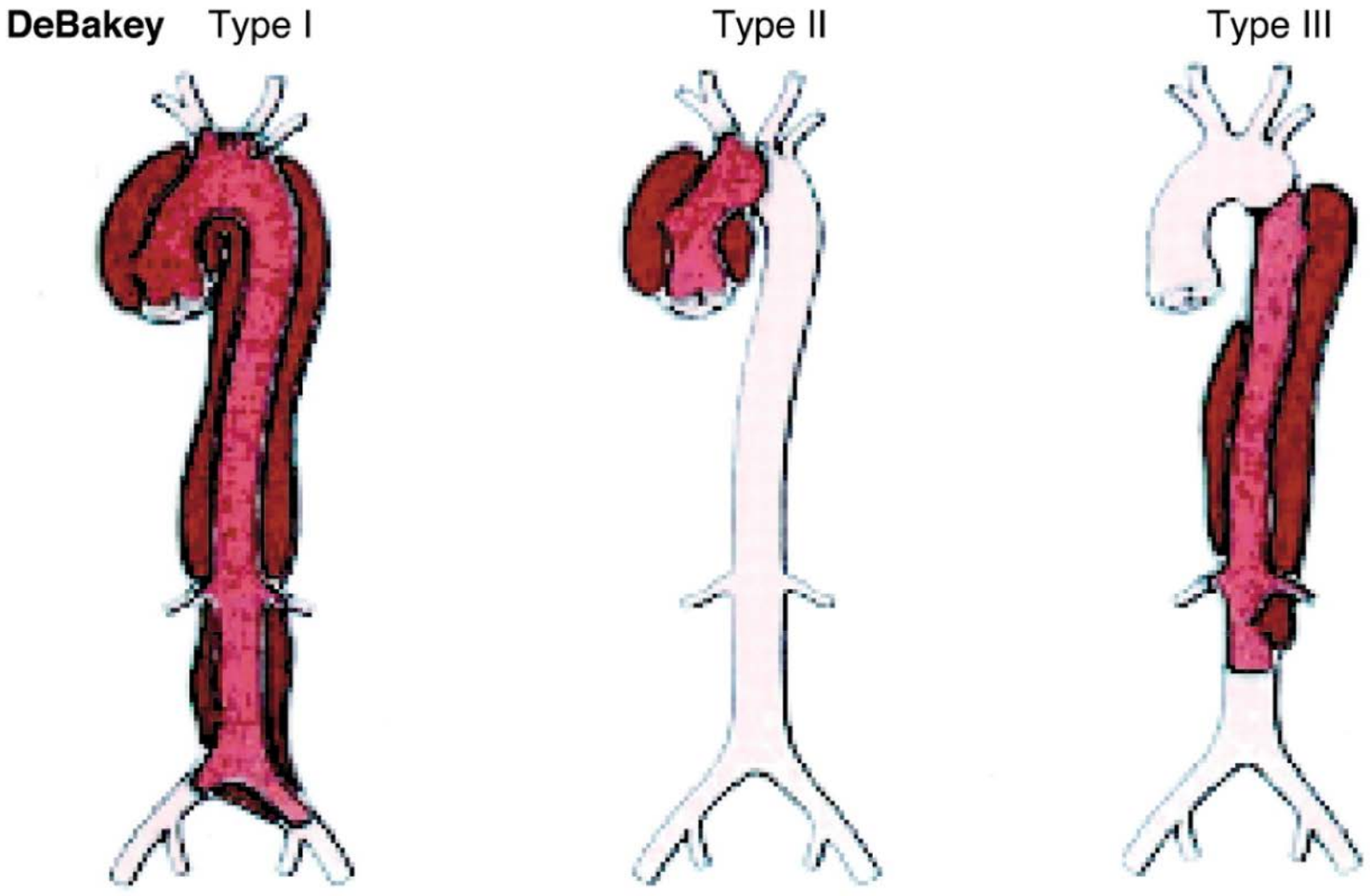
Classification of Thoracic Aortic Dissection



DeBakey

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

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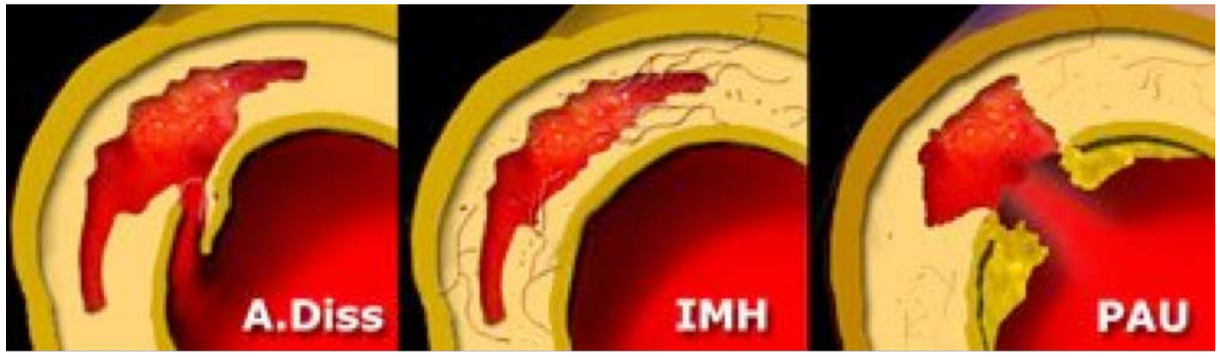
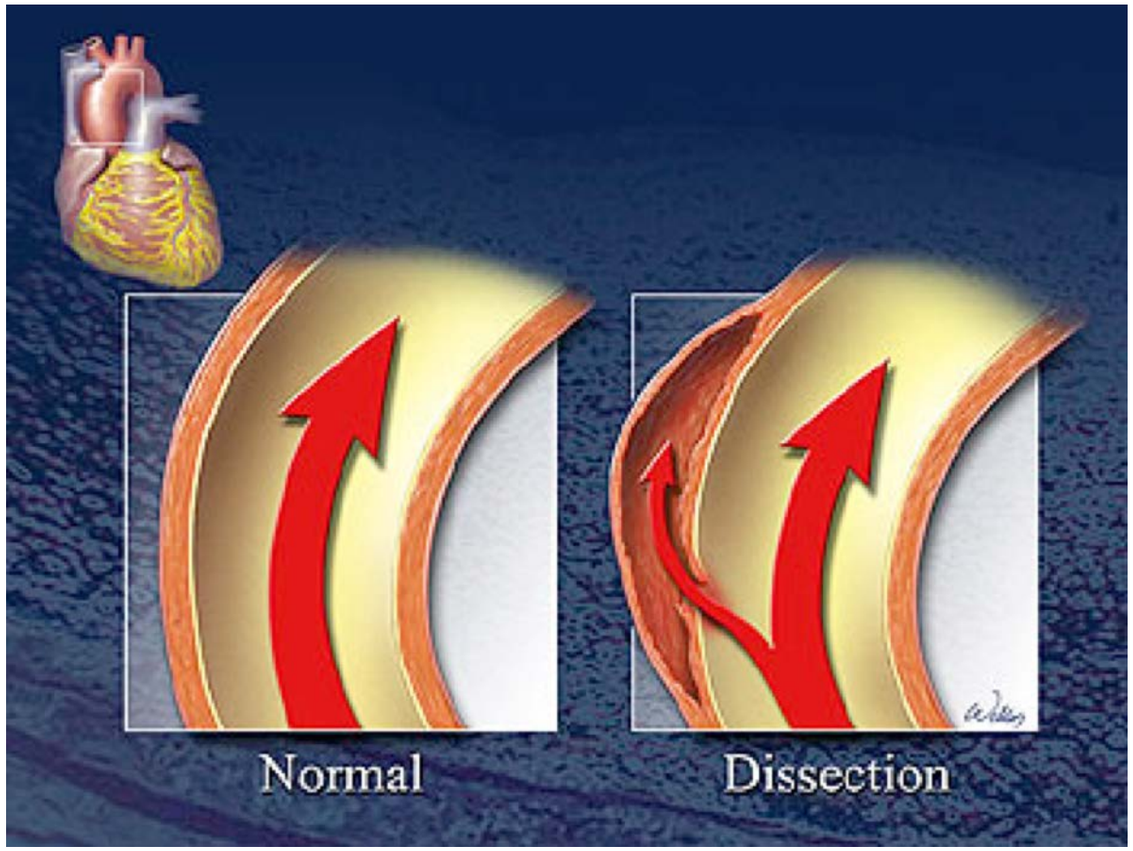
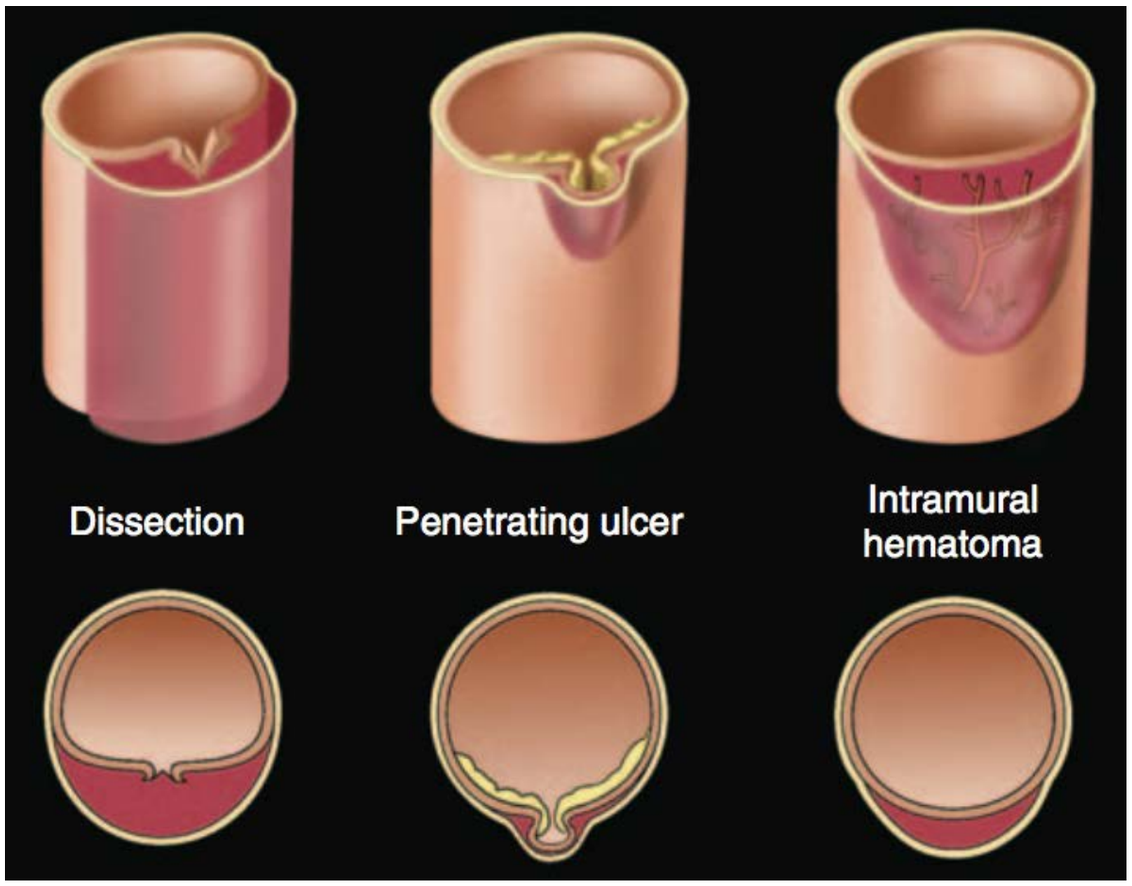
Pathophysiology







Classic Presentation (International Registry of Acute Aortic Dissection)

- **Sudden onset** - 84% describe a sudden onset of pain
- **Severe** chest pain often described as a “tearing” sensation
- Radiation of the pain to the **back**
- Syncope is not uncommon but a highly non-specific symptom unless accompanied by some of the above symptoms

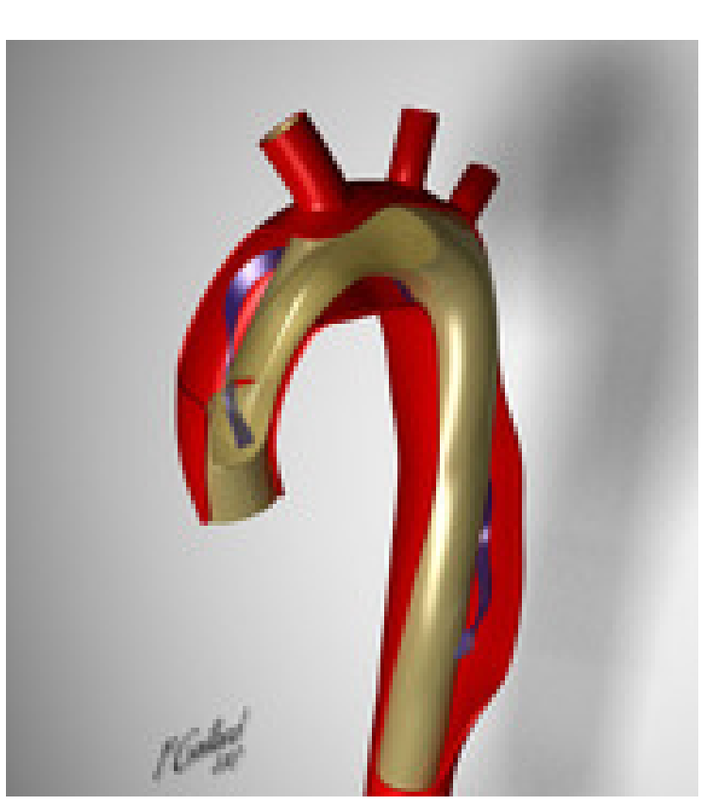
Acute Aortic Dissection Risk Score

- **High risk condition:** Marfans, FH of aortic dissection, known AV disease, recent AV manipulation
- **High risk pain features:** chest, back, abdominal pain of abrupt onset, severe, ripping or tearing quality
- **High risk exam features:** evidence of perfusion deficits (pulse deficit, SBP difference, focal neurologic deficit along with the pain), new aortic insufficiency murmur, hypotension or shock

Rogers AM, et al. Circulation 2011;123:2213.

Work-Up for Thoracic Aortic Dissection

- Imaging is key element to diagnosis
- The options are **CTA, TEE or MRA**
- Class 1 meta-analysis the sensitivity/specificity:
  - CTA 100%/98%
  - TEE 98%/95%
  - MRA 98%/98%
- Angiography and IVUS can also detect dissections



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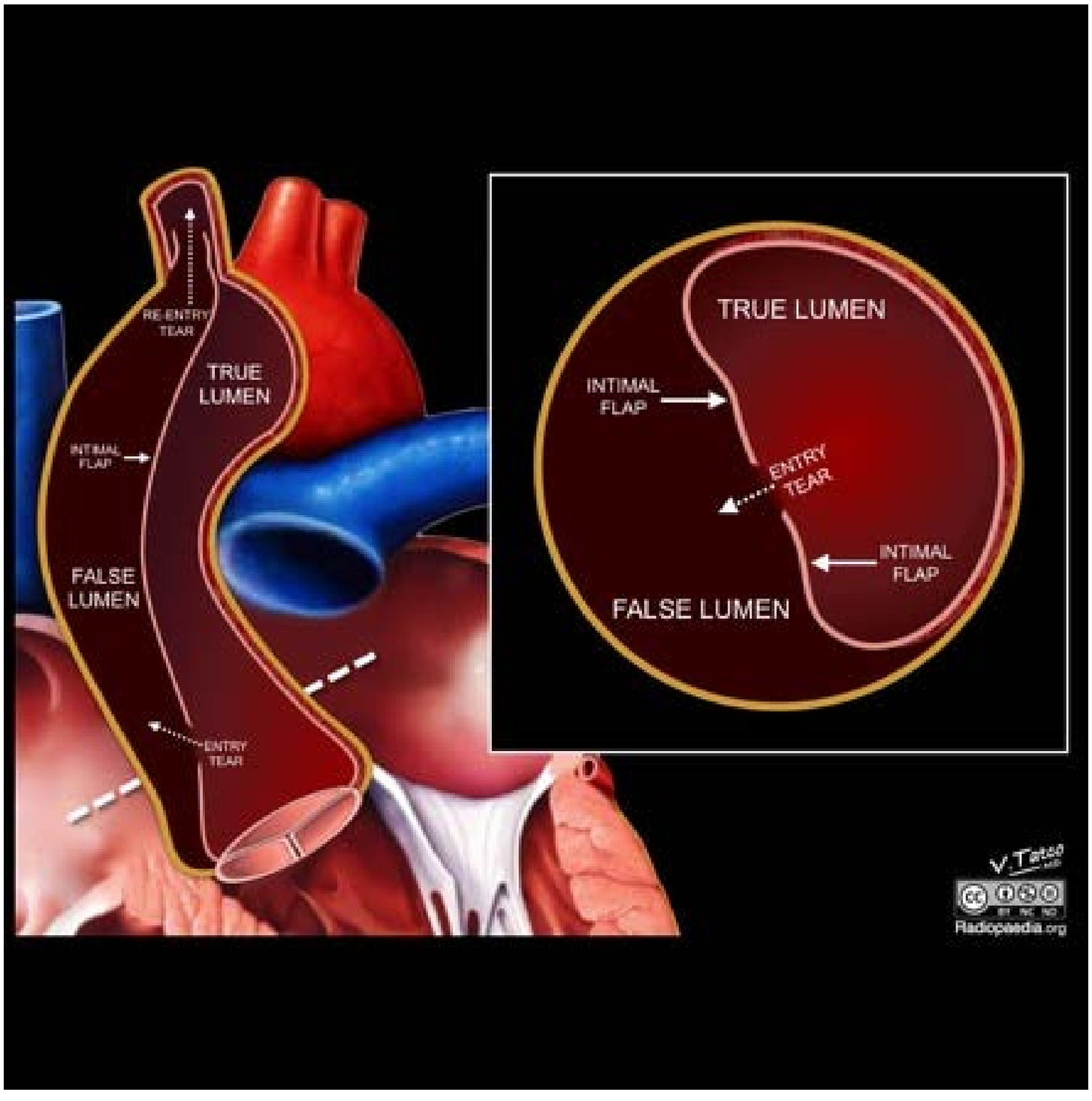
True Lumen - False Lumen



