

# **Ascending Aortic Pathology: Three Things You Need to Know**

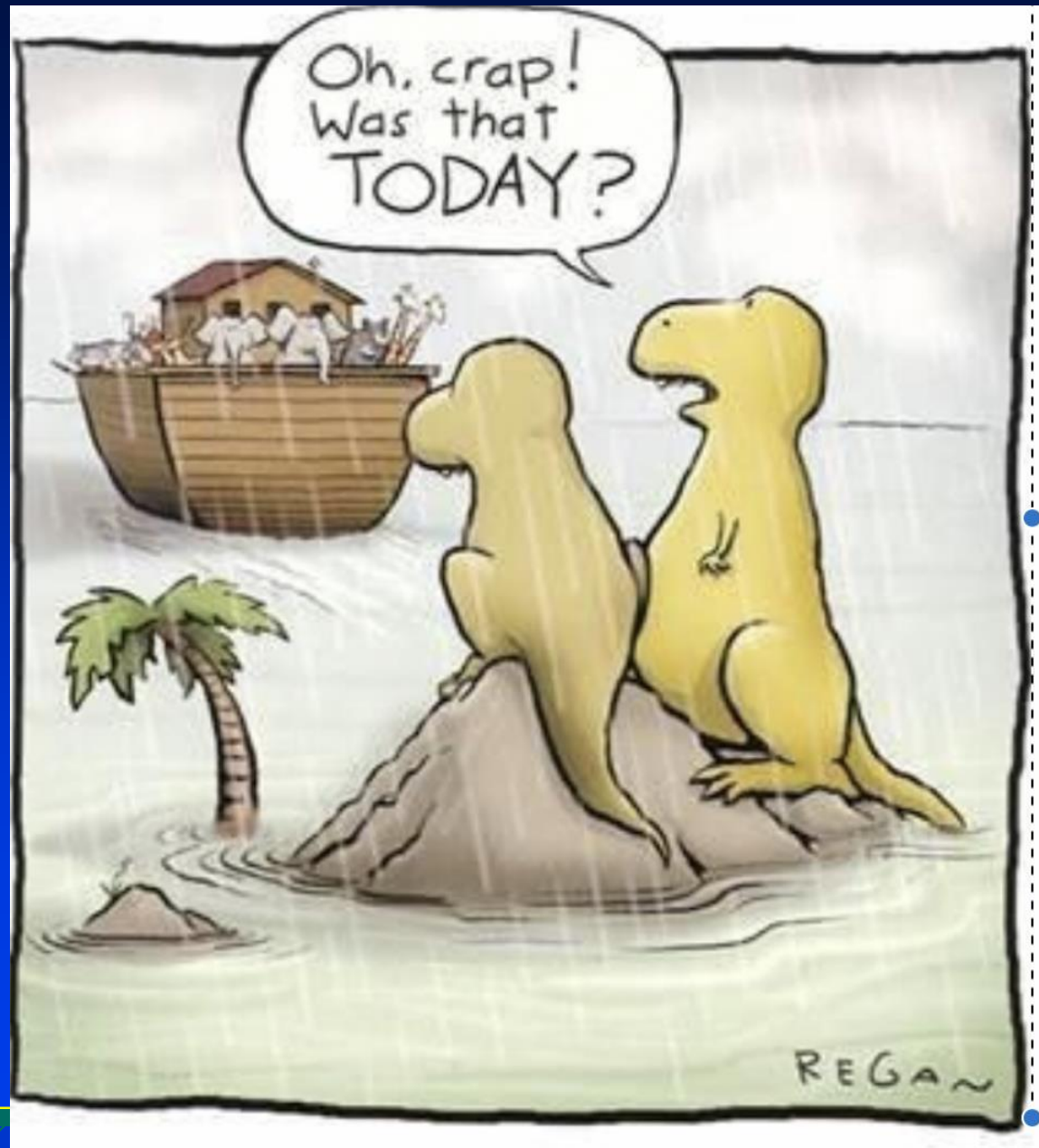
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## Personal/Professional Financial Relationships with Industry

| External Industry Relationships *  | Company Name | Role |
|--|--------------|------|
| Equity, stock, or options in biomedical industry companies or publishers | None         |      |
| Board of Directors or officer  | None         |      |
| Royalties from Emory/PHI or from external entity                         | None         |      |
| Industry funds to Emory/PHI for my research                              | None         |      |
| Other  | None         |      |



# Three Things

- *Diagnosis*
- *Prevention*
- *When to refer*



# Three Things

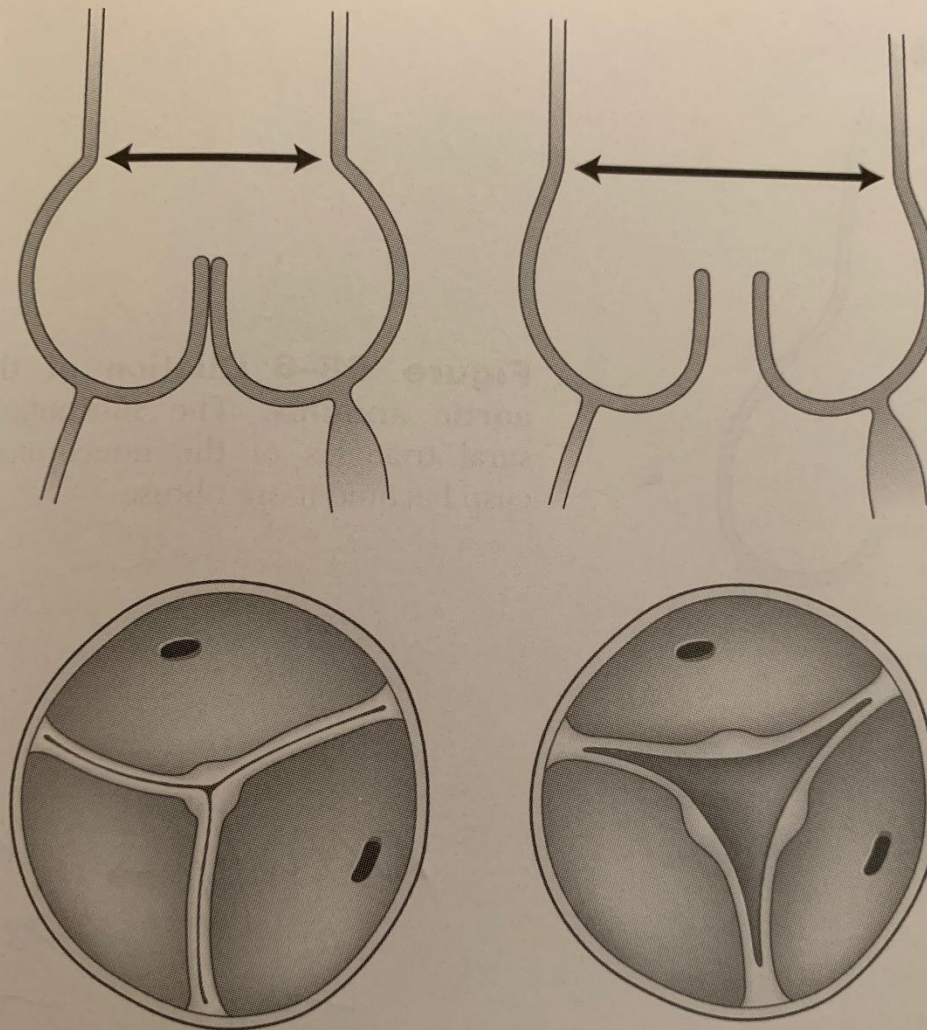
- *Ctscan chest w or w/o*
- *Treat hypertension/stop smoking, aggressively treat CAD, pulm disease*
- *5.0 cm (\*), close scrutiny on women*



# Three More Things

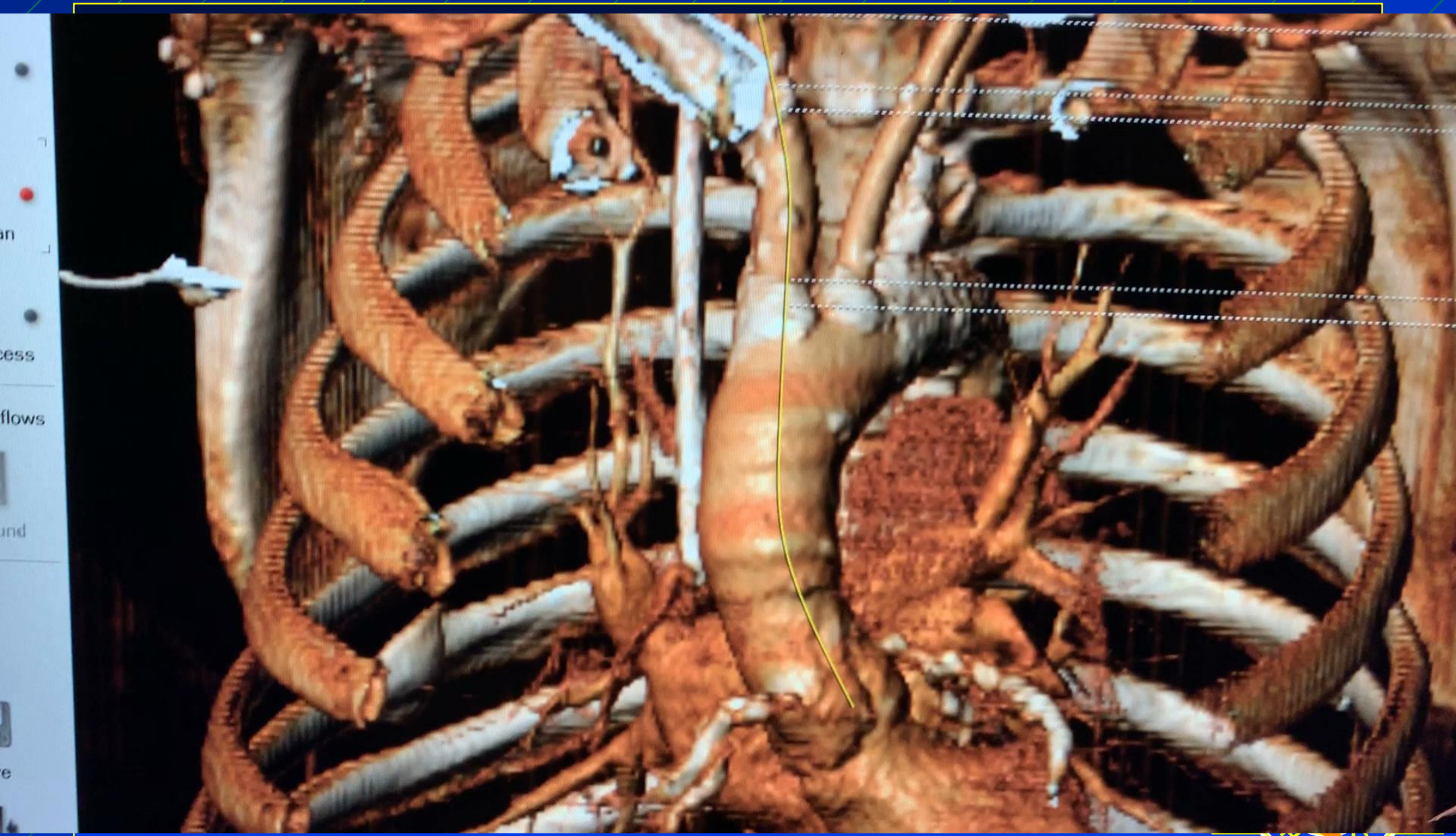
- *Aneurysms ascending aorta and arch*
- *Type A and B dissections*
- *Will not discuss thoracoabdominal or AAA*





**Figure 68-4** Dilation of the sinotubular junction causes aortic insufficiency.





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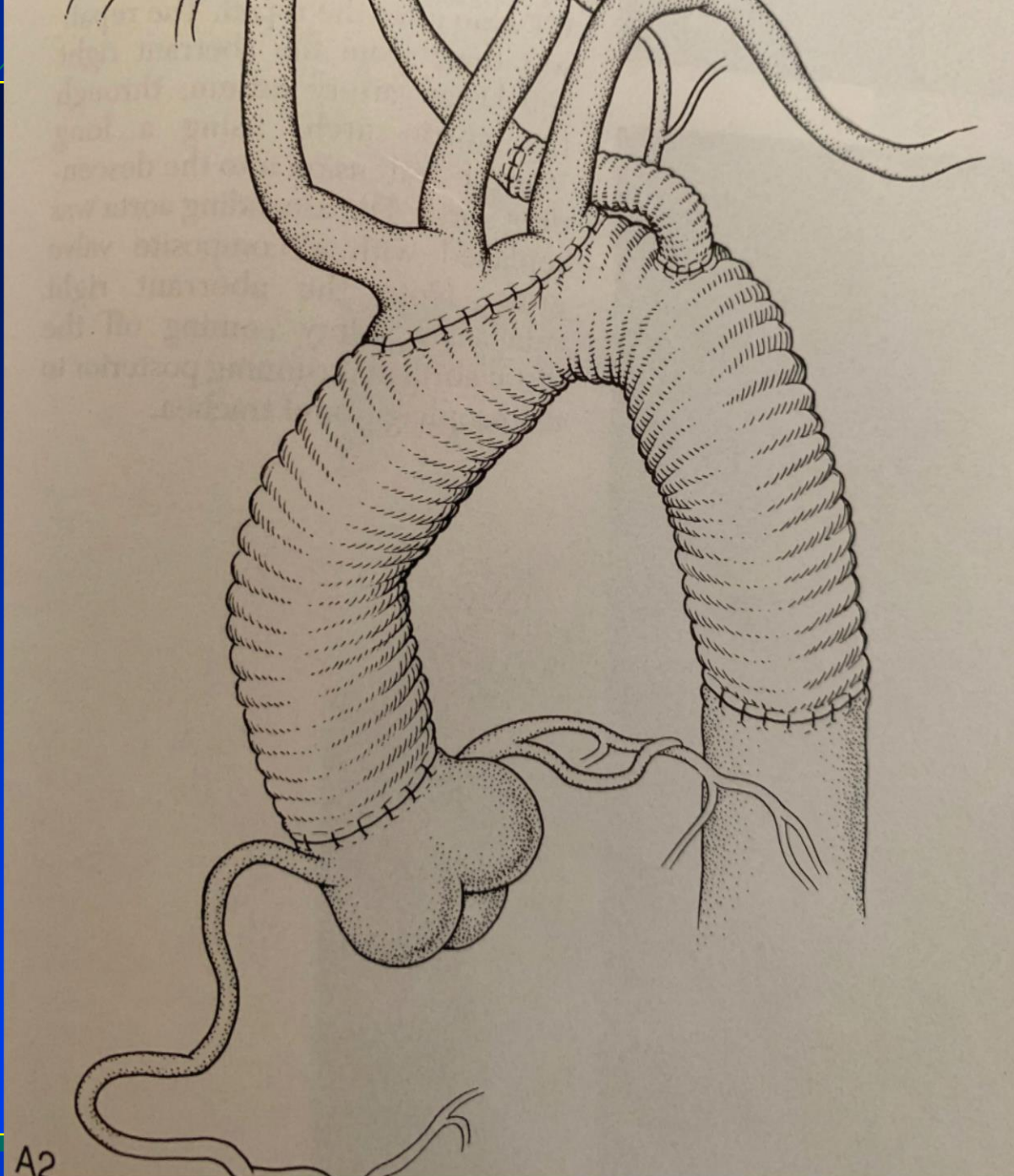
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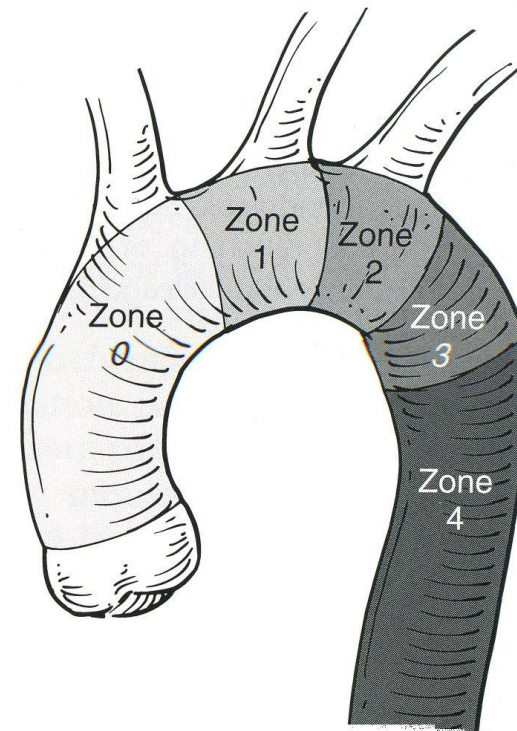
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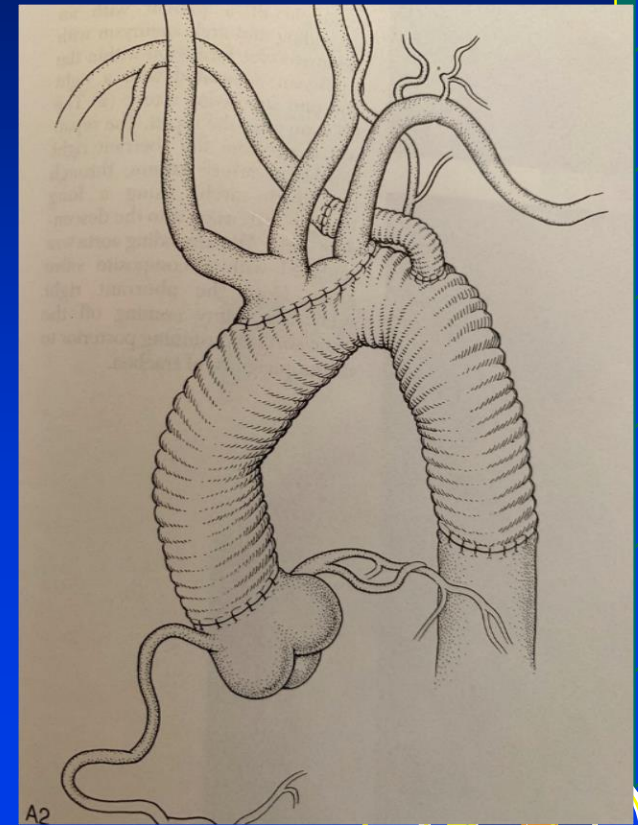
# Aneurysm

