



Stent Use in Coarctation of the Aorta

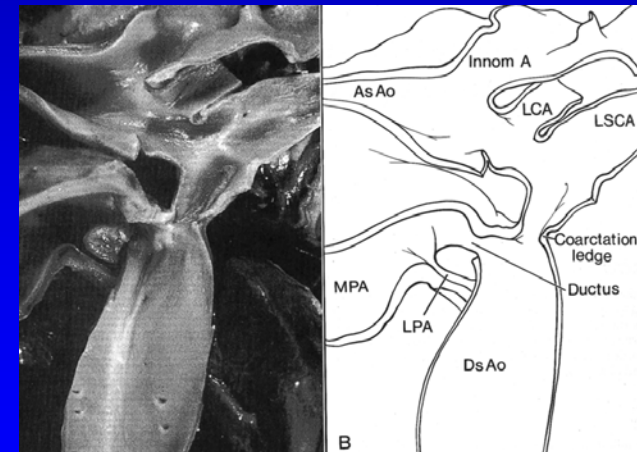
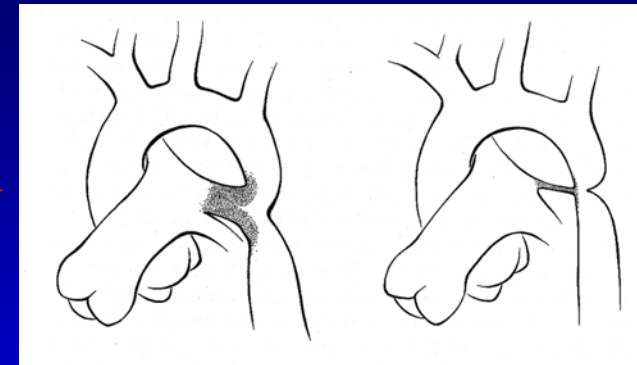
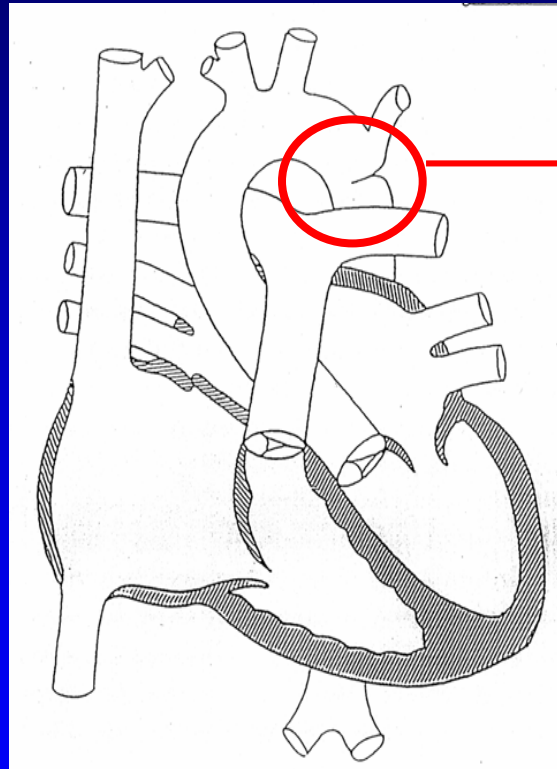
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Texas Children's Hospital
Associate Professor, Dept of Pediatrics
Baylor College of Medicine
Houston, TX

Stent use in coarctation of the aorta

- Various morphologies of COA
- Stents available for COA
- Stent implantation techniques
 - Special considerations
- Stent complications

COA-anatomy

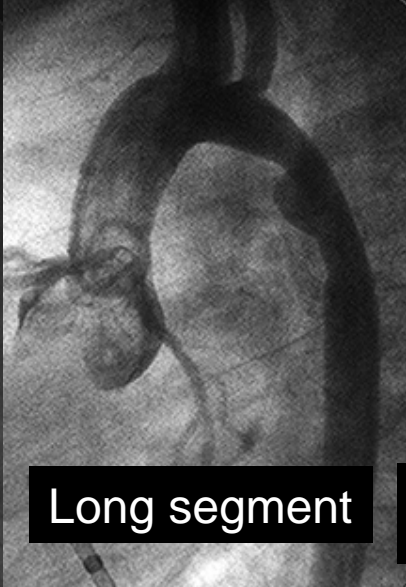
- Ridge like medial thickening, usually at the juxtaductal region
- Extension of ductal tissue into aorta
- Decreased aortic flow in utero



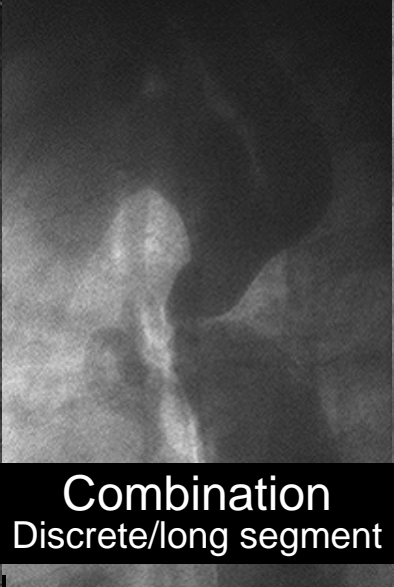
Variations of COA



Discrete



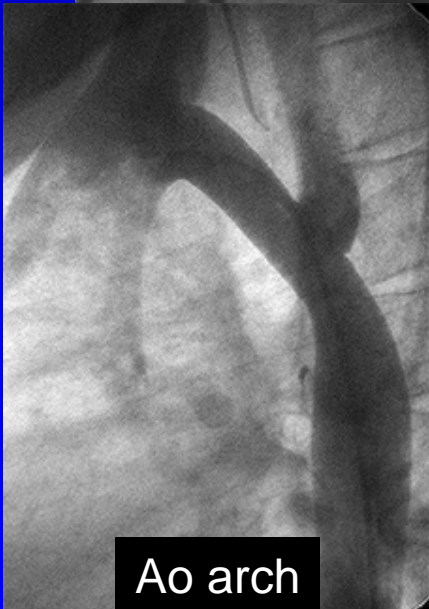
Long segment



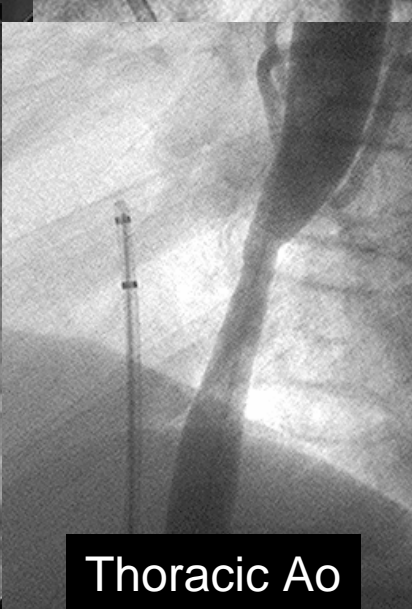
Combination
Discrete/long segment



Fold/kink



Ao arch



Thoracic Ao



Abdominal Ao



Multiple levels

Coarctation / recoarctation of the aorta

- Indications for intervention:
 - ≥ 20 mm Hg gradient
 - Upper extremity hypertension
 - Decreased left ventricular function regardless of gradient
- Late repair (> 9 years):
 - accelerated atherosclerosis
 - persistent systemic hypertension
 - berry aneurysm

Interventional options: Based on anatomy

- Discrete
 - Angioplasty first option
 - Stent if residual gradient
- Long segment
 - Stent
 - If severe, test dilation with low pressure balloon
- Kink/fold
 - Need stent to straighten out aorta
- Arch, thoracic, abdominal COA
 - Usually long segment; need stent
 - Adjacent to major arterial side branches

Interventional options: Based on patient size & aorta diameter

- Patient size ≤ 25 kg
 - Femoral arteries may be too small to accommodate large sheath (minimal 9 Fr sheath)
 - Femoral artery angiogram to evaluate size
 - Angioplasty first option
- Normal diameter adjacent to COA ≤ 10 mm
 - Angioplasty first
 - Insufficient long term data to prove that stents dilated < 10 mm can be serially dilated to adult size (at least 18 mm diam)
- In extreme cases (ie, poor surgical candidates), will stent if angioplasty inadequate
 - Use medium size stents on smaller balloons
 - Will require future surgical removal

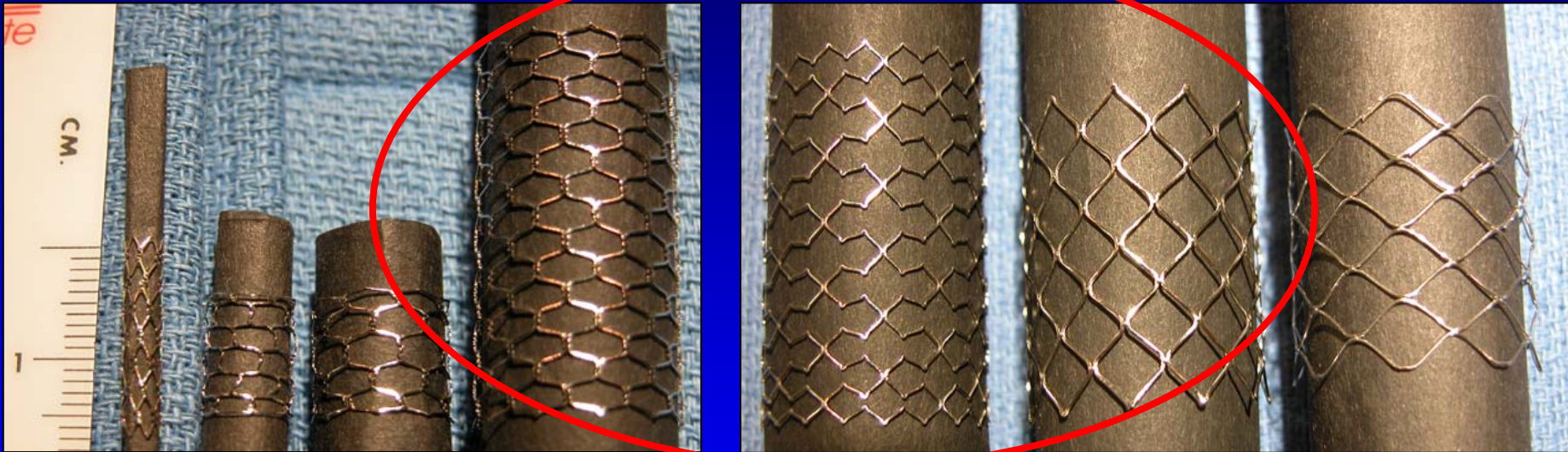
COA-Stent implantation techniques

- Careful measurement of COA and adjacent normal anatomy (may need multiple angled views)
- Retrograde course: stiff exchange guidewire across COA to right subclavian artery or ascending aorta
- Balloon size 80-110% of adjacent normal anatomy
- If severe COA:
 - Evaluate aortic wall compliance with test balloon dilation using low pressure (2-4 atmospheric pressure)
 - If high compliance, consider implant stent with smaller balloon and serially dilated over time.
- Post-stent angiography to evaluate for dissection or aneurysm
- Have surgical backup available

COA- Stent implantation: Complications

- Stent malposition / embolization
- Thromboembolic events / CNS
 - Fully heparinize (keep ACT >200)
- Vascular (femoral artery) trauma
- Aneurysm formation
- Dissection (Surgical emergency)

Stent selection for COA



Velocity

Genesis medium

Genesis large

Genesis XD

Maxi-LD

Palmaz XL

CP 8-zig

Large
(max 18 mm
diam.)

Extra large stents
(max 24 mm diam.)

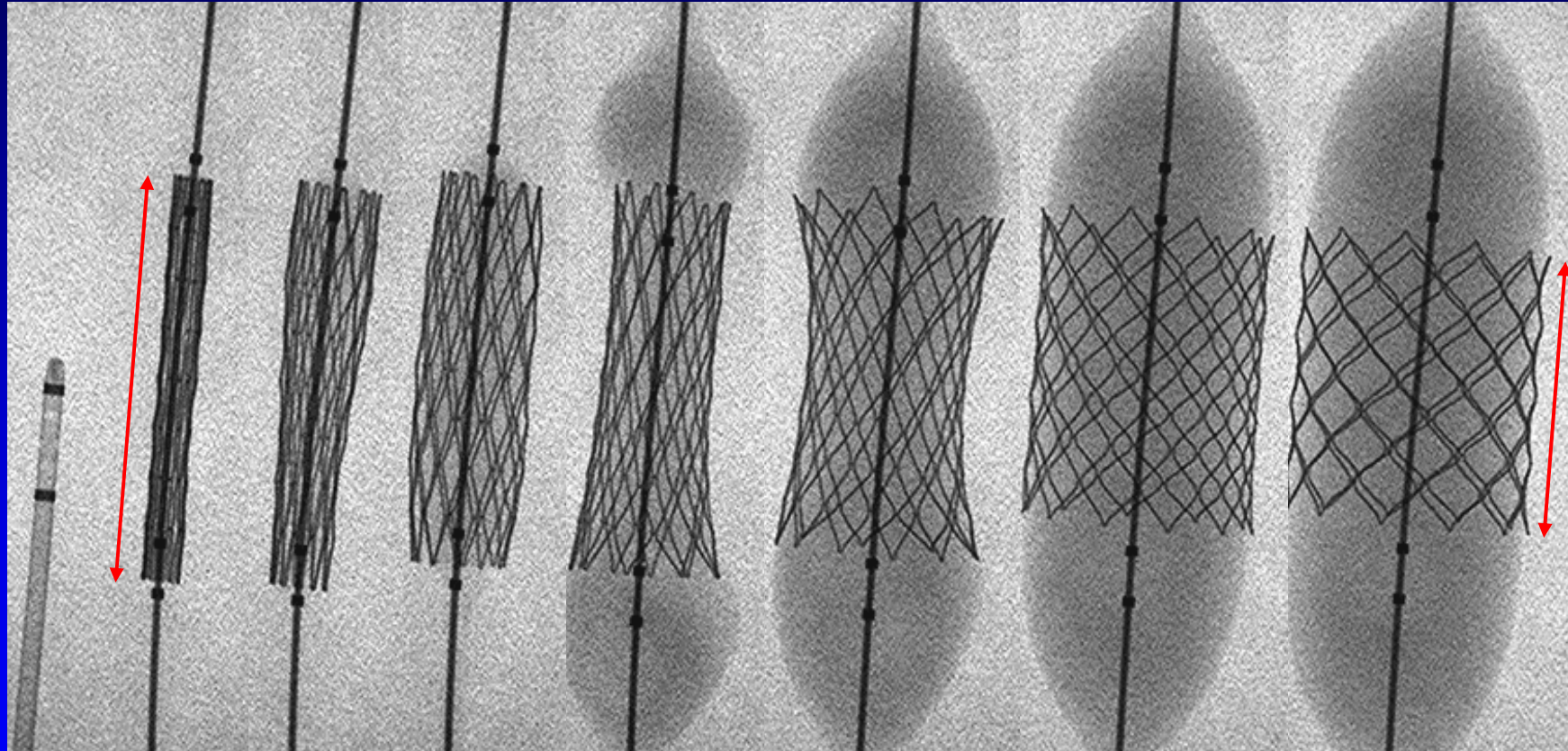
Small
(max 5 mm
diam.)

Medium
(max 8-10 mm
diam.)

Use only these for COA

Palmaz XL

Dilated w/ 24 mm BIB

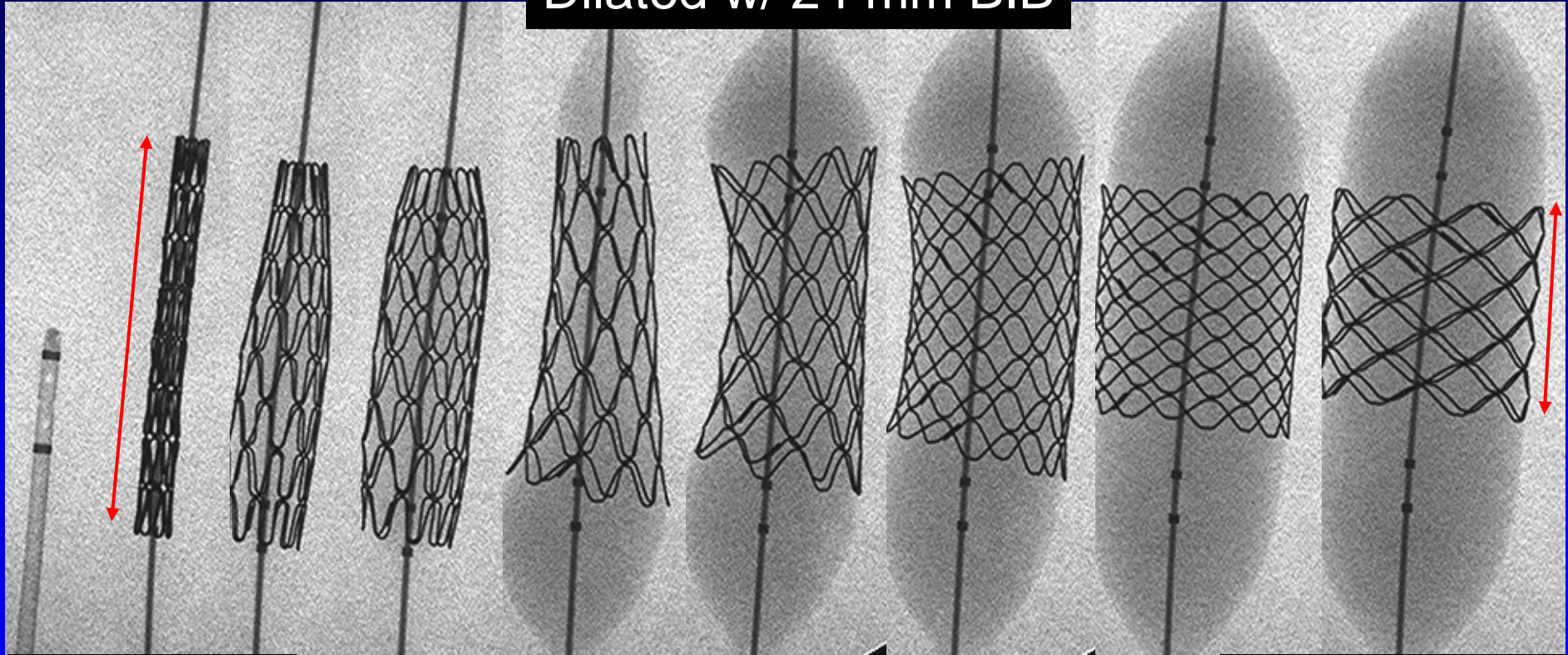


Undilated
40mm length

24mm diam
27.6mm length
(31% FS)

CP 8-zig

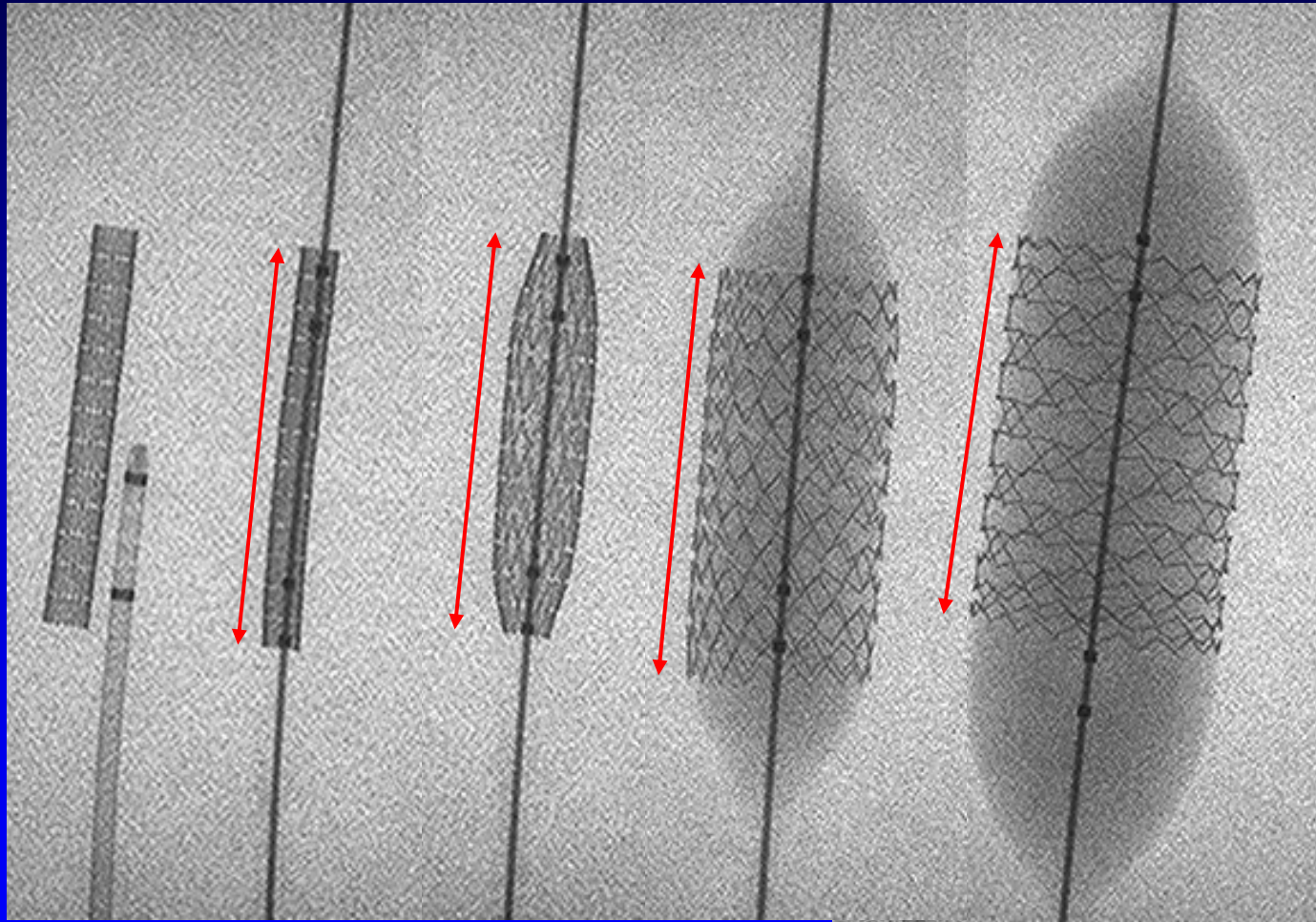
Dilated w/ 24 mm BIB



Undilated
45mm length

24mm diam
23.4mm length
(48% FS)