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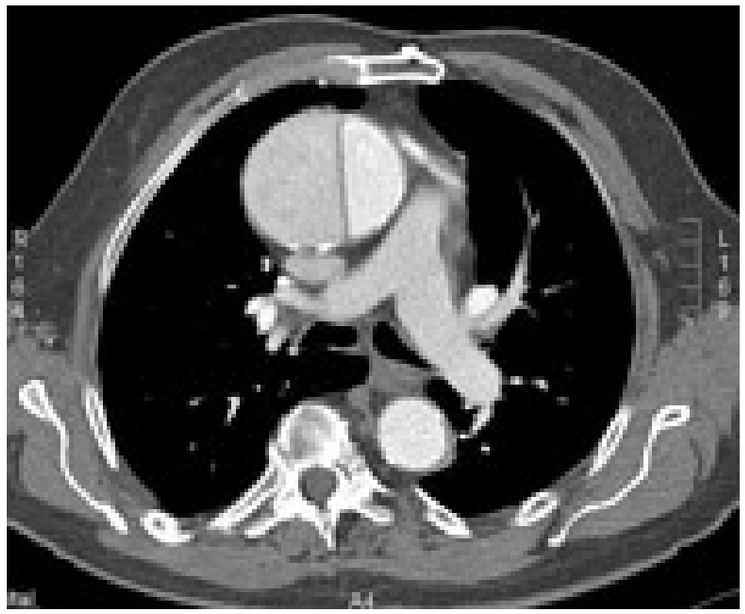
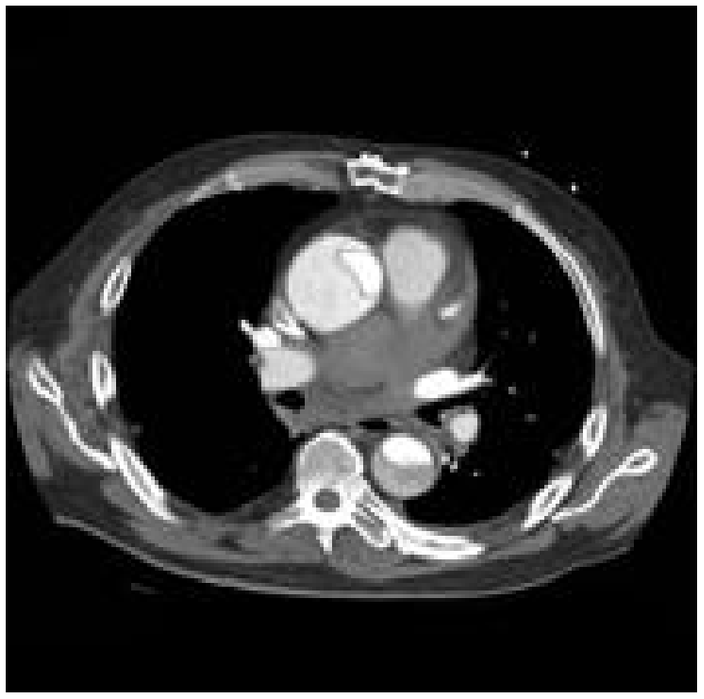
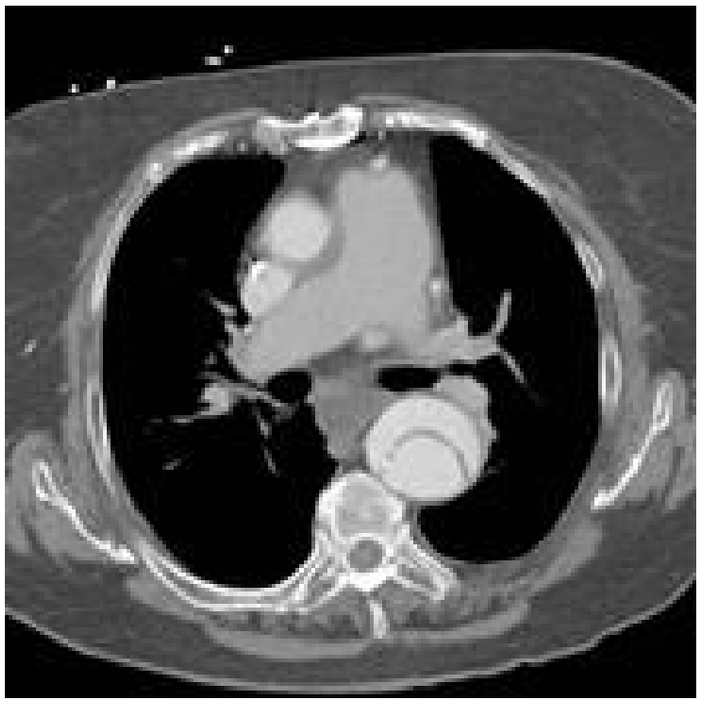
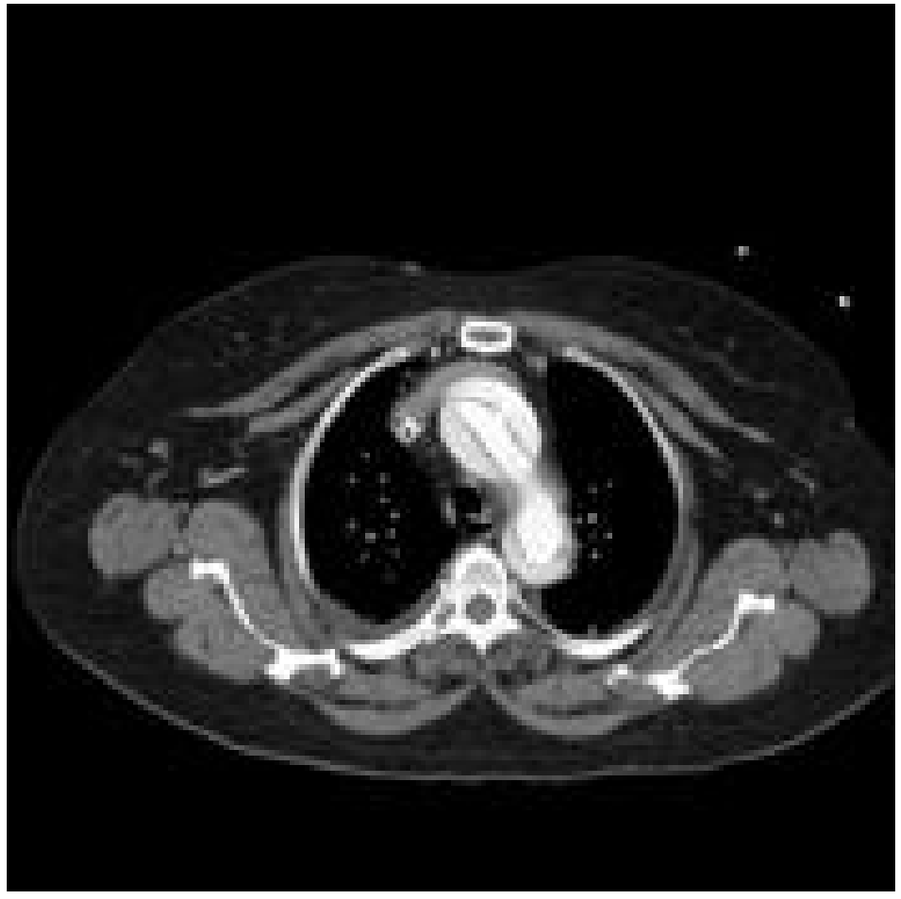
Imaging the Thoracic Aorta









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Imaging the Thoracic Aorta

Initial Treatment in ED

- Reduce shearing force of blood flow by - blood pressure and heart rate control
- **Esmolol** - beta blocker, rapid onset, short duration of action
- **Nitroprusside** - lower the blood pressure, arterial and venous vasodilator
- Nitroprusside reduces the pressure while esmolol blocks the reflex increase in heart rate, blood velocity is reduced with a concomitant reduction in shear force

Next Step

- Type A dissection - rapid notification of CT Surgery or transfer to hospital capable of providing surgery

- Type B dissections - medical management with aggressive treatment of BP is the mainstay of treatment

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Surgery for Ascending Aortic Aneurysms and Type A Thoracic Aortic Dissections

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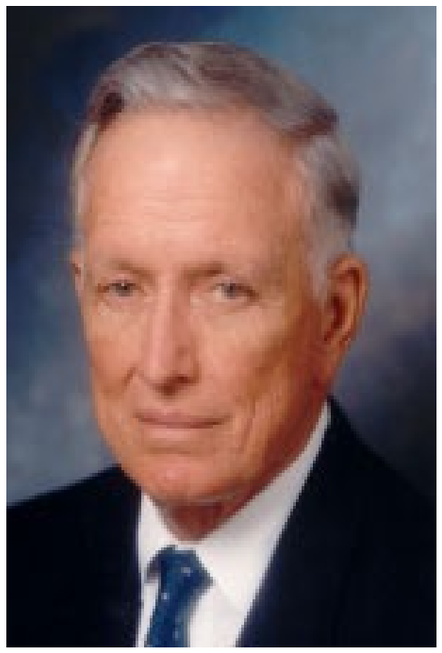
First Resection of Thoracic Aorta Aneurysm

Cooley DA, DeBakey ME: Resection of entire ascending aorta in fusiform aneurysm using cardiopulmonary bypass. JAMA 1956:162:1158-1159



DeBakey ME, Crawford ES, Cooley DA, Morris GC: Successfull resection of fusiform aneurysm of aortic arch with replacement by homograft.
Surg Gynaecol Obstet 1957;105:657-664

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Criteria for Surgical Intervention of the Ascending Aorta

- **Emergency:**
  - Acute dissection or rupture
- **Elective:**
  - Aortic Diameter >5.5 cm in diameter
  - Aneurysm growth rate >0.5 cm/year
  - Aortic diameter >4.5 cm in patients undergoing aortic valve surgery
  - Ratio of aortic area to body height >10 cm^2/m
  - Aortic aneurysm >4.5 - 5.0 cm with genetically associated aortic diseases