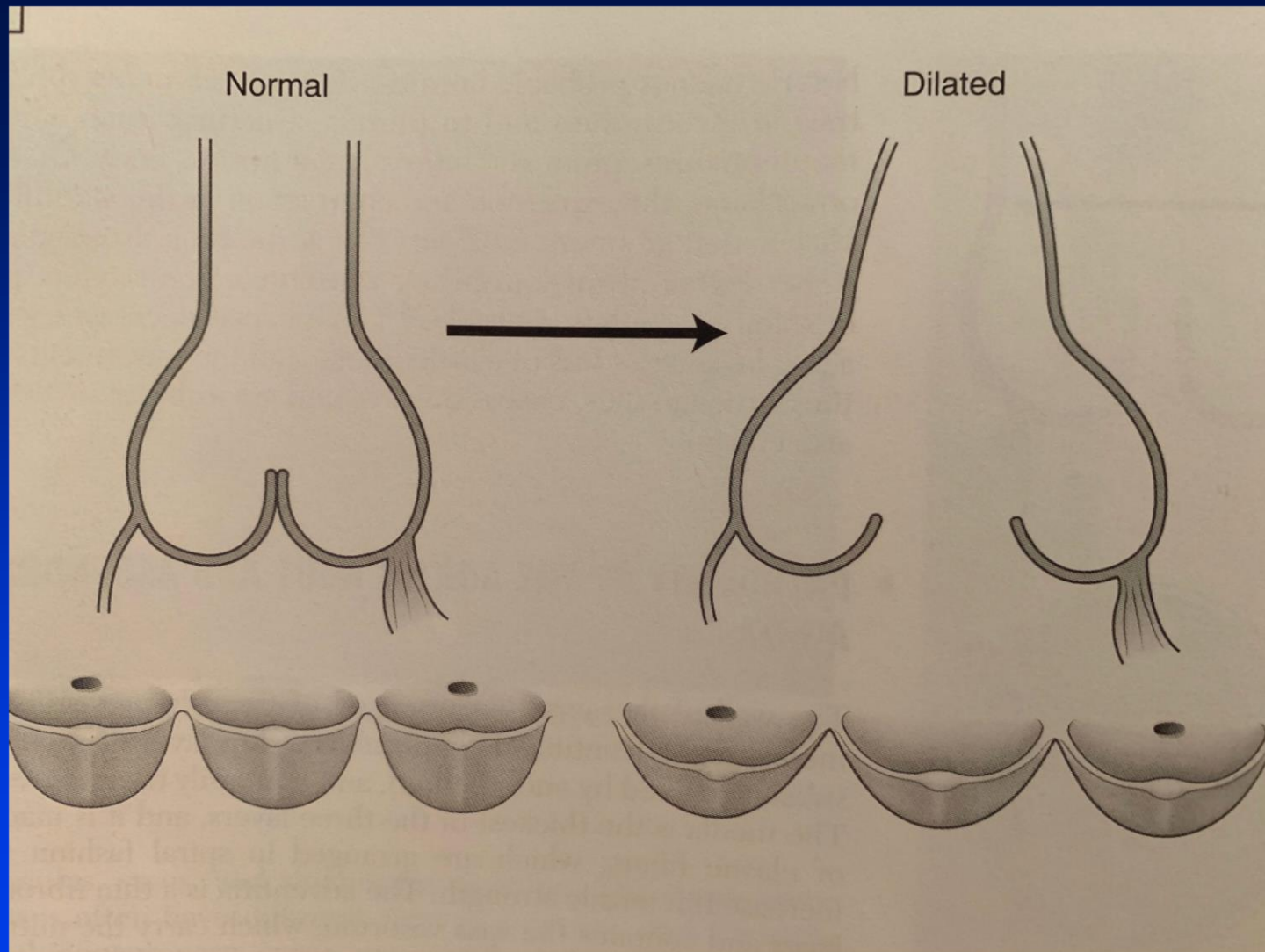
- ⇒ *50% Greater than normal*
- ⇒ *Size reflective of gender, age, BSA*
- ⇒ *Contributing factors*
  - ⇒ *Connective tissue*
  - ⇒ *Htn*
  - ⇒ *Family history*
  - ⇒ *PMHx cashd, pulm disease, PVD*

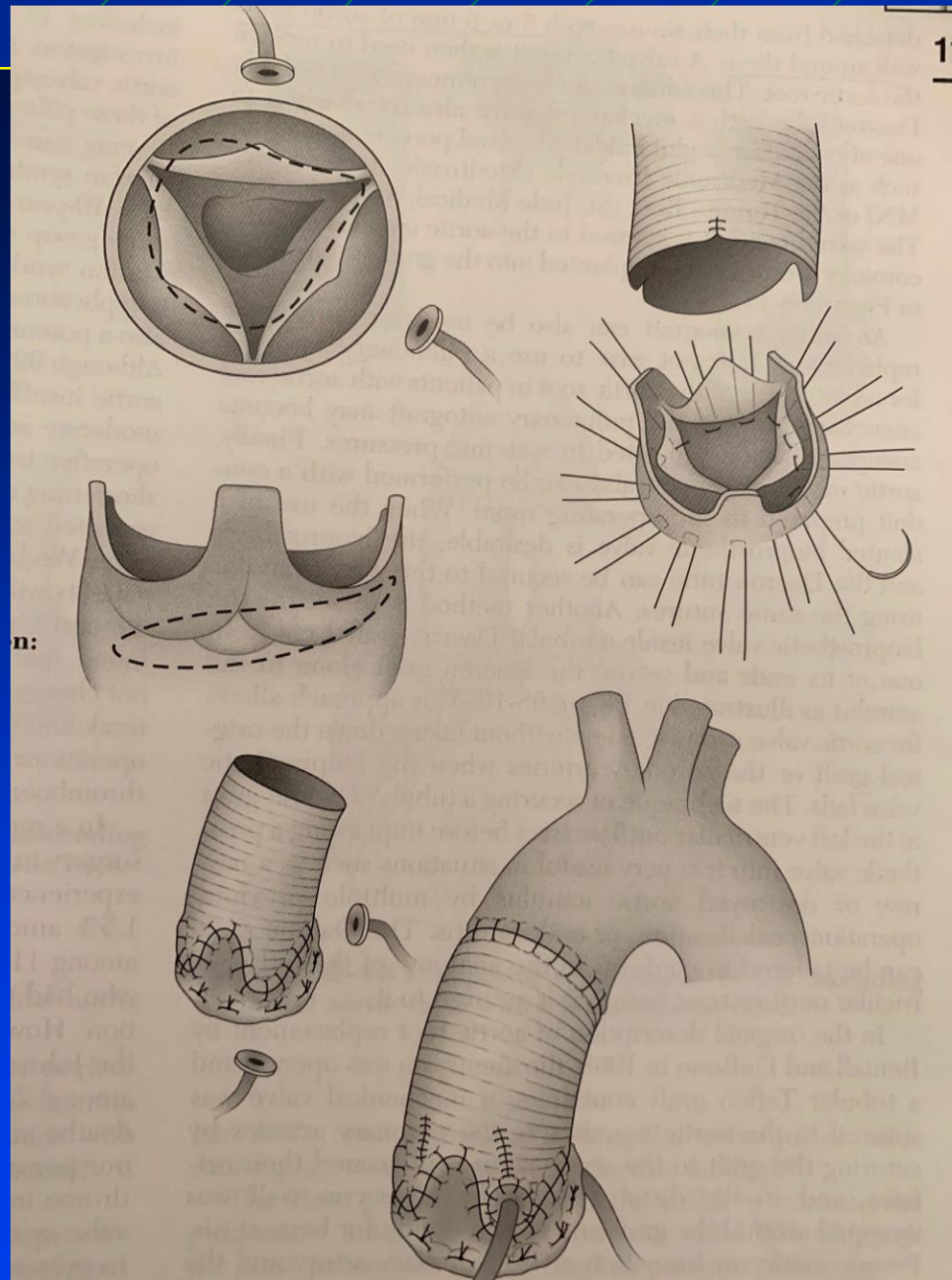


# Aortic Root Aneurysm

- ⇒ *Less associated with atherosclerosis*
- ⇒ *Annuloaortic ectasia*
- ⇒ *Aortic valve regurgitation*
- ⇒ *Bicuspid AoV*
- ⇒ *Heritable disorders of connective tissue (Marfan's)*
- ⇒ *Dissection*







# Ascending Aneurysm

- ***Medial degeneration***

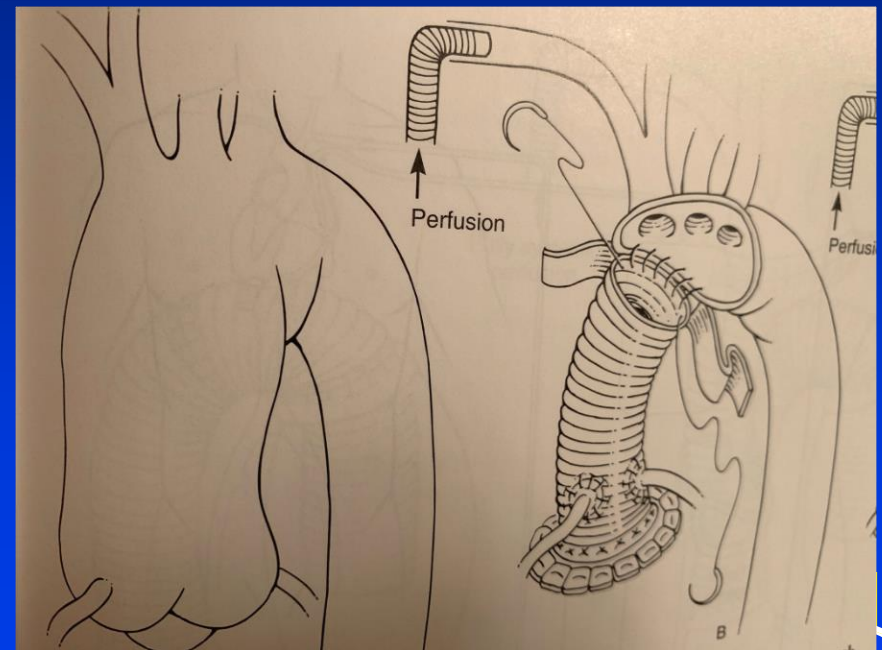
- ⇒ *Less associated with atherosclerosis*