EV3 MaxLD- serial dilation w/ 18 mm BIB, then 24 mm BIB



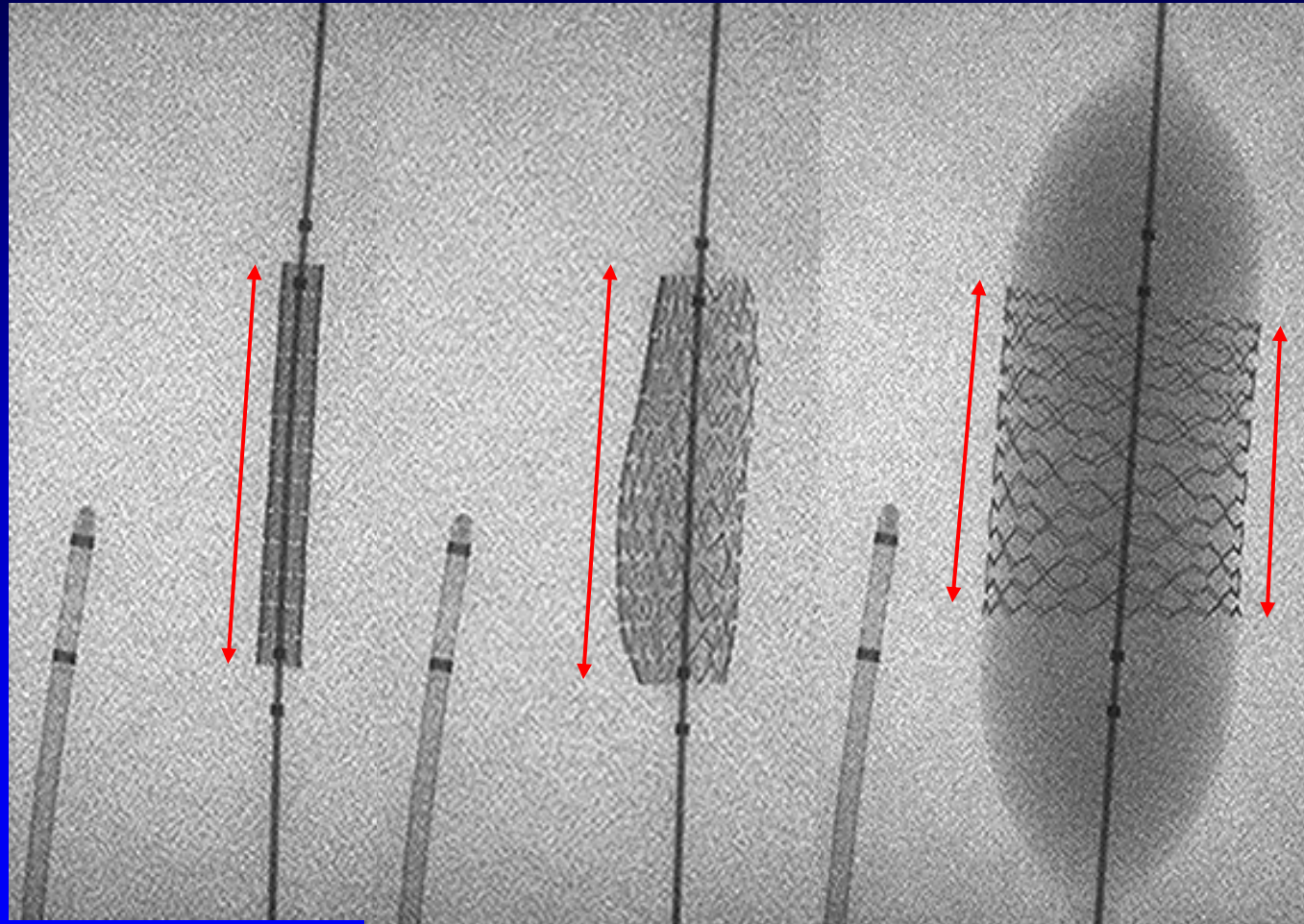
Undilated
34.4 mm

9 mm
34.3 mm

18 mm
34.1-34.7 mm

24 mm
32.7 mm
4.9% shortening

EV3 MaxLD-direct dilation w/ 24 mm BIB



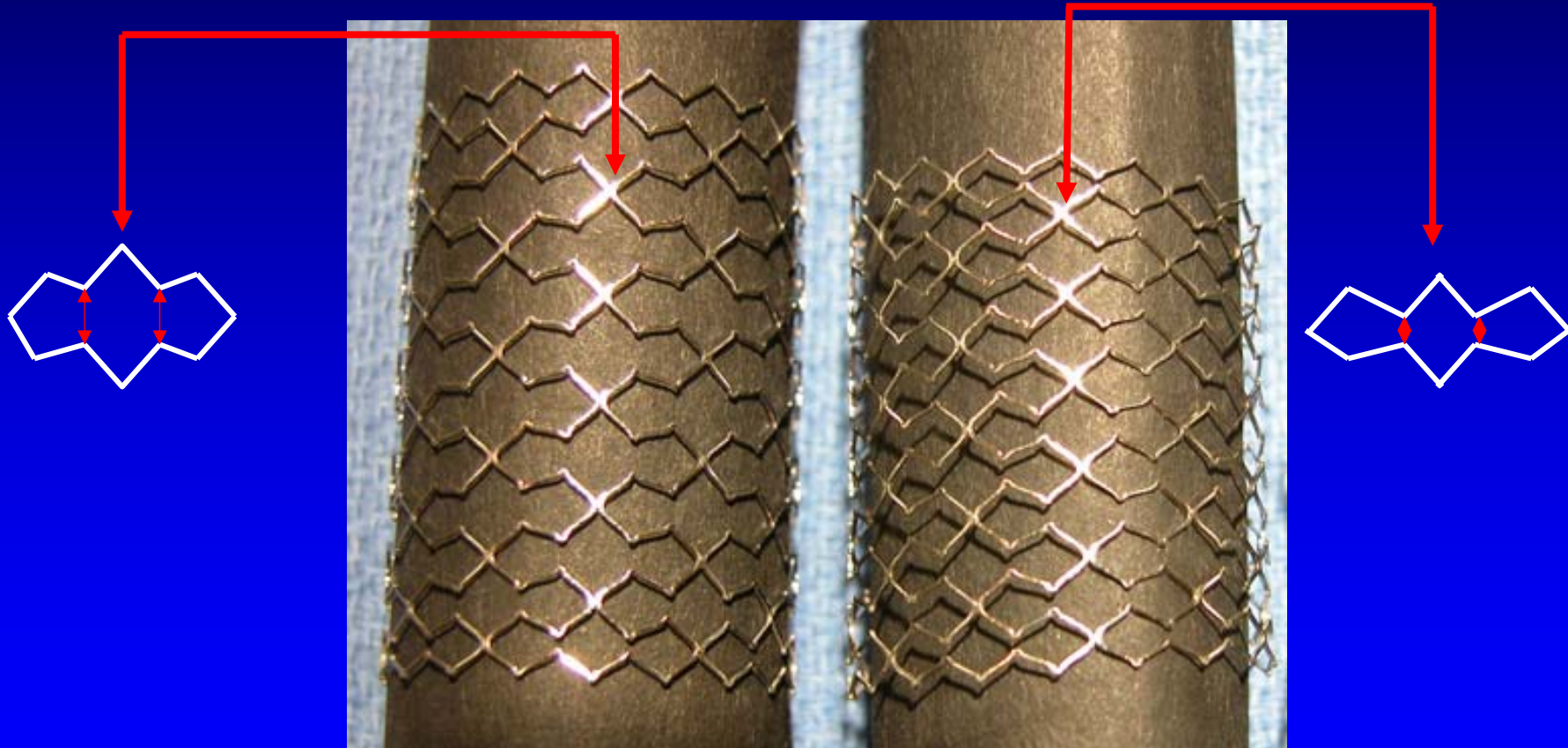
Undilated
34.8 mm

12 mm
34.8 mm

24 mm
25.2-28.2 mm
(23.3% FS)

MaxLD 24 mm expansion

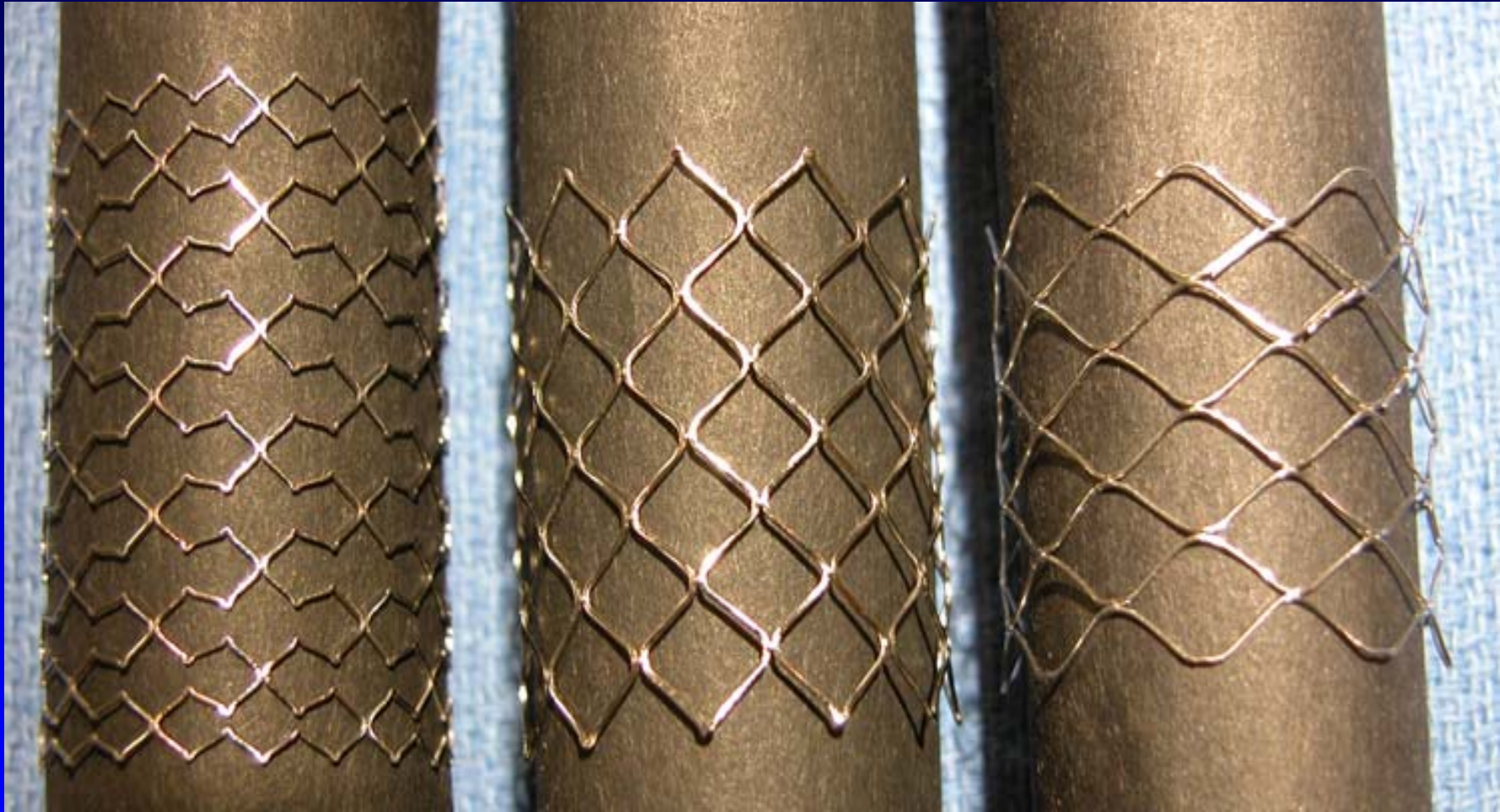
Variable length based on expansion of open-cells



Serial dilation

Single dilation

Comparison of extra large stents (24 mm diameter)