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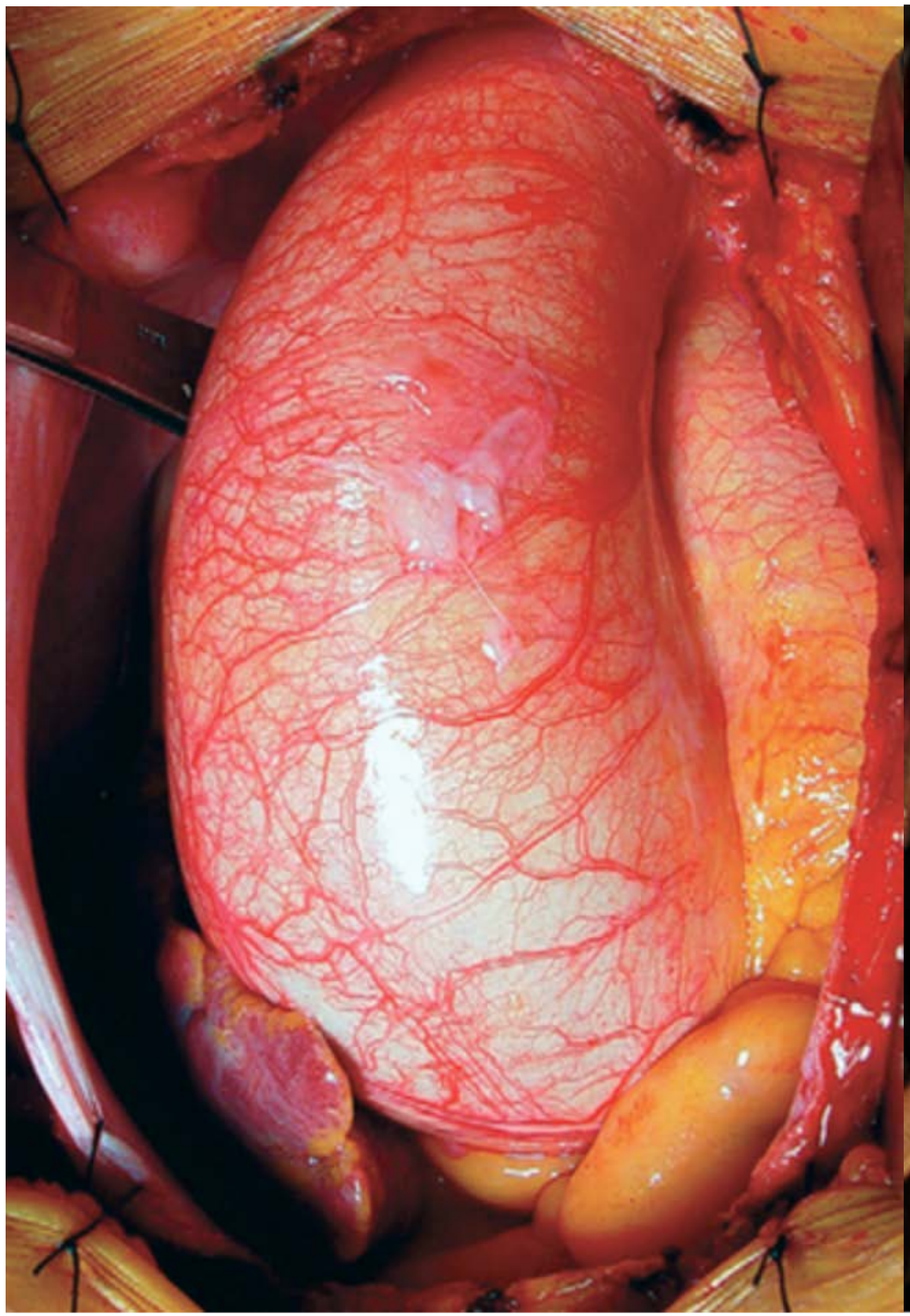
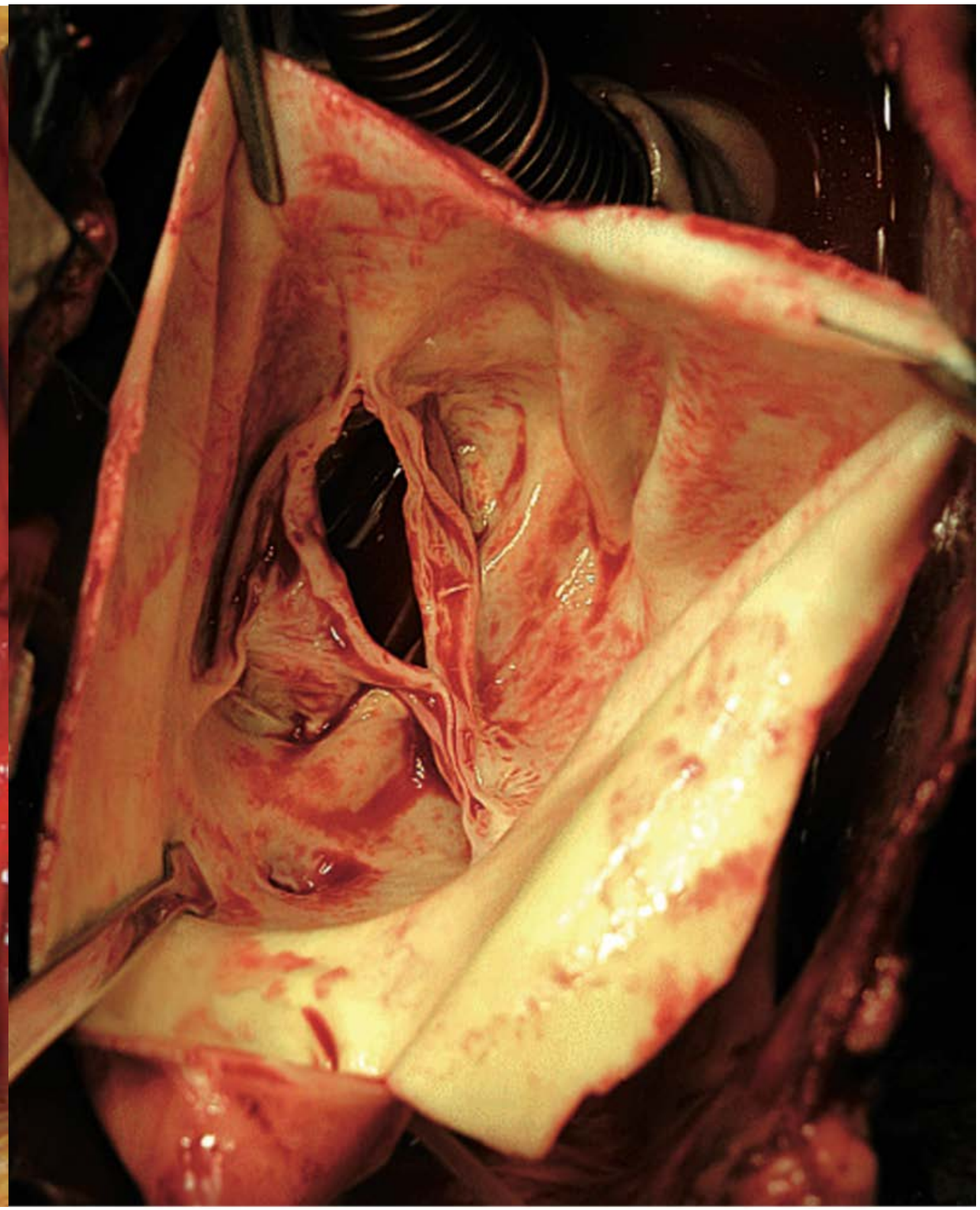
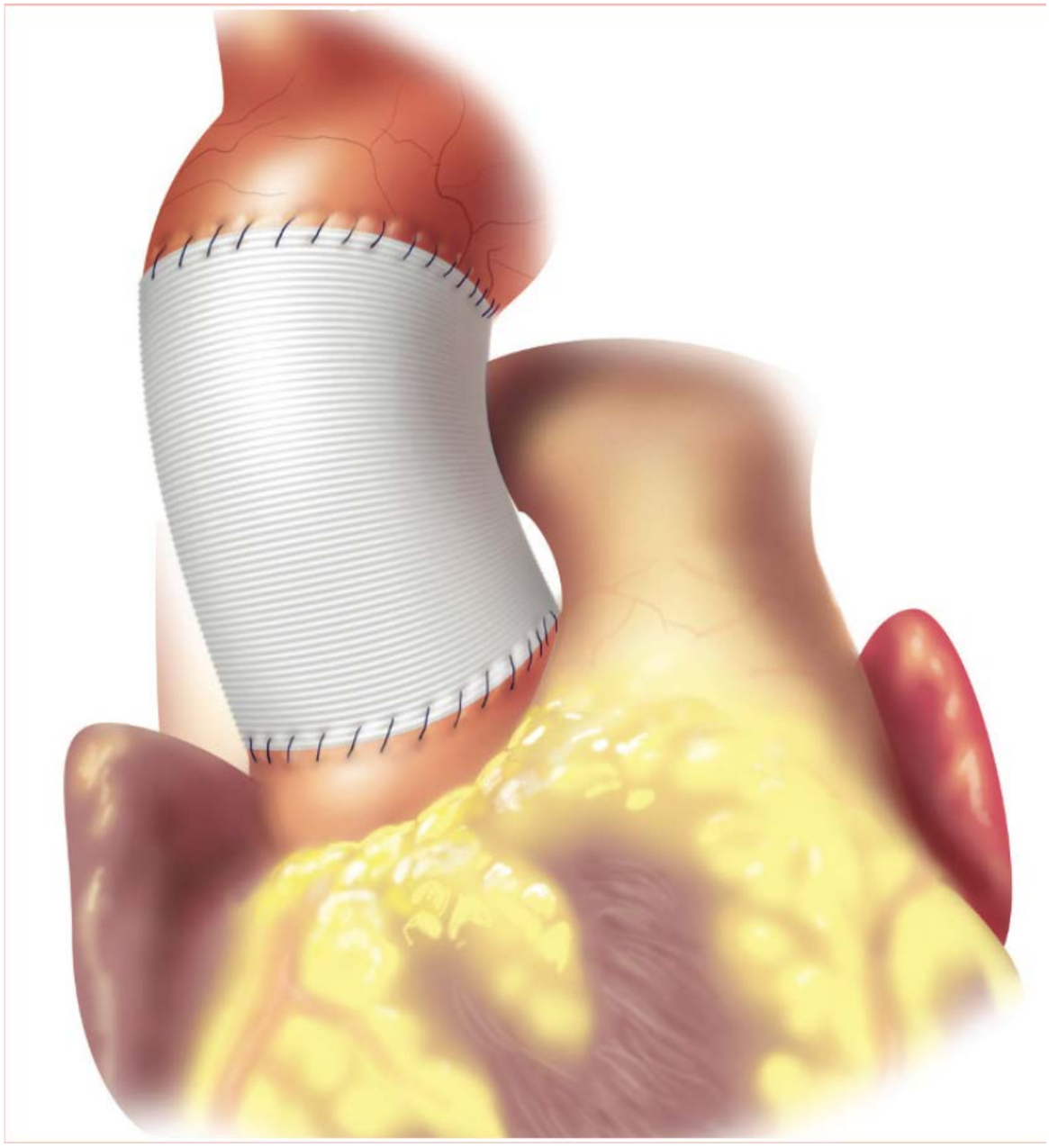
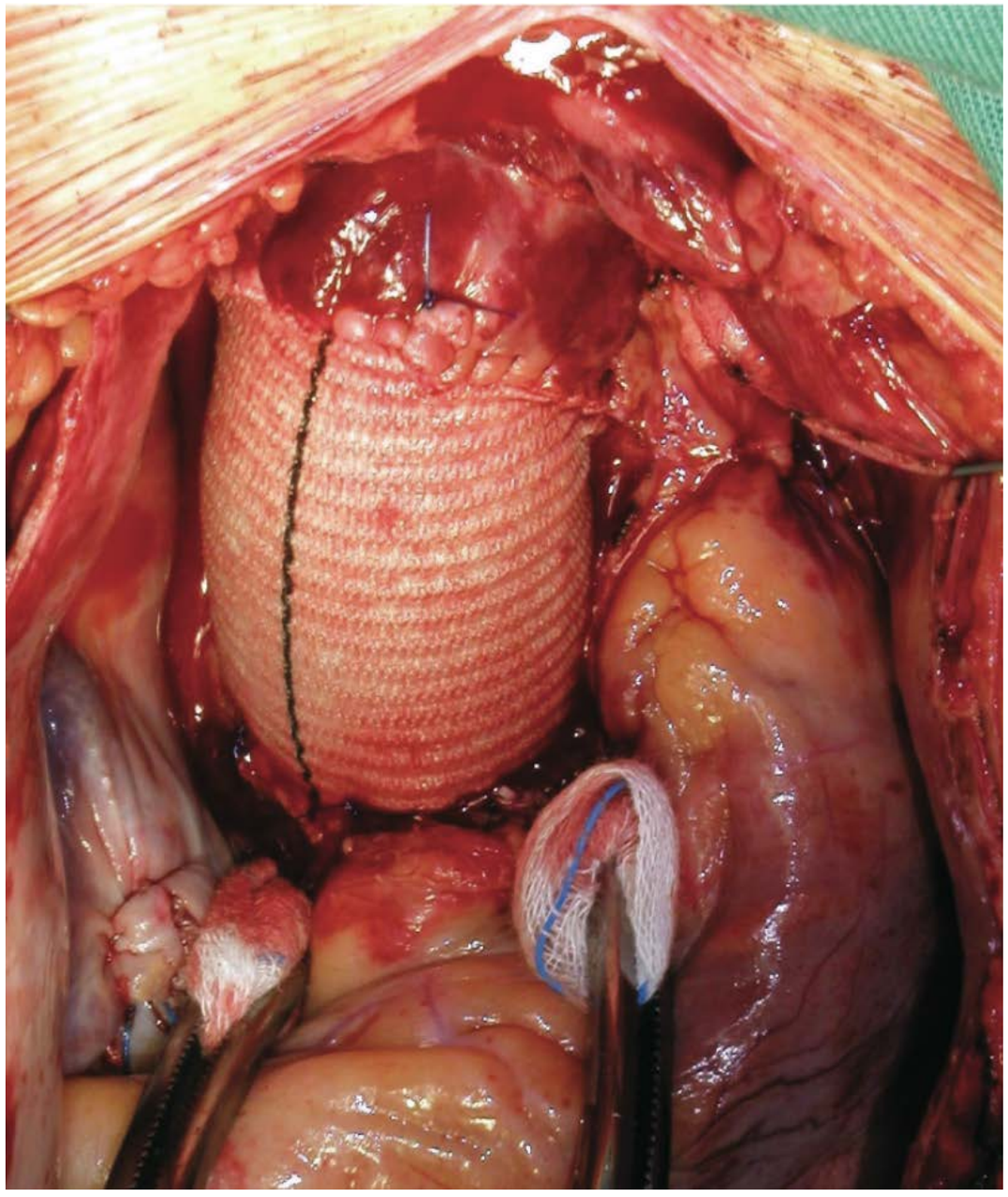
Congenital Bicuspid Aortic Valve with Dilation of the Ascending Aorta









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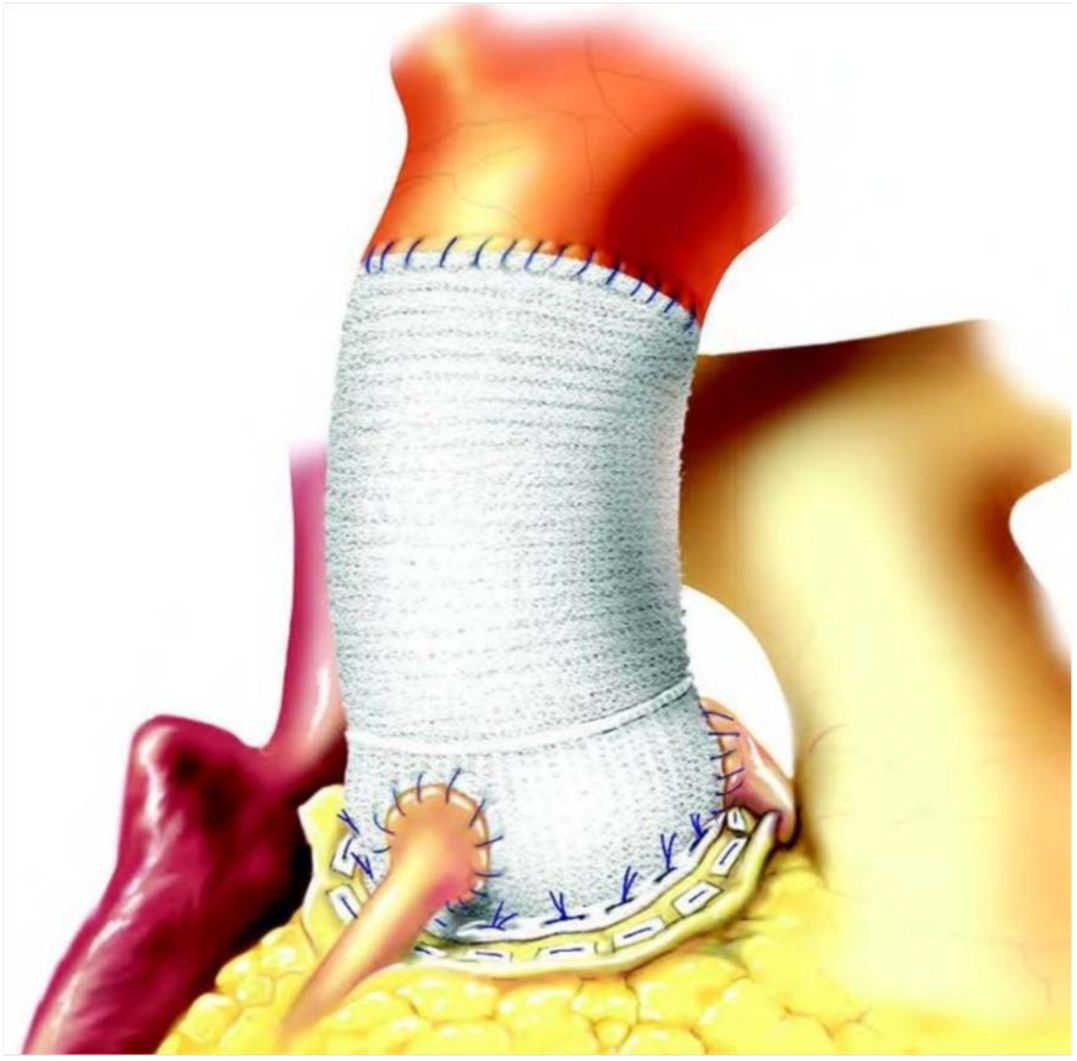