- ⇒ *More with HTN*

- ⇒ *Idiopathic*

- ⇒ *Heritable disorders of connective tissue*

- ⇒ *Dissection*



# Arch Aneurysm

- ***Medial degeneration***

- ⇒ *Some atherosclerosis*

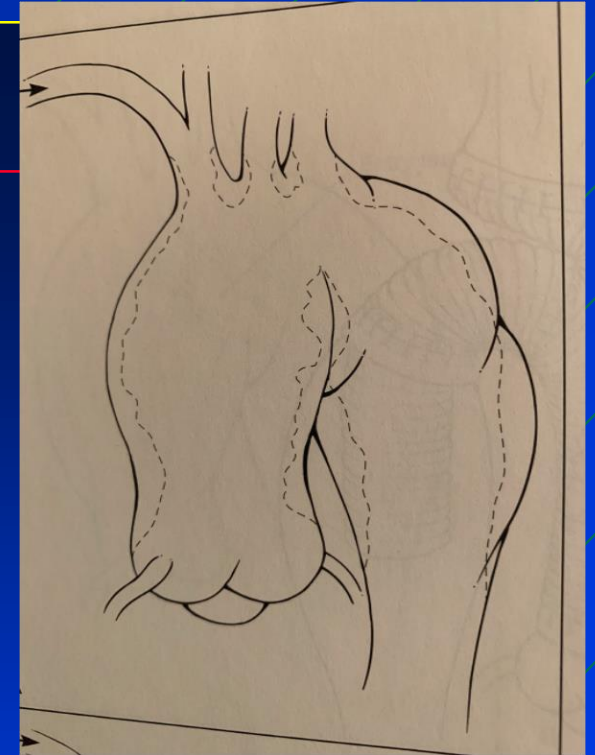
- ⇒ *More with HTN*

- ⇒ *Idiopathic*

- ⇒ *Heritable disorders of connective tissue*

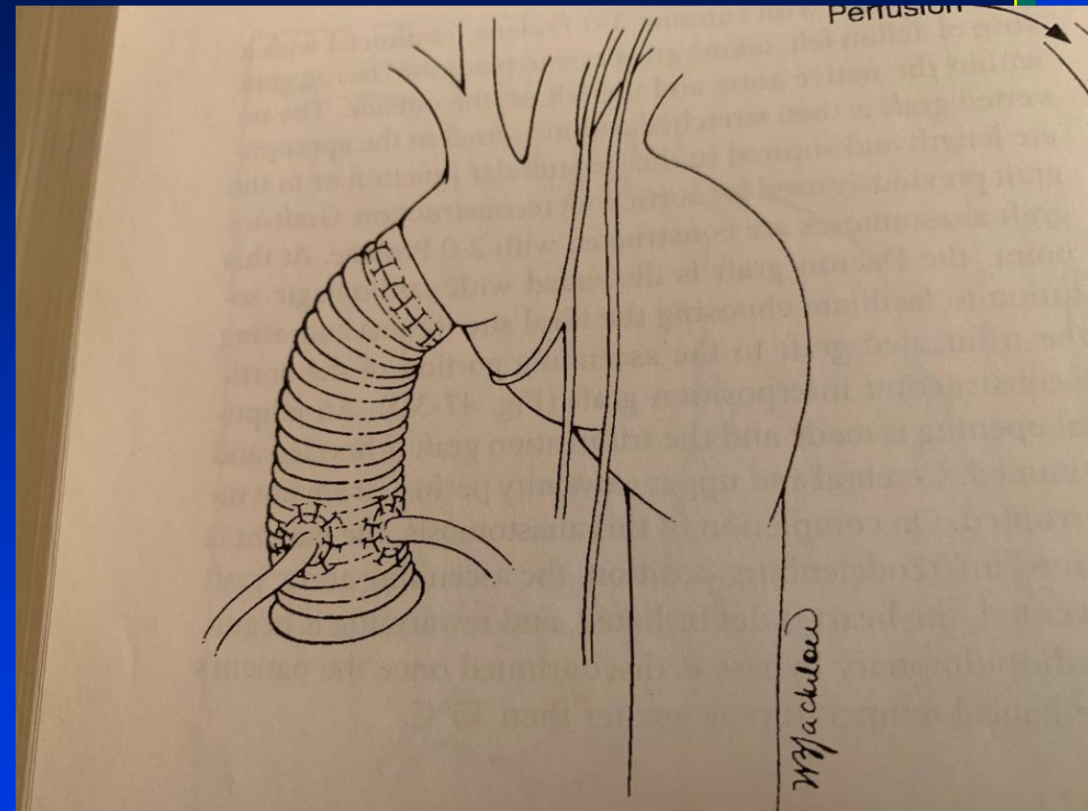
- ⇒ *Dissection*

*usually not isolated*



# Descending Thoracic Aneurysm

- **HTN**
  - ⇒ *Atherosclerosis*
  - ⇒ *Dissection*
  - ⇒ *Sometimes saccular*

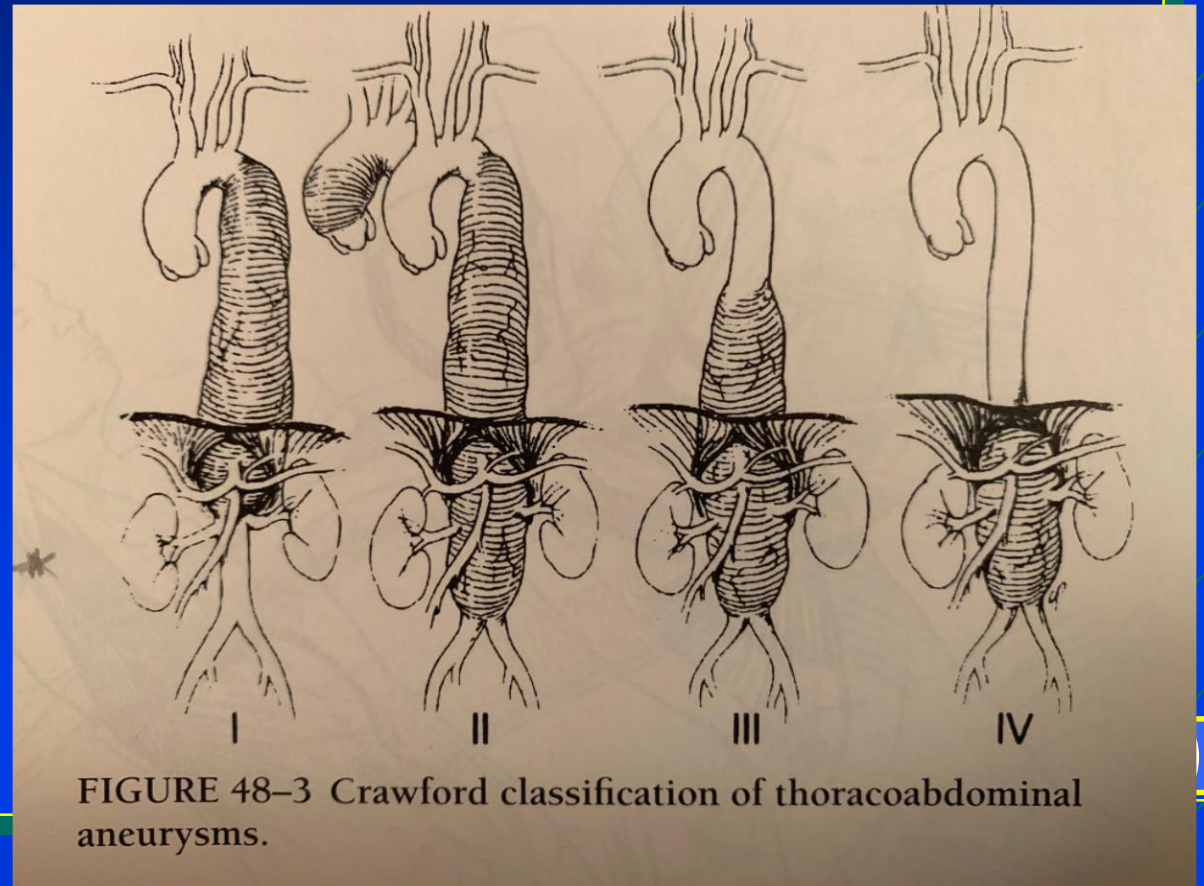


# Thoracoabdominal Aneurysm

- **HTN**

- ⇒ *Atherosclerosis*

- ⇒ *Dissection*



# Surgical Outcomes

- ⇒ *Elective aneurysm repair: 2- 9% mortality*
  - ⇒ *Stroke, renal failure, etc.*
- ⇒ *Dissection: 25 – 57% mortality*
- ⇒ *Rupture: higher*



# 304 patients thoracic aneurysms

18 DAVIES ET AL  
YEARLY RUPTURE OR DISSECTION RATES

Ann Thorac Surg  
2002;73:17-28

Table 1. Demographic Data on 304 Patients With Thoracic Aortic Aneurysms<sup>a</sup>

| Variable                                       | n   | %    | Mean | Median | Range        |
|--|-----|------|------|--------|--------------|
| Sex (male)                                     | 179 | 58.9 |      |        |              |
| Age at presentation (y)                        |     |      | 59.8 | 65.8   | 8.8 to 93.7  |
| Initial aortic size (cm)                       |     |      | 5.0  | 4.7    | 3.5 to 11.0  |
| Radiologic follow-up (mo)                      |     |      | 43.1 | 31.6   | 0.0 to 262.6 |
| Marfan syndrome                                | 28  | 9.2  |      |        |              |
| Aneurysm size                                  |     |      |      |        |              |
| 3.5 to 3.9 cm                                  | 33  | 10.9 |      |        |              |
| 4.0 to 4.9 cm                                  | 133 | 43.8 |      |        |              |
| 5.0 to 5.9 cm                                  | 78  | 25.7 |      |        |              |
| ≥ 6.0 cm                                       | 60  | 19.7 |      |        |              |
| Aneurysm location                              |     |      |      |        |              |
| Ascending                                      | 219 | 72.0 |      |        |              |
| Arch   | 18  | 5.9  |      |        |              |
| Descending                                     | 28  | 9.2  |      |        |              |
| Thoracoabdominal                               | 39  | 12.8 |      |        |              |
| Hypertension (n = 240)                         | 142 | 59.1 |      |        |              |
| Cardiac disease (n = 219)                      | 96  | 43.8 |      |        |              |
| Tobacco use (n = 220)                          | 81  | 36.8 |      |        |              |
| Pulmonary disease (n = 225)                    | 47  | 20.9 |      |        |              |
| Carotid disease (n = 209)                      | 23  | 11.0 |      |        |              |
| Renal disease (n = 220)                        | 30  | 13.6 |      |        |              |
| Coronary artery disease (n = 304)              | 82  | 27.0 |      |        |              |
| Congestive heart failure (n = 304)             | 34  | 11.2 |      |        |              |
| Stroke or transient ischemic attacks (n = 304) | 25  | 8.2  |      |        |              |
| Abdominal aortic aneurysm (n = 304)            | 31  | 10.2 |      |        |              |

<sup>a</sup>Totals may not add up to 100% because of rounding.



# 304 patients thoracic aneurysms

⇒ *Size & annual risk of rupture, death, dissection*

⇒ 4 – 4.9 cm: 6%

⇒ 5 – 5.9 cm: 7%

⇒ 6.0 or greater: 16%

Davies et al. ATS  
2002;73:17-28



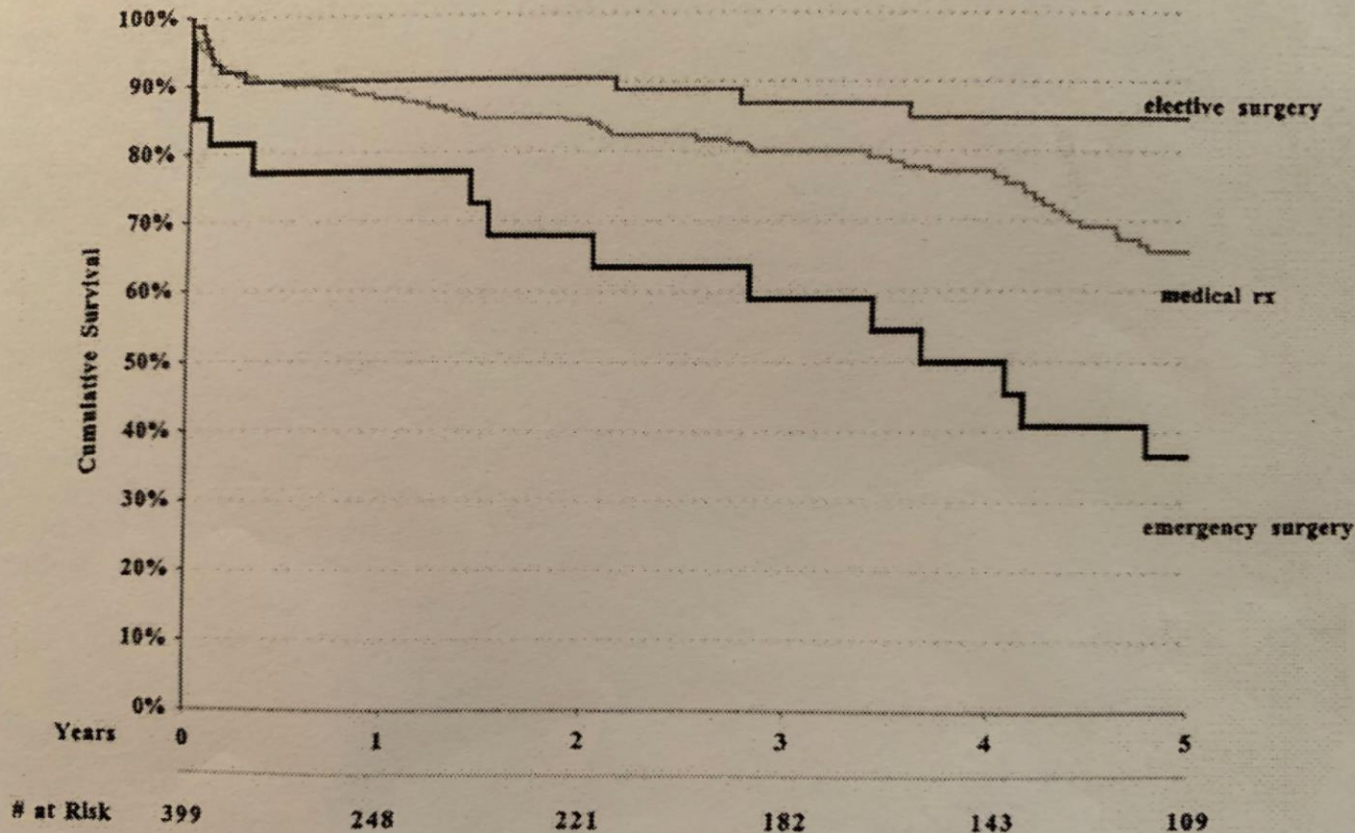
# 304 patients thoracic aneurysms

- ⇒ *“other” vascular conditions predicted worse outcomes (CVA, CAD, AAA)*
- ⇒ *“Pulmonary” worse outcomes*
- ⇒ *Male gender protective*
- ⇒ *Mean growth rate 0.10 cm/year*

Davies et al. ATS  
2002;73:17-28



# 304 patients thoracic aneurysms



Davies et al. ATS  
2002;73:17-28



# Connective Tissue

⇒ *Loeys-Dietz: 4 cm*

⇒ *Marfan and others: 4.5 cm*



# Bicuspid AoV

- ⇒ *1-2% population*
- ⇒ *“most” will have an issue (3/4 stenosis)*
- ⇒ *9 – 18 fold increase in Ao dilatation*
- ⇒ *Apoptosis of neural crest derivatives*
- ⇒ *Discuss surgery for aneurysm 4.5 cm*