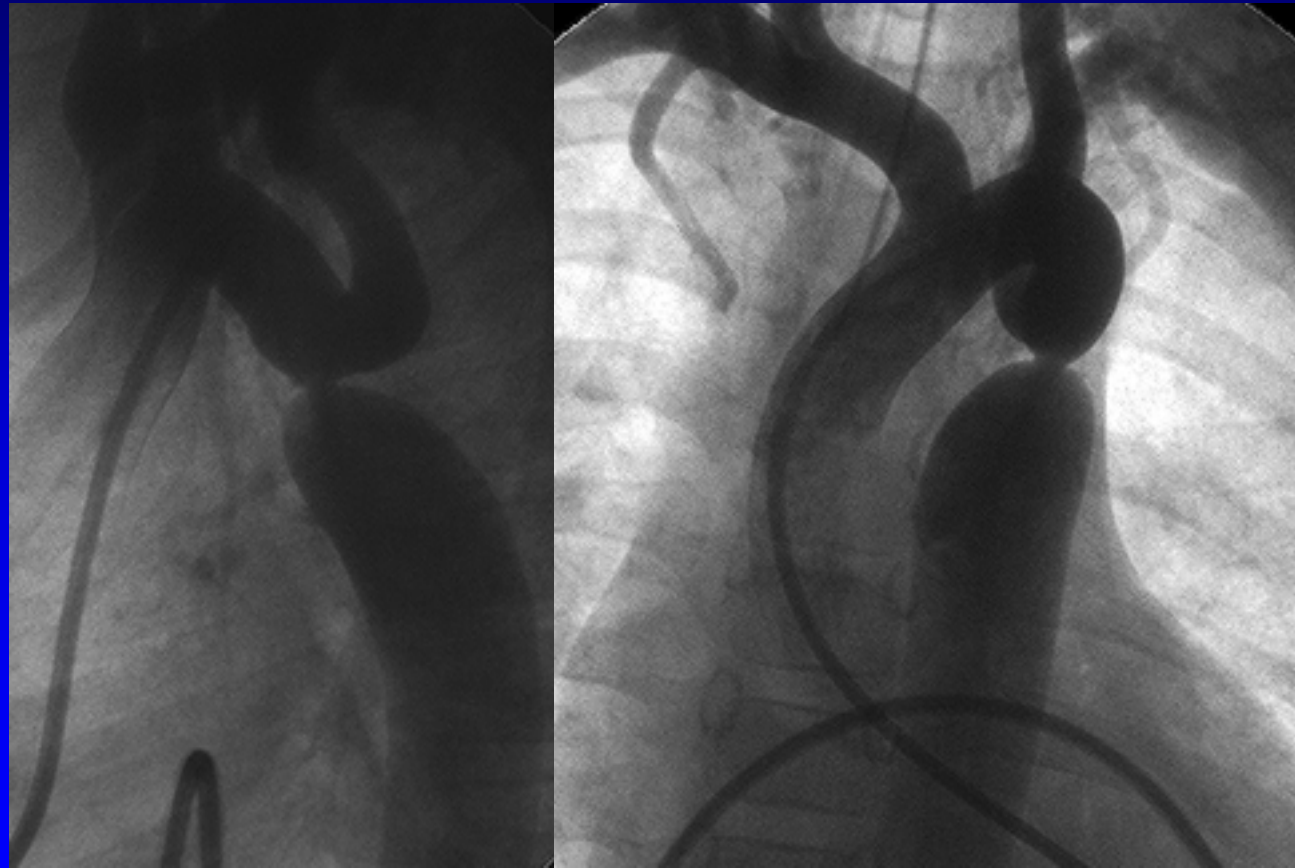
Max LD

Palmaz XL

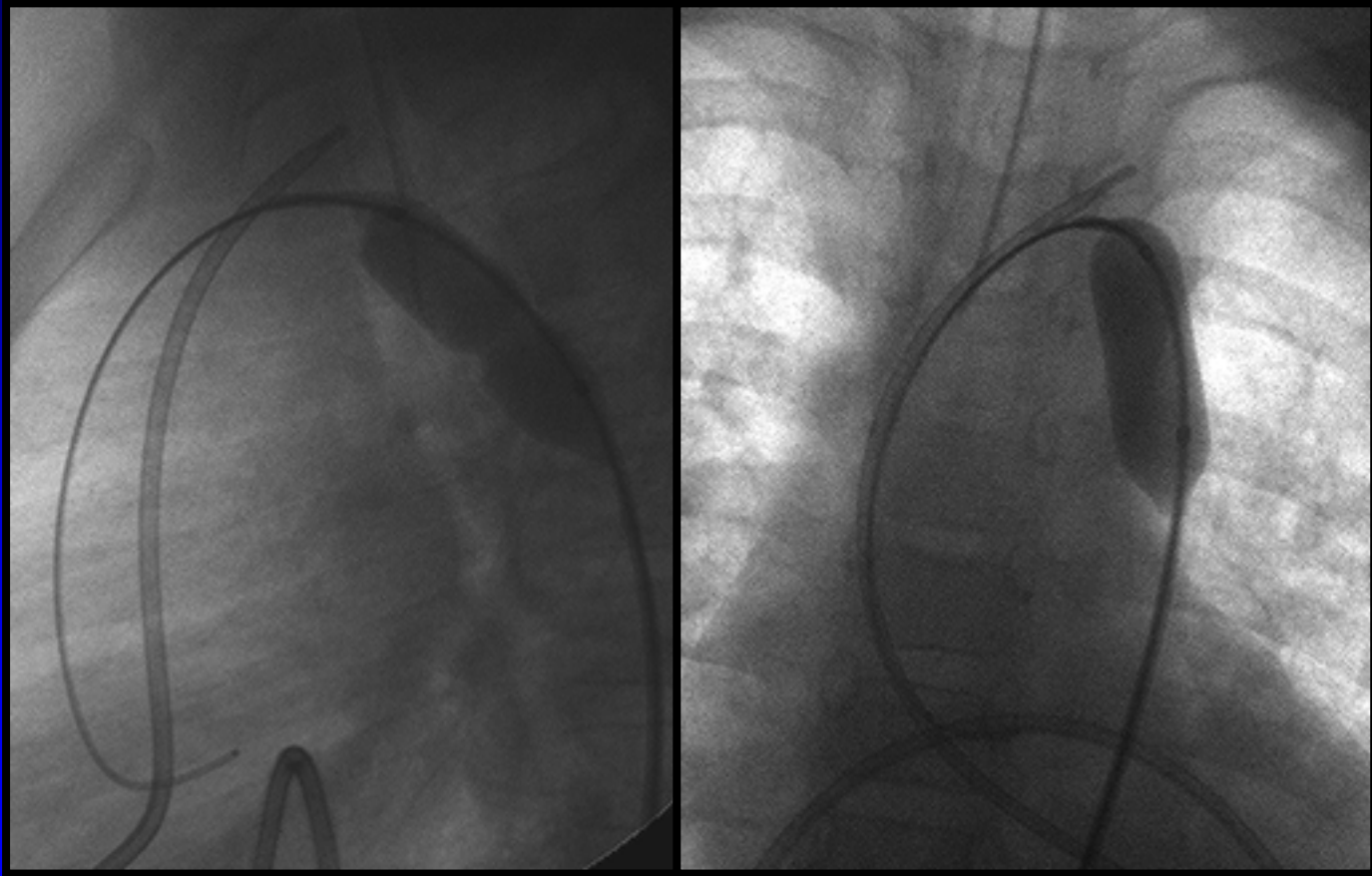
CP 8-zig

Coarctation of the Aorta

- Balloon dilation



Angioplasty of COA



Pre & post dilation angiogram

Lat

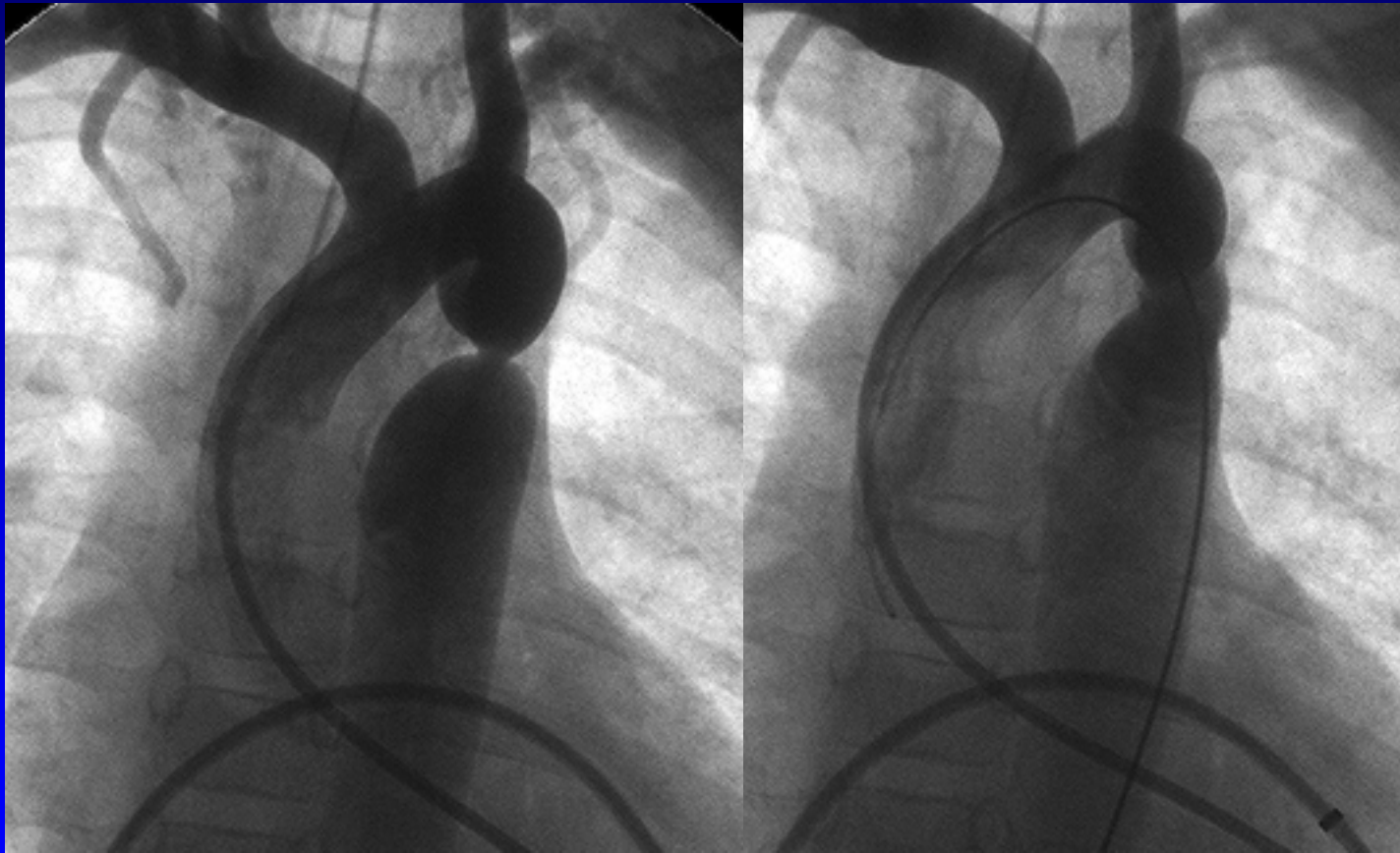


pre

post

Pre & post dilation angiogram

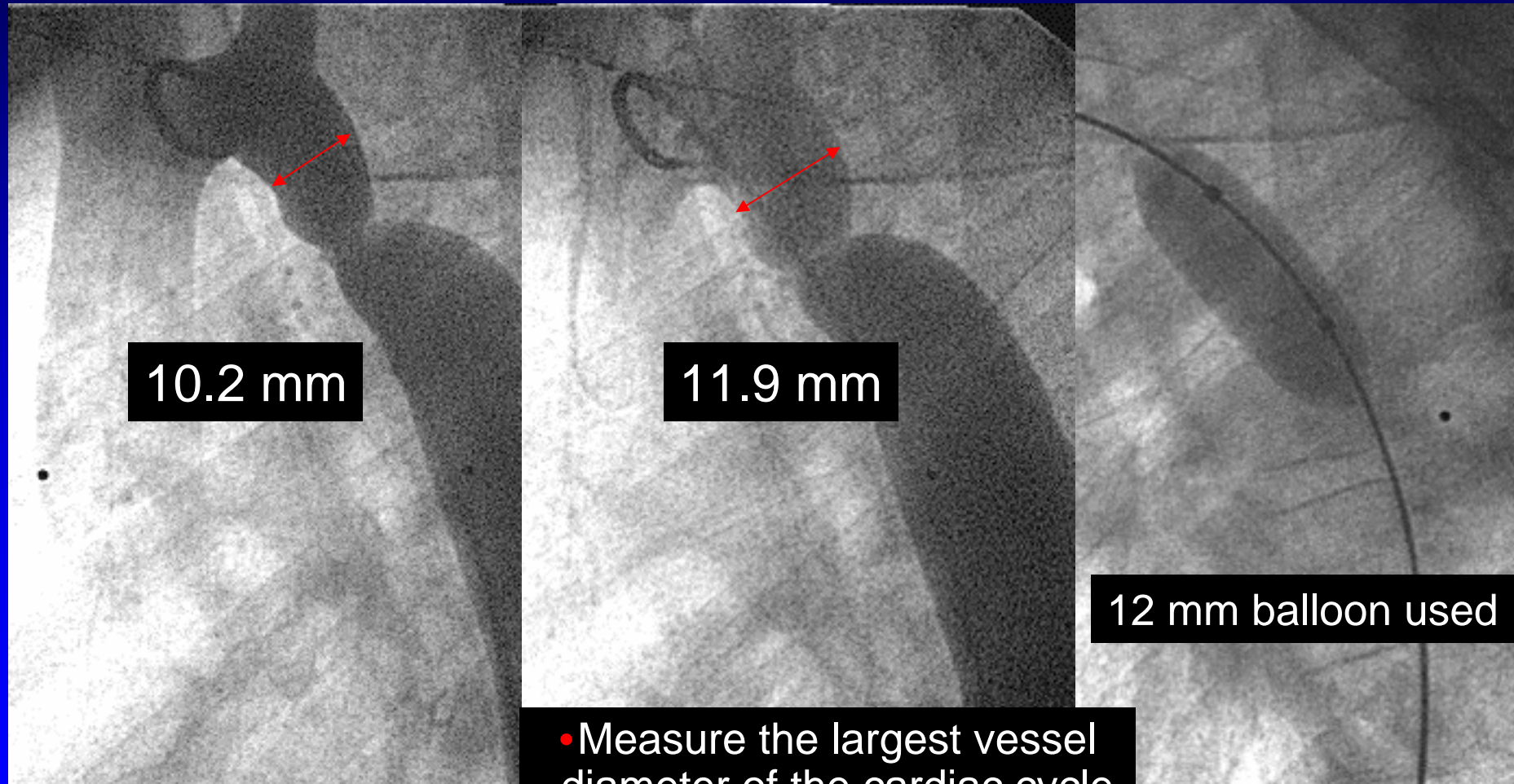
AP



pre

post

Aortic diameter changes with a pulsatile aorta



Pre and post dilation gradients



Asc Ao 100/57
Desc Ao 68/53

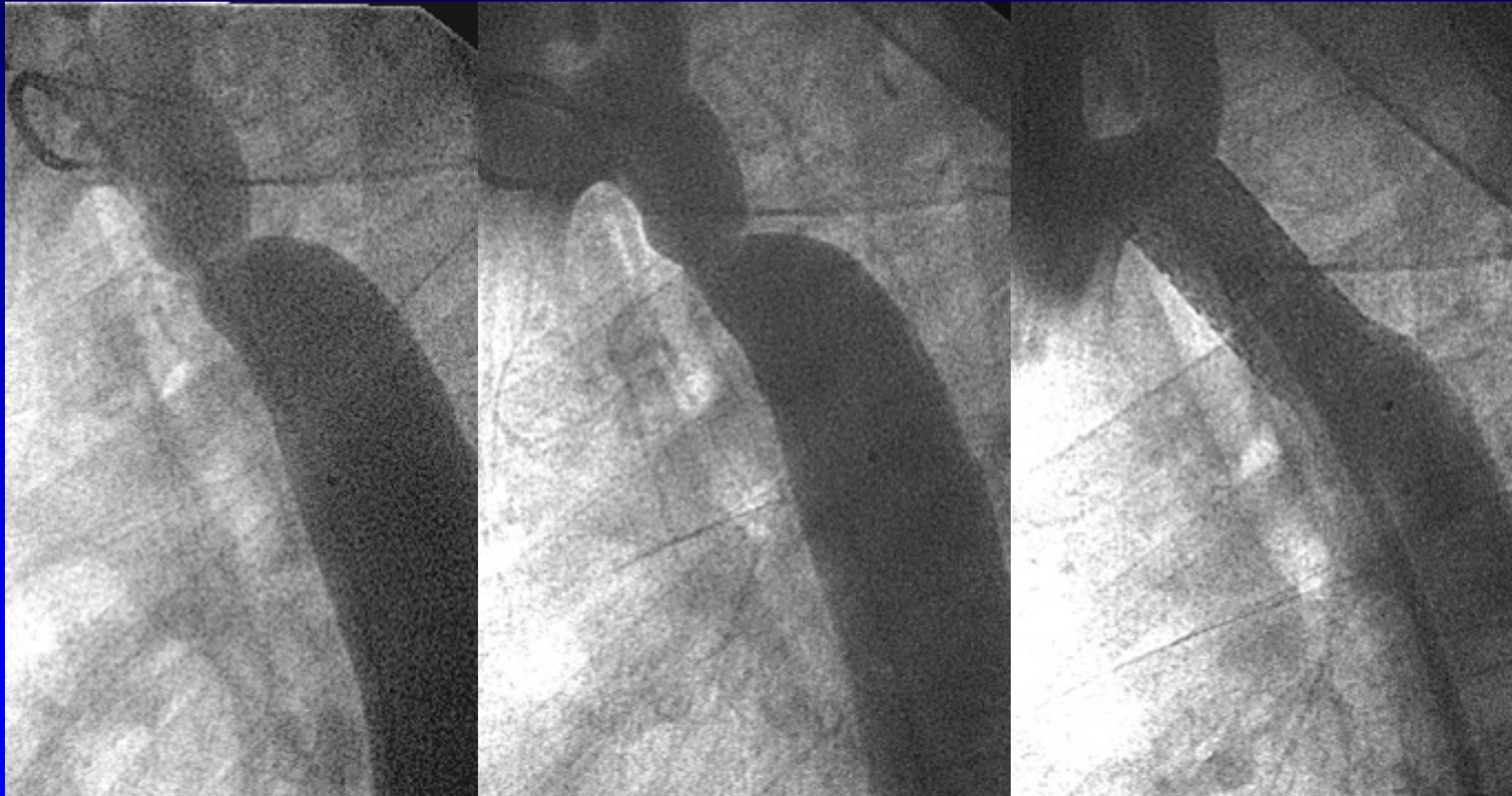
Asc Ao 92-100/61
Desc Ao 80/58

Now what would you do?
Stop and wait or proceed to stent?

Pre-dilation

Post-dilation

Comparison of aortograms



Pre-dilation

Post-dilation

Post-stent

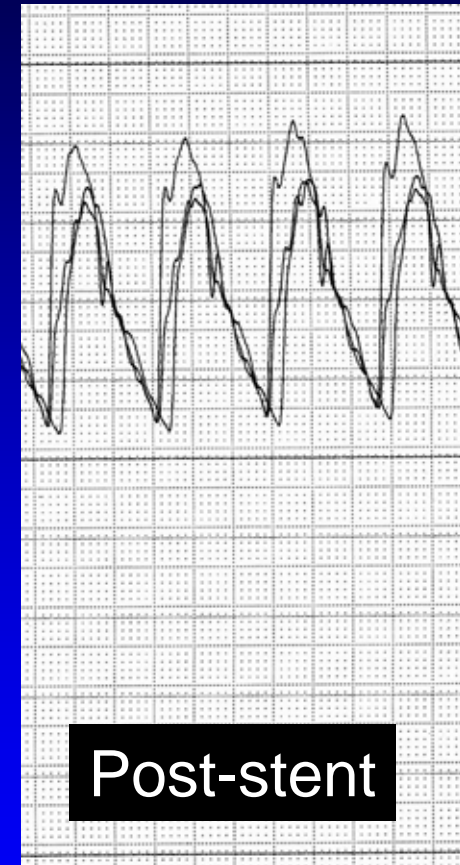
Comparison of gradients



Asc Ao 100/57
Desc Ao 68/53

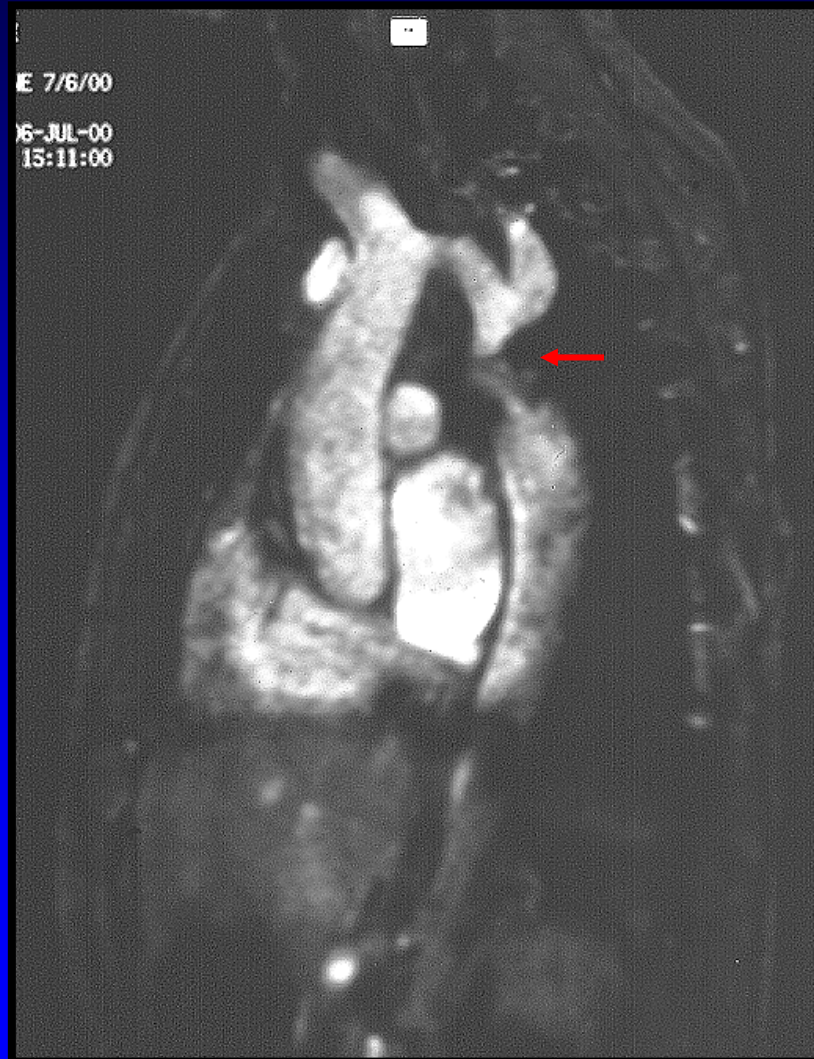


Asc Ao 100/61
Desc Ao 80/58



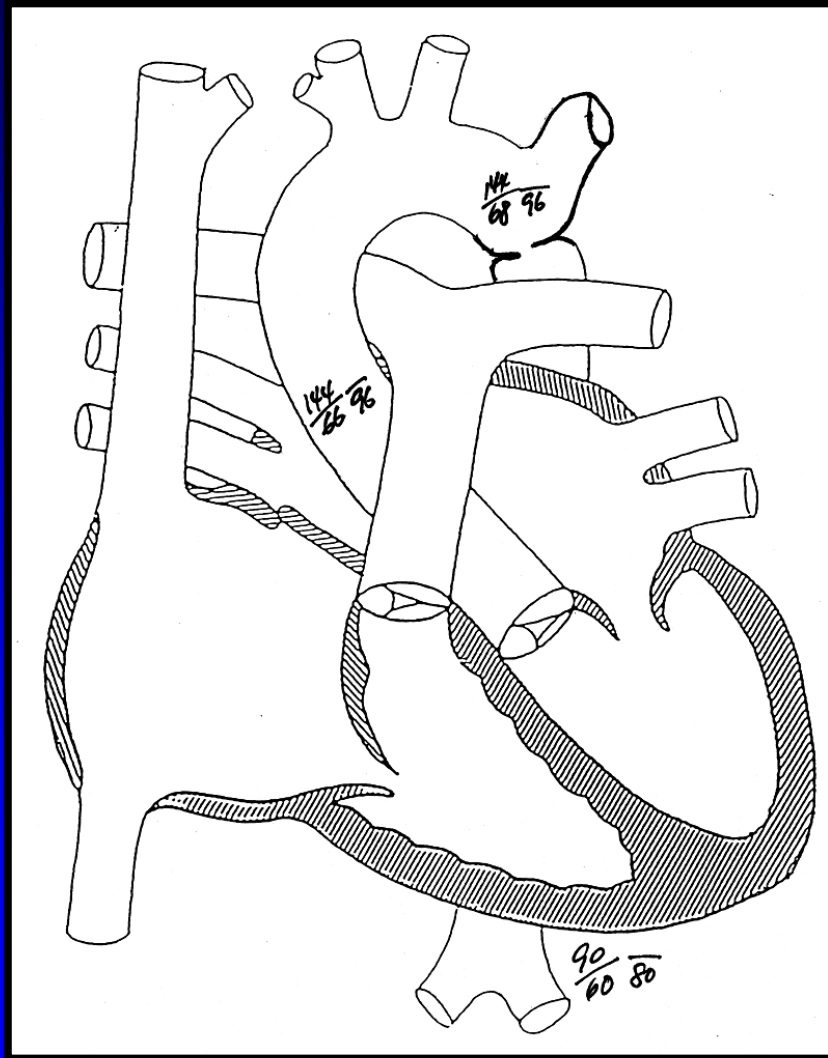
Asc Ao 90/53
Desc Ao 84/54

25 yr. F w/ severe pre-eclampsia during second trimester pregnancy



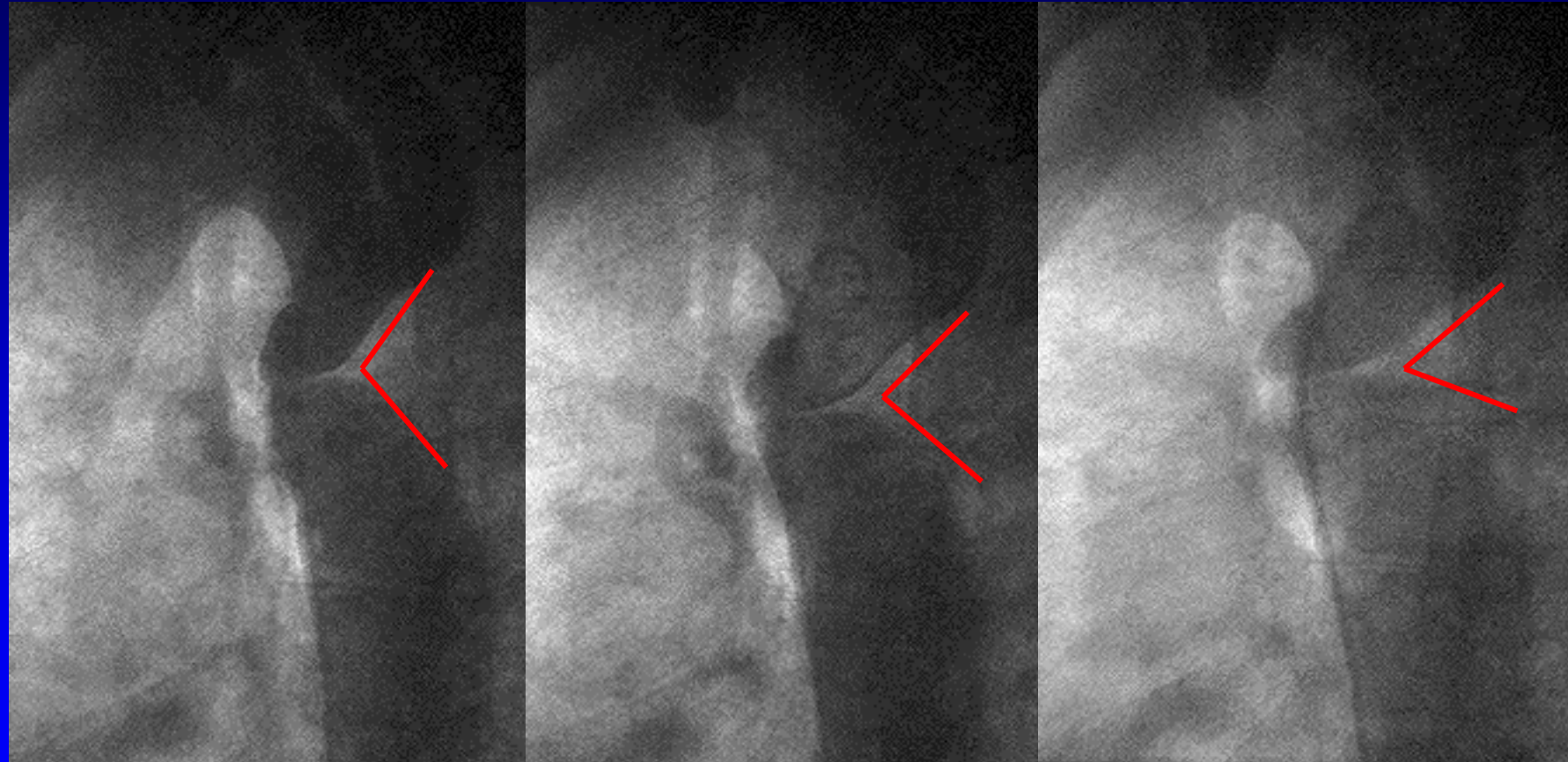
- Severe discrete COA
- Surgery vs. stent?
- Radiation vs. bypass surgery?