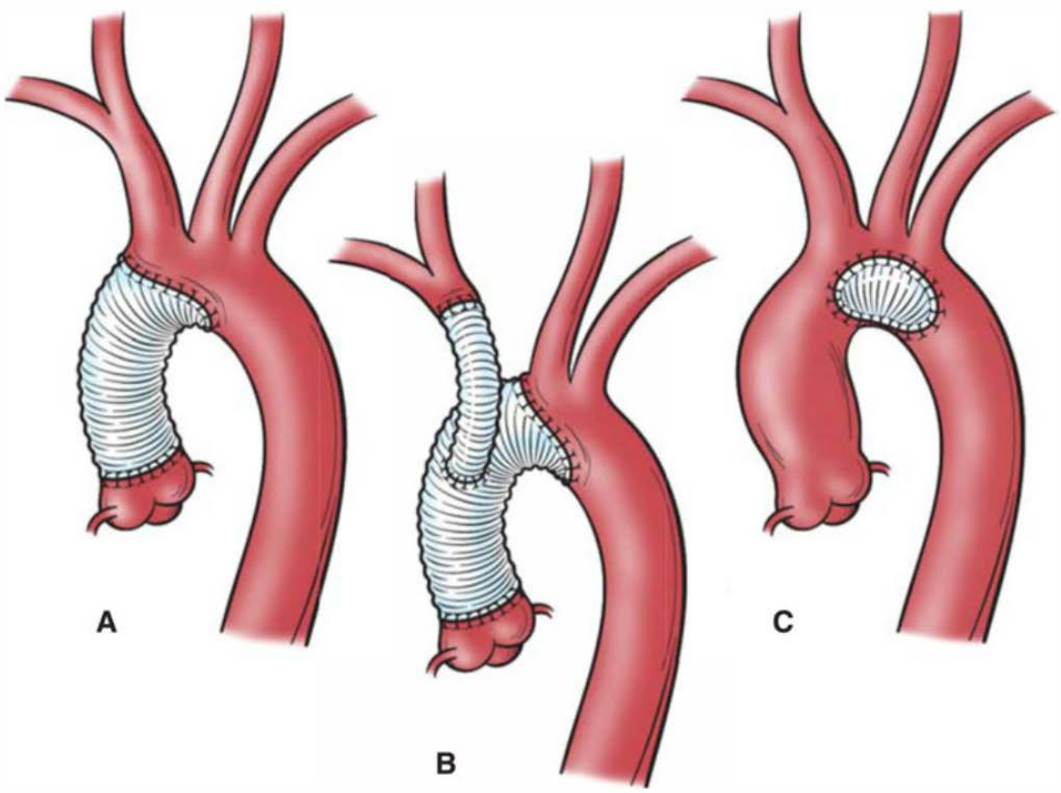

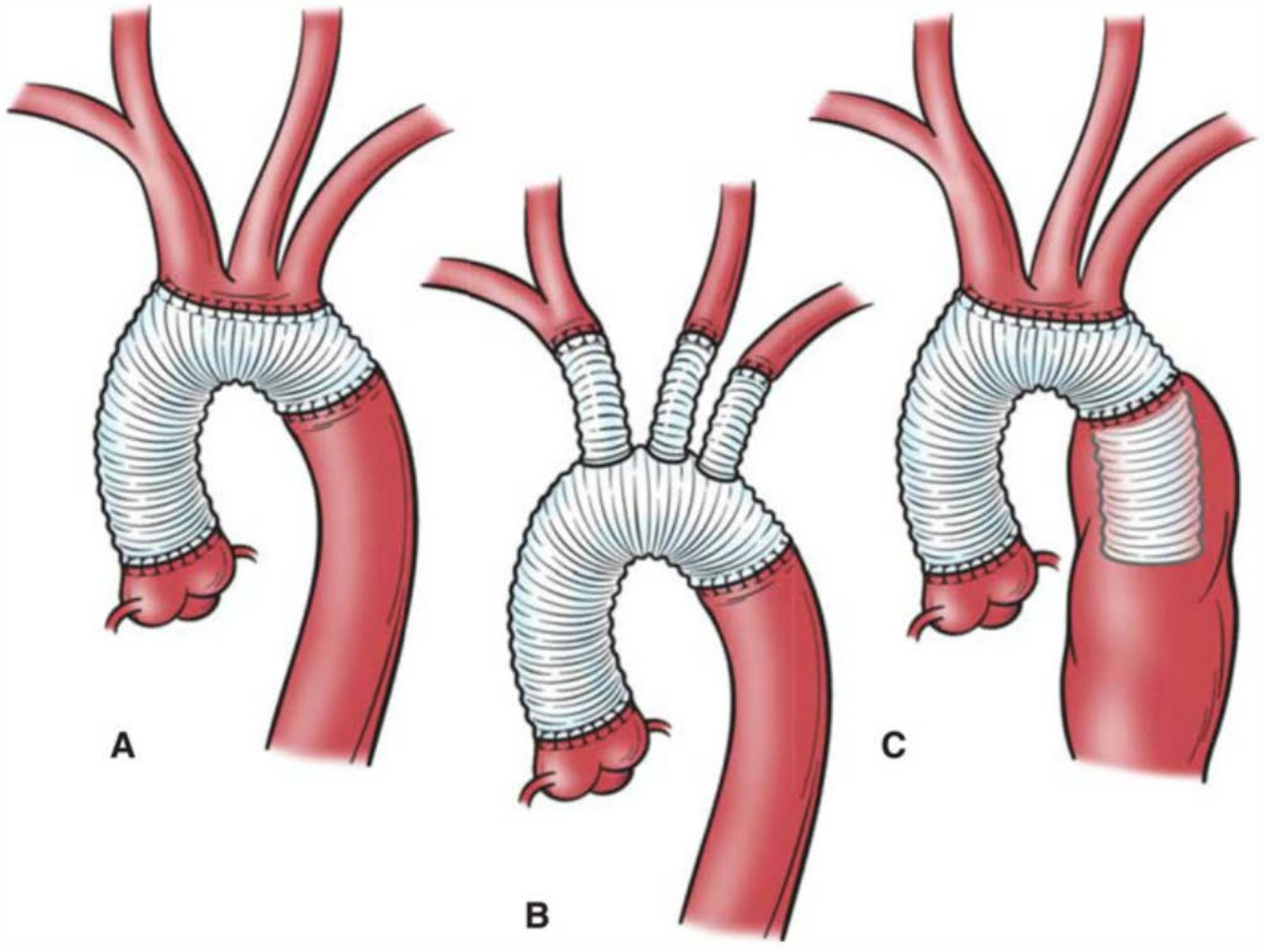

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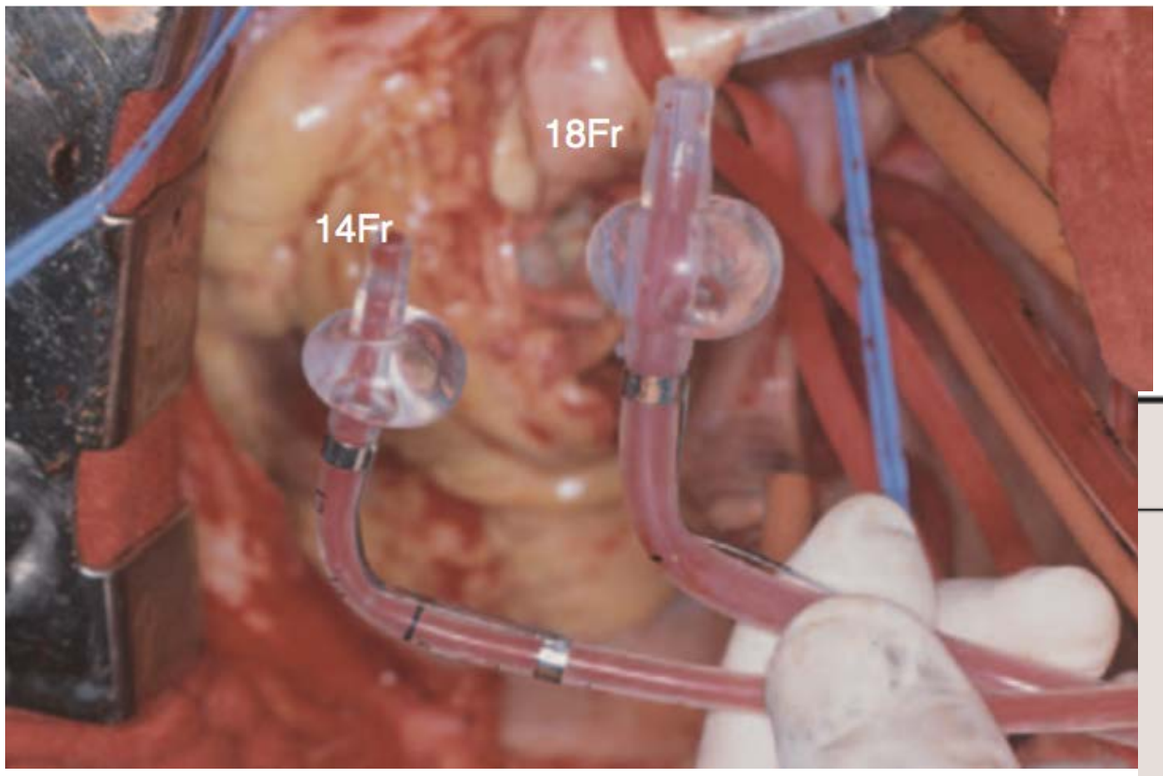
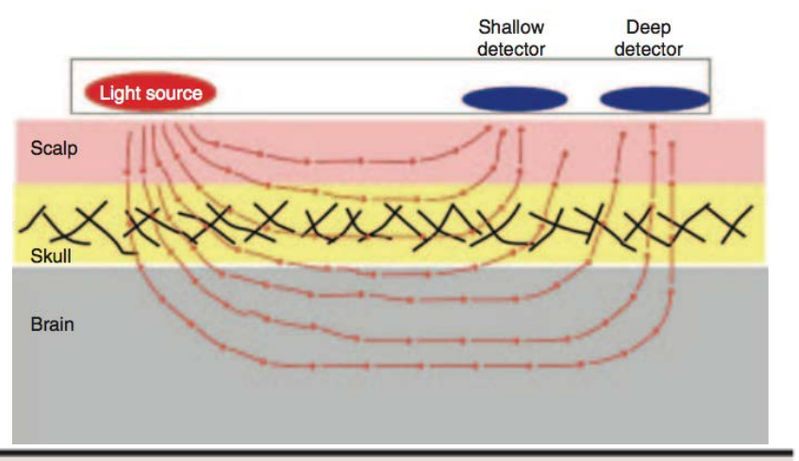
New Techniques for Cerebral Protection

Transcranial Cerebral Oximetry

Moderate Hypothermia (28 ºC)

Antegrade Cerebral Perfusion





Circulatory arrest time	Stroke incidence (%)
7–29 minutes	4
30–44 minutes	7.5
45–59 minutes	10.7
60–120 minutes	14.6

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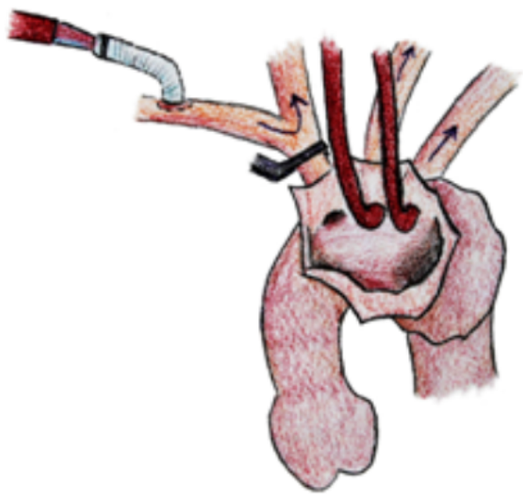
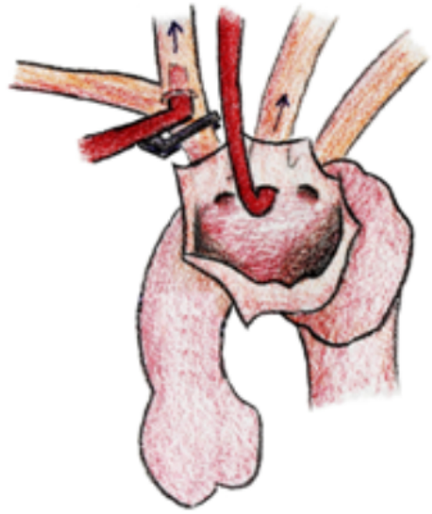
Total Arch Replacement

Venous Cannulation	Dual Stage	Dual Stage
Arterial Cannulation	Axillary (graft)	Innominate (direct)
Cerebral Cannulation	LCCA & LSA	LCCA
		
Aorta side arm graft	Yes	Sometimes
Cardioplegia Delivery	Bentley, Polystans, Retro	Polystans (5 right angled & 6 Straight)
Pressure Monitoring	R. Radial Femoral	R. Radial Femoral
Anastomosis Order	1. Distal Aorta 2. Proximal Aorta 3. Head Vessels a. LSA b. LCCA c. Innominate	1. Distal Aorta 2. Head Vessels a. LSA b. LCCA c. Innominate 3. Proximal Aorta

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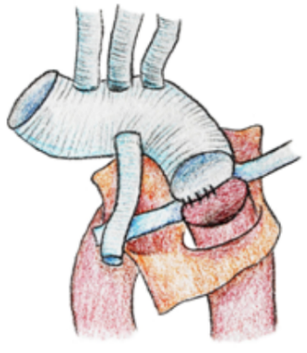
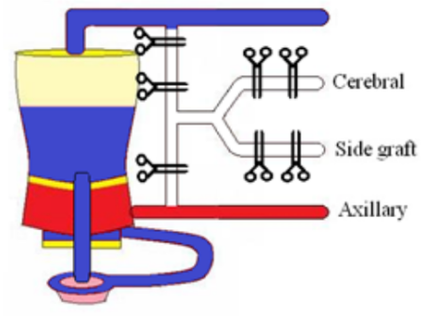
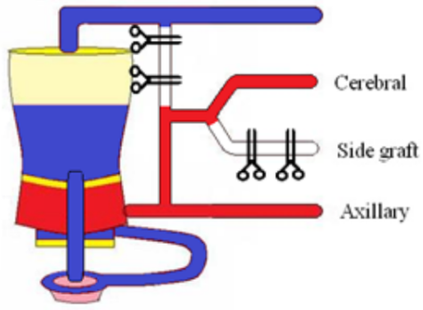
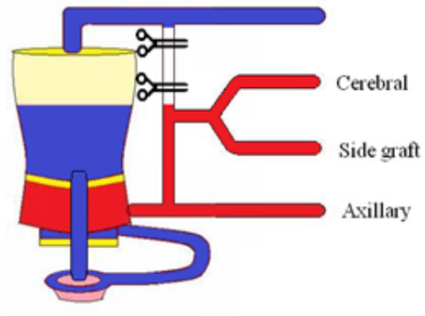
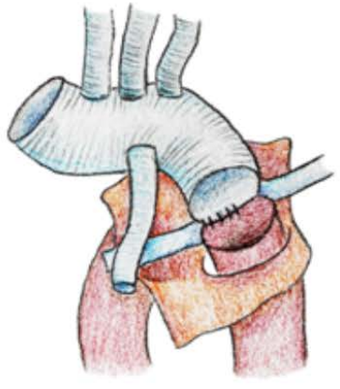
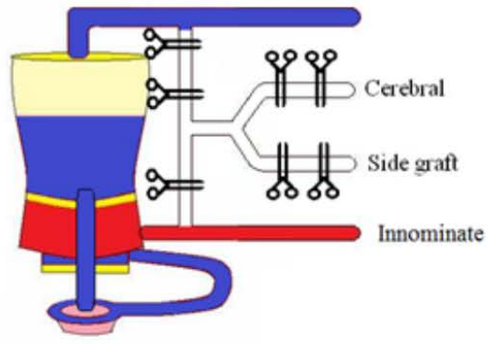
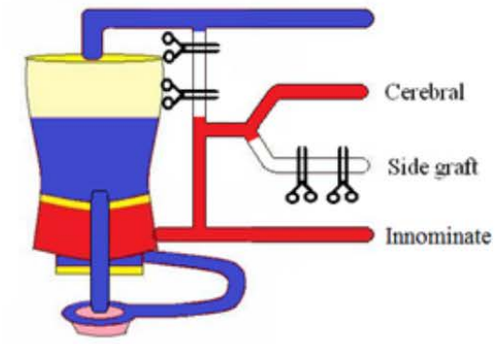
Cool to 24 °C Start ACP via axillary Puts in 13 Fr or 15 Fr cannulas to LCCA & LSA Start ACP via Cerebral (LCCA & LSA) **Distal Aorta anastomosis**  Start lower body perfusion via side arm graft Continue ACP via axillary & head vessels Re-warm to 28 °C	Cool to 24 °C Start ACP via axillary  Start ACP via Cerebral (LCCA & LSA)  May need to partial clamp axillary line to regulate flow to the cerebral vessels. Start lower body perfusion via side arm graft  Continue ACP via axillary & head vessels Rewarm to 28 °C

Cool to 24 °C Start ACP via innominate Puts in 13 Fr or 15 Fr cannula into LCCA Start ACP via cerebral line (LCCA) **Distal Aorta anastomosis** 	Cool to 24 °C Start ACP via innominate  Start ACP via cerebral line (LCCA)  May need to partial clamp innominate line to regulate flow to the LCCA.

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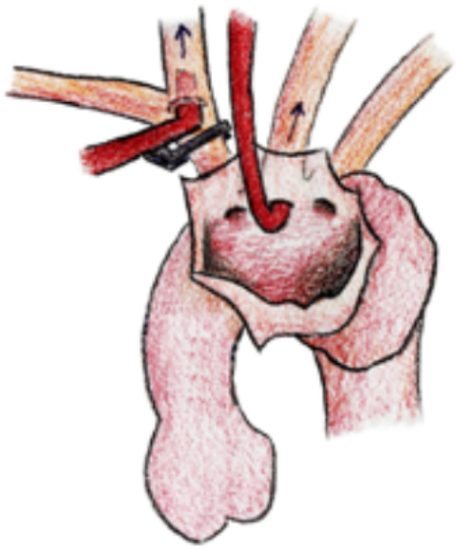
Hemi Arch Replacement

Venous Cannulation	Bi-caval	Dual Stage
Arterial Cannulation	Central (Aorta)	Innominate (direct)
Cerebral Cannulation	Innominate & LCCA ± LSA 	LCCA 
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Conclusions

- Aortic surgery is well established and indicated for aortic dissection and aneurysmal disease

- Novel techniques for cerebral perfusion continue to improve outcomes

- Complex ascending aorta and aortic arch aneurysm surgery require several monitoring / therapeutic measures in order to minimize neurologic complications