# Diagnosis

⇒ *History:*

⇒ *Asymptomatic*

⇒ *Pain*

⇒ *PMHx*

⇒ *Fam hx*

⇒ *Social hx*



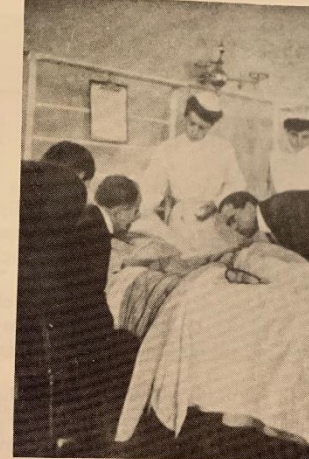
# Diagnosis

⇒ *Physical:*

⇒ *vitals*

⇒ *Cardiopulmonary*

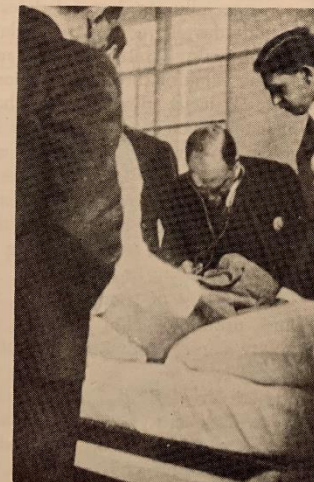
⇒ *Vascular exam*



Inspection



Palpation

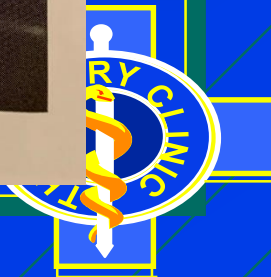


Auscultation



Contemplation

SNAPSHOTS OF OSLER AT THE BEDSIDE



# Diagnosis

⇒ *CT*

⇒ *TTE*

⇒ *TEE*

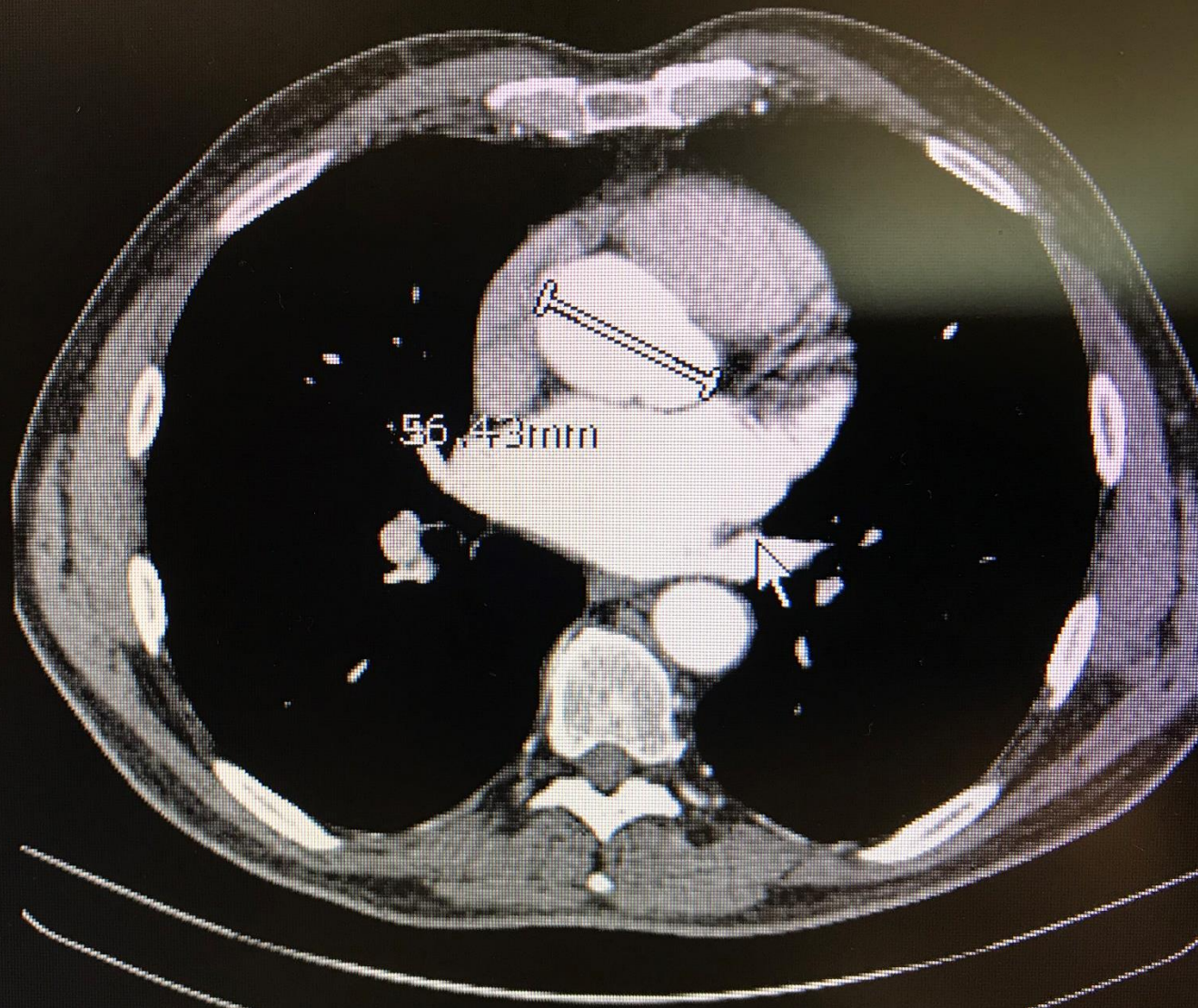
⇒ *Measurement mindful of axis*



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CT ANGIOGRAM



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3 of 187

CT ANGIOGRAM CHEST W WO

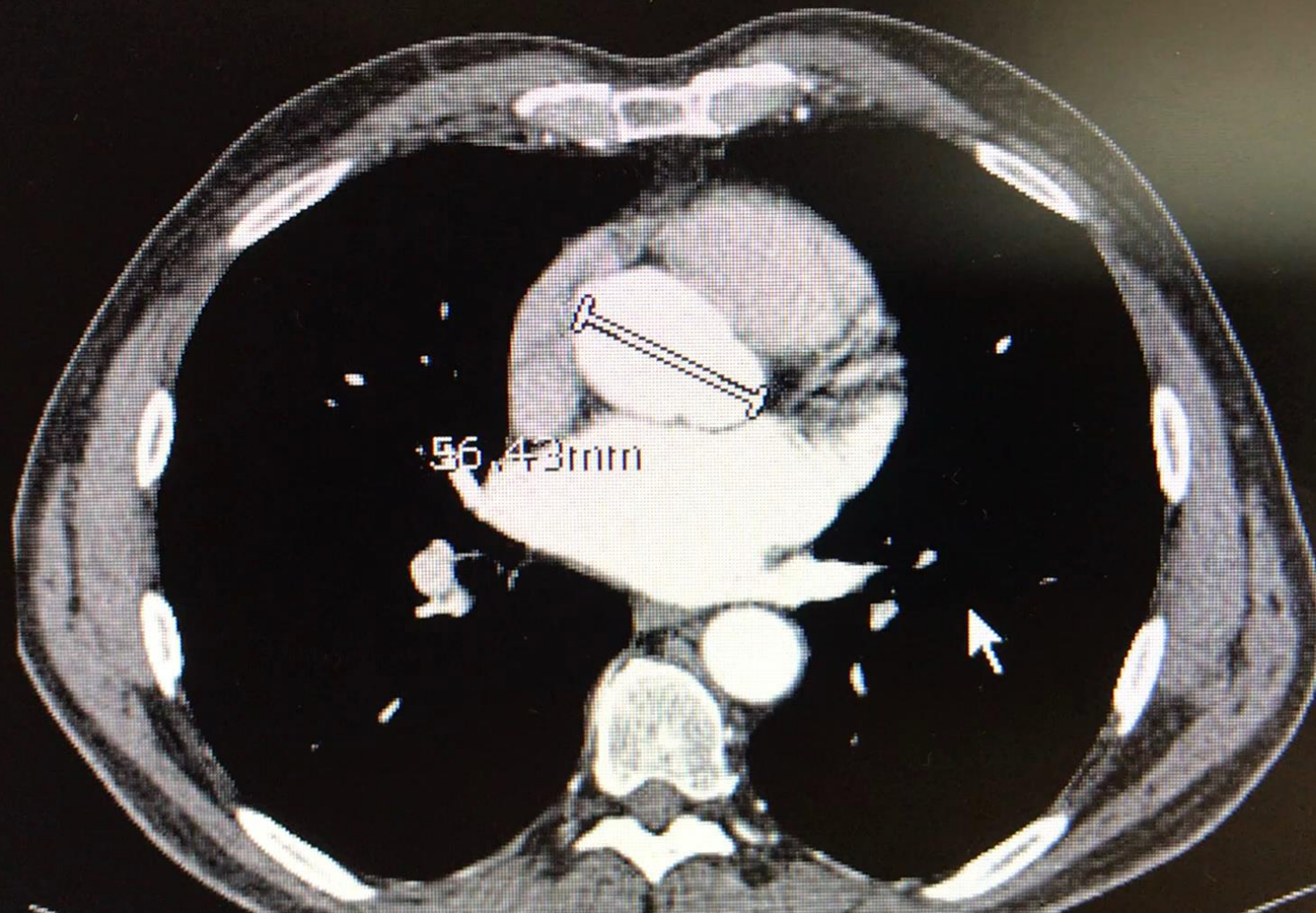
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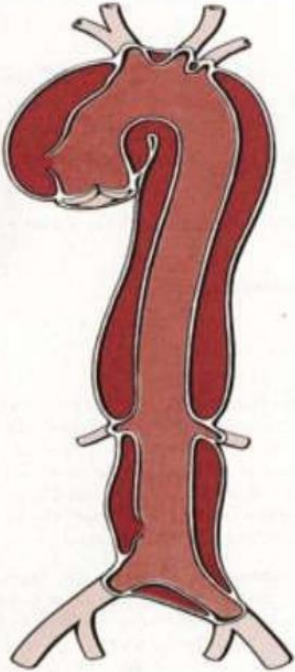
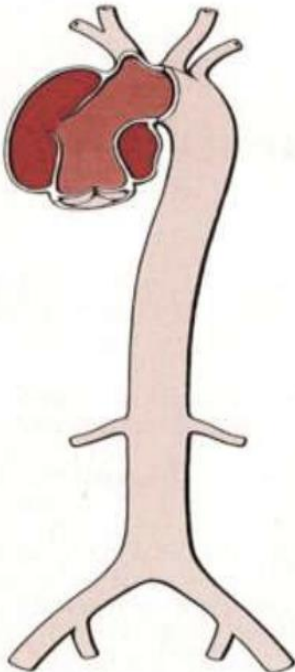
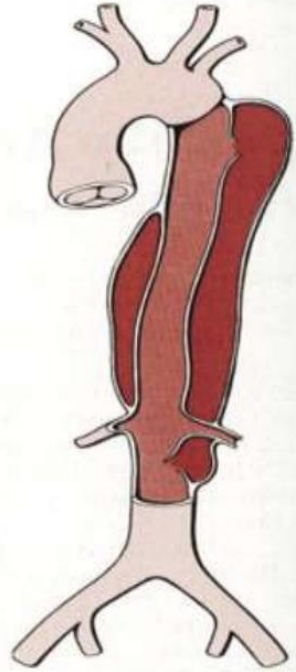
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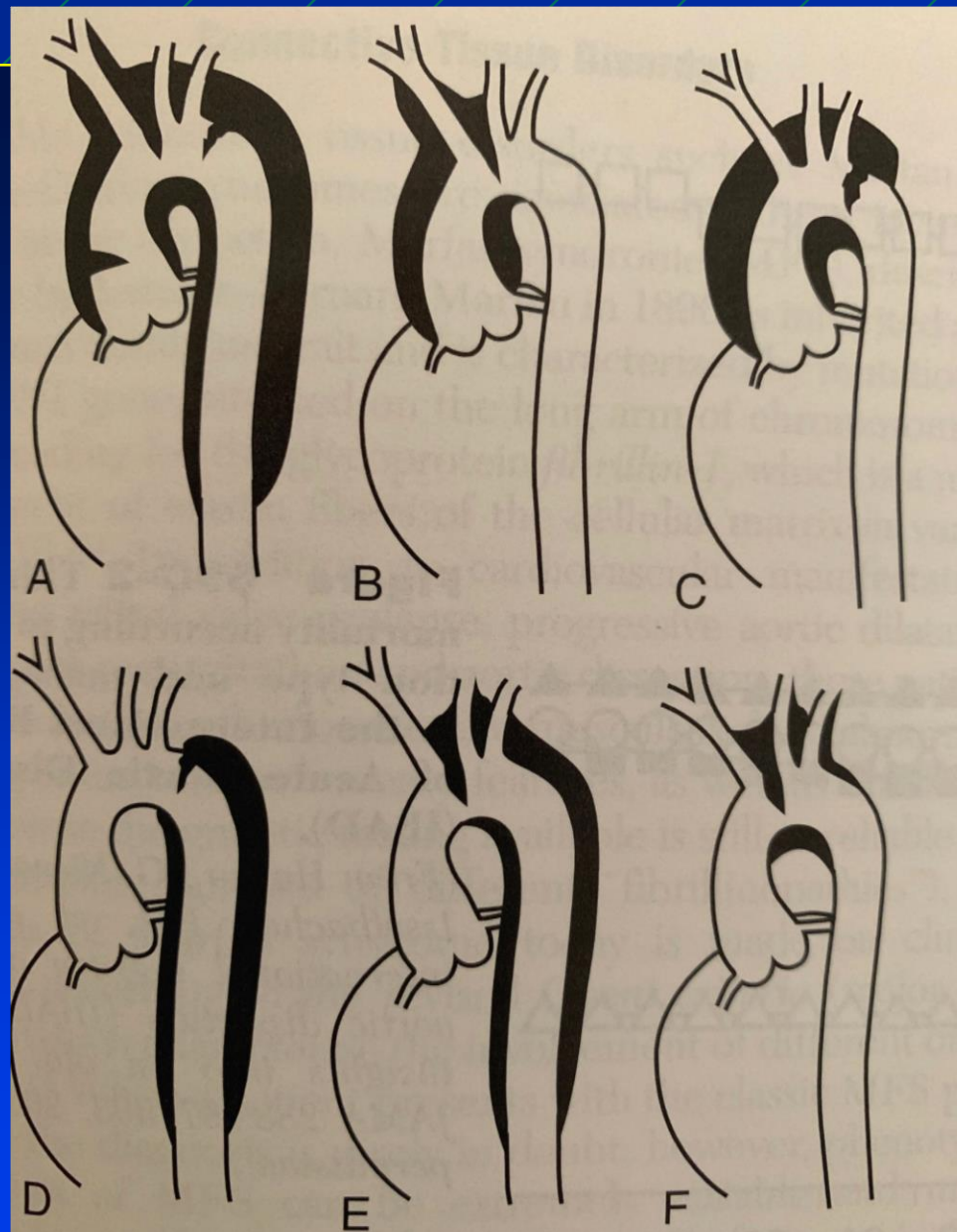
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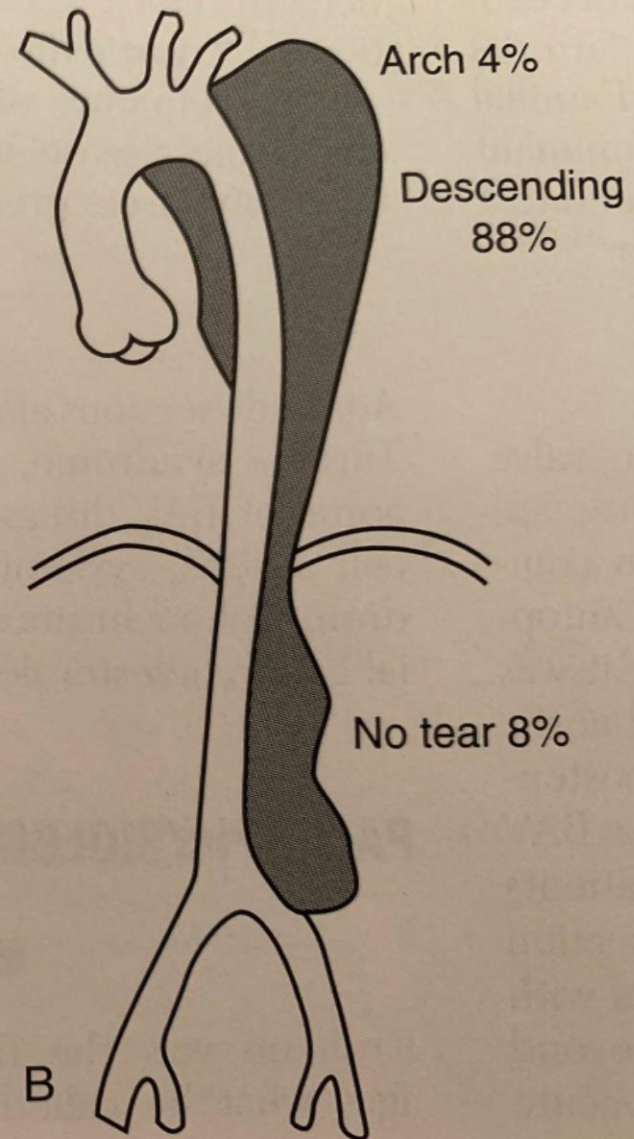
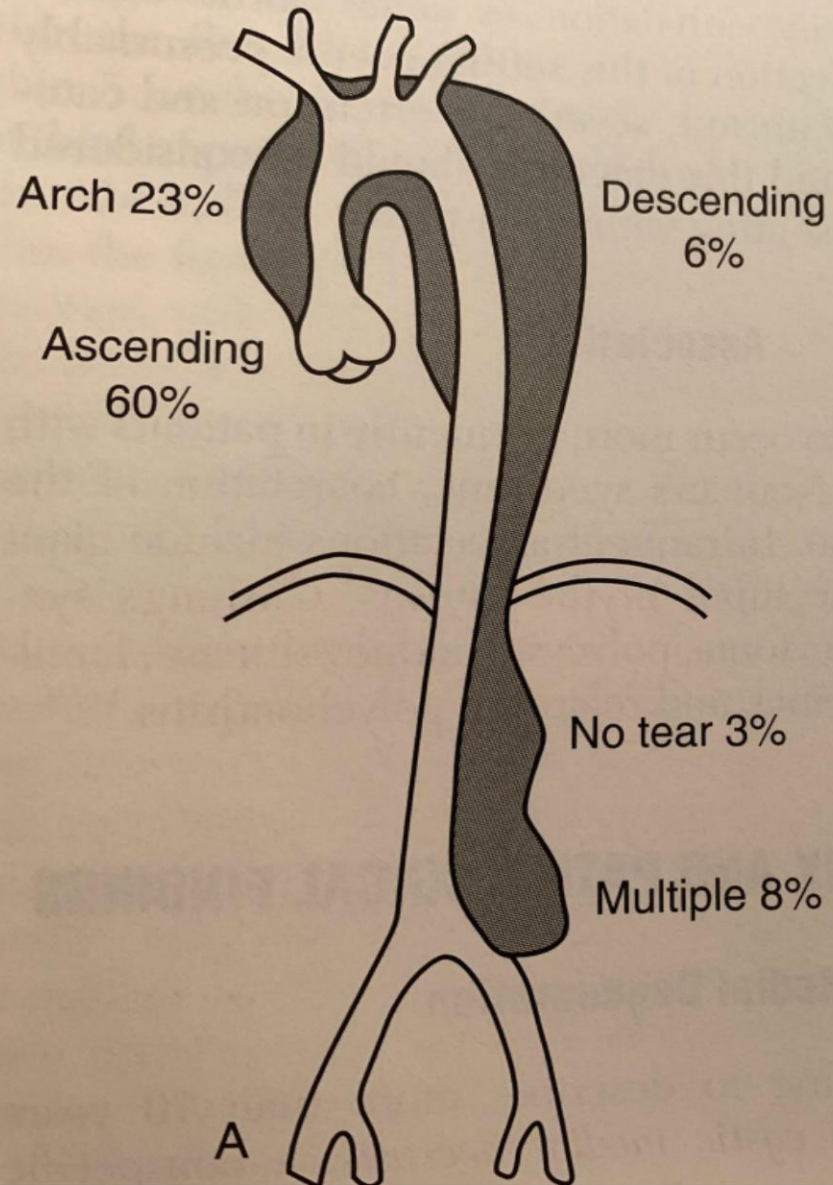


| De Bakey Type I   | Type II  | Type III  |
|---|--|---|
|    |  |  |
| <b>Stanford</b>   | <b>Type A</b>  | <b>Type B</b>   |
| <p><b>De Bakey</b></p> <p>Type I      Originates in the ascending aorta, propagates at least to the aortic arch and often beyond it distally</p> <p>Type II      Originates in and is confined to the ascending aorta</p> <p>Type III      Originates in the descending aorta and extends distally down the aorta or, rarely, retrograde into the aortic arch and ascending aorta</p><br><p><b>Stanford</b></p> <p>Type A      All dissections involving the ascending aorta, regardless of the site of origin</p> <p>Type B      All dissections not involving the ascending aorta</p> |  |   |



**69C-1** Schematic illustration of the Stanfo





# Aortic Dissection

- ⇒ *Risk factors (dp/dt)*
  - ⇒ *Aneurysm*
  - ⇒ *Connective tissue d/o*
  - ⇒ *Bicuspid AoV and AI*
  - ⇒ *Smoking*