Cath data

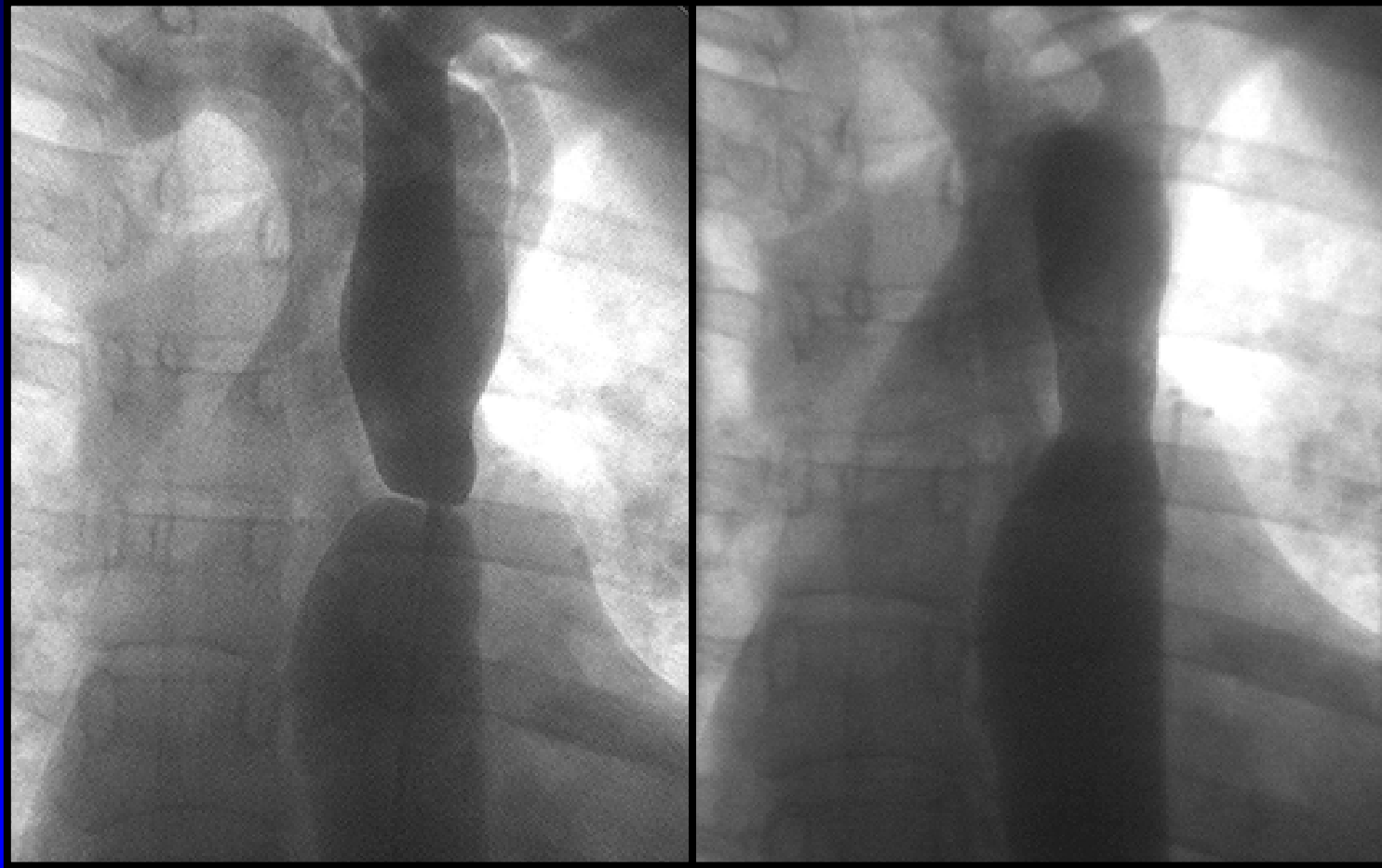


- 54 mmHg gradient
- Min diam: 4.6-5.7 mm
- Isthmus diam: 13-15 mm

Dynamic posterior bend



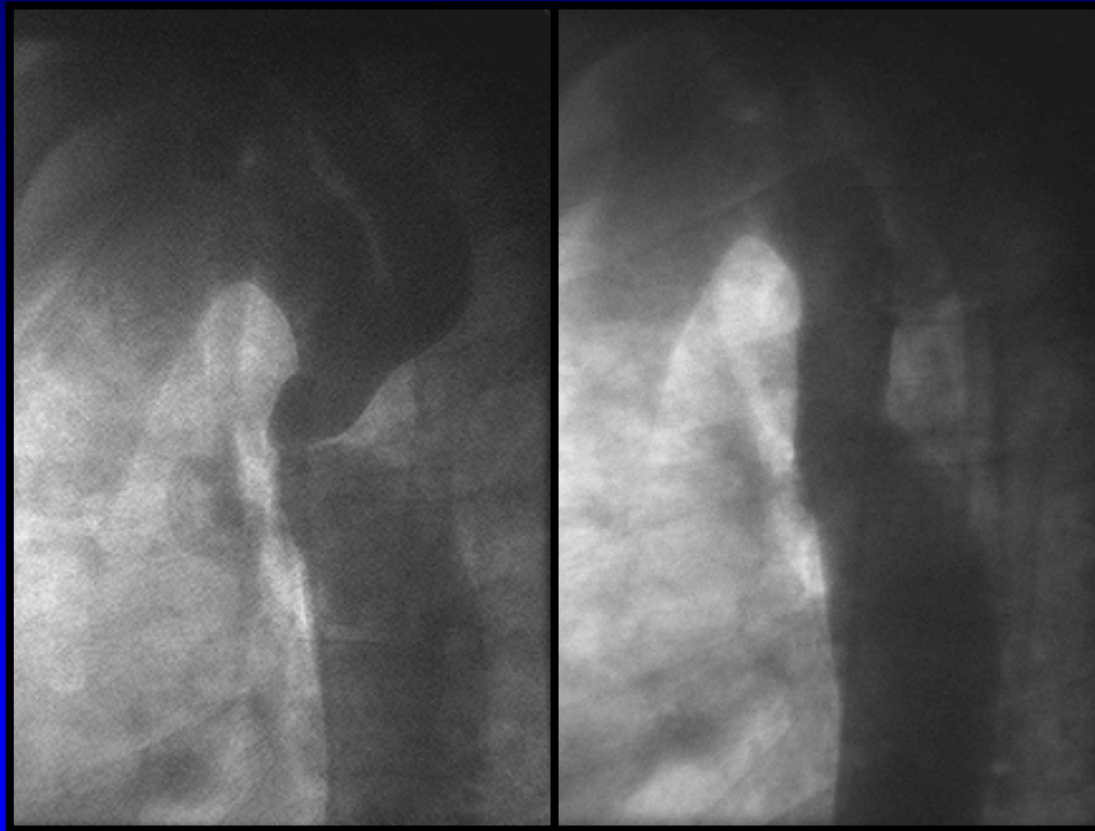
Pre & post AP angiogram



Pre

Post

Pre & post lat angiogram



Pre

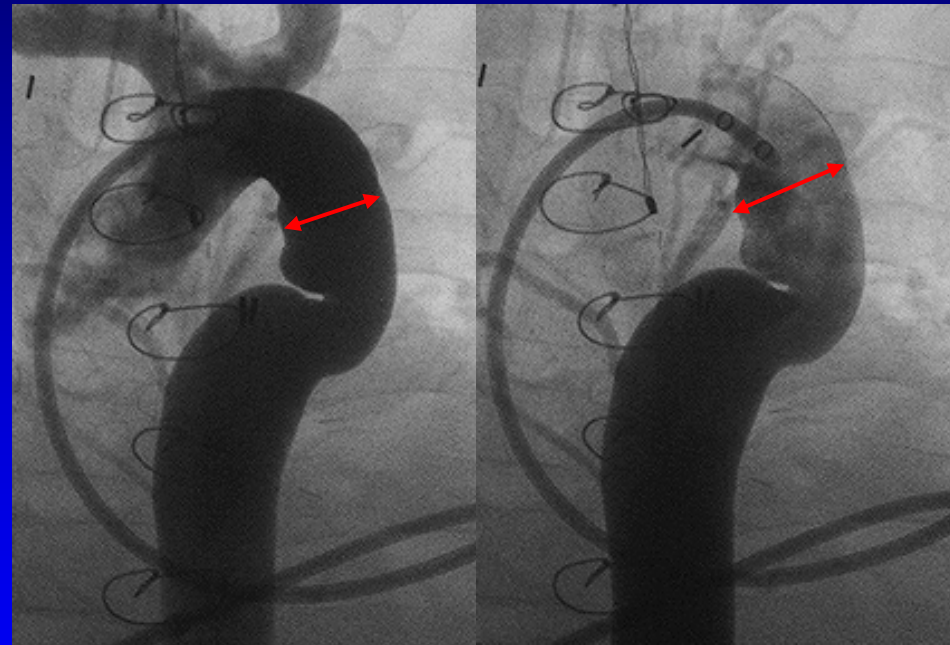
Post

QuickTime?and a
Video decompressor
are needed to see this picture.

Stent prevents
dynamic bend

S-bend COA

QuickTime?and a
Motion JPEG A decompressor
are needed to see this picture.



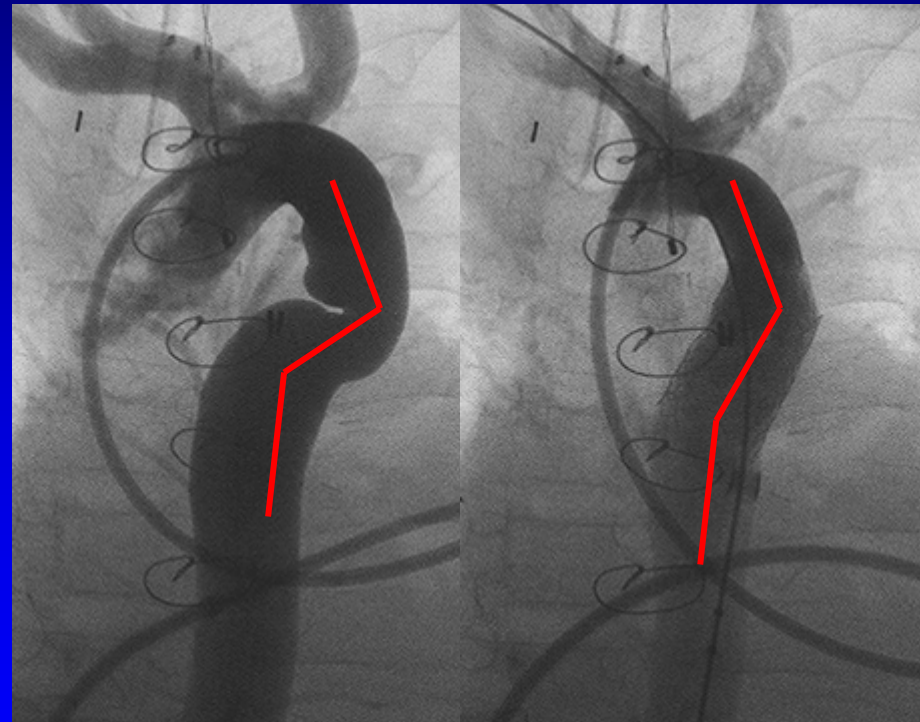
Vessel diameter change
during cardiac cycle

Stent straighten out the S-bend

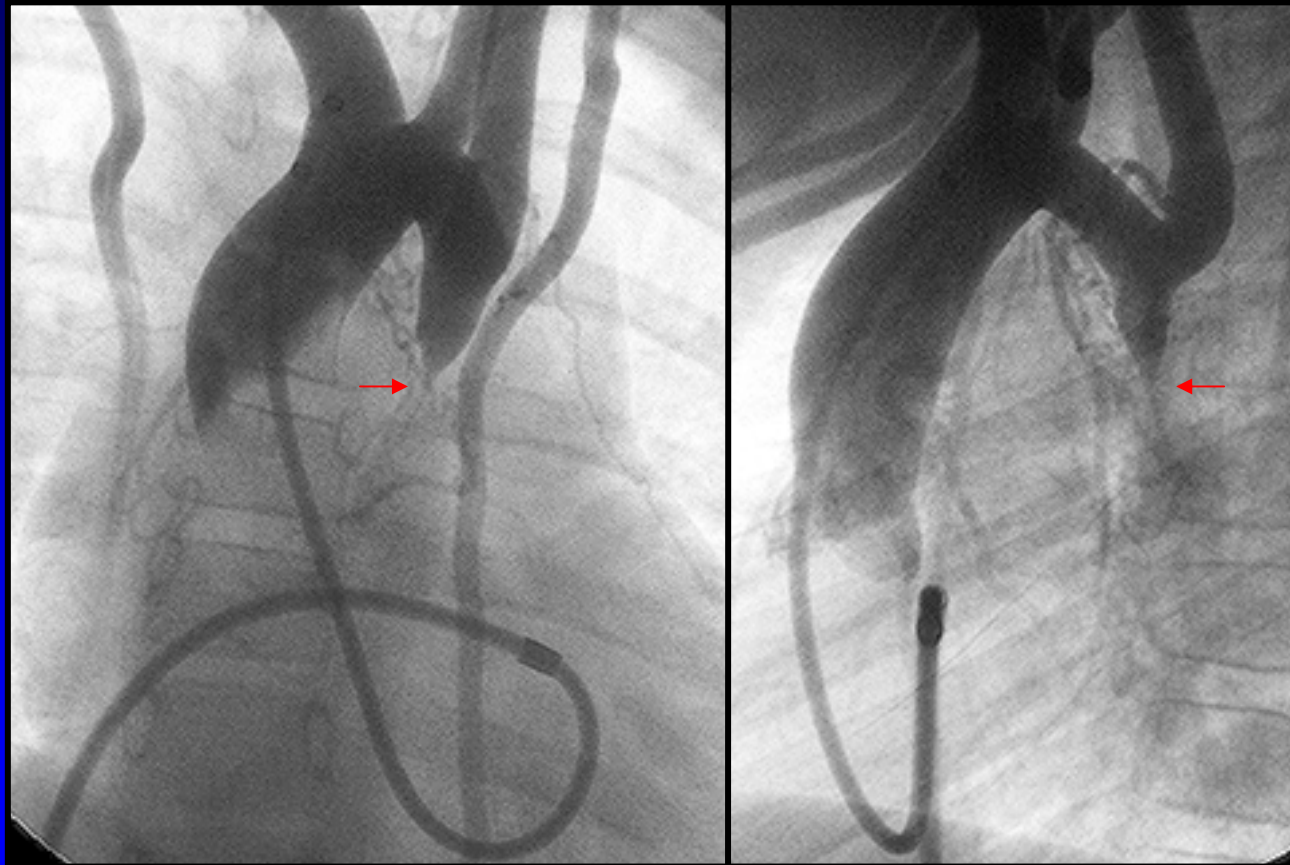
Stent implant

Pre

Post



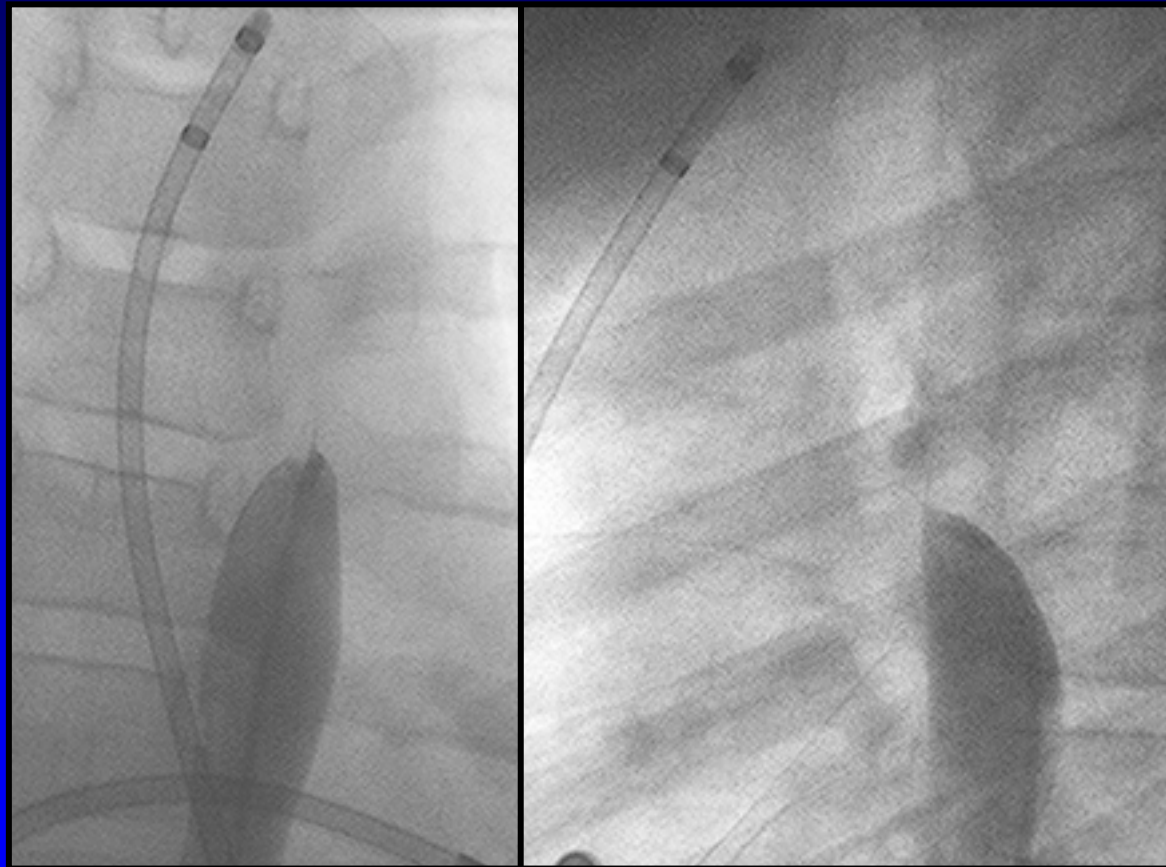
Severe coarctation of the aorta-(virtual interruption)



AP

Lat

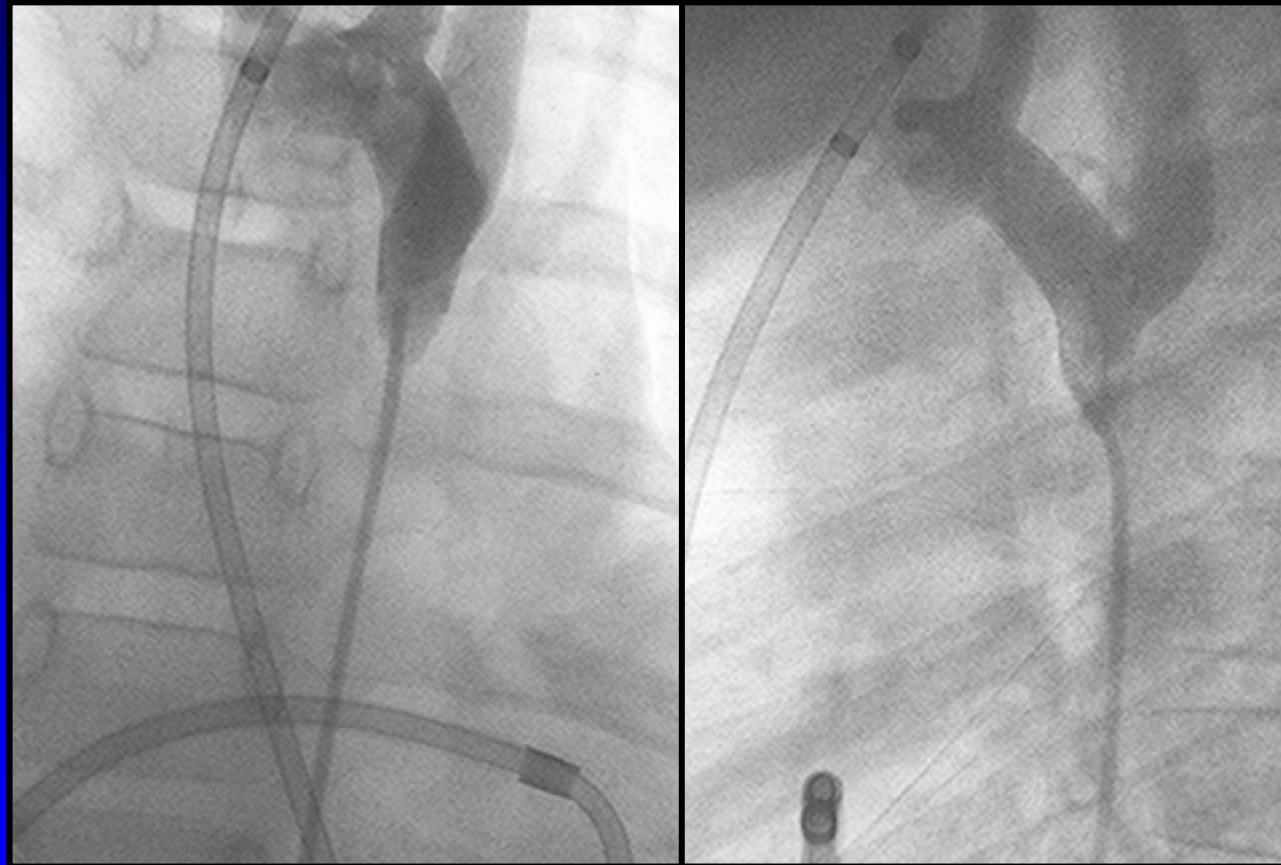
Severe coarctation of the aorta-(virtual interruption)



AP

Lat

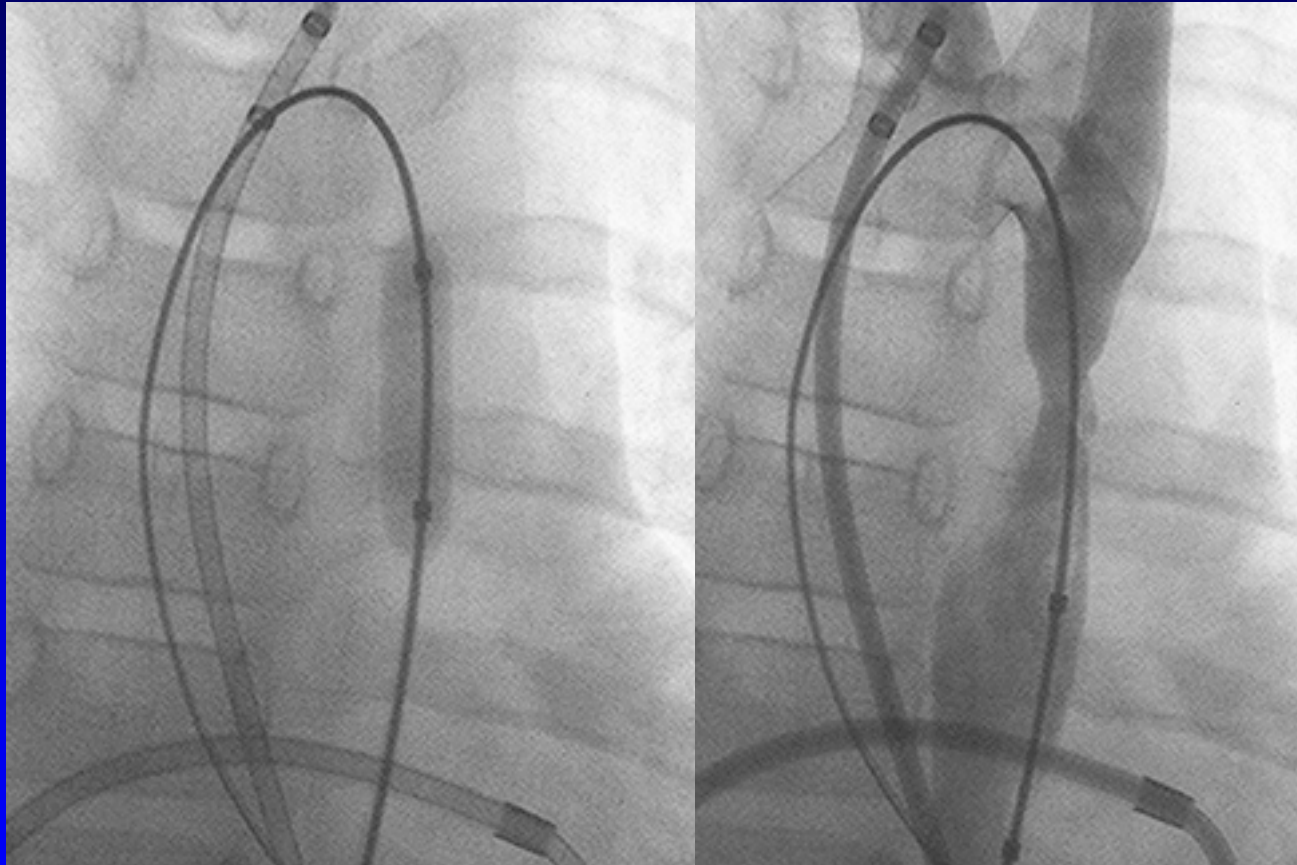
Crossing coarctation w/ wire & catheter



AP

Lat

Test dilation w/ 10 mm low pressure balloon (2-4 atmospheric pressure)