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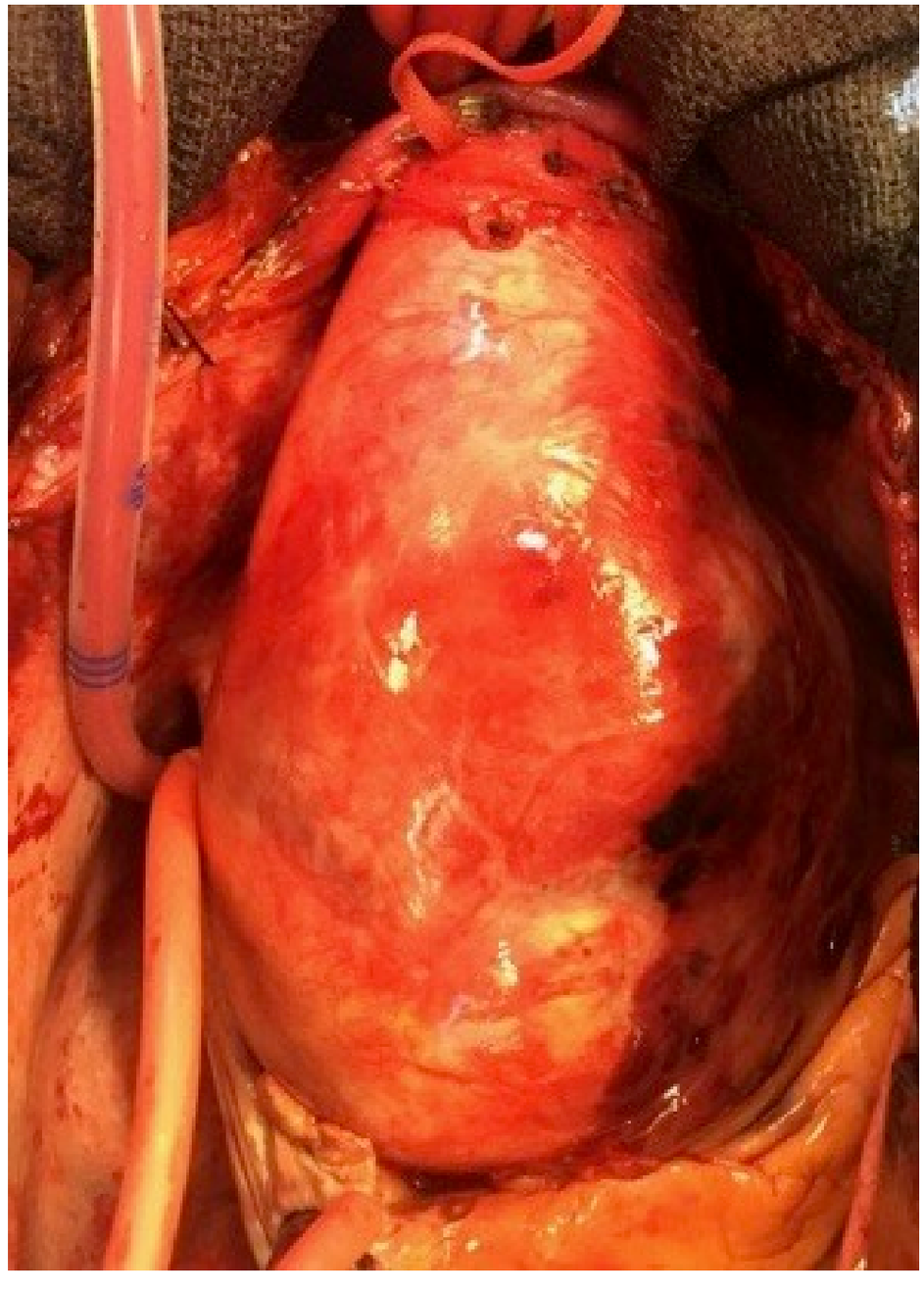
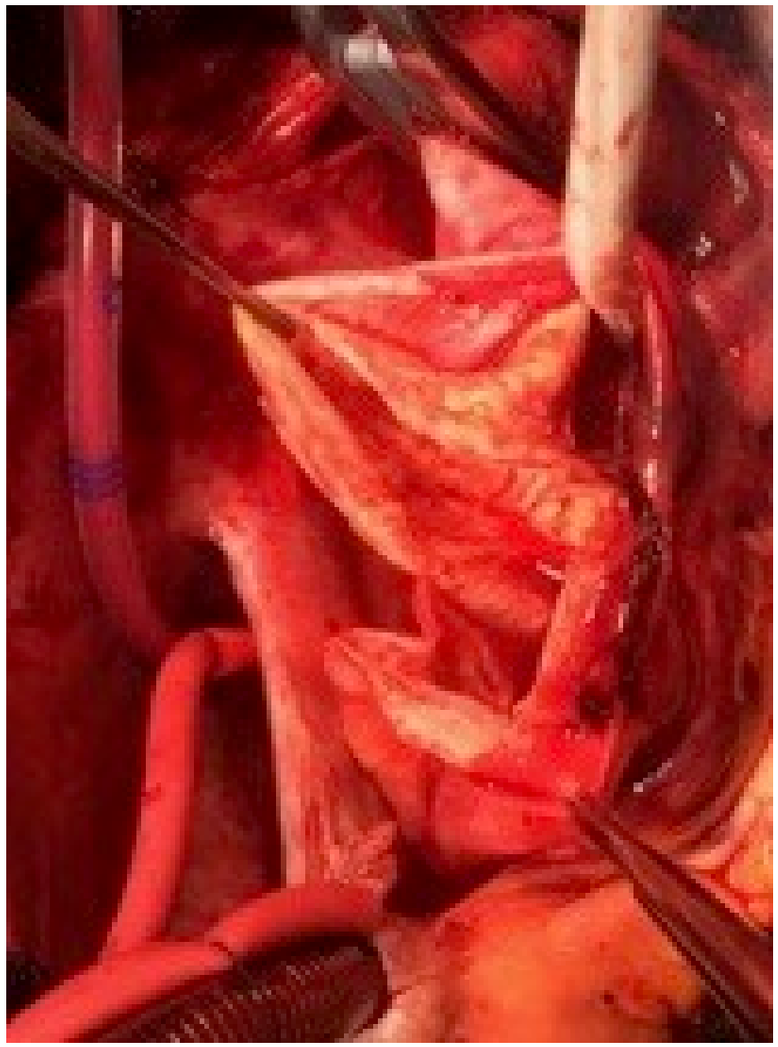
Case: BL 64 yo M, Acute Type A Aortic Dissection, Tx from OSH, Aortic Root Replacement / Hemiarch

- Initial presented with N/V, given GI cocktail, Sent home
- Represented with diaphoresis, tachycardia, back pain, elevated Cr



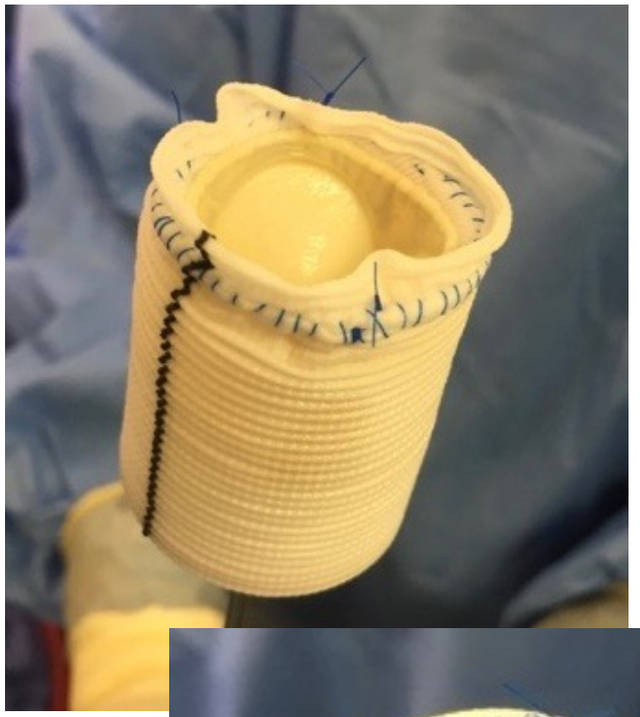
Keck Medicine of USC

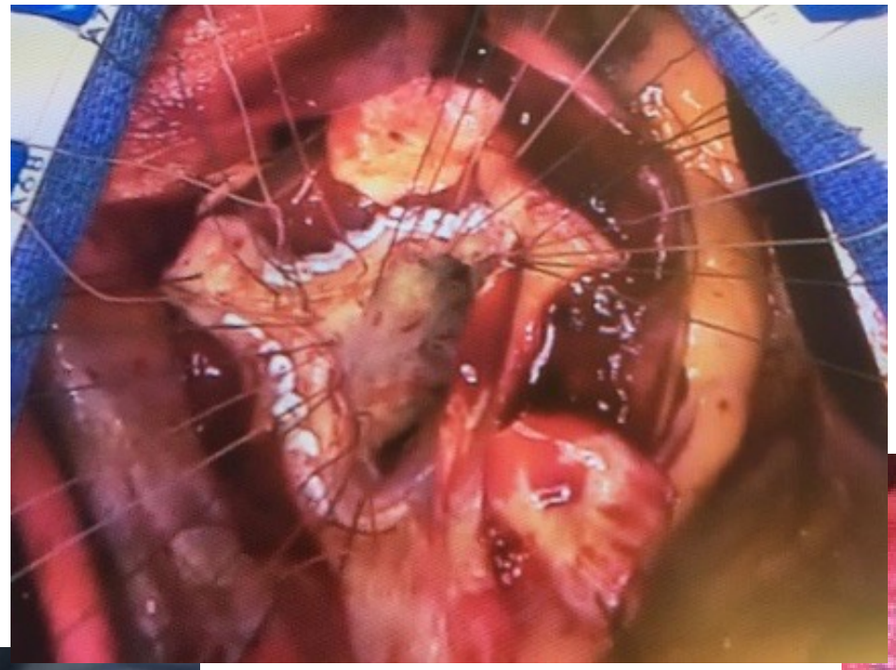
Case: Aortic Dissection
Aortic Root Replacement / Hemiarch

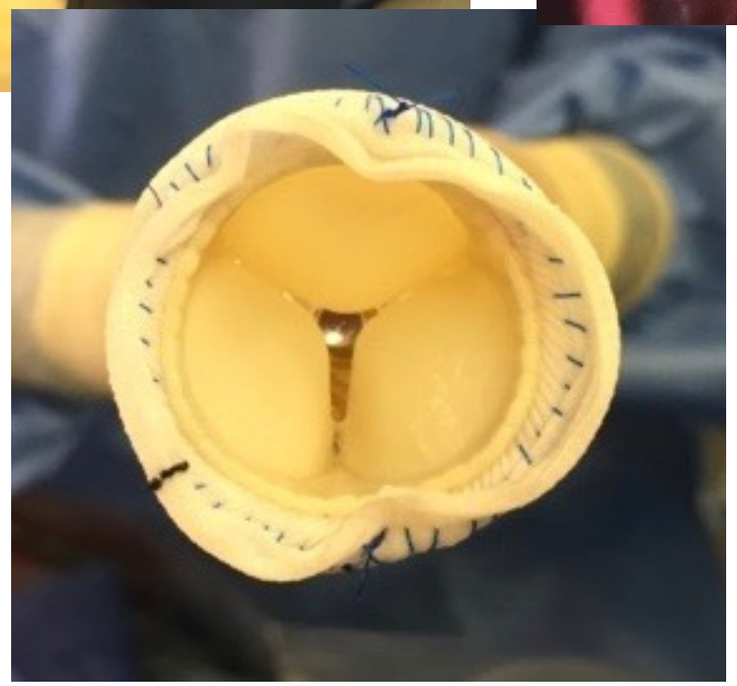


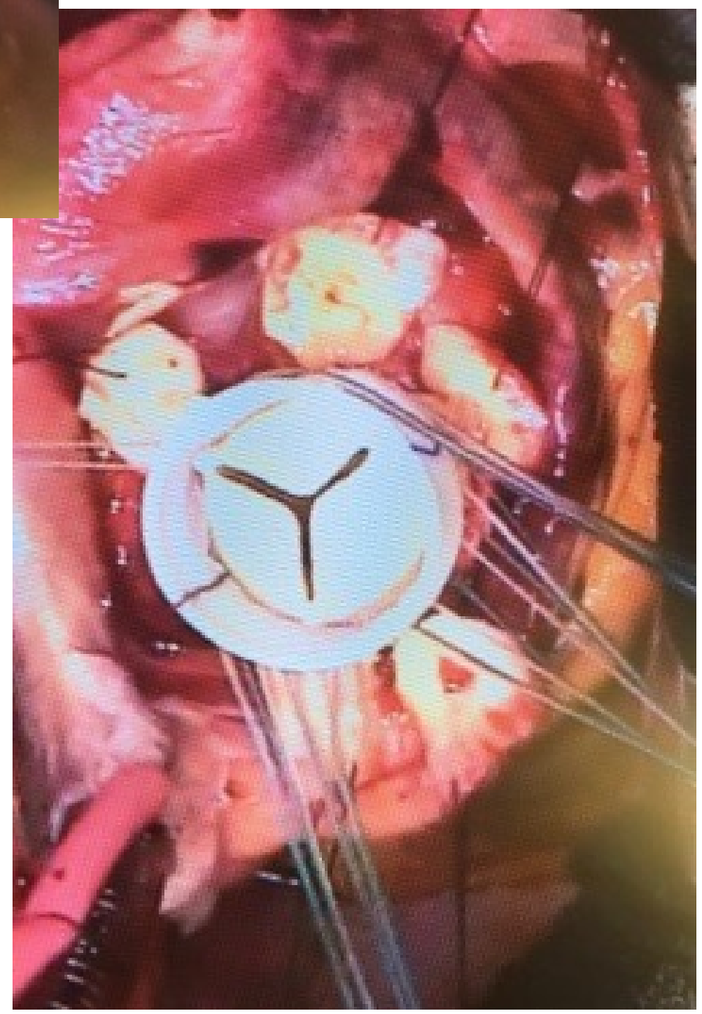
Keck Medicine of USC

Case: Aortic Dissection
Aortic Root Replacement / Hemiarch









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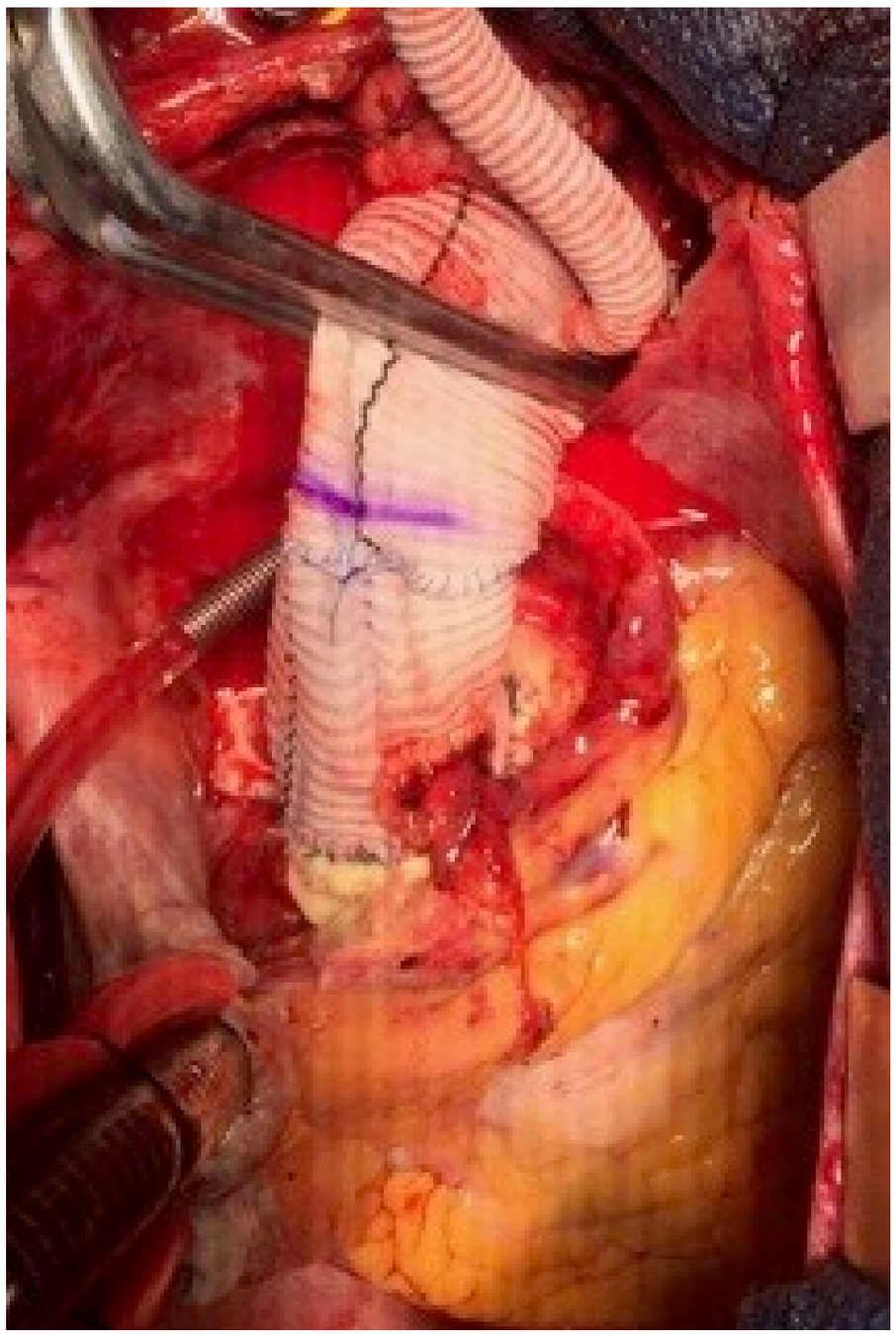
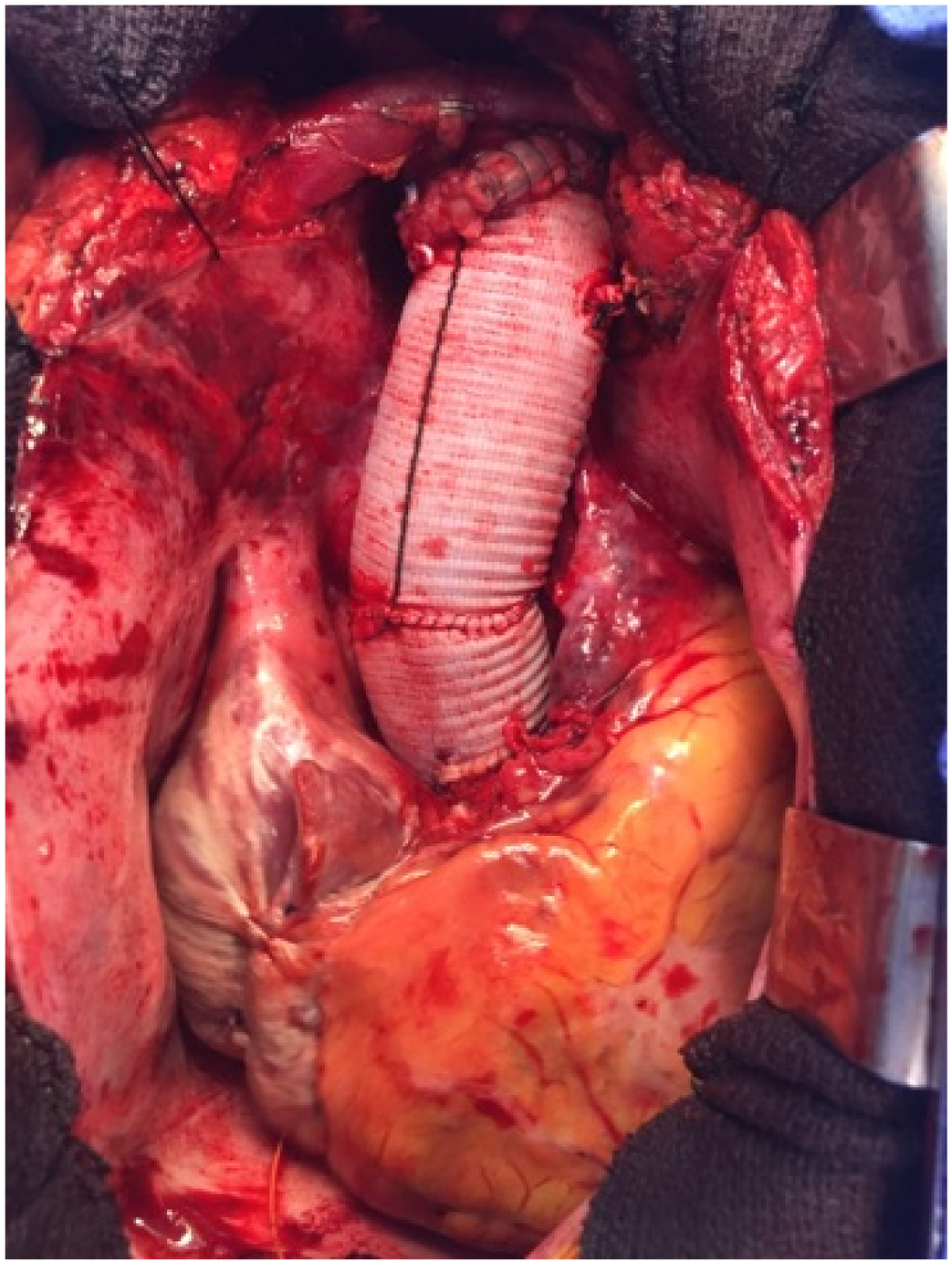
Case: Aortic Dissection
Aortic Root Replacement / Hemiarch,
Discharged home POD #5