# Aortic Dissection

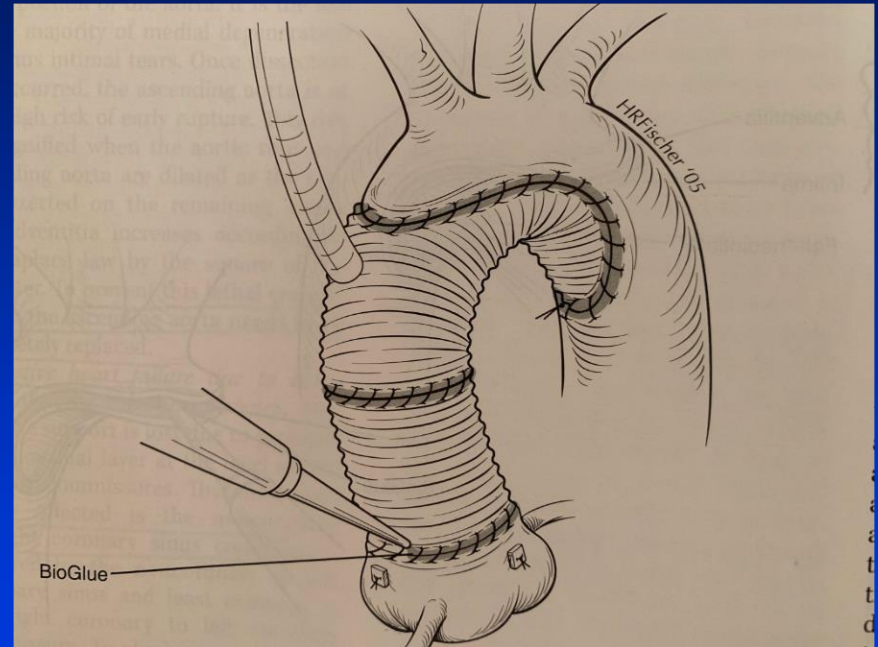
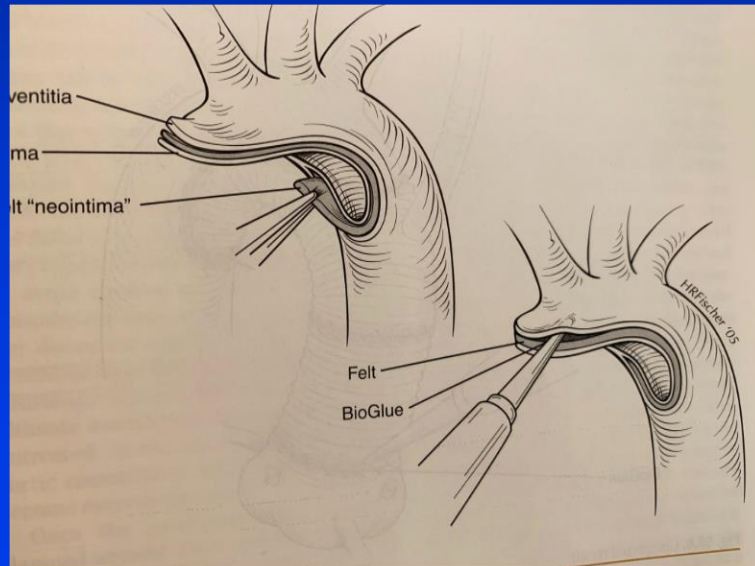
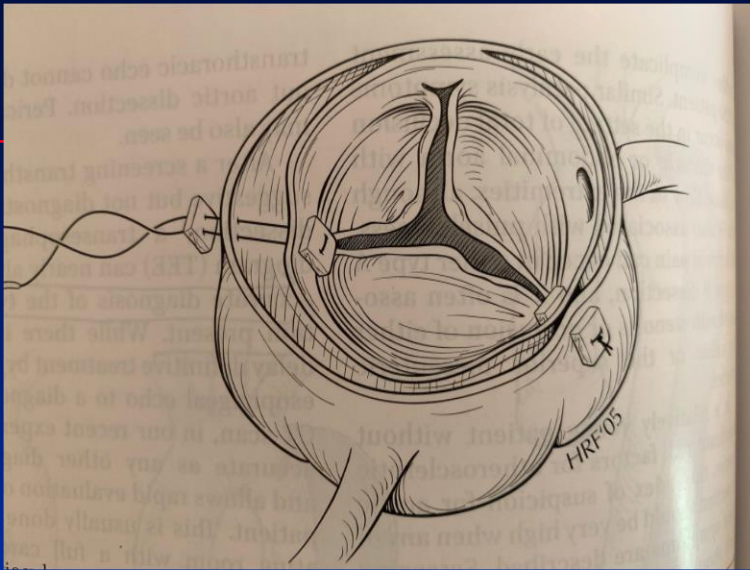
⇒ *Type A*

⇒ *Immediate surgery*

⇒ *2% risk of death per hour in first 48 hours*

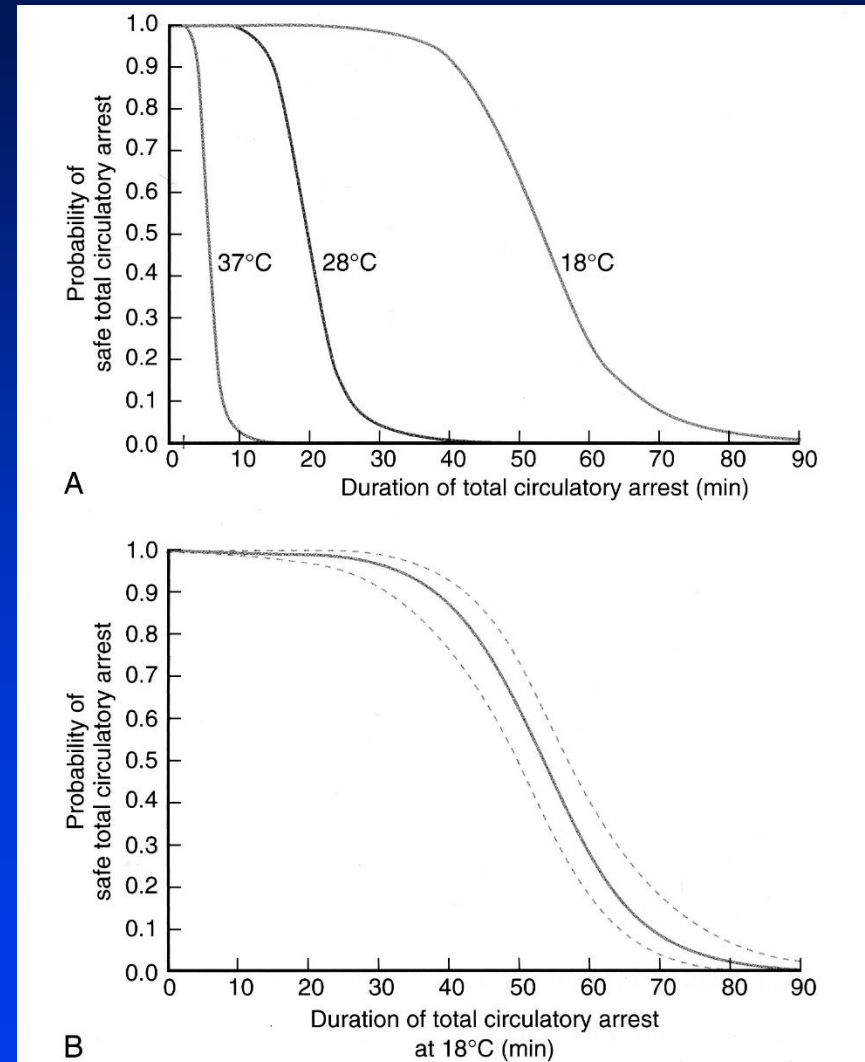


# Aortic Dissection



# Hypothermic Circulatory Arrest

- **Barnard 1963**
  - ⇒ 2 patients, one survived
  - ⇒ 4/5 patients died
- **Griepp 1975**
  - ⇒ First series of patients ascending aortic aneurysms



## BRAIN PROTECTION: 656 DHCA

| Time (minutes) | Stroke |
|----------------|--------|
| 7–29           | 4%     |
| 30–34          | 7.5%   |
| 45–59          | 10.7%  |
| 60–120         | 14.6%  |

Univariate: Age, CVA, CA time, CPB time, +Desc repair

Multivariate: CVA, Desc/TAA/TAAA repair, CPB time (AR)

# Aortic Dissection

⇒ *Type B*

⇒ *Medical treatment*

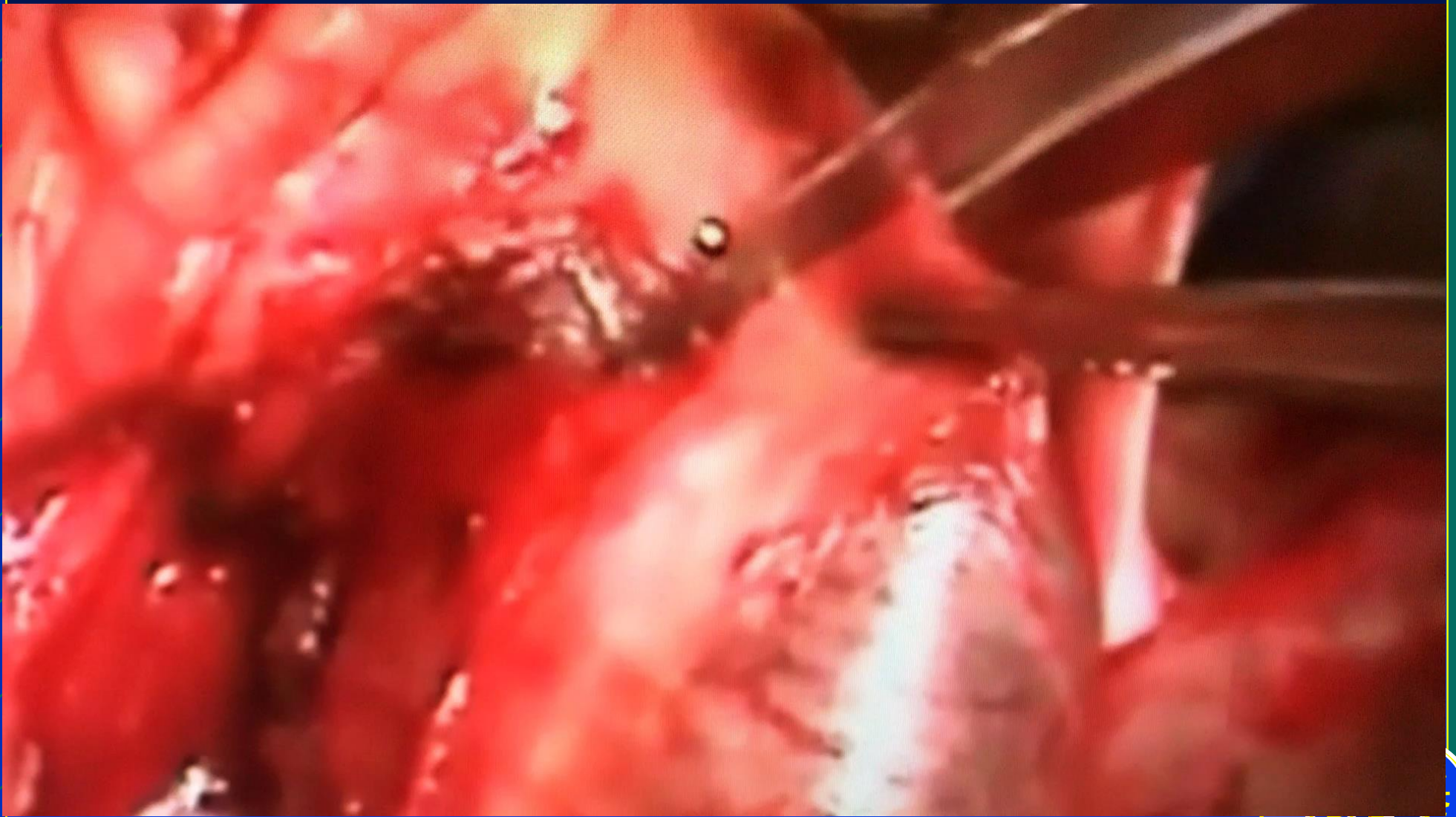














Dissection



12  
m  
.1  
3%  
50  
Off  
gen



53Hz  
15cm  
Z 1.1  
2D  
58%  
C 50  
P Off  
Gen



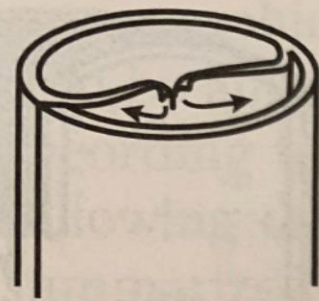
PAT T: 37.0C  
TFF T: 37.0C



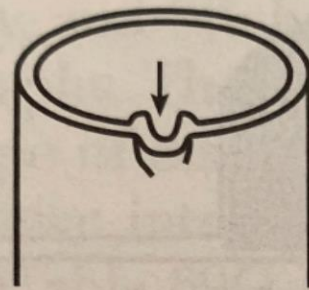
# Goals of surgery Type A

- ⇒ *Competent Aov*
- ⇒ *Replaced ascending to prox arch*
- ⇒ *Reconstructed root*
- ⇒ *Distal “type B” aorta*

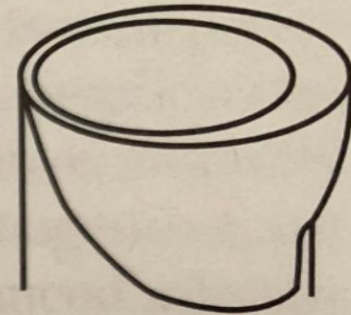
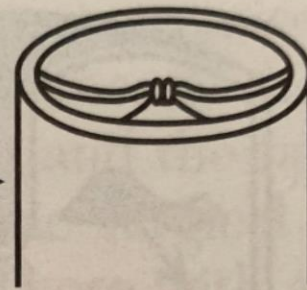




Aortic  
dissection



Penetrating ulcer

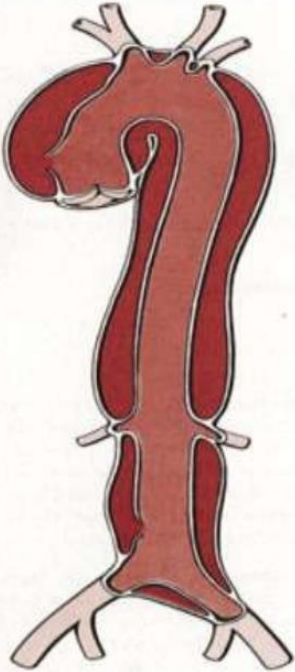
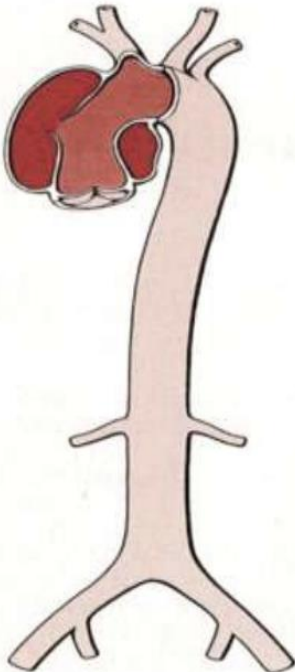
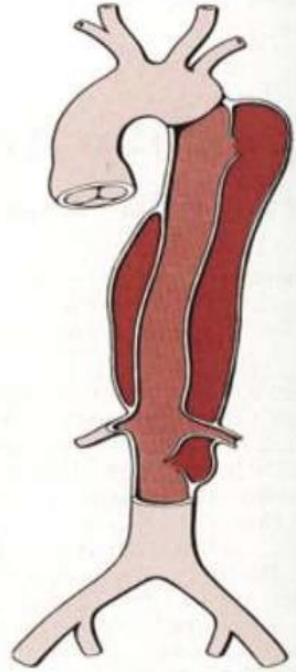


Intramural  
hematoma

**Figure 69C-4** Schematic illustration of classic aortic dissection with a distinct intimal flap separating the true and false lumina (left); penetrating atherosclerotic ulcer with a localized intimal lesion burrowing into the media and leading in some cases to localized dissection (middle); and intramural hematoma without intimal lesion (right).