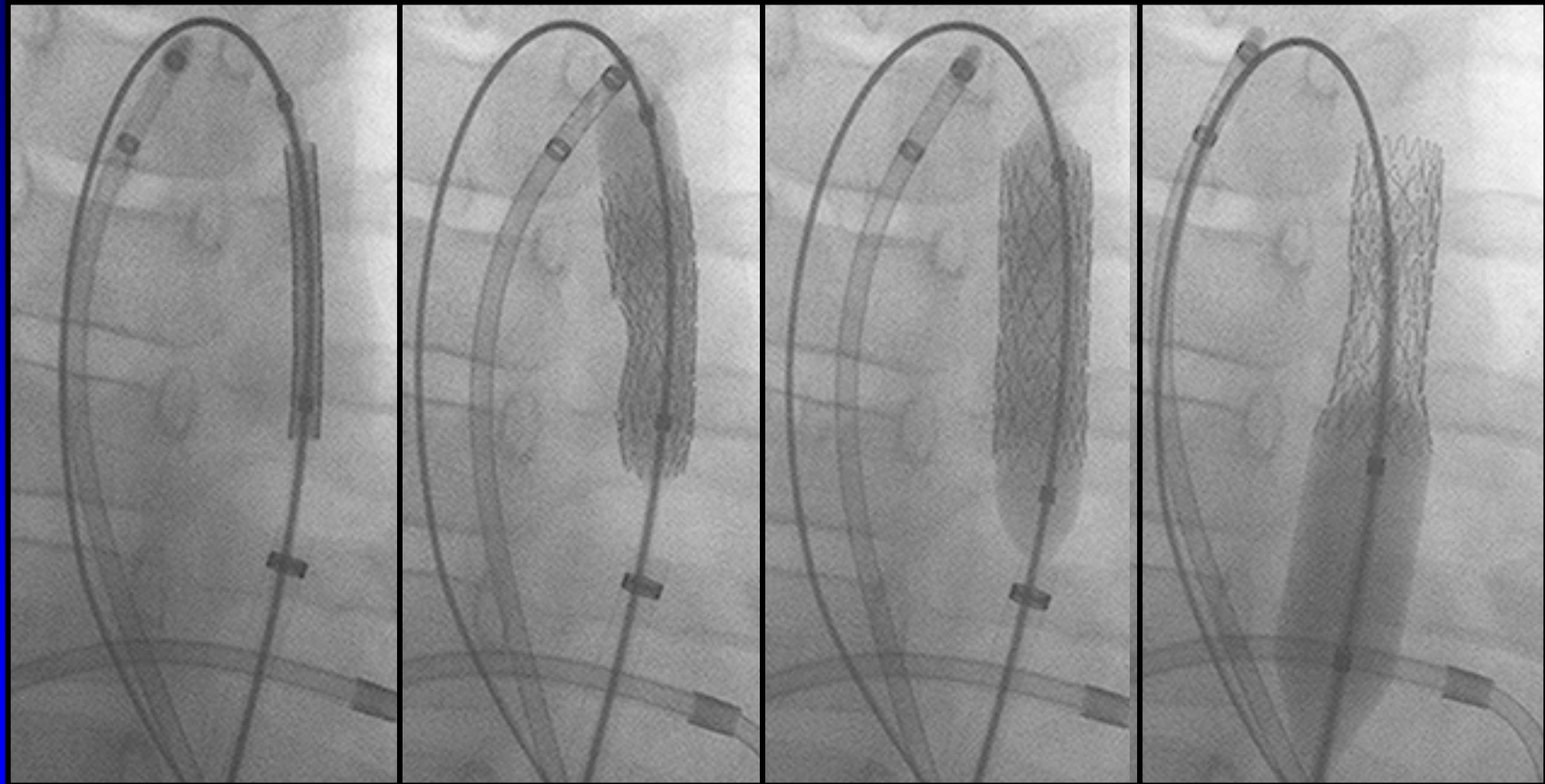


Compliant vessel wall

Residual coarctation

Stent implantation

MaxLD 36mm on 12 mm balloon



Flared distal end
w/ 14 mm balloon

Pre and post stent angiograms

AP



Pre

Post

Pre and post stent angiograms

Lat



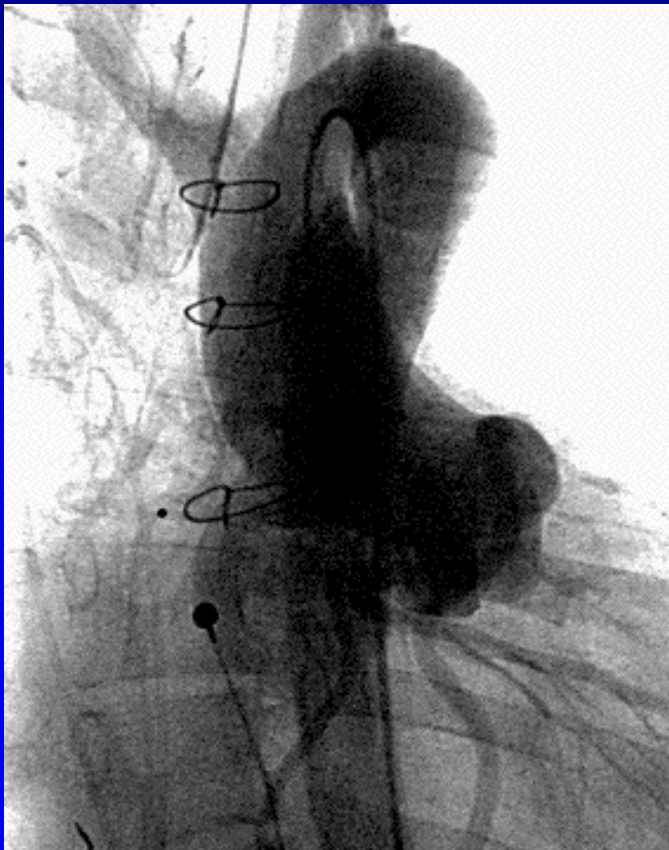
Pre

Post

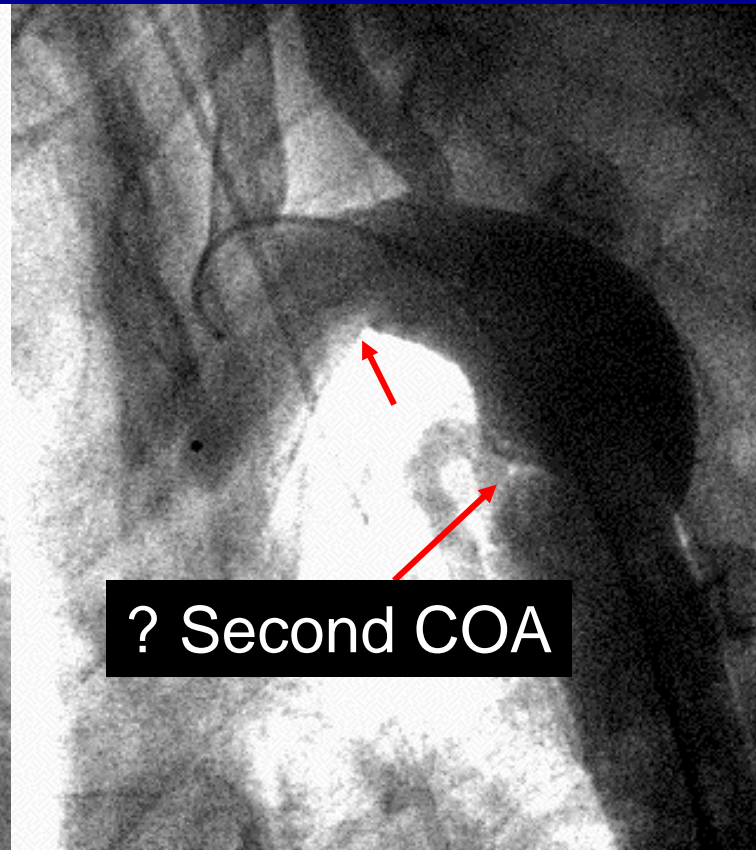
Multiple views may be needed to view entire aorta

21 year old M with post-surgical re-COA

AP



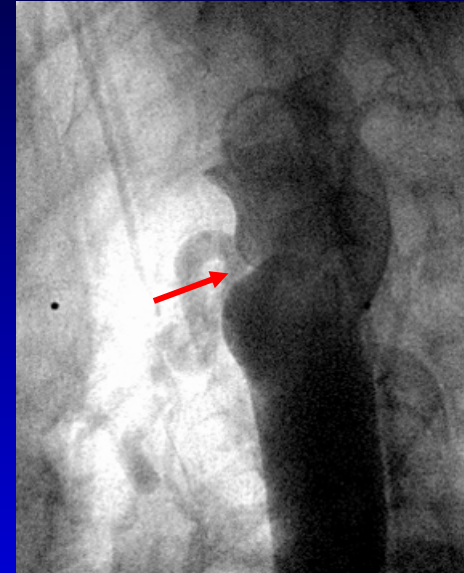
Lat



Multiple views may be needed to view entire aorta

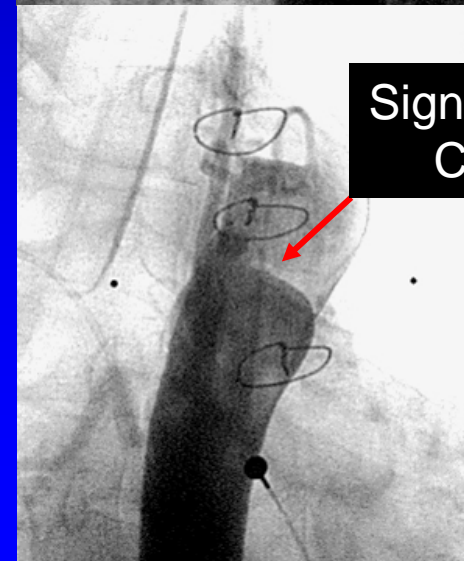
LAO 69

QuickTime and a decompressor are needed to see this picture.



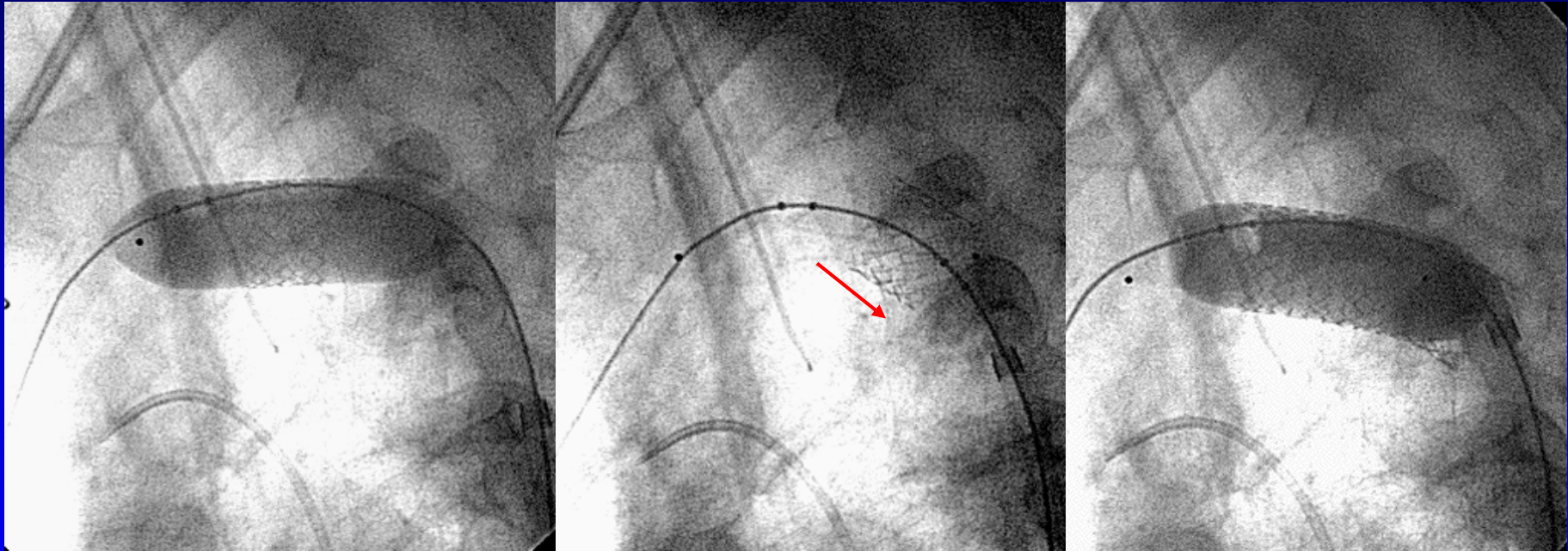
RAO20
CAU14

QuickTime and a decompressor are needed to see this picture.



Significant
COA

Stent implantation

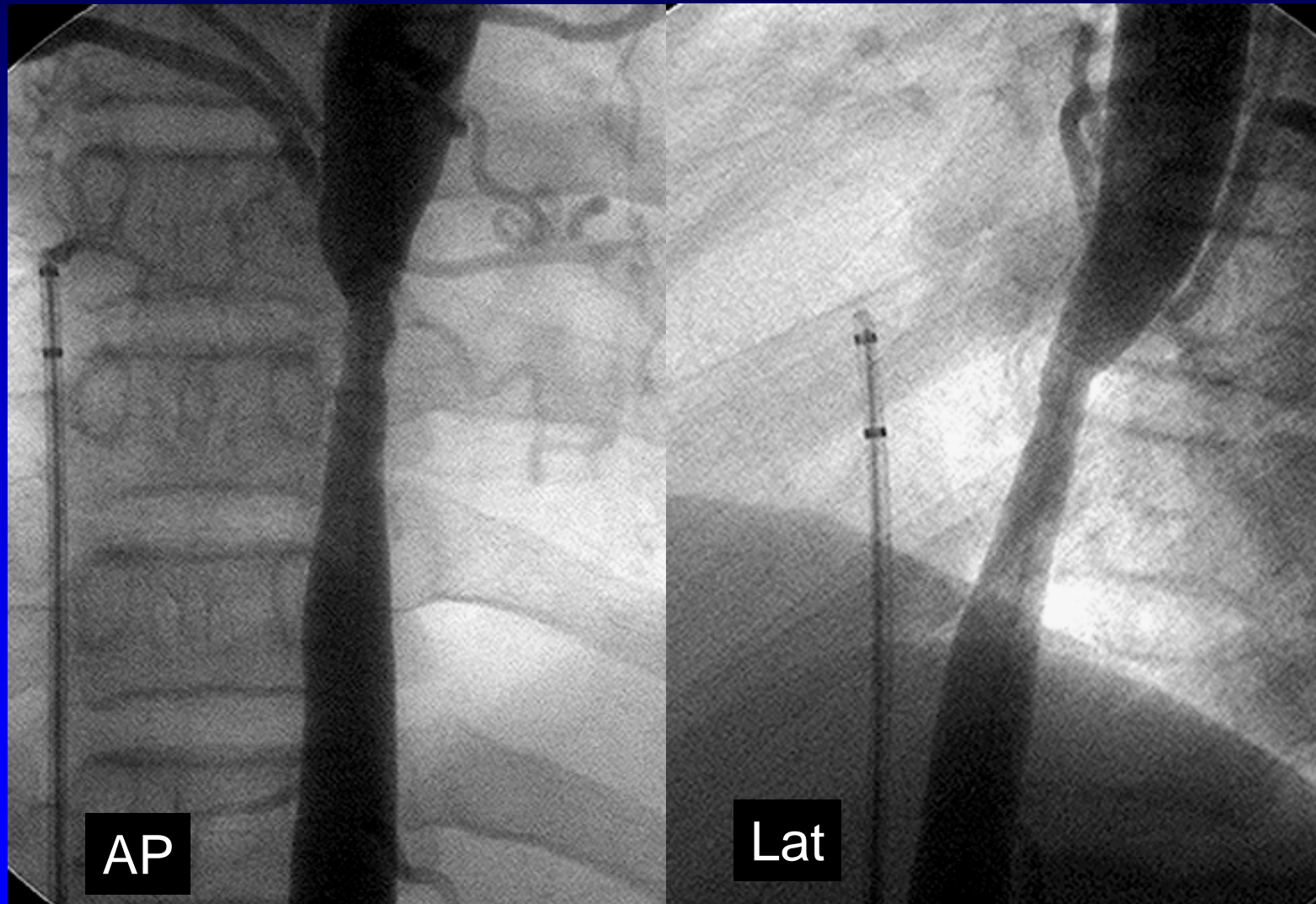


Stent #1
MaxLD16

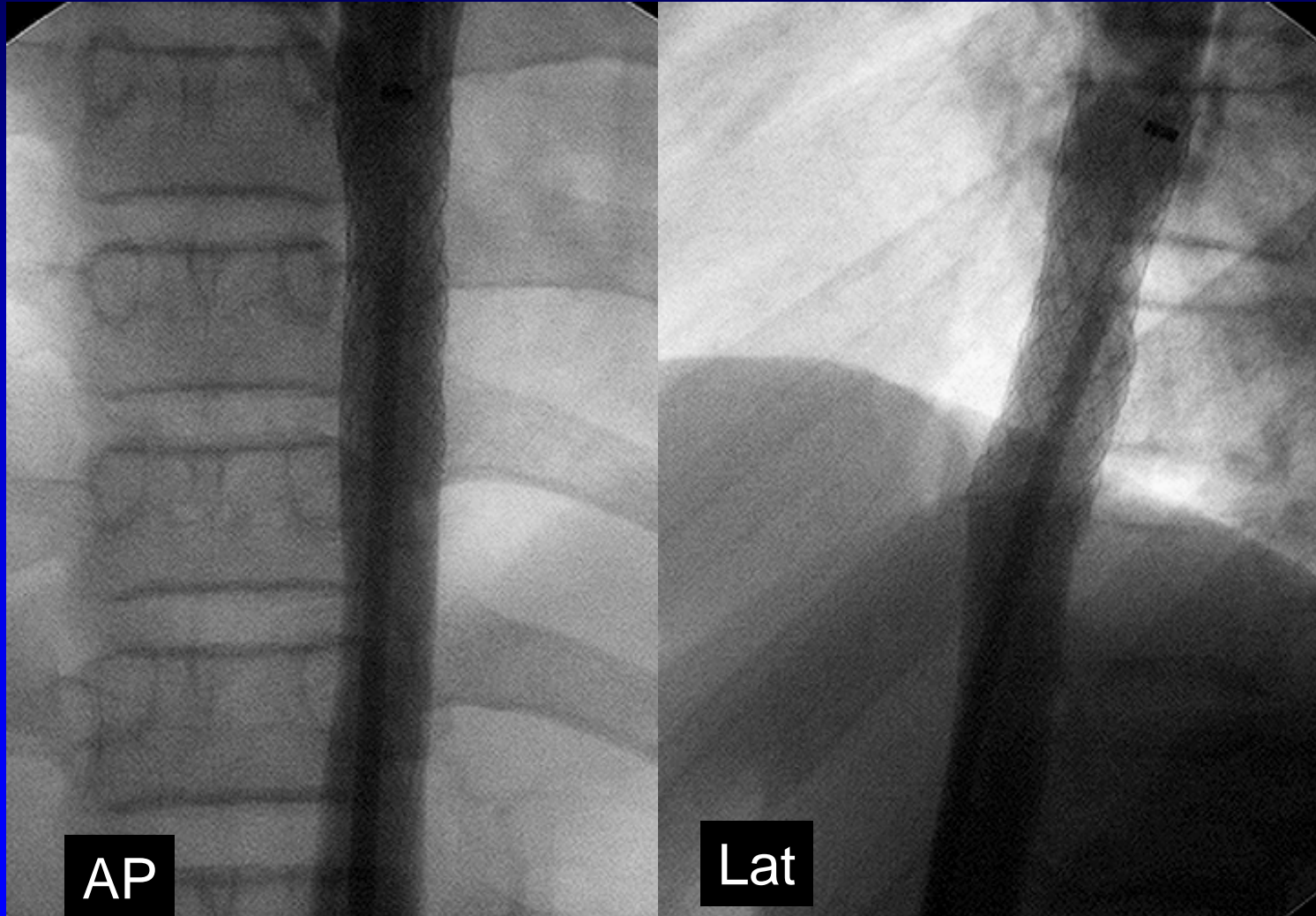
Stent embolized

Stent #2
MaxLD26

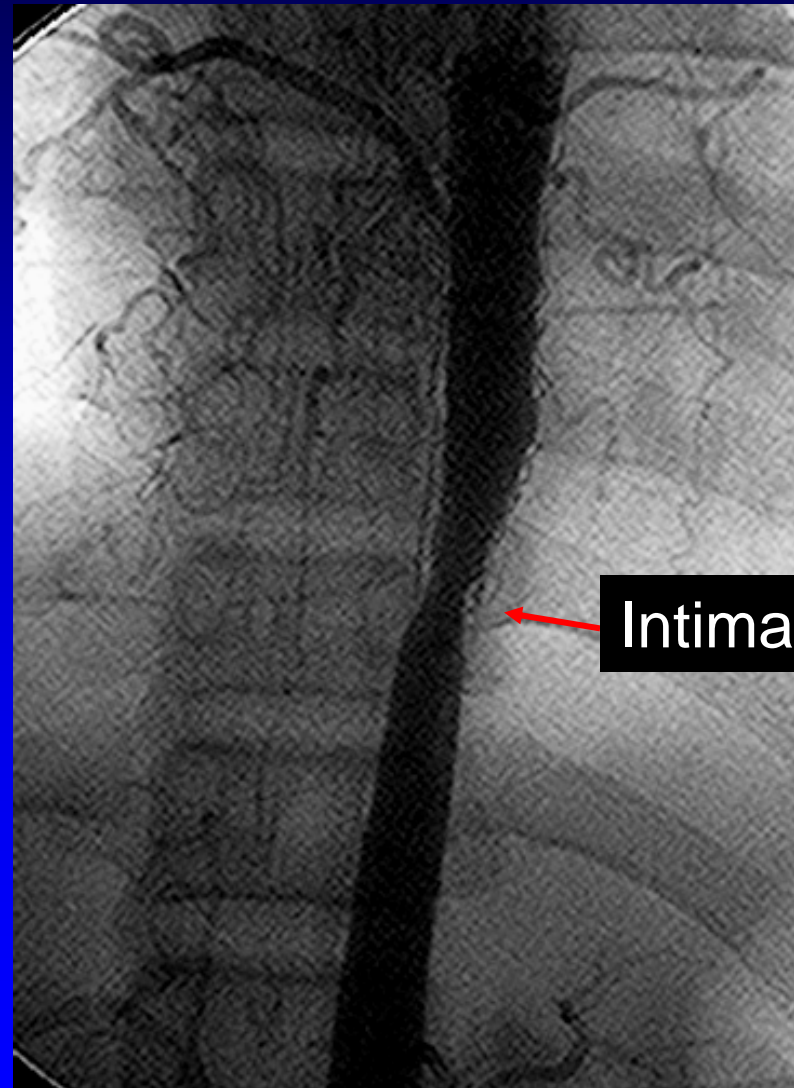
15 yo M w/ severe mid-thoracic COA



Post implantation of 2 stents (P308)