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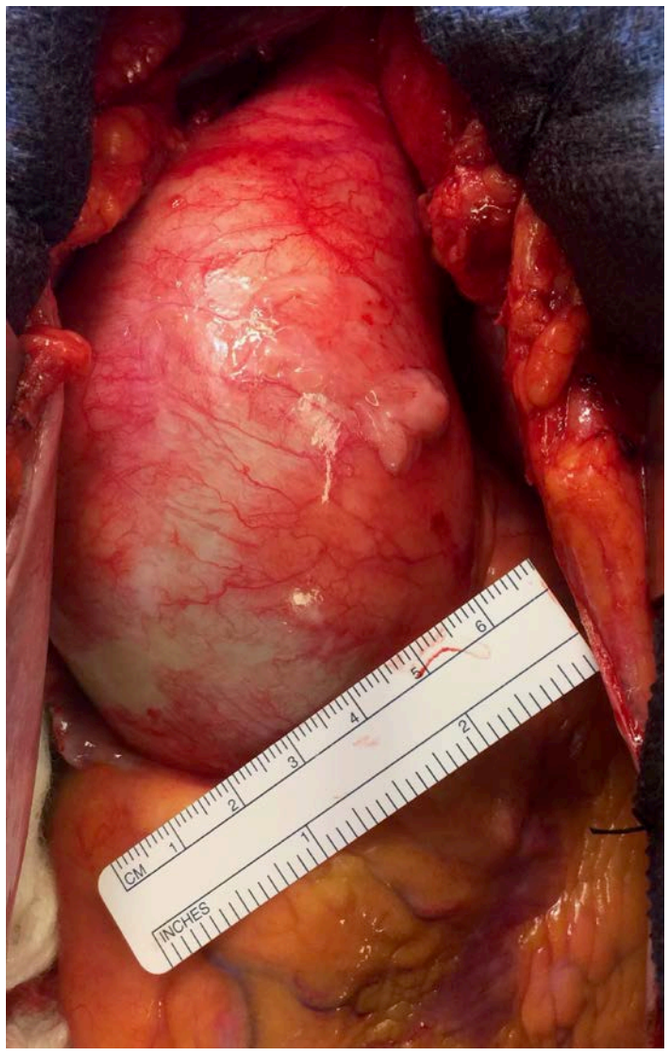
Case: MB 76 yo M, Sev AI,
Asc Ao Aneurysm 6.1cm
Aortic Root Replacement / Hemiarch



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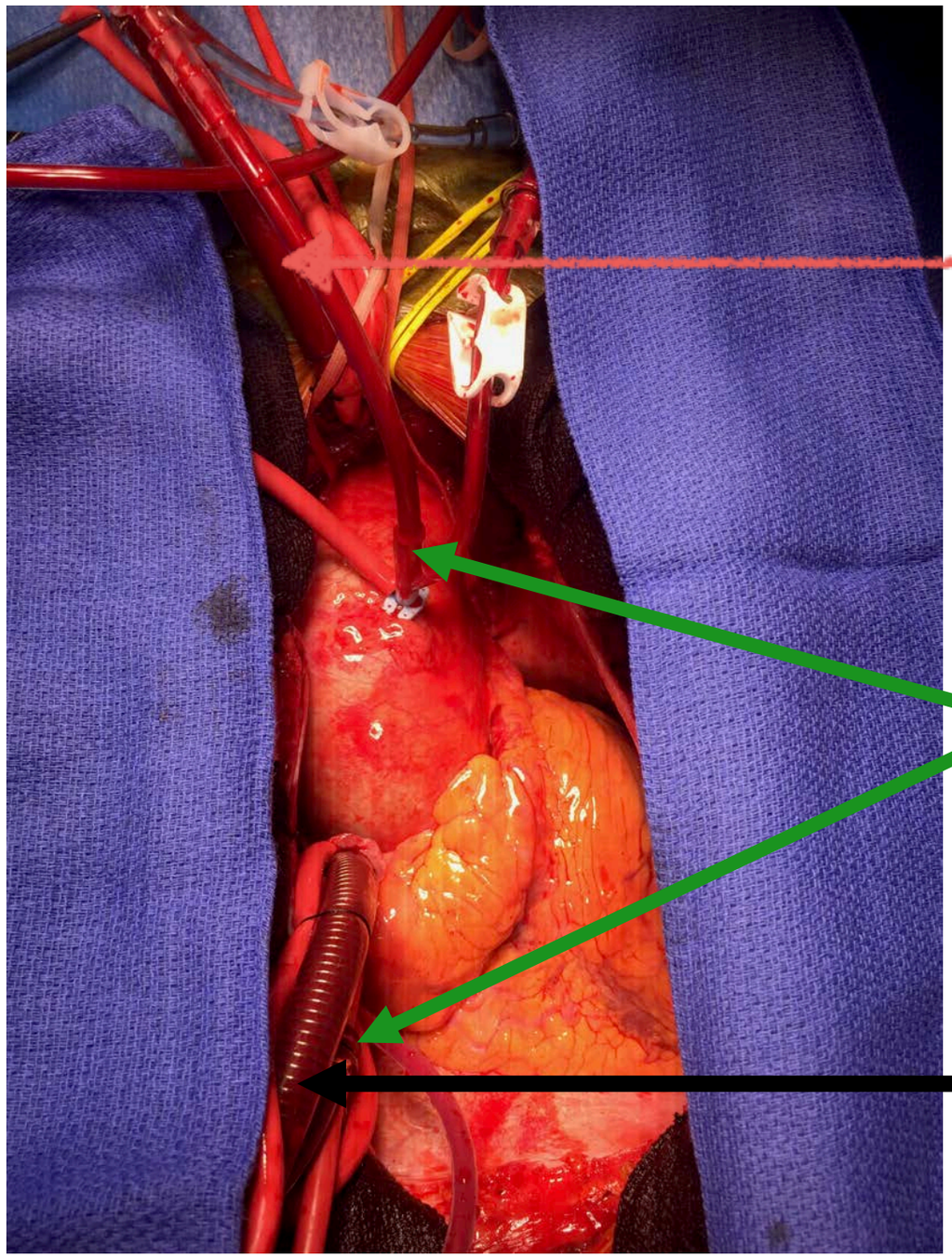
Case: Asc Ao Aneurysm 6.8cm
Aortic Root Replacement / Hemiarch



Innominate Artery Cannula

Cardioplegia

Venous Cannula

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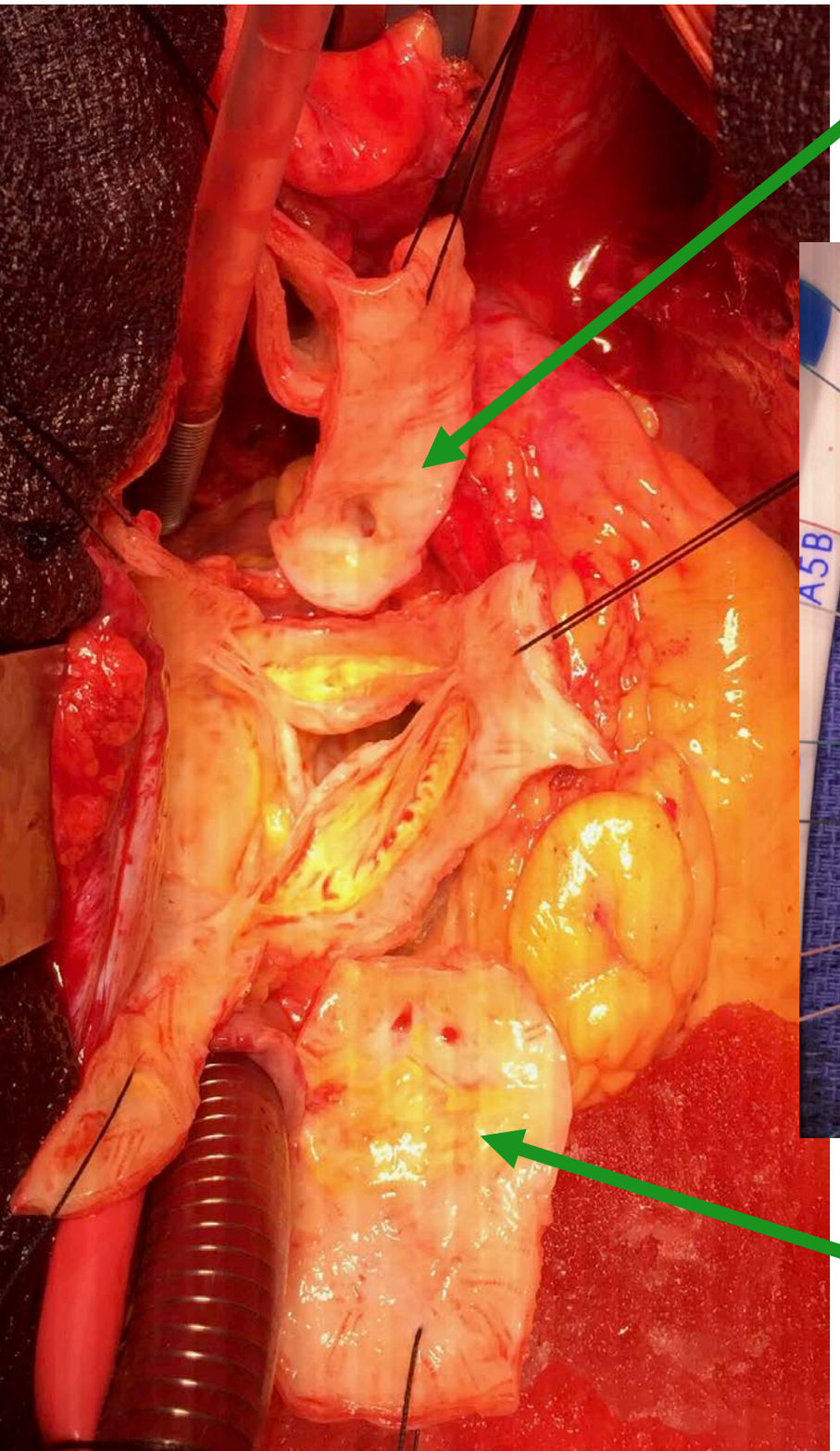
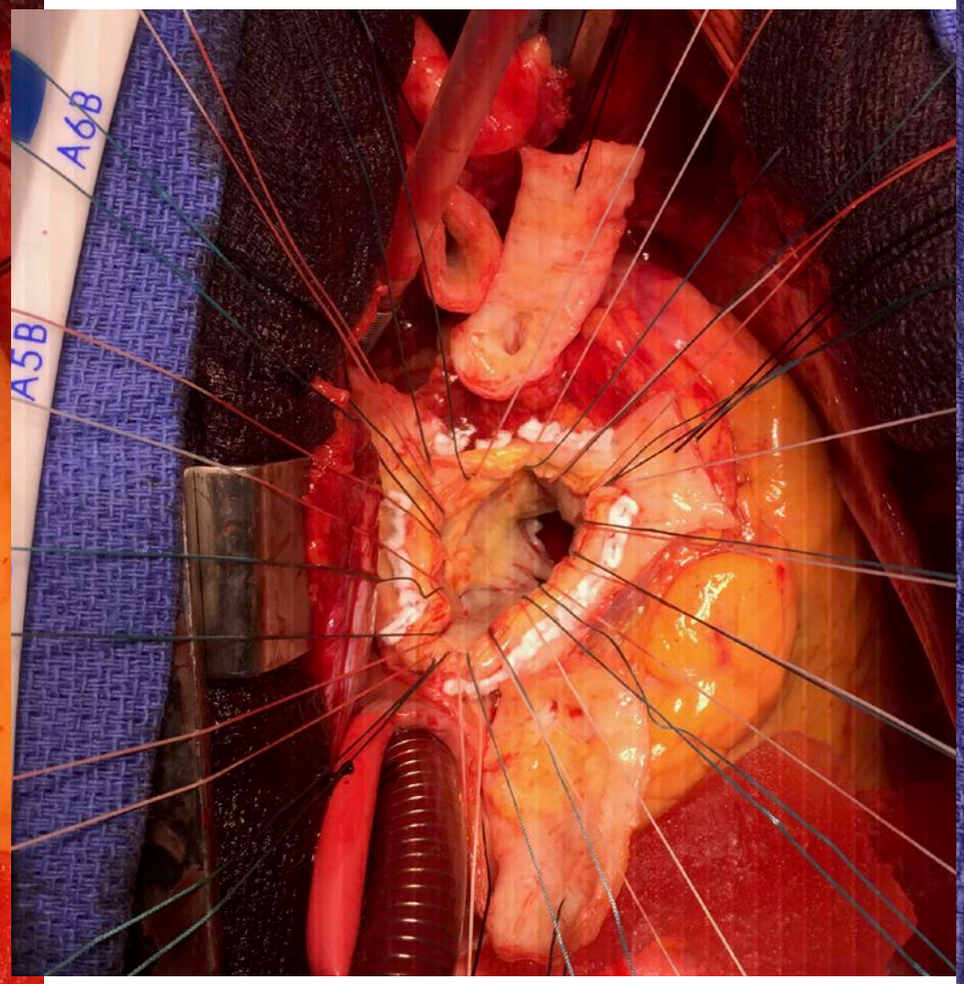
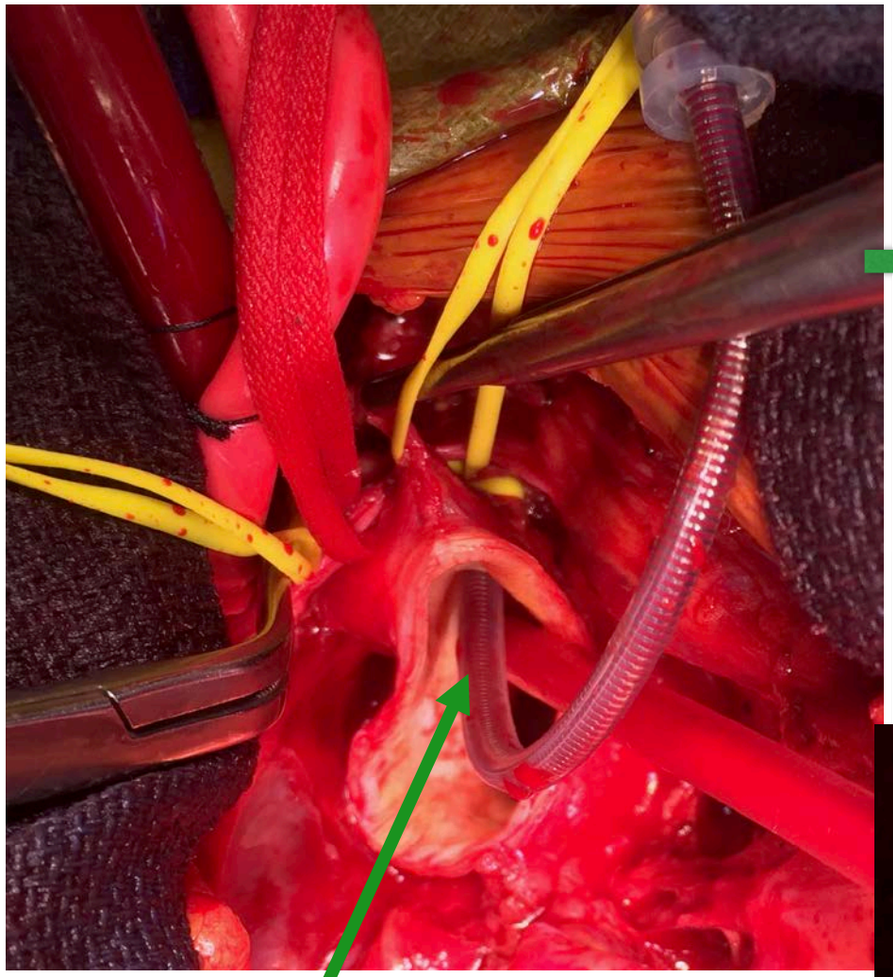
Case: Asc Ao Aneurysm 6.8cm
Aortic Root Replacement / Hemiarch