(From Coady MA, Rizzo JA, Elefteriades JA: Pathologic variants of thoracic aortic dissections. Penetrating atherosclerotic ulcers and intramural hematomas. *Cardiol Clin* 17:637-657, 1999, with permission.)



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# Descending Aortic Dissection

- Usually classified as distal to the Left Subclavian Artery
- Multiple re-entry tears with a true and false lumen
- Usually not initially aneurysmal
- Perfusion of major branch vessels is paramount



# Type B dissections stratification

- Acute uncomplicated- relative symptom free with chest pain and other symptoms resolving with blood pressure control; **Medical Mgmt**
- Acute complicated- mal-perfusion to visceral, renal, carotid, spinal cord, or mesenteric vessels. Also includes rupture, uncontrolled HTN, persistent pain; **Surgical Mgmt**



# Type B dissection stratification

- Chronic Type B dissection- typically defined as >14 days from initial presentation. These are managed depending on clinical changes and symptoms
- Try to manage patients medical until they become Chronic Type B dissections. Surgical intervention within the first 2 weeks has a markedly higher morbidity and mortality rate.



# Initial treatment

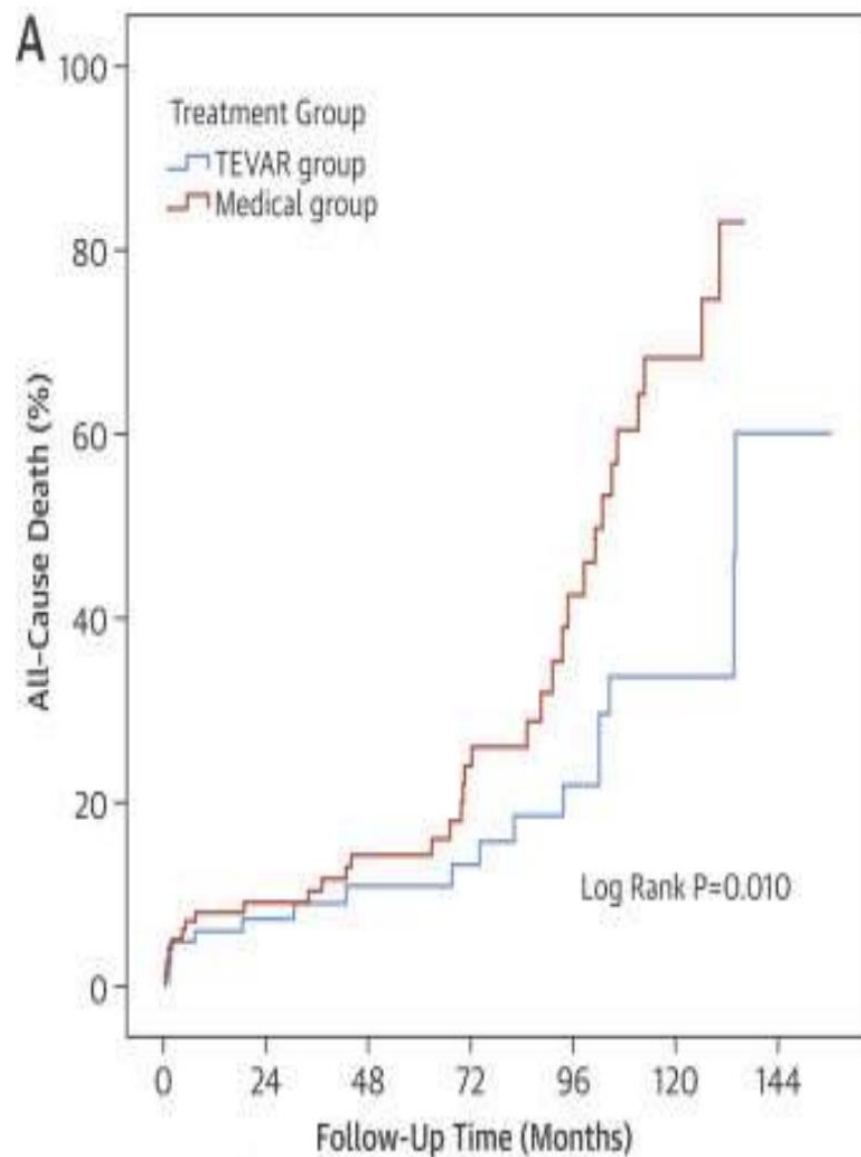
- Immediate management of pain and elevated blood pressure.
- Target Systolic pressure of less than 100-110mmhg
- Beta-blocker for  $HR < 60$
- Addition of calcium channel blockers to reduce heart rate often required
- Addition of vasodilators only after Beta-blockade. (nitroprusside)



# Instead-XL Trial

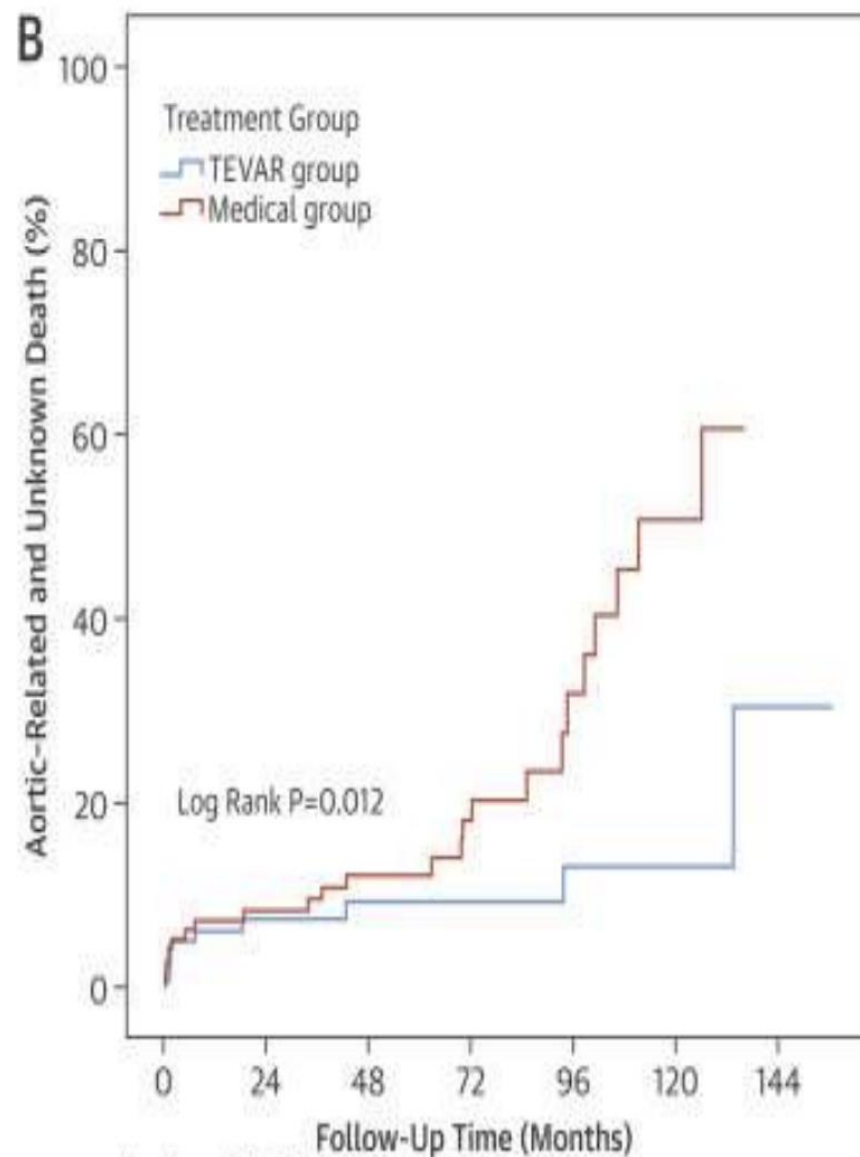
- Trial looking at OMT (optimal medical management ) (n=68) vs TEVAR + OMT (n=72) in 140 patients over 5 years with chronic type B dissections.
- Initially there was little significance between the groups.
- At 2-5 years however, significant differences were seen.





Number of Patients at Risk

|       |     |    |    |    |    |    |
|-------|-----|----|----|----|----|----|
| TEVAR | 184 | 64 | 43 | 36 | 23 | 11 |
| BMT   | 154 | 82 | 62 | 38 | 16 | 6  |



Number of Patients at Risk

|       |     |    |    |    |    |    |
|-------|-----|----|----|----|----|----|
| TEVAR | 184 | 64 | 43 | 36 | 23 | 11 |
| BMT   | 154 | 82 | 62 | 38 | 16 | 6  |

# INSTEAD-XL Trial

- Landmark analysis between TEVAR and OMT reveal:
  - All cause mortality significant (0% vs 16.9%  $p=.0003$ )
  - Aortic specific mortality (0% vs 16.9%  $p=.0005$ )
  - Progression of disease (4.1% vs 28.1%;  $p=.004$ )



# INSTEAD XL Conclusions

- Benefit of TEVAR in chronic Type B dissections is not realized until years 2-5.
- Not unreasonable to proceed with endovascular treatment if life expectancy is great than 2 years.



## Other Type B studies

⇒ *Leshnower ATS 2018;105:31-9*

*398 aTBAD*

⇒ *46% OMT patients need TEVAR*

⇒ *Excellent job of TEVAR w complic*

⇒ *5% mortality*

⇒ *ADSORB trial (aTBAD random)*

⇒ *No diff in mortality at 1 yr*

⇒ *INSTEAD trial: “subacute” and chronic*



## DISSECTIONS AT A GLANCE

- Acute uncomplicated type B thoracic dissections should first be treated with medical management.
- Acute complicated type B thoracic dissections are best managed by endovascular stent graft treatment.
- Chronic type B thoracic dissections can be managed medically, with surgery, or by stent graft treatment when there is expansion of the false lumen.
- Type A aortic dissections should be treated with open surgery.

# Three Things

- *Ctscan chest w or w/o*
- *Treat hypertension/stop smoking, aggressively treat CAD, pulm disease*
- *5.0 cm (\*), close scrutiny on women*



# Three Things: Surgery

- *Symptoms/progressive AI*
- *operate before 6 cm*
- *Serial imaging; rate of 10% incr in size over 6 – 12 mos (5mm)*
- *Influence of etiology*

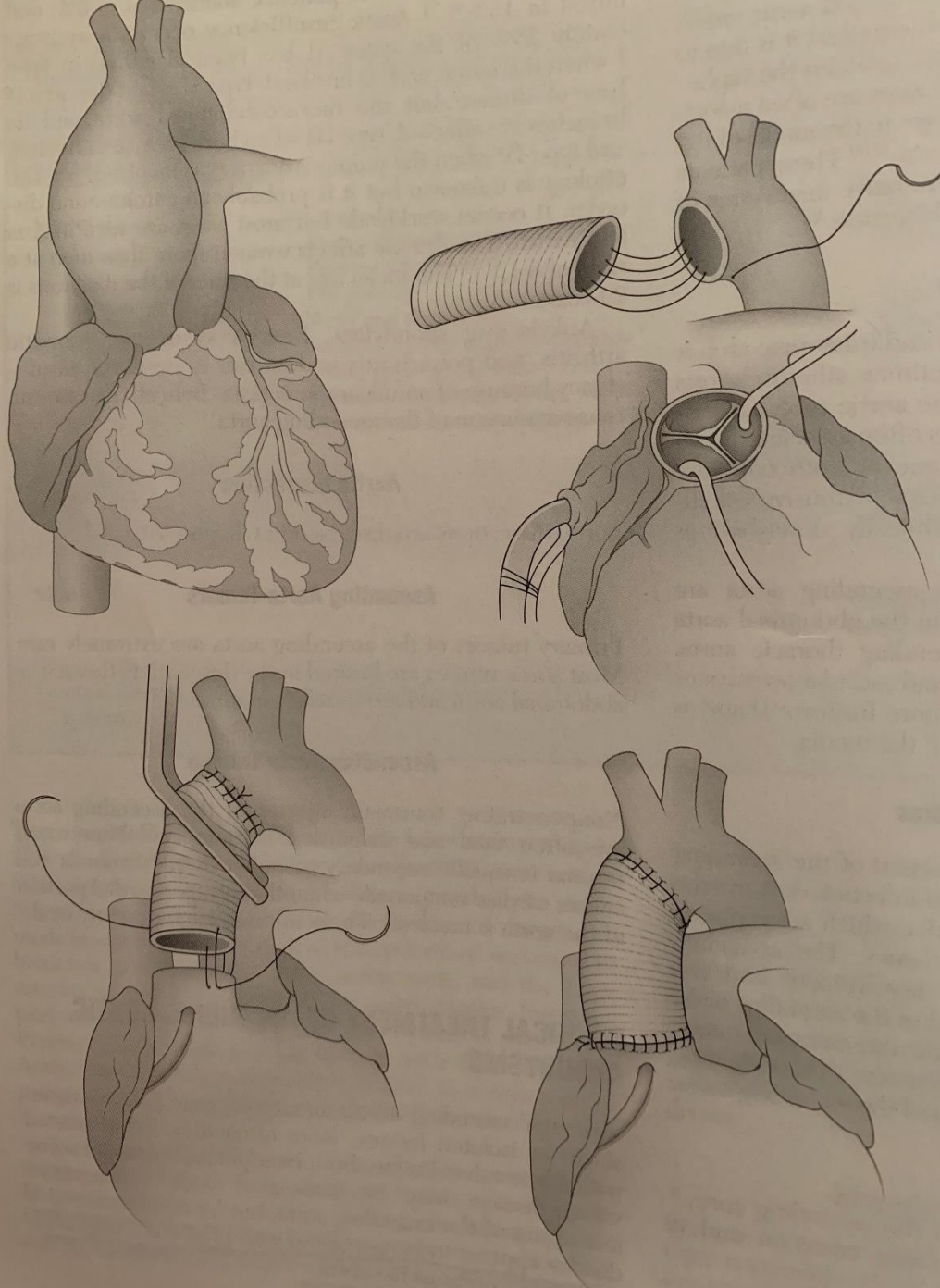


# Etiology

- *Bicuspid AoV: 4.5 cm (esp w AI)*
- *Marfan: 4.5 cm*
- *Loey-Dietz: 4.0 cm*
- *Family or personal history of aortic syndromes or uexplained sudden death: 4.5 cm*