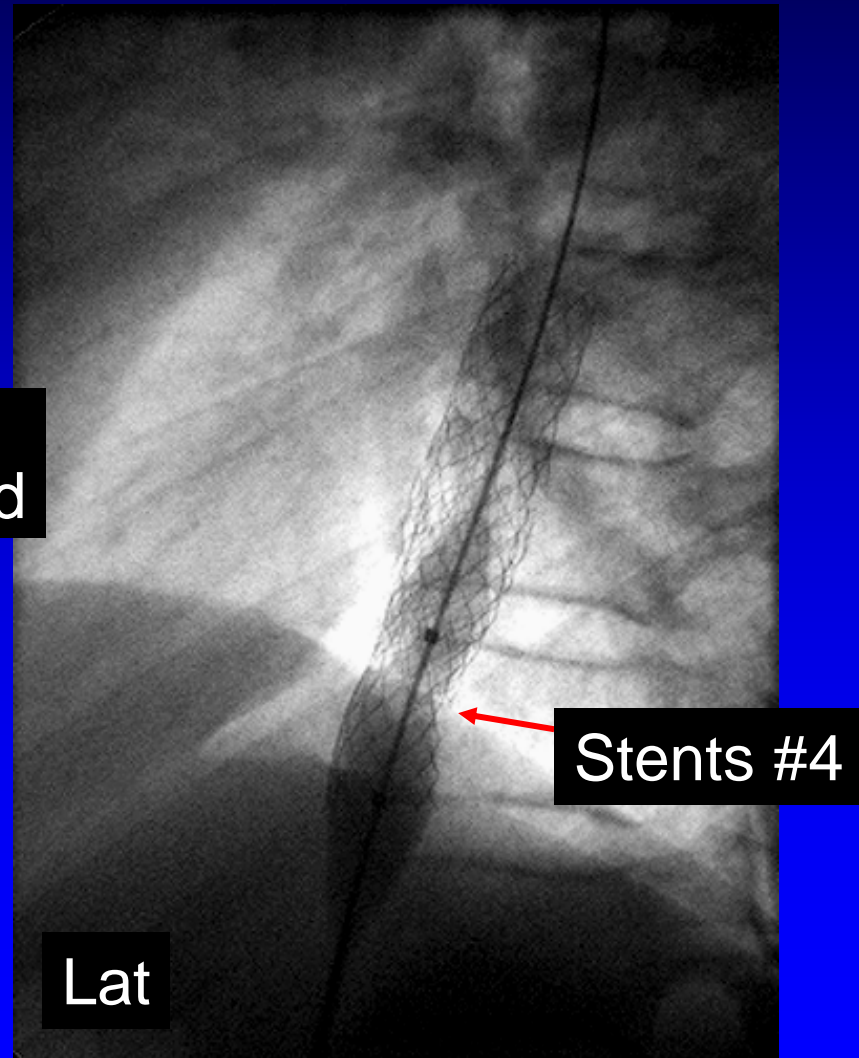
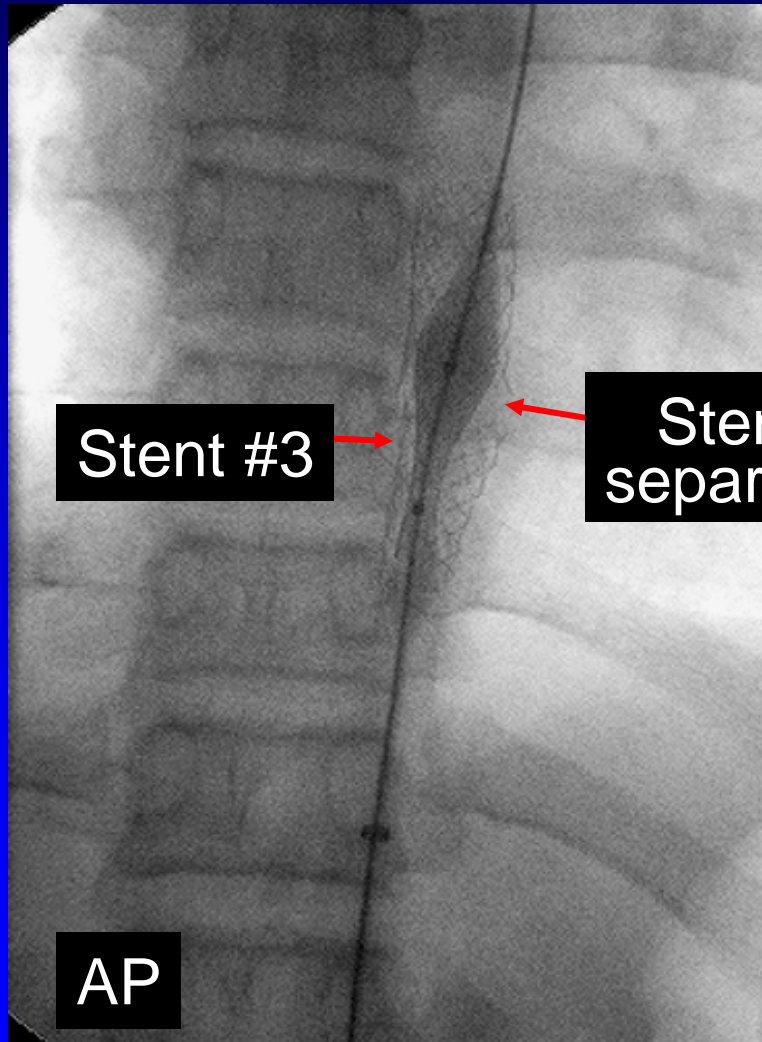