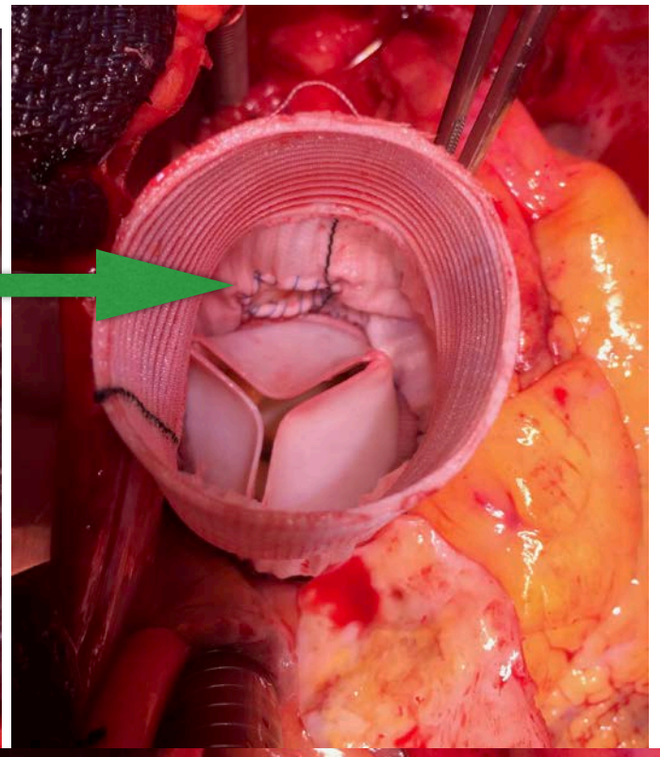




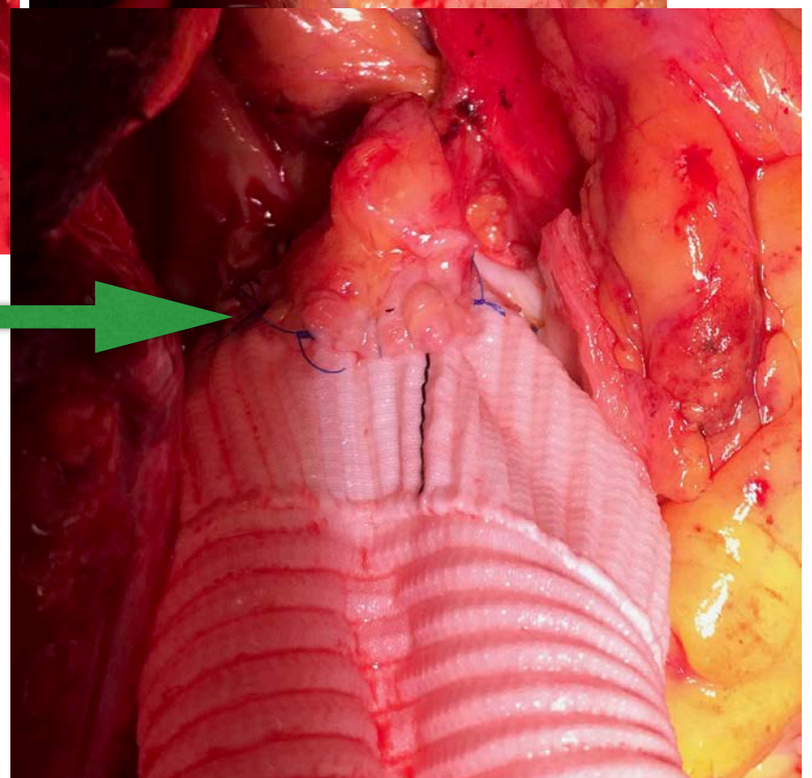
Keck Medicine of USC

Case: Asc Ao Aneurysm 6.8cm
Aortic Root Replacement / Hemiarch

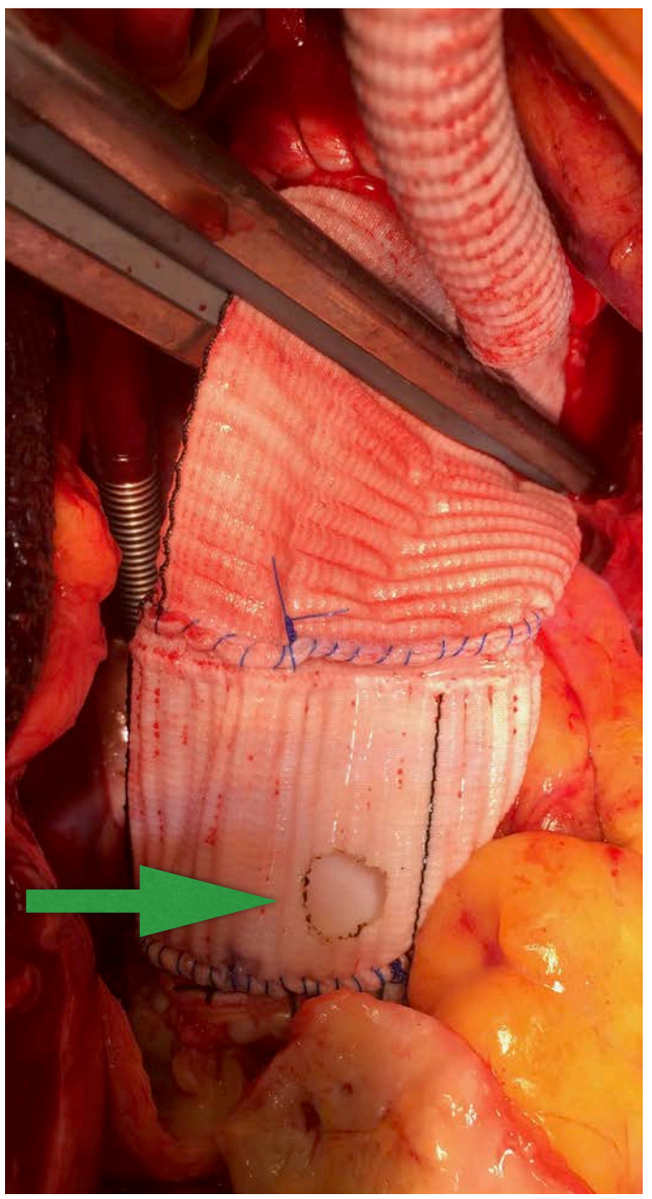




Selective Antegrade Cerebral Perfusion



Coronary Reimplantation



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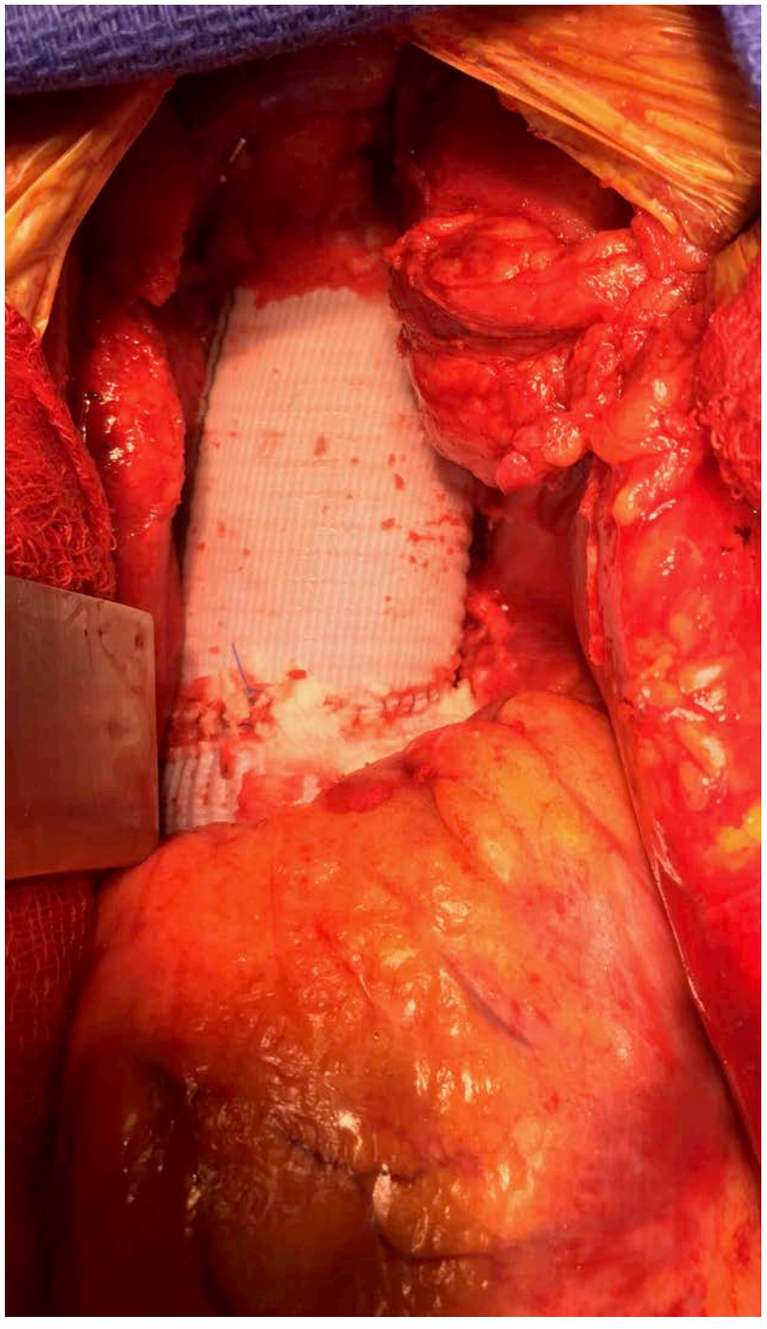
Case: Asc Ao Aneurysm 6.8cm
Aortic Root Replacement / Hemiarch
Discharged home POD #7



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Case: AF 84 yo M, Type A dissection, recent EVAR with preop LHC

LEFT VENTRICULOGRAPHY:
Ejection fraction estimated at 55%. No mitral regurgitation was seen. The aortic root was severely dilated.

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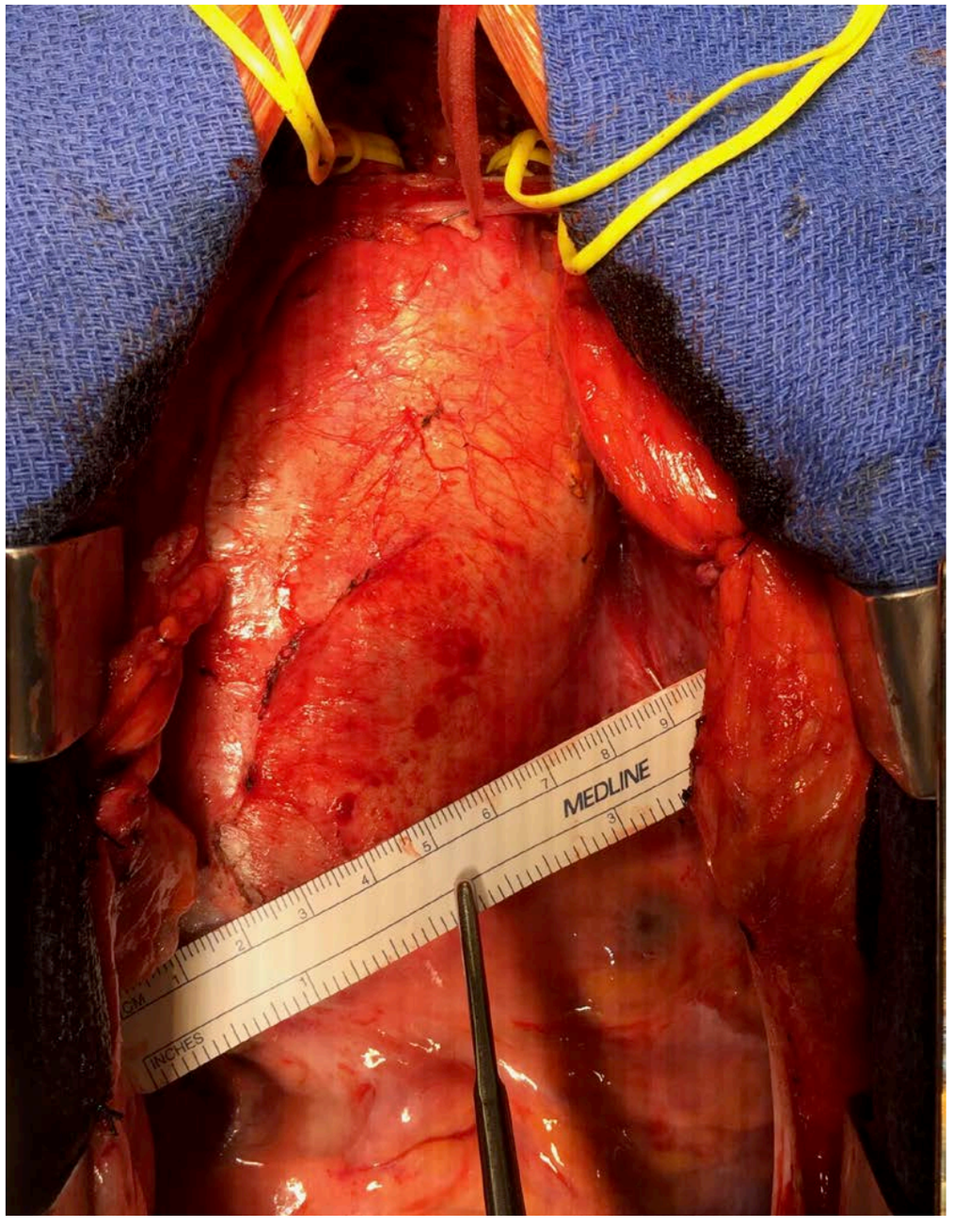
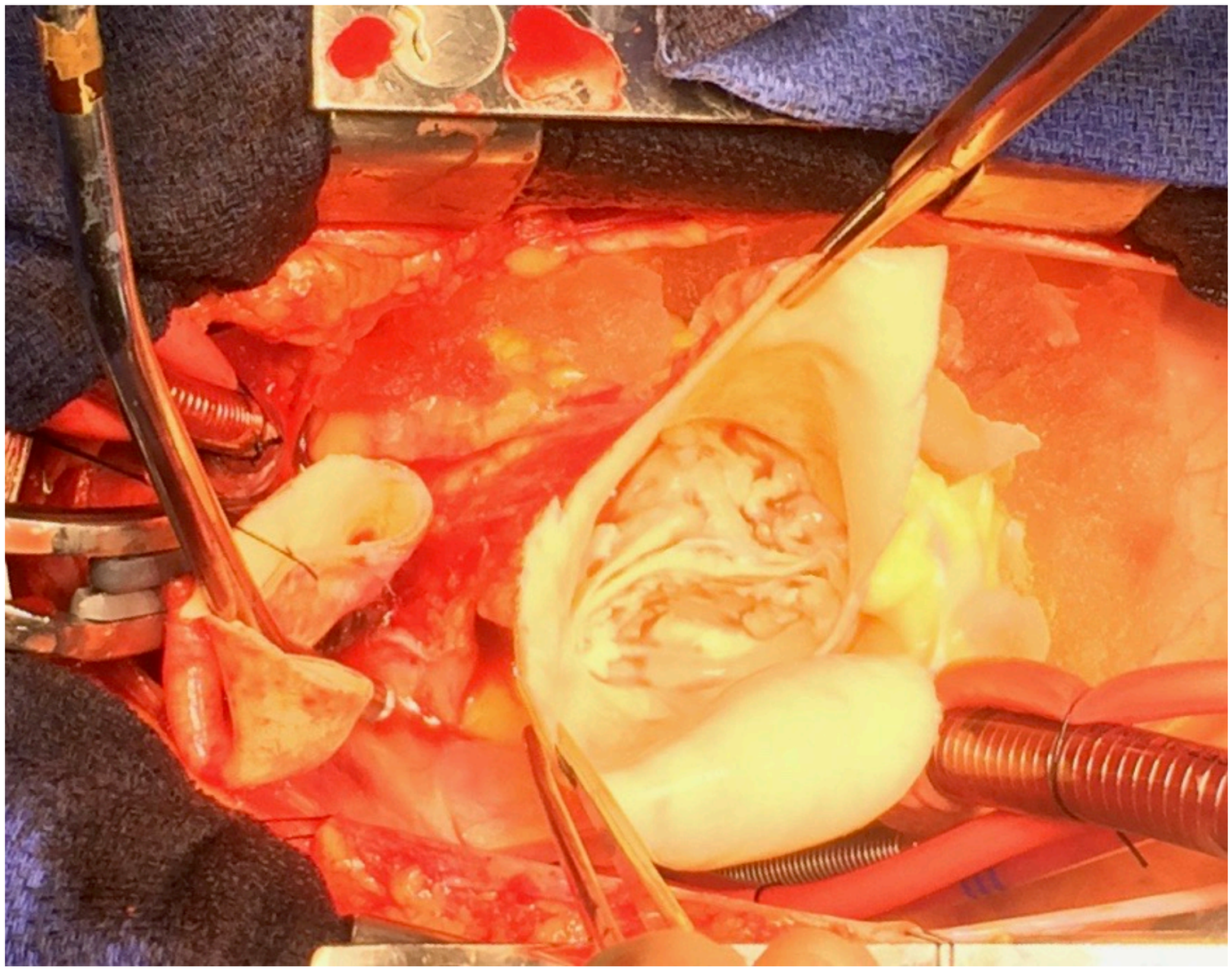
Case: AF 84 yo M, Type A dissection 9.6cm, recent EVAR with preop LHC