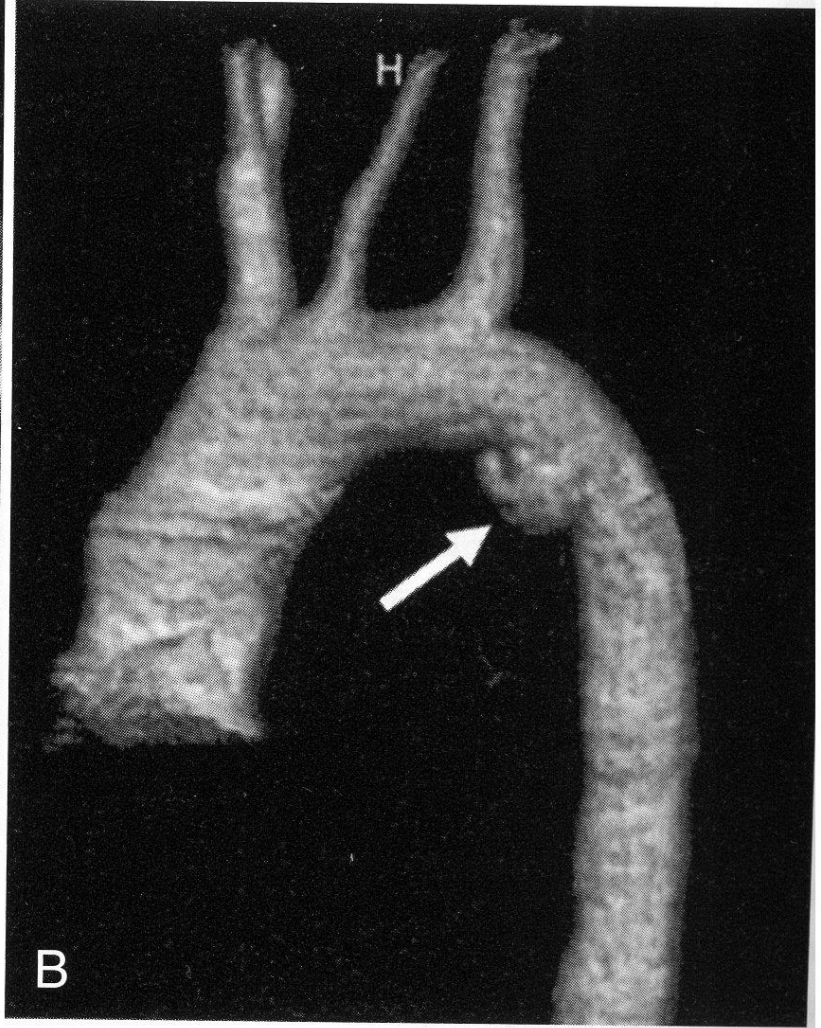
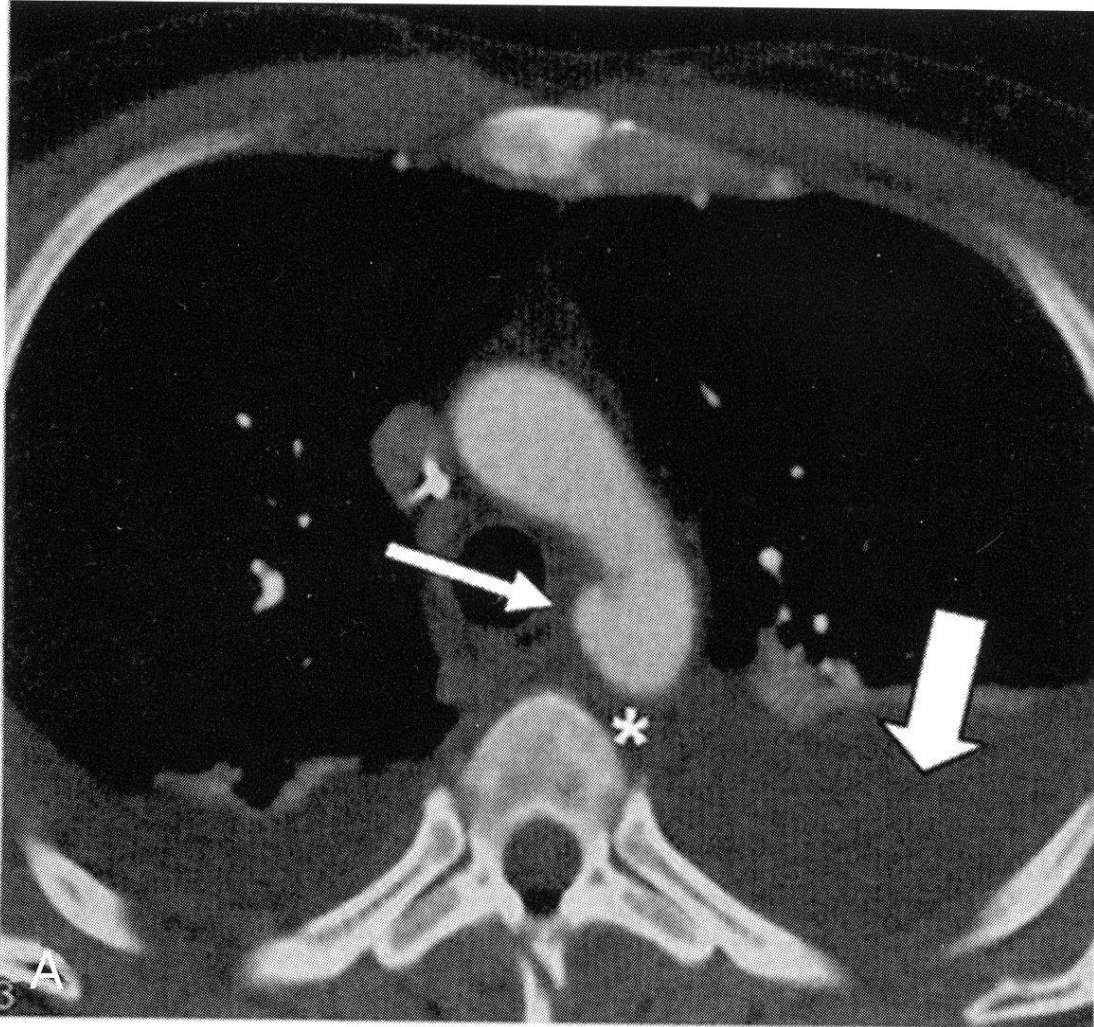


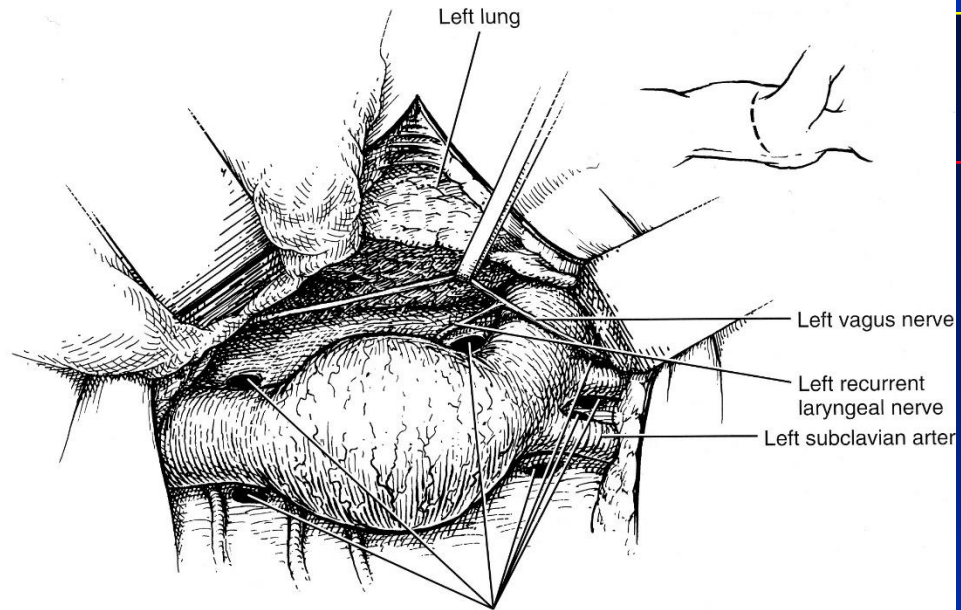




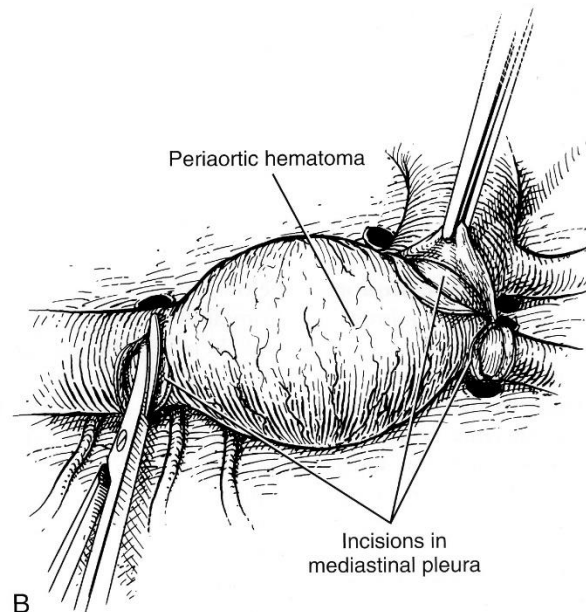


# Aortic transection



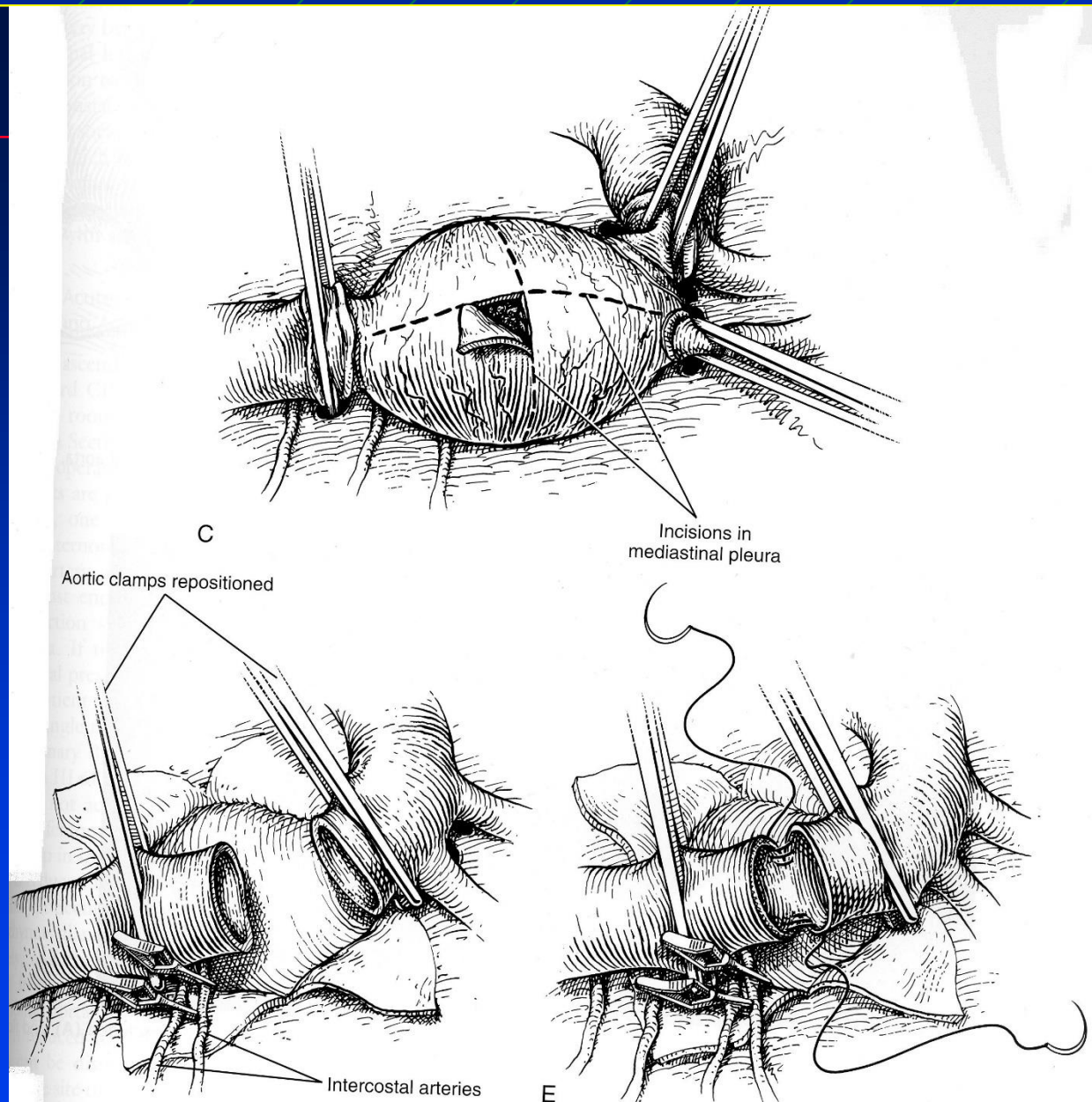


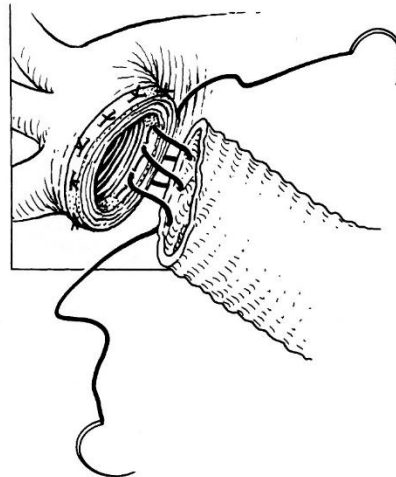
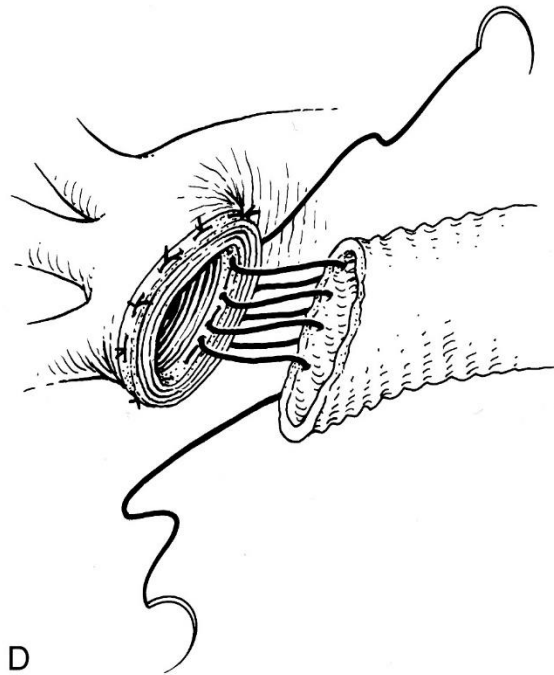
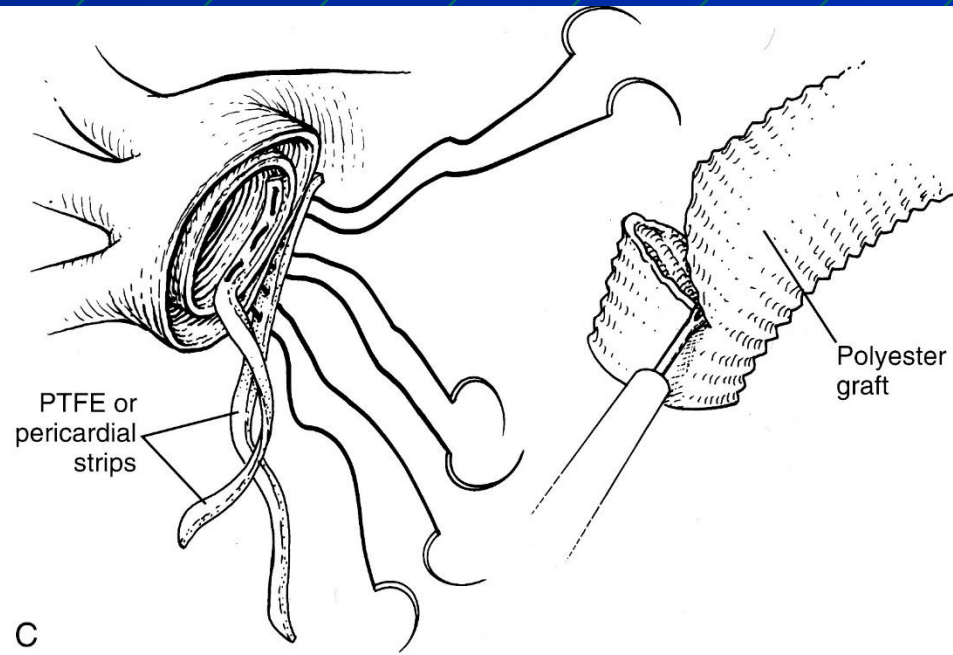
A