1 year follow-up: Re-COA at distal stent edge



Intimal proliferation

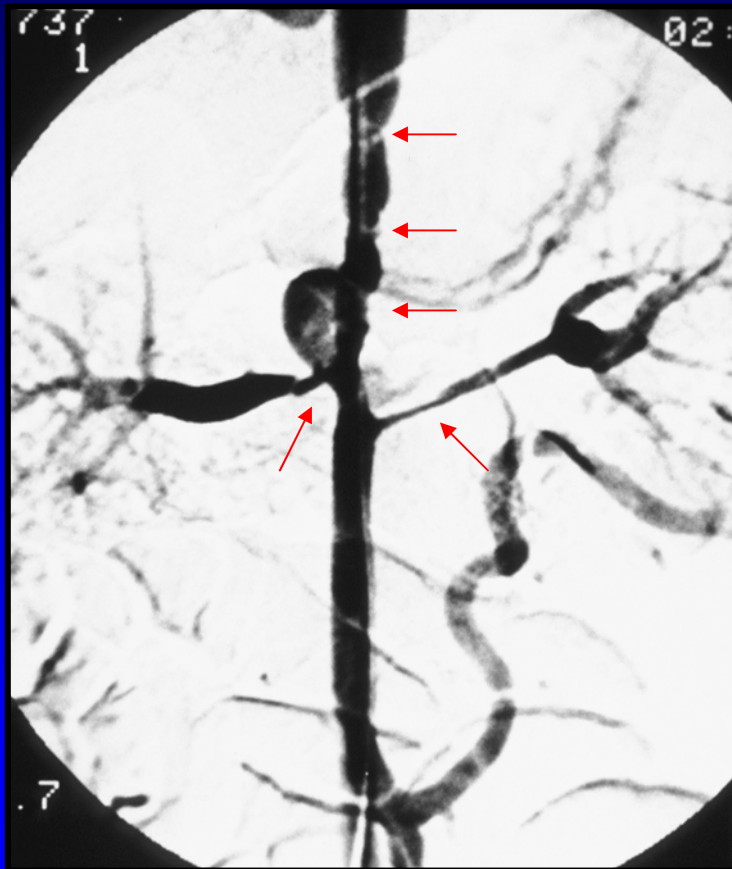
Implantation of 2 additional stents



Post implantation angiograms



Neurofibromatosis w/ mid-aortic syndrome



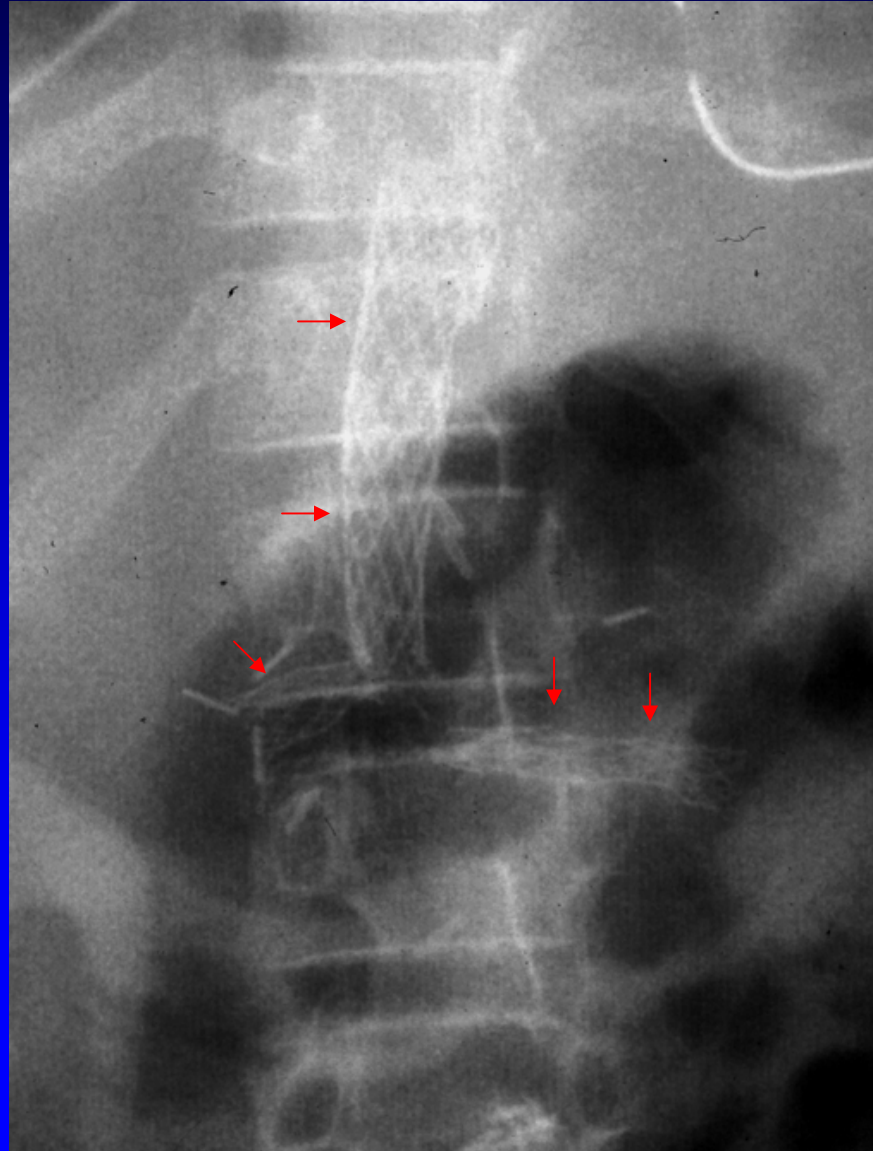
Pre-op angiogram



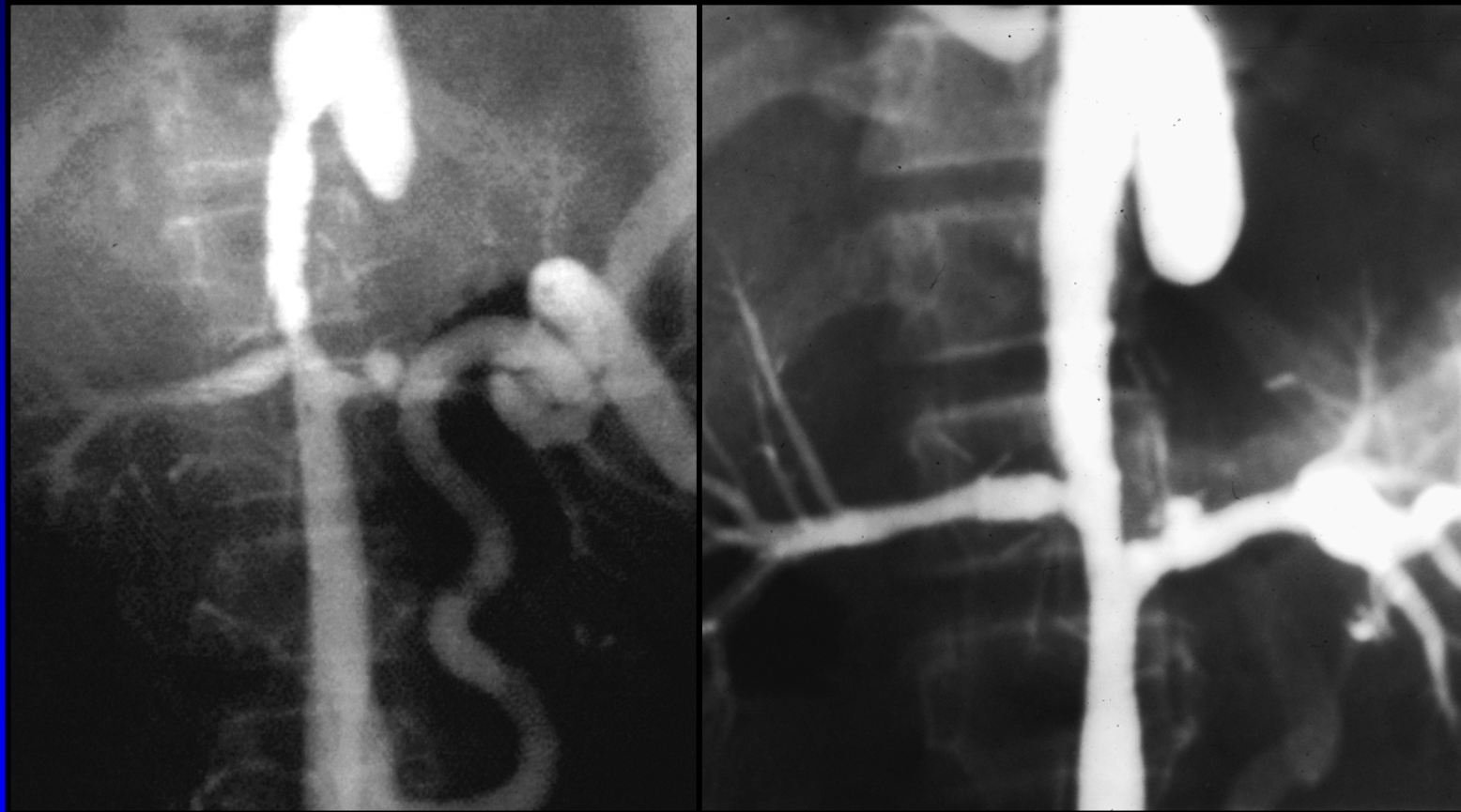
Post-op: residual stenosis

S/P aortic & bilateral renal artery stents

5 stents
implanted



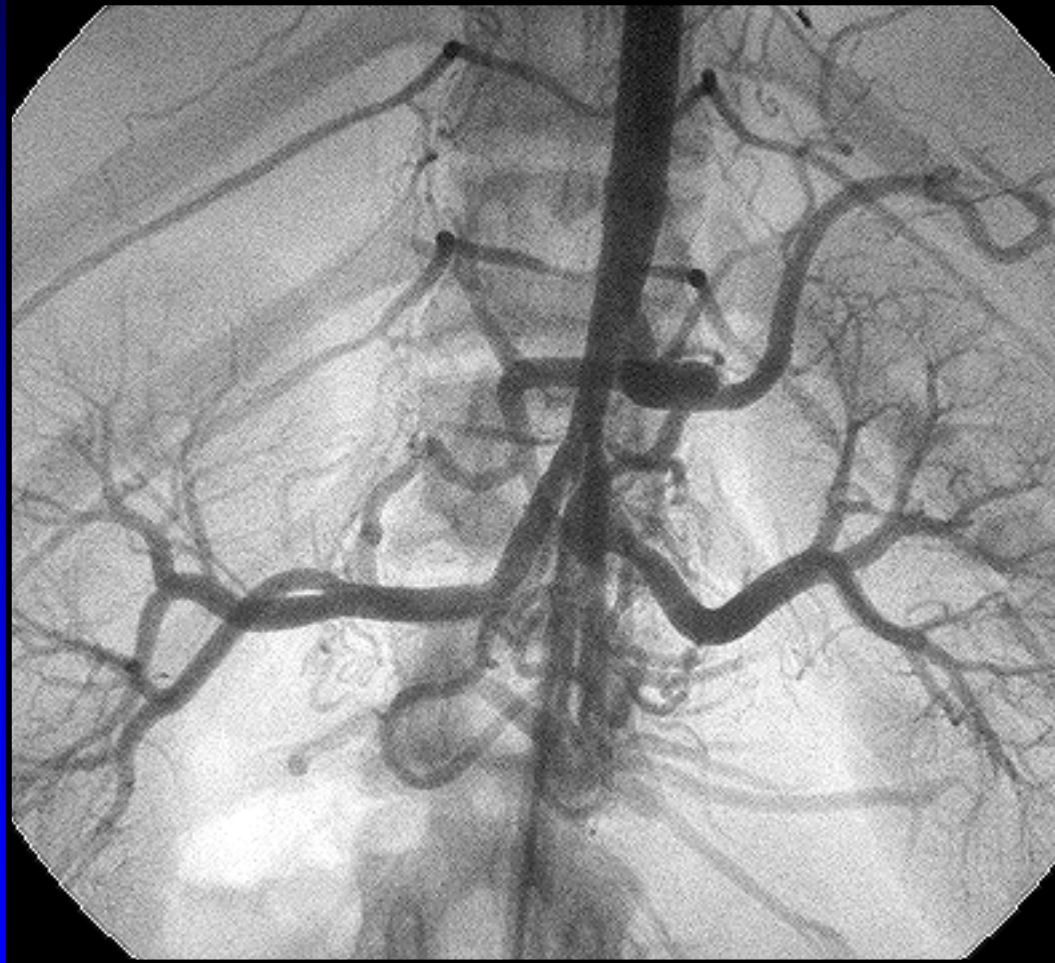
Pre and post angios



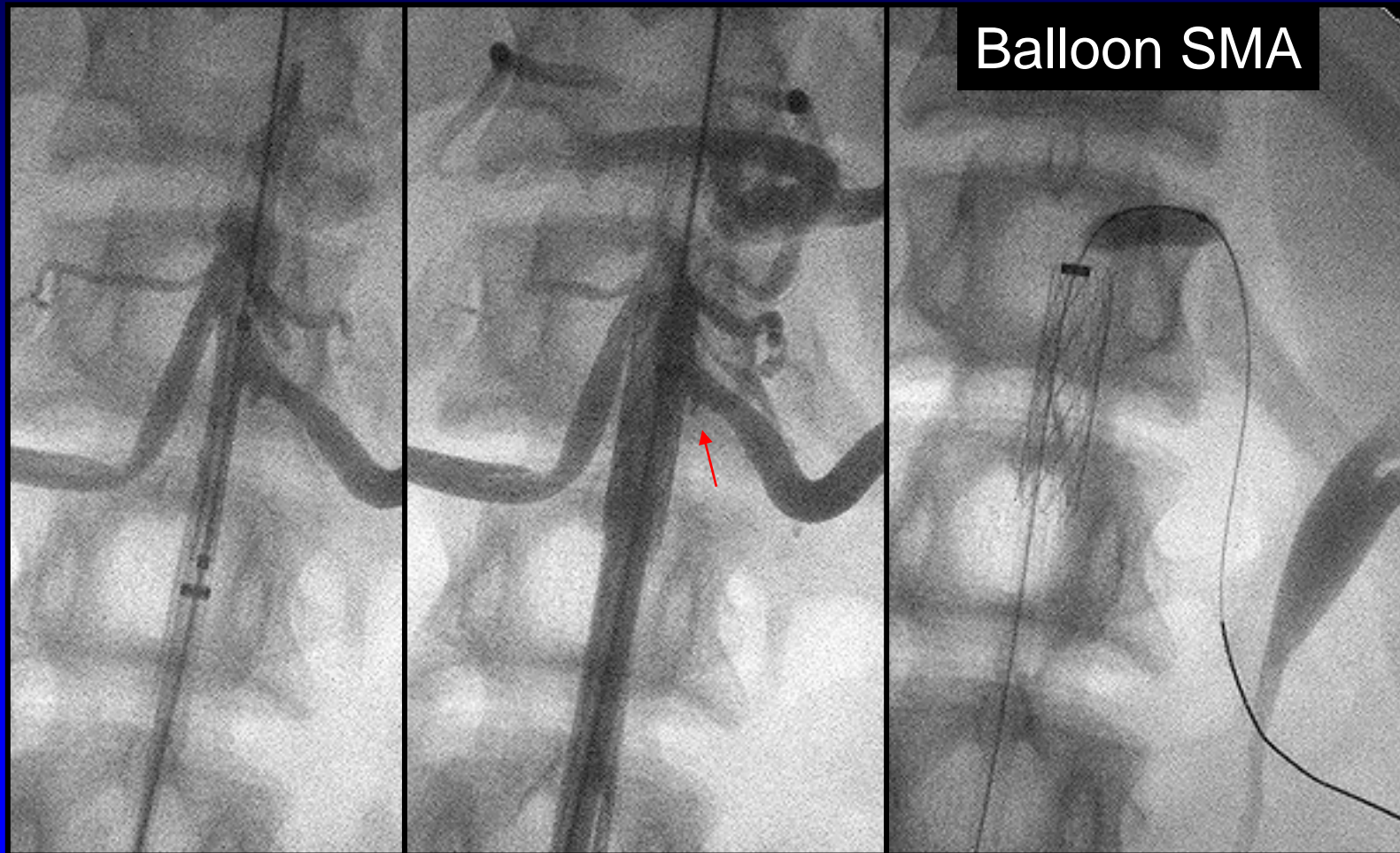
Pre

Post

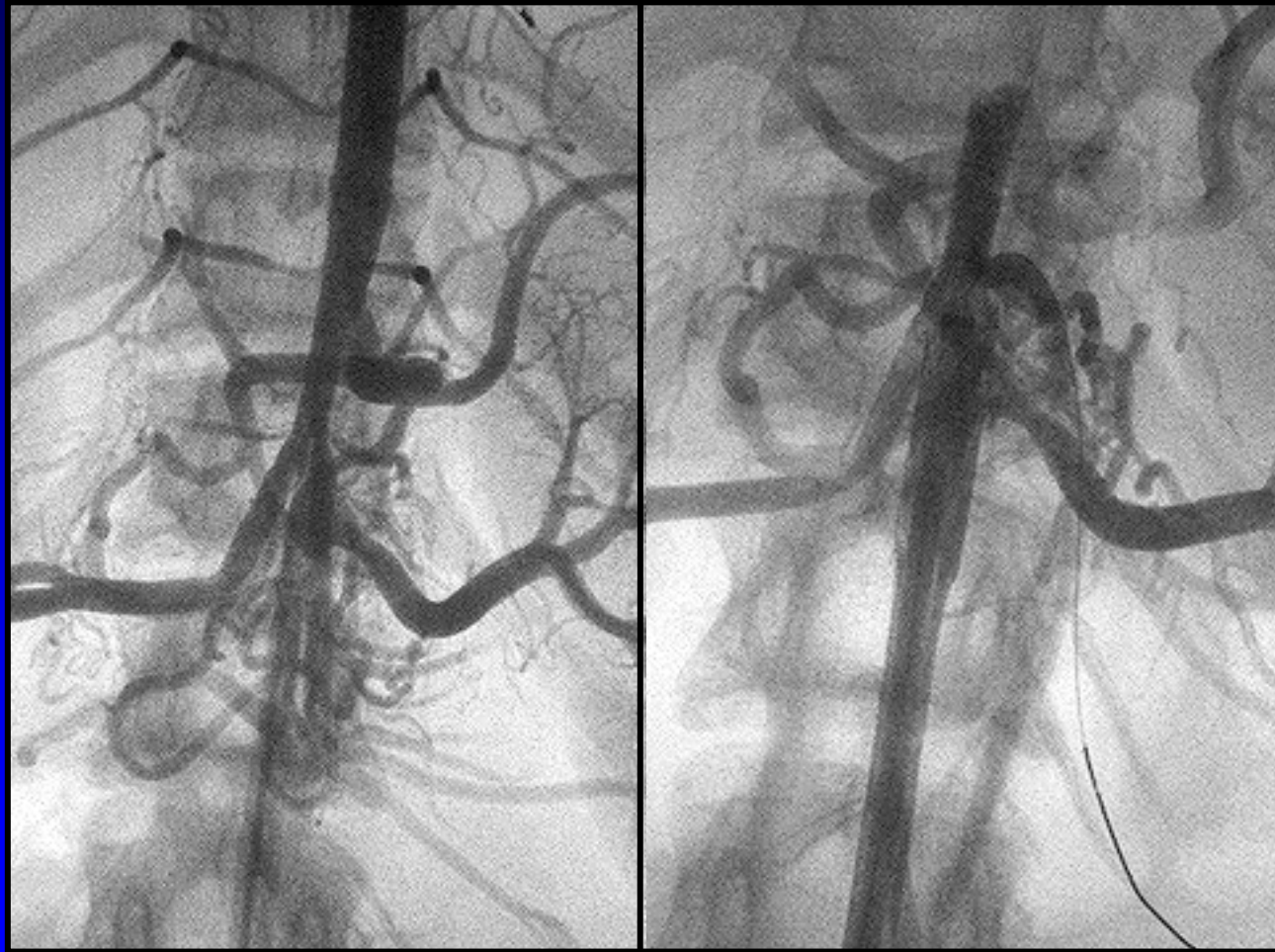
William's syndrome w/ long abdominal COA across renal arteries



Implant stent jailed left renal artery



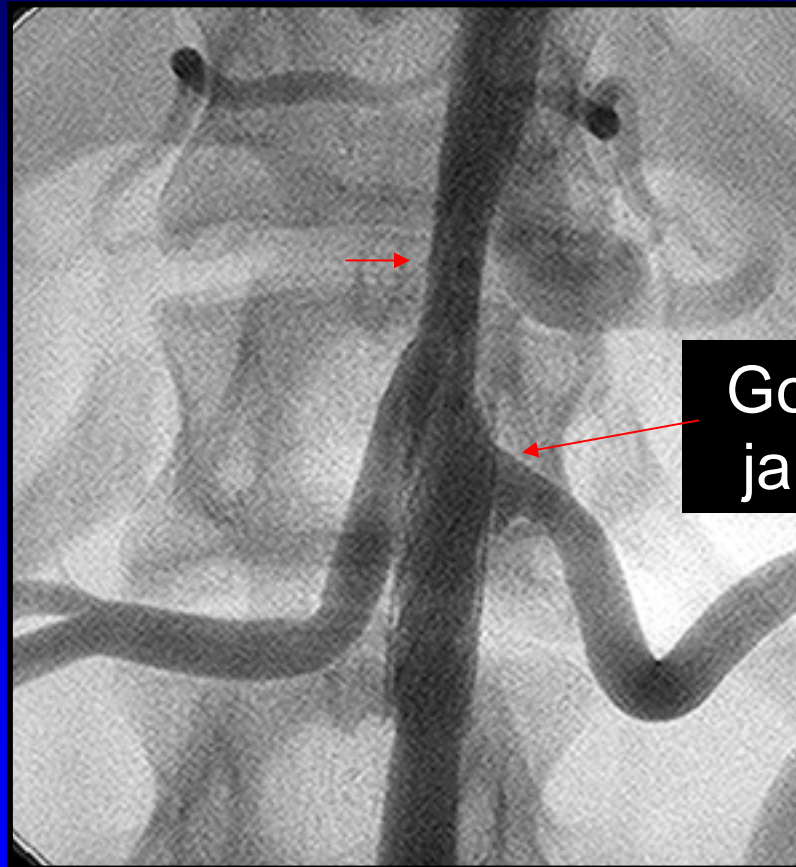
Pre and post angios



Pre

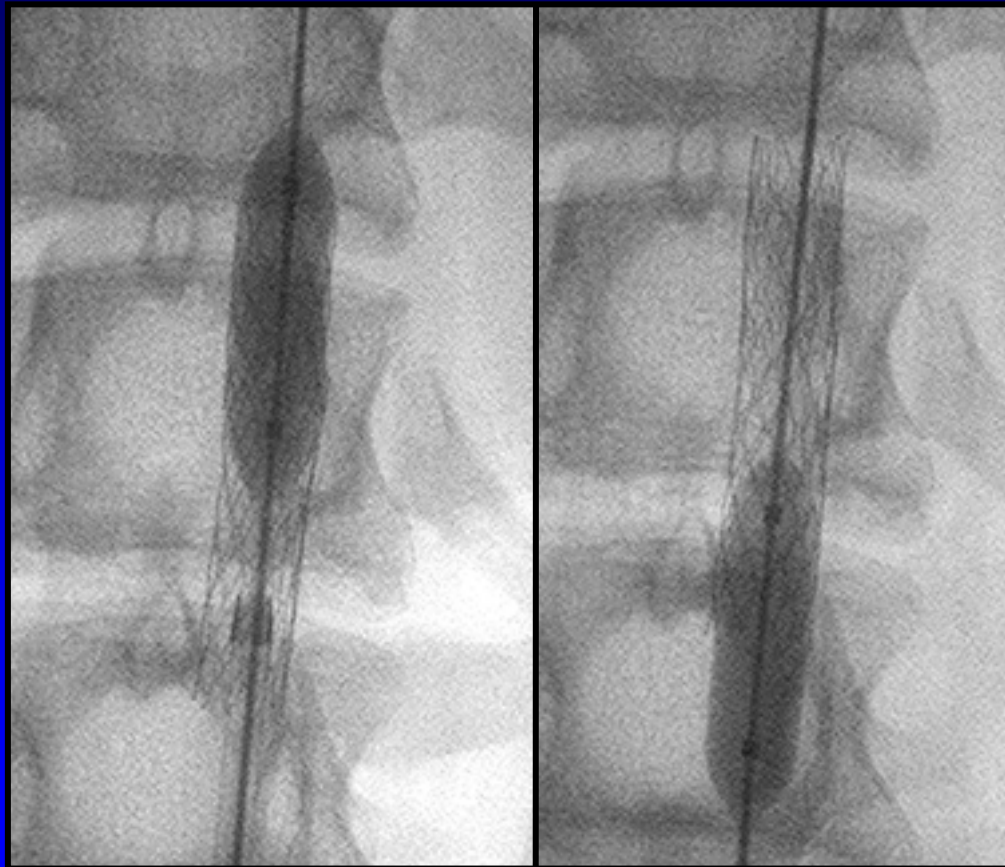
Post

6 month F/U cath: recoarctation

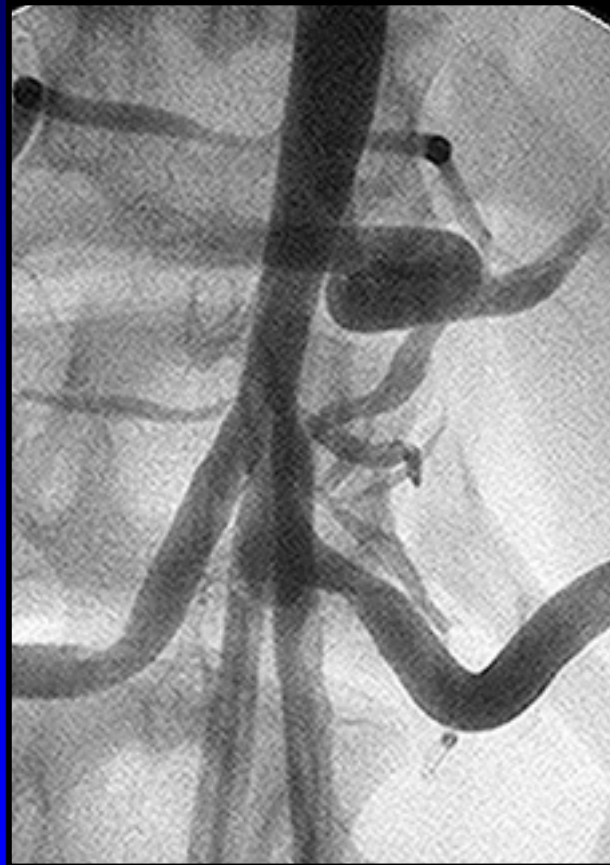


Good flow through
jailed renal artery

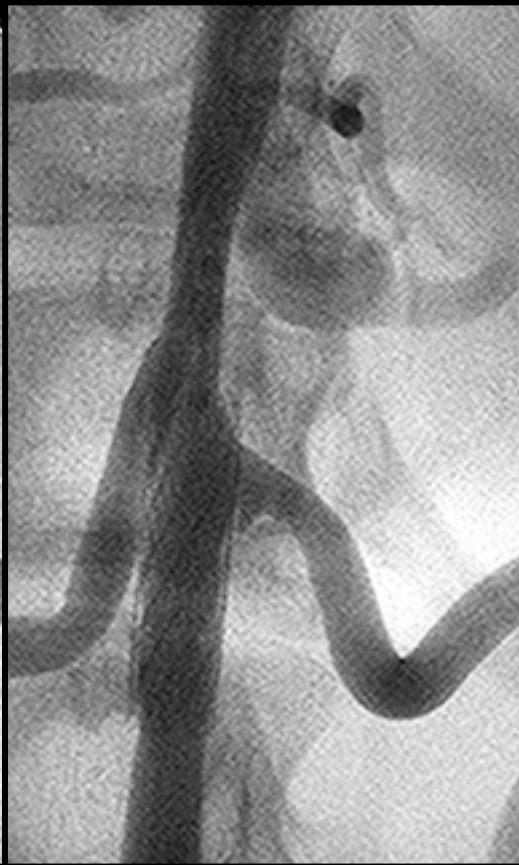
S/P additional stents in aorta



Pre and post angiograms



Pre



F/U cath

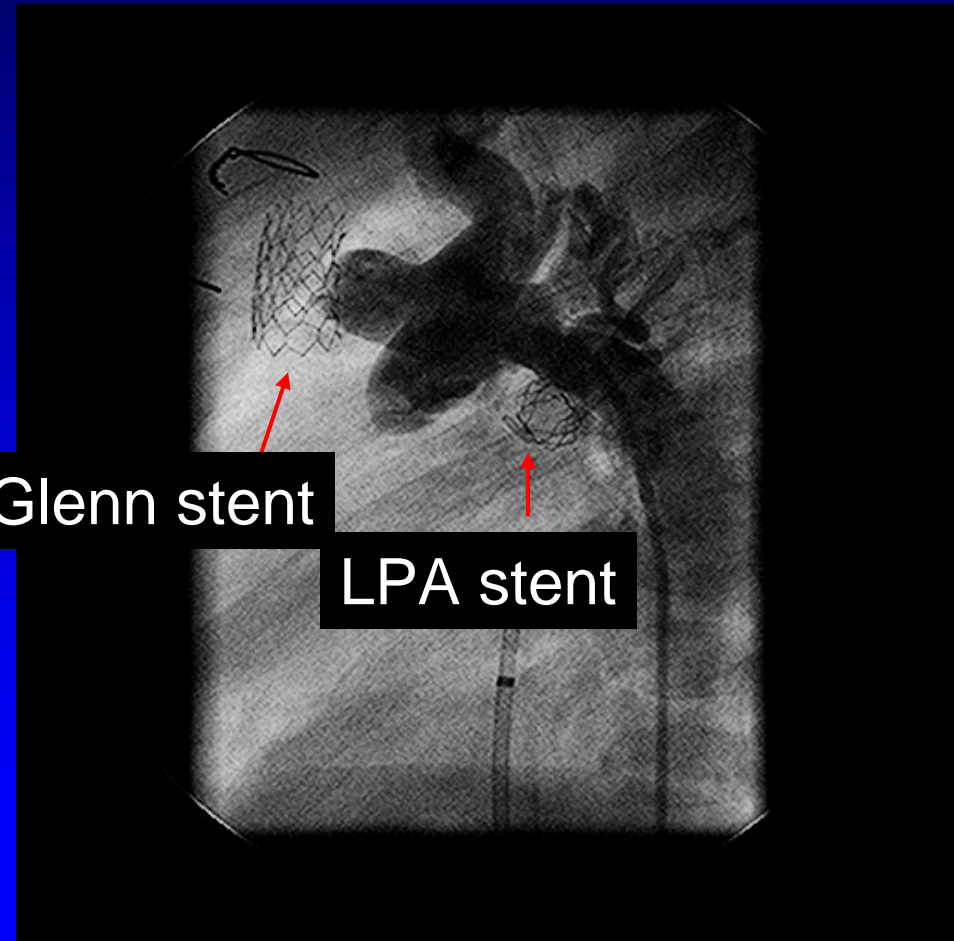


Post-additional stent

Bilateral jailed
renal artery

Angiogram of 8.2 kg infant with HLHS s/p Glenn

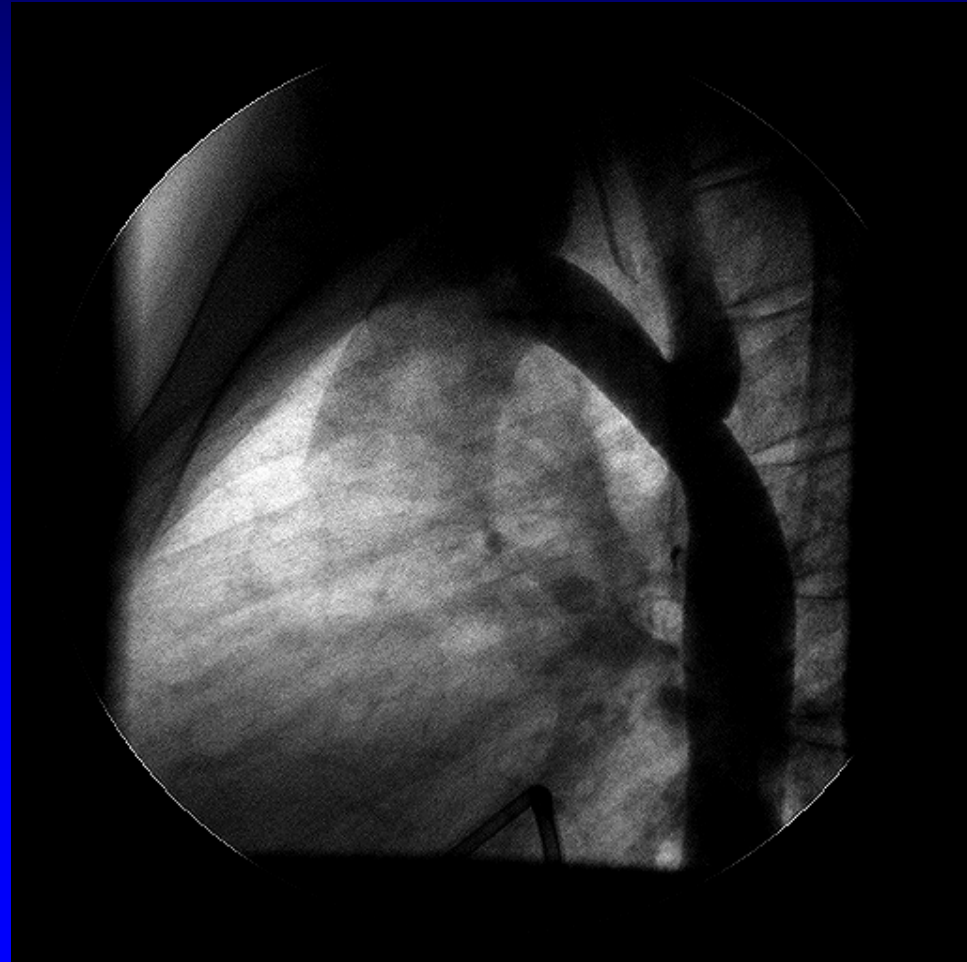
- HLHS s/p Glenn
- LPA stenosis s/p stent
- Glenn stenosis s/p stent
- Severe neo-aortic coarctation
- Only 5mm Hg grad due to poor RV function
- Considered for heart transplant



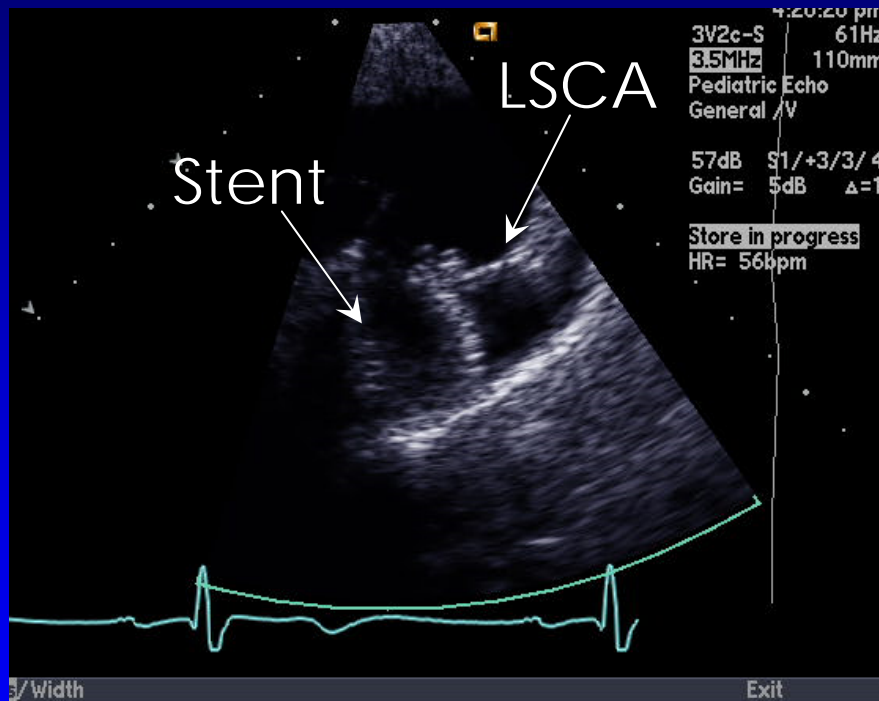
Coarctation-pre stent

14 yoF s/p COA repair
as infant with arch
hypoplasia

Arch gradient: 19mmHg

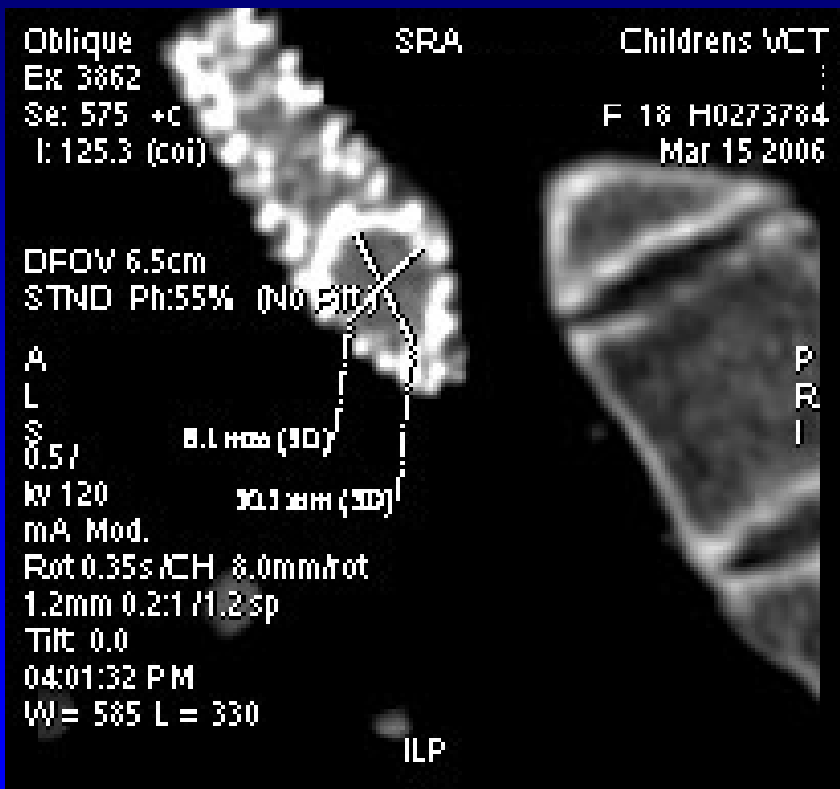


Echocardiogram-good flow through subclavian artery



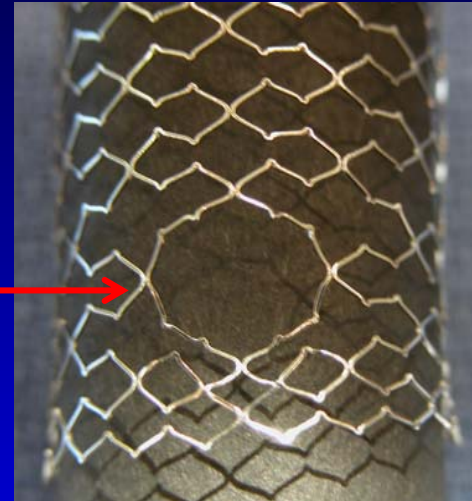
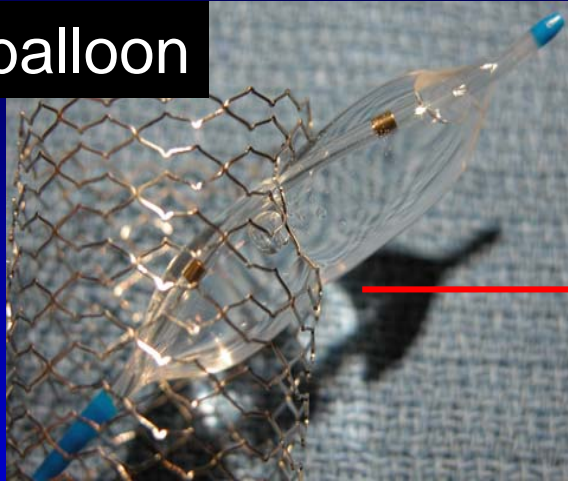
QuickTime?and a
Sorenson Video decompressor
are needed to see this picture.