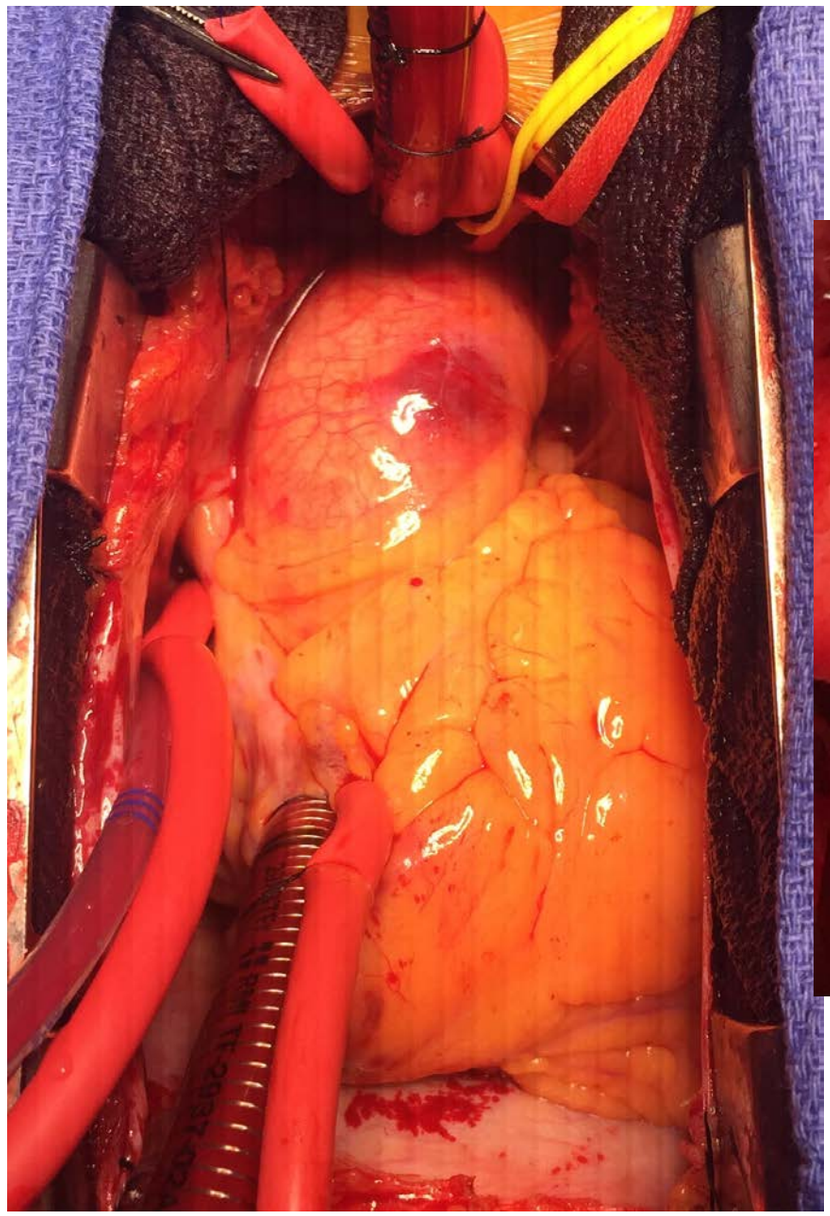
Keck Medicine of USC

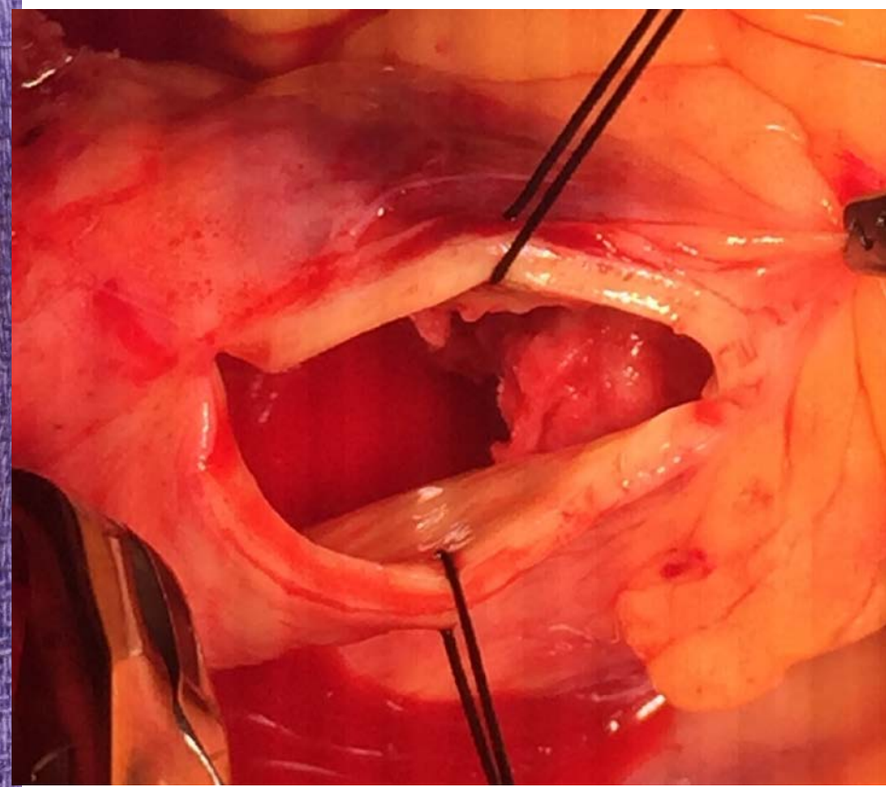
Case:75 yo M, Bicuspid, Asc Aeurysm
Aortic Root Replacement



Keck Medicine of USC

Case: AL 66 yo F acute abdominal pain, SMA embolus, Asc Ao giant thrombus





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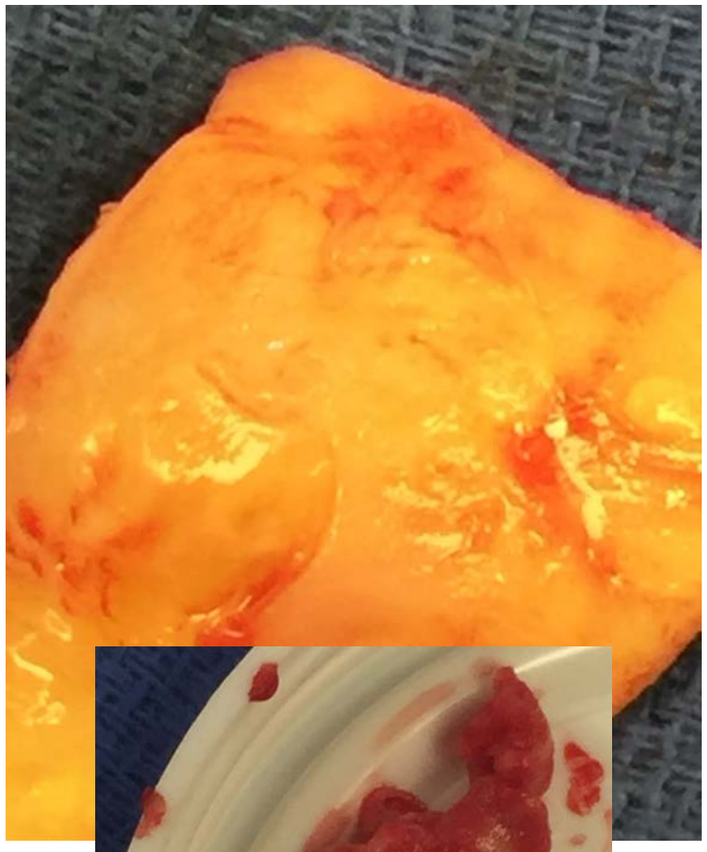

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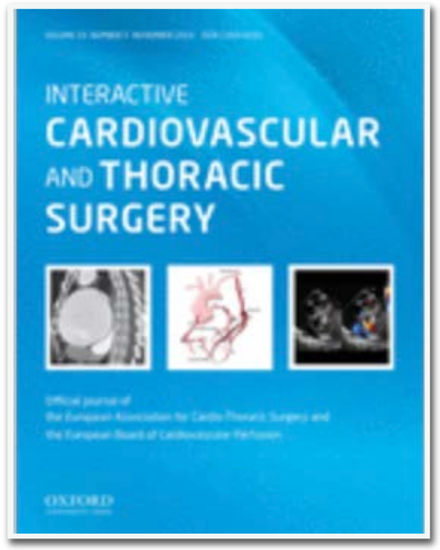


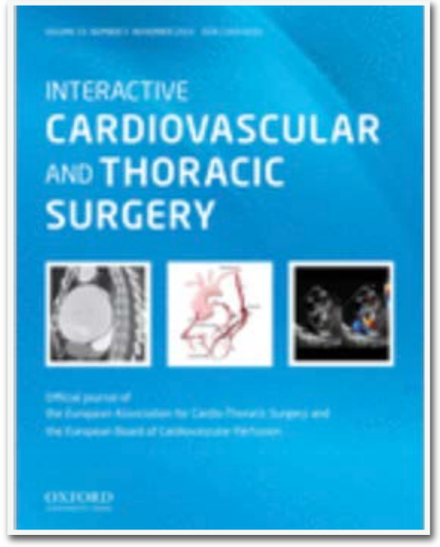
Interactive CardioVascular and Thoracic Surgery 12 (2011) 1048–1050

www.icvts.org

Case report - Aortic and aneurysmal

Giant thrombus in the ascending aorta that caused systemic embolism

Takahiro Sawada*, Tomoki Shimokawa



Interactive CardioVascular and Thoracic Surgery 9 (2009) 532–534

www.icvts.org

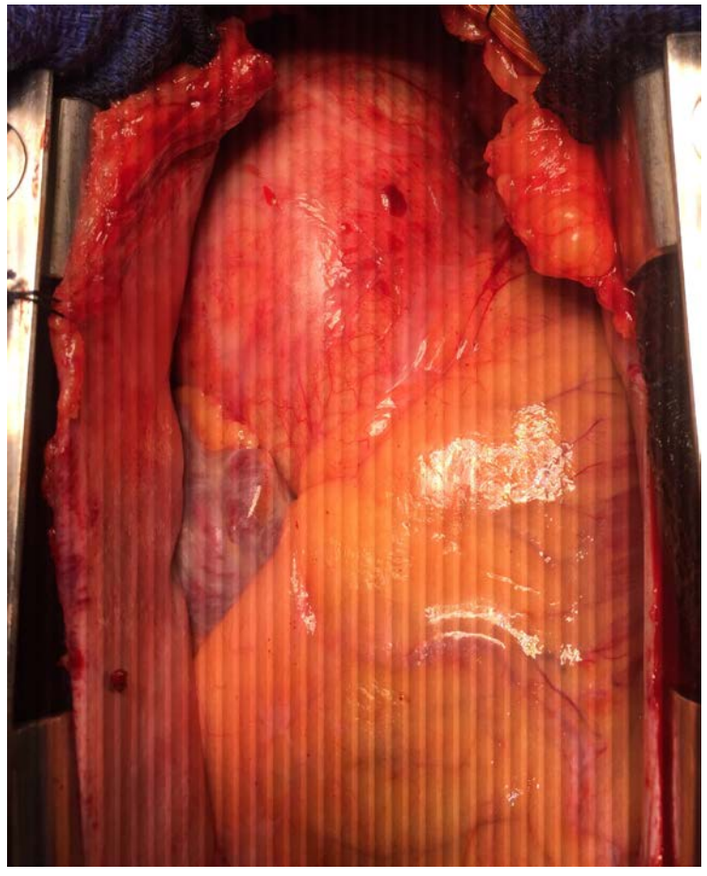
Case report - Cardiac general

Floating intra-aortic thrombus presenting as distal arterial embolism

Dimitrios Pousios*, Theodoros Velissaris, Simon Duggan, Geoff Tsang

Keck Medicine of USC

Case: DC 69 yo M, Asc aneurysm 4.7cm followed as outpt, Type A dissection, Aortic Root / Hemiarch



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Case : PG 62 yo M, Acute R MCA Stroke, Type A dissection

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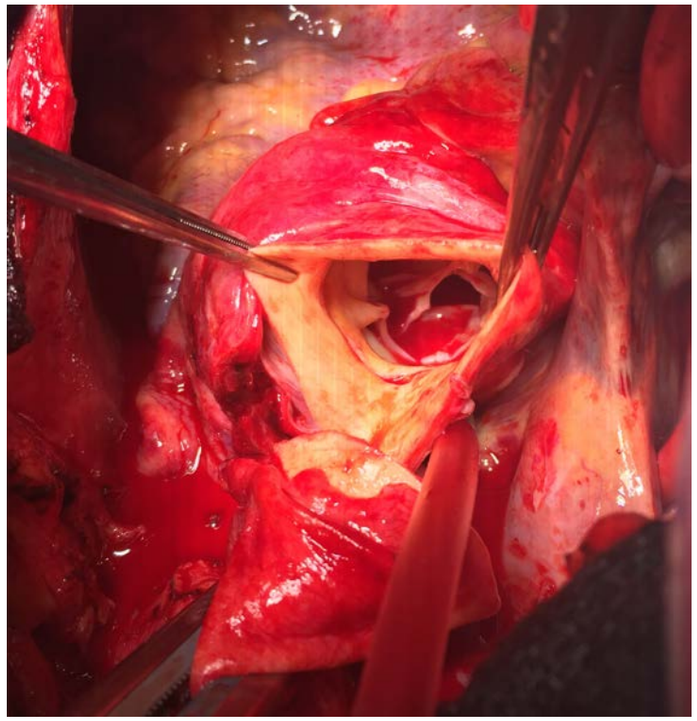
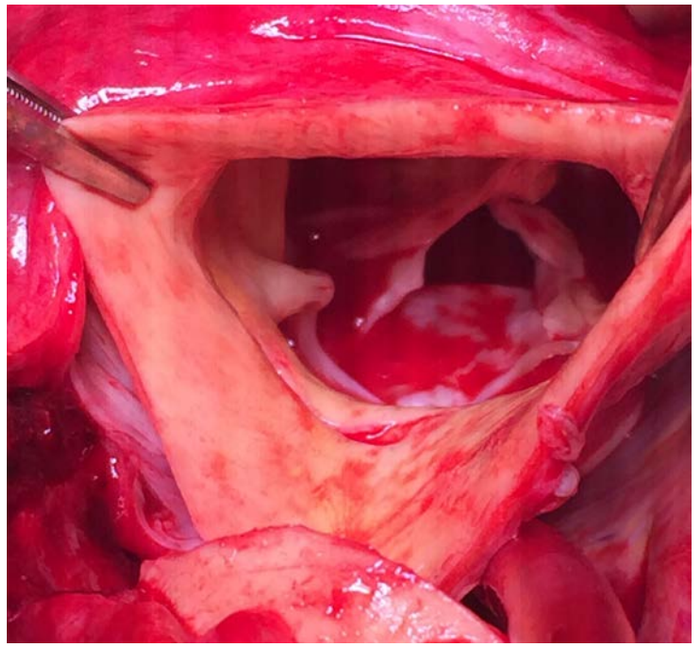
Case: Acute R MCA Stroke, Type A dissection





Thank you.