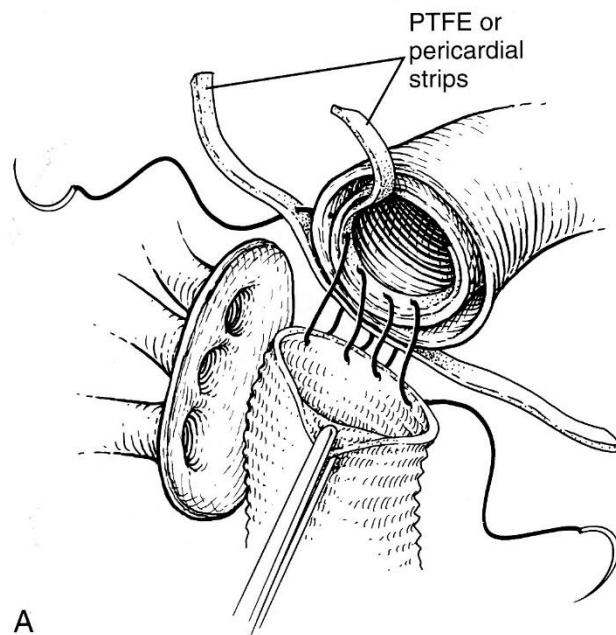


B

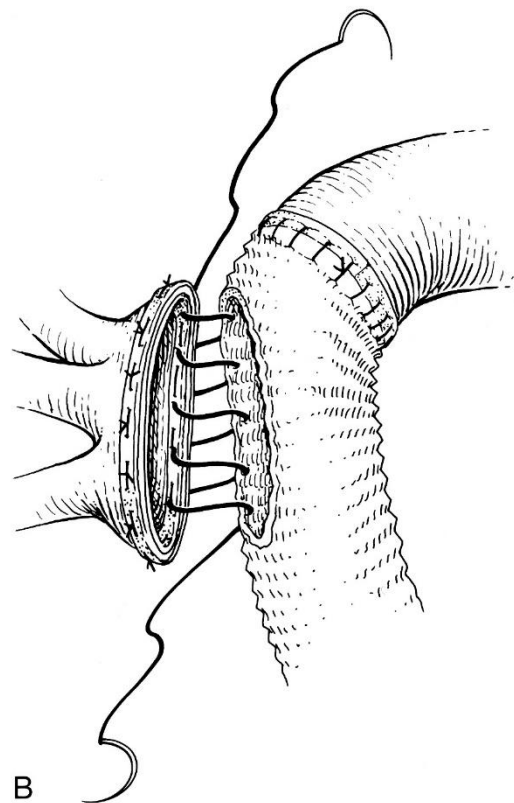




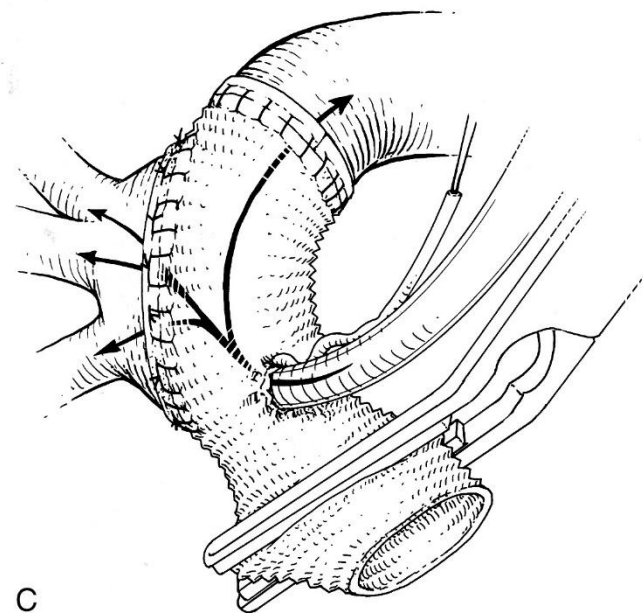




A

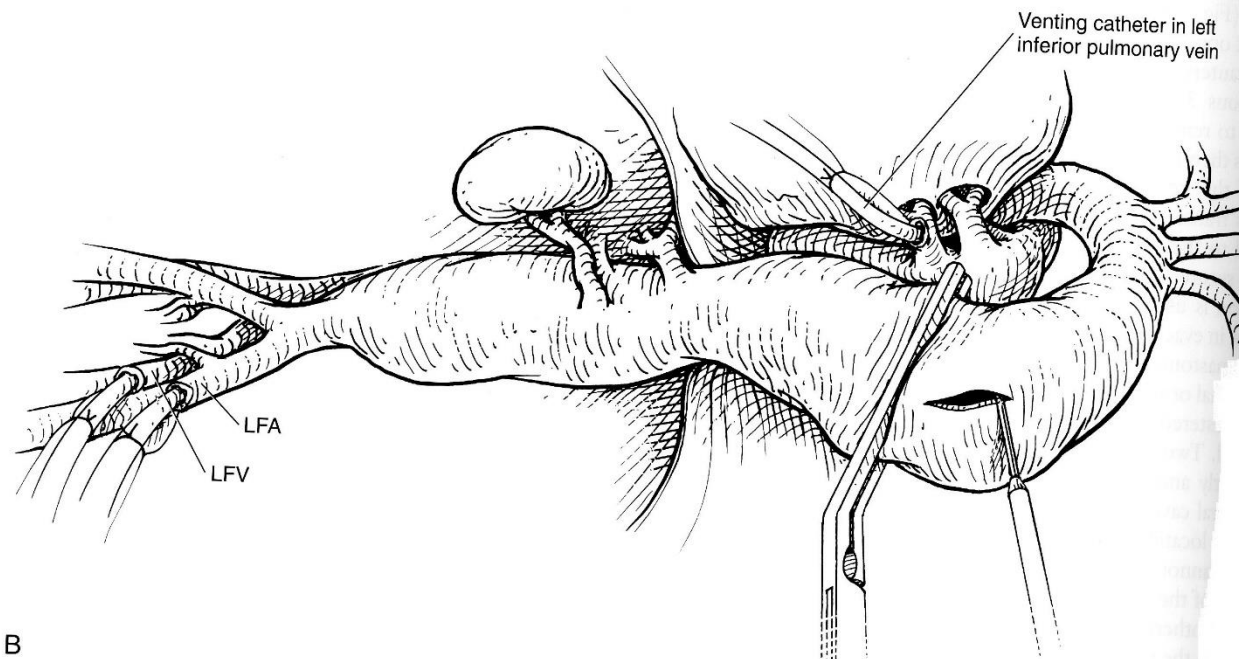
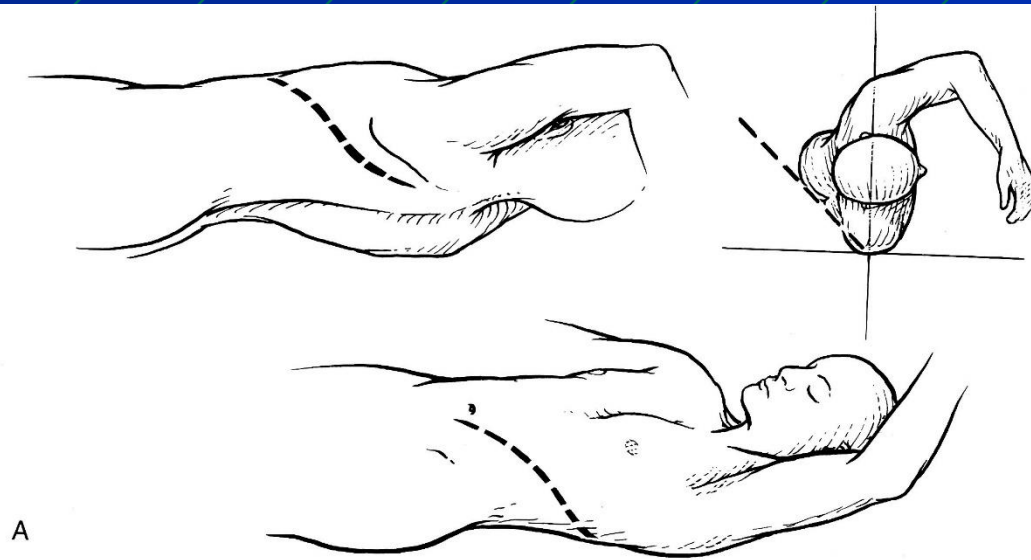


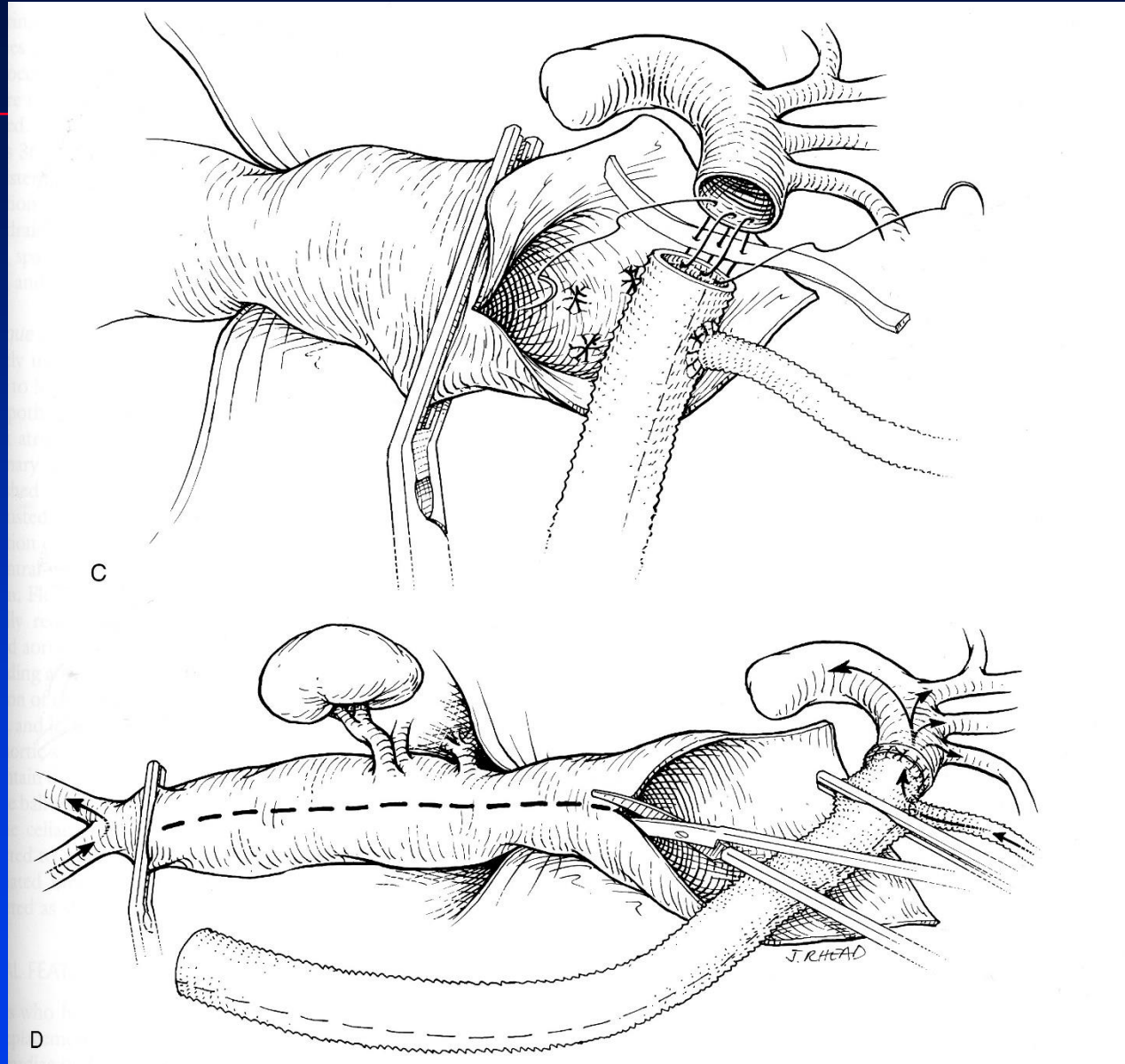
B

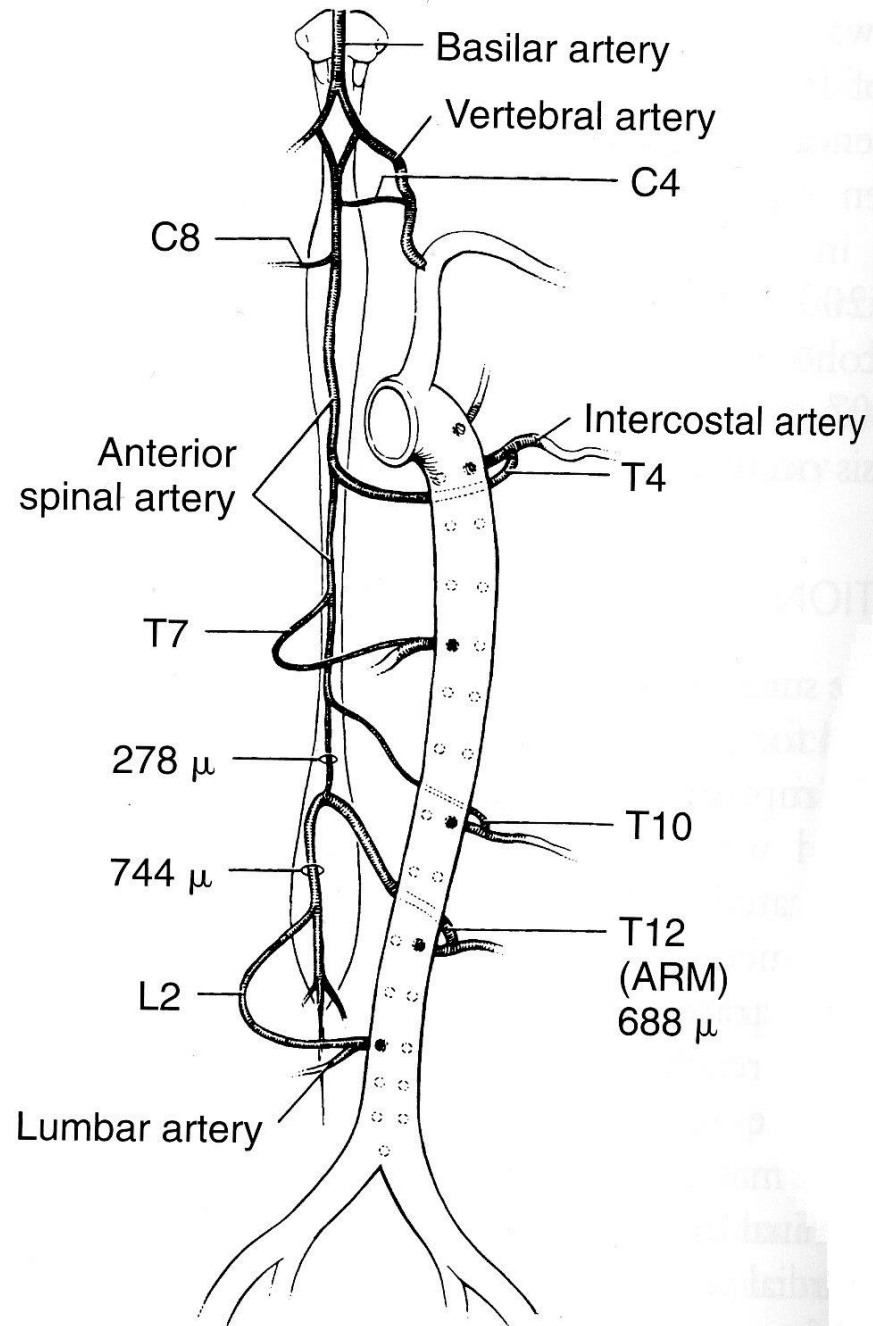


C









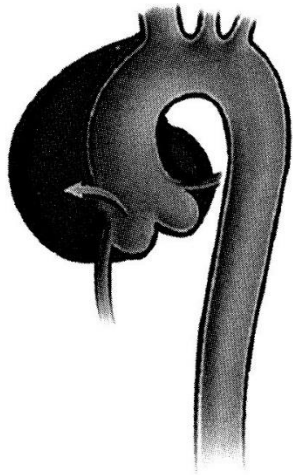
# Dissection

DeBakey classification

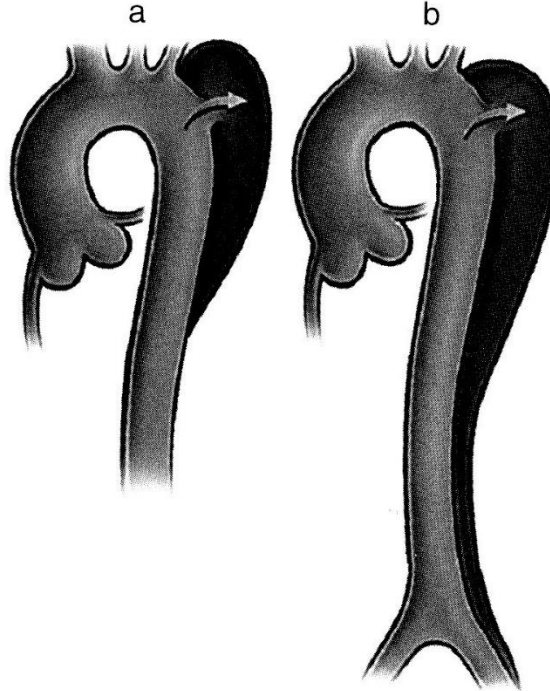
Type I



Type II

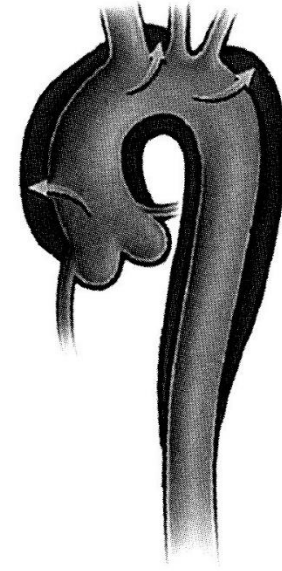


Type III



Stanford classification

Type A



Type B