CT Angiogram

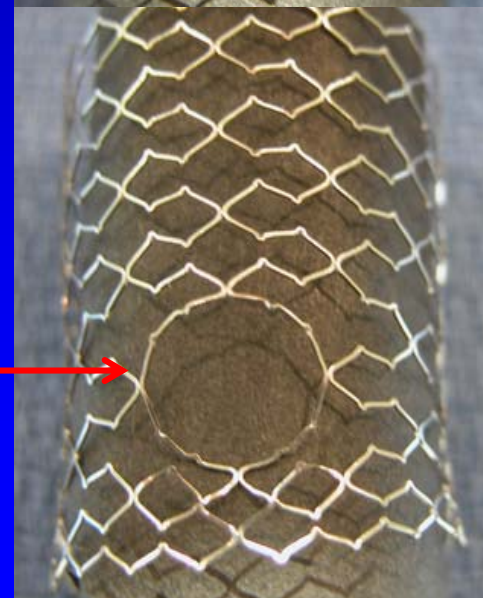
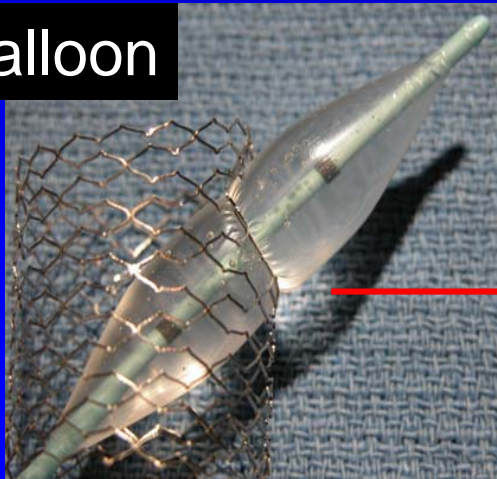


MaxLD stent - cell dilation w/ 10, then 12 mm balloon

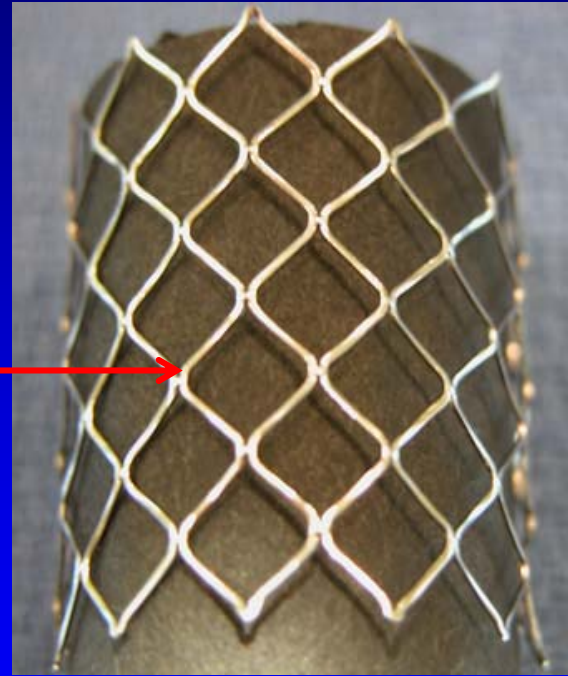
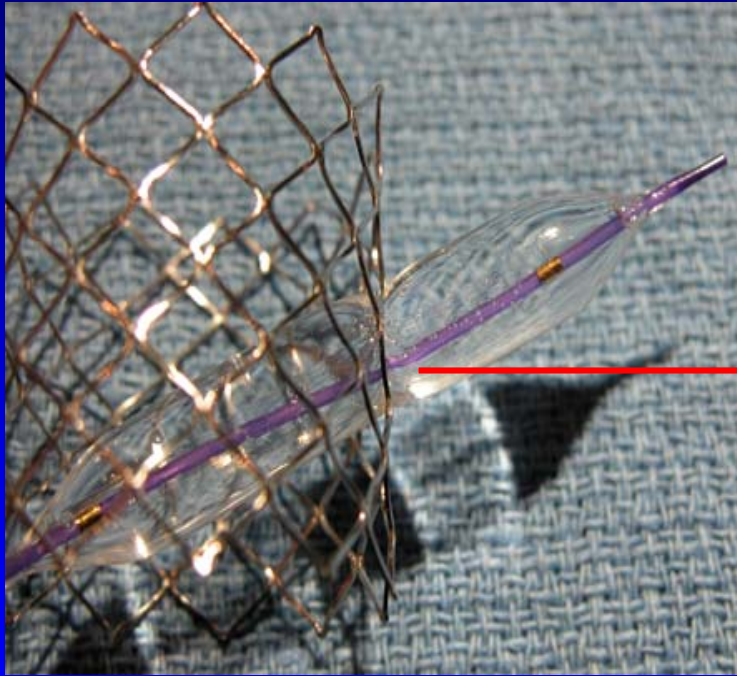
10 mm balloon



12 mm balloon



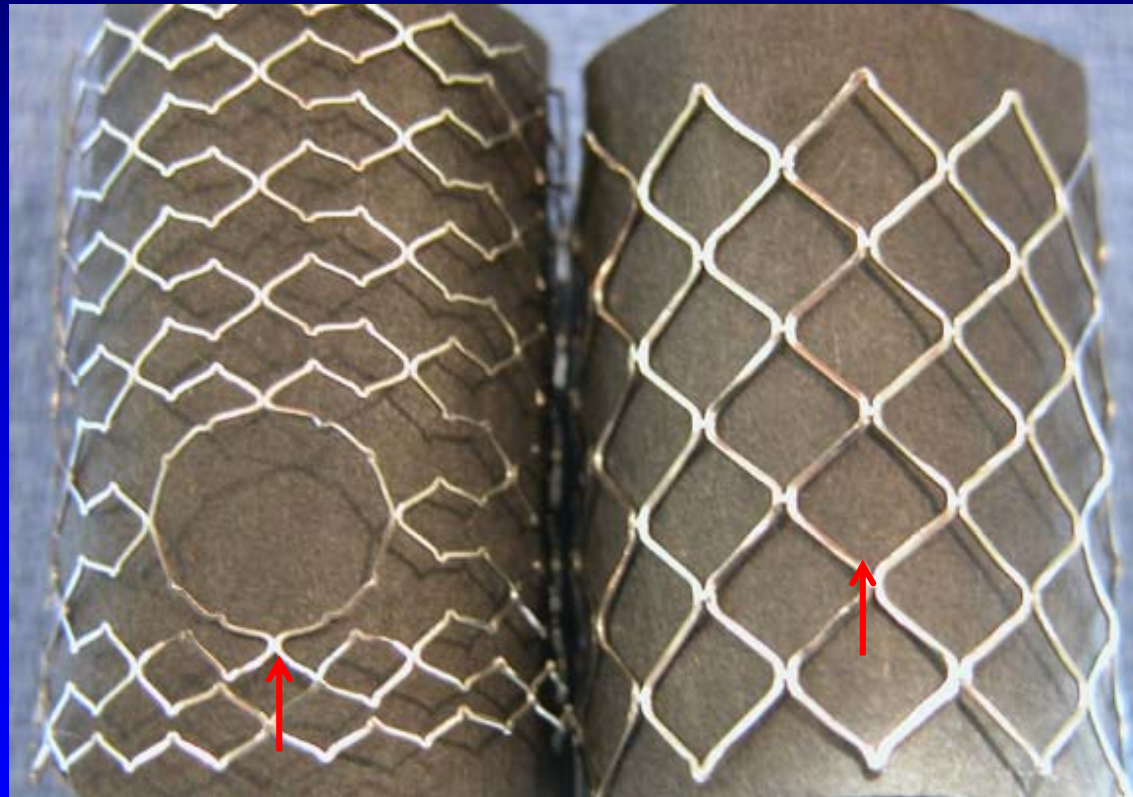
Palmaz XL stent - cell dilation w/ 6, then 8 mm balloon



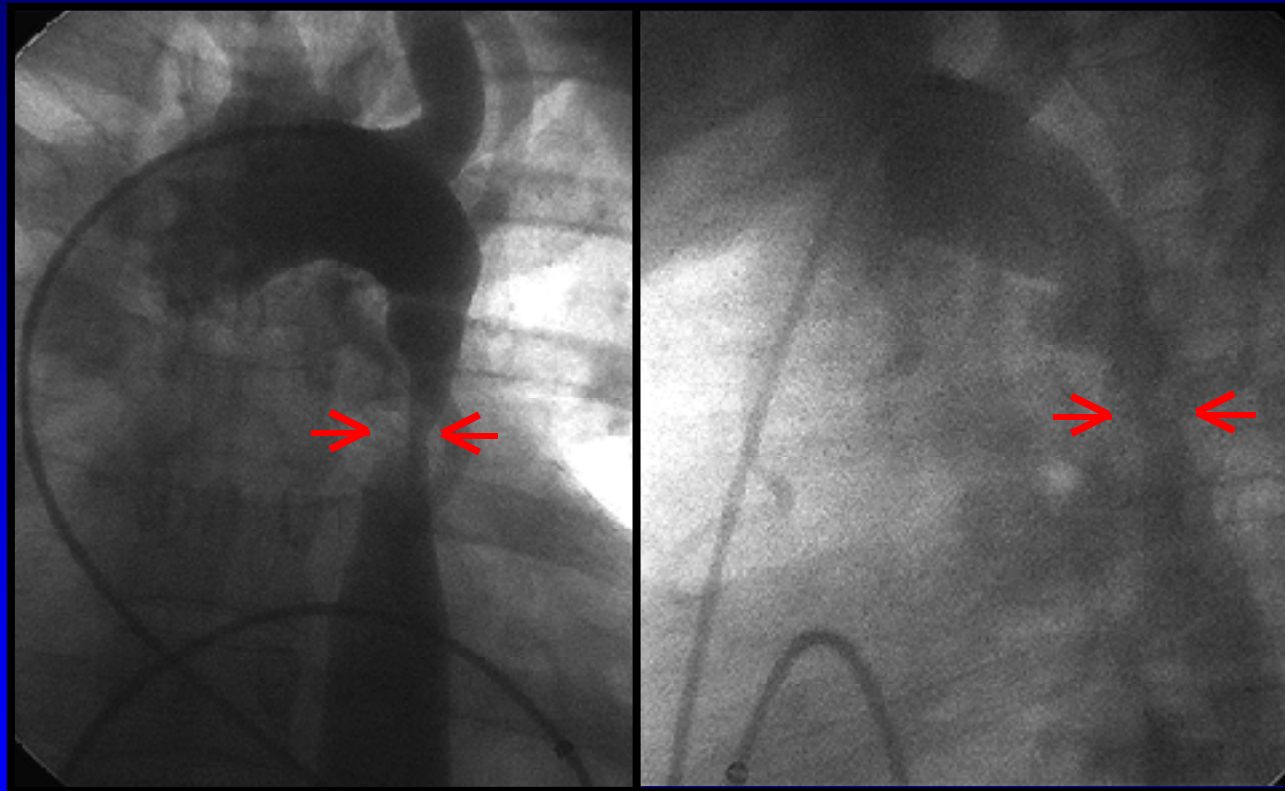
Comparison on cells after max dilation

12 mm balloon

8 mm balloon



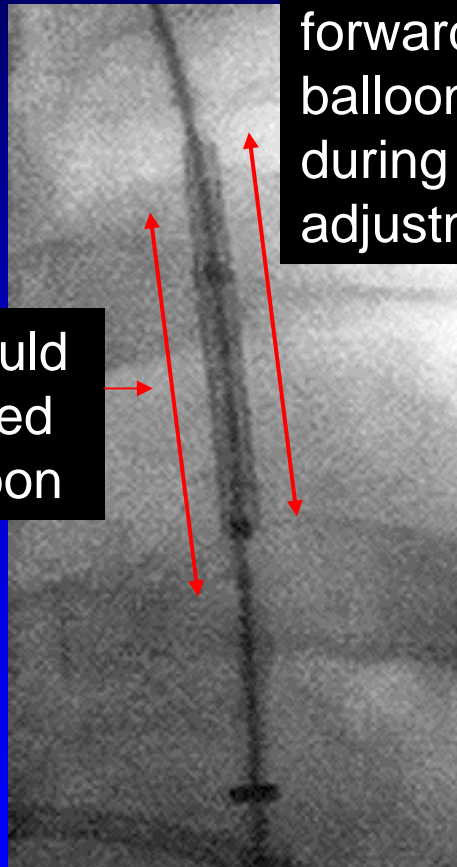
25 yo w/ systemic hypertension: Long segment coarctation of the Aorta



AP (3.8mm)

Lat

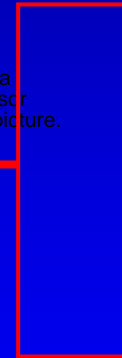
Poorly-centered stent slipped forward during inflation



Stent slipped forward on balloon during adjustment

Stent should be centered over balloon

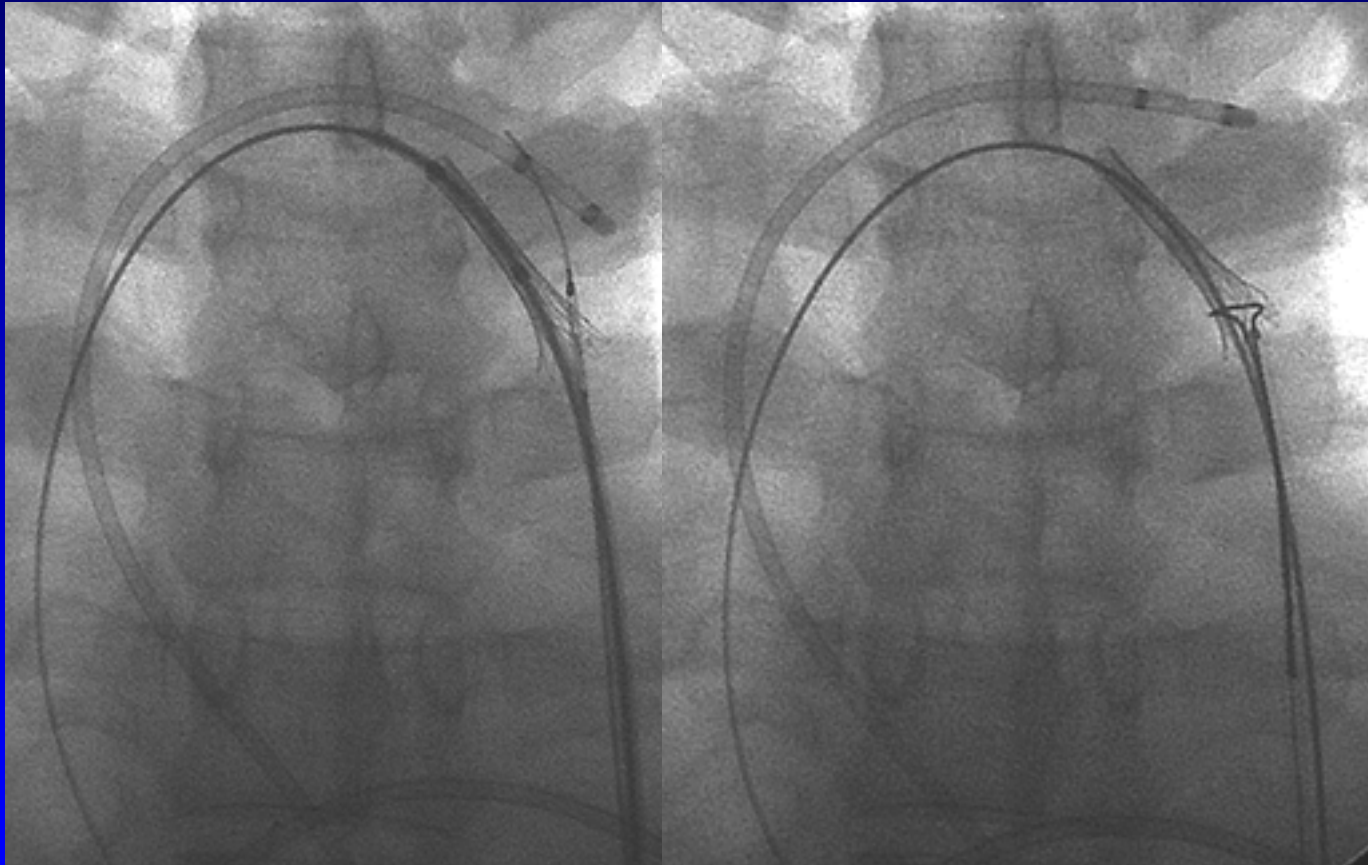
QuickTime?and a Video decompressor are needed to see this picture.



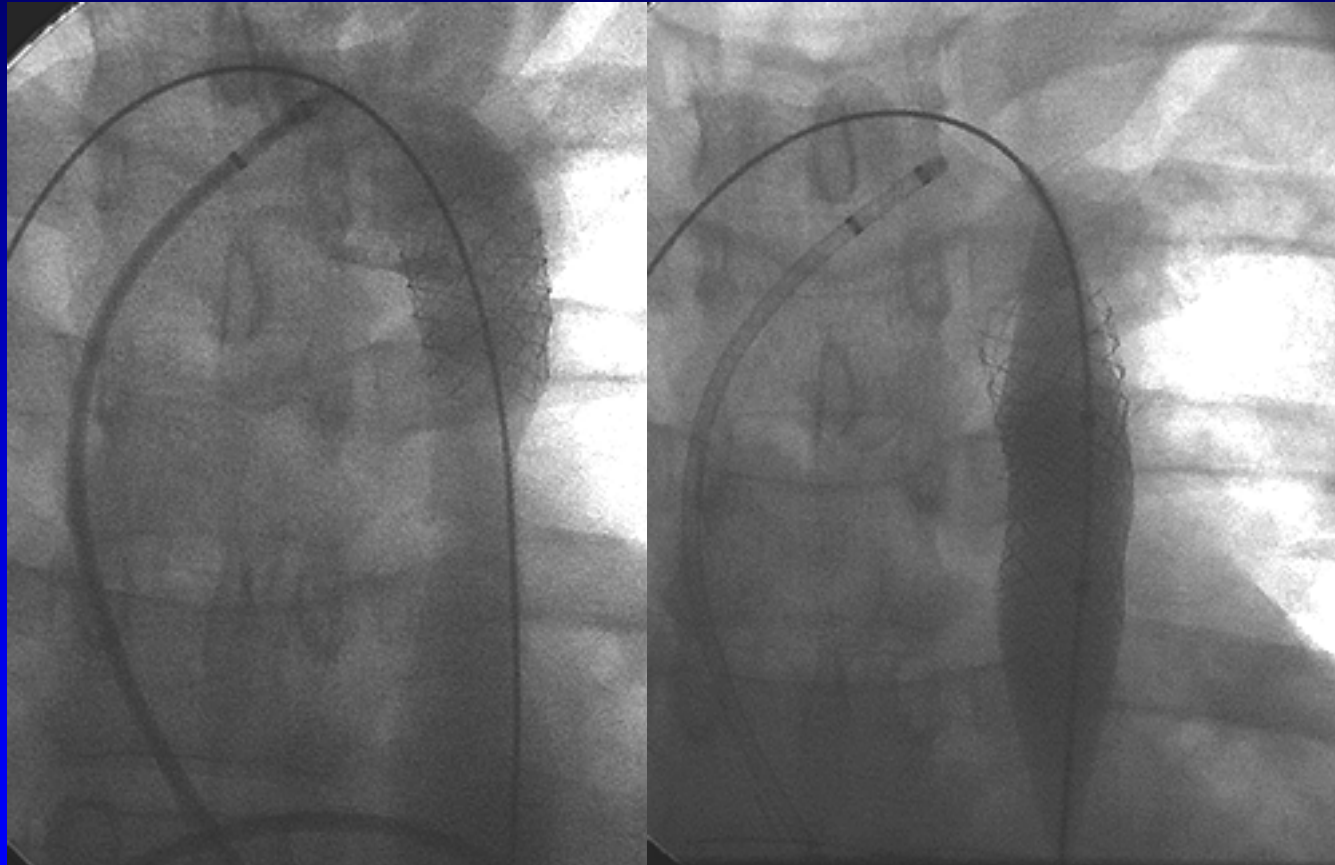
Maneuvers to reposition stent

With grabber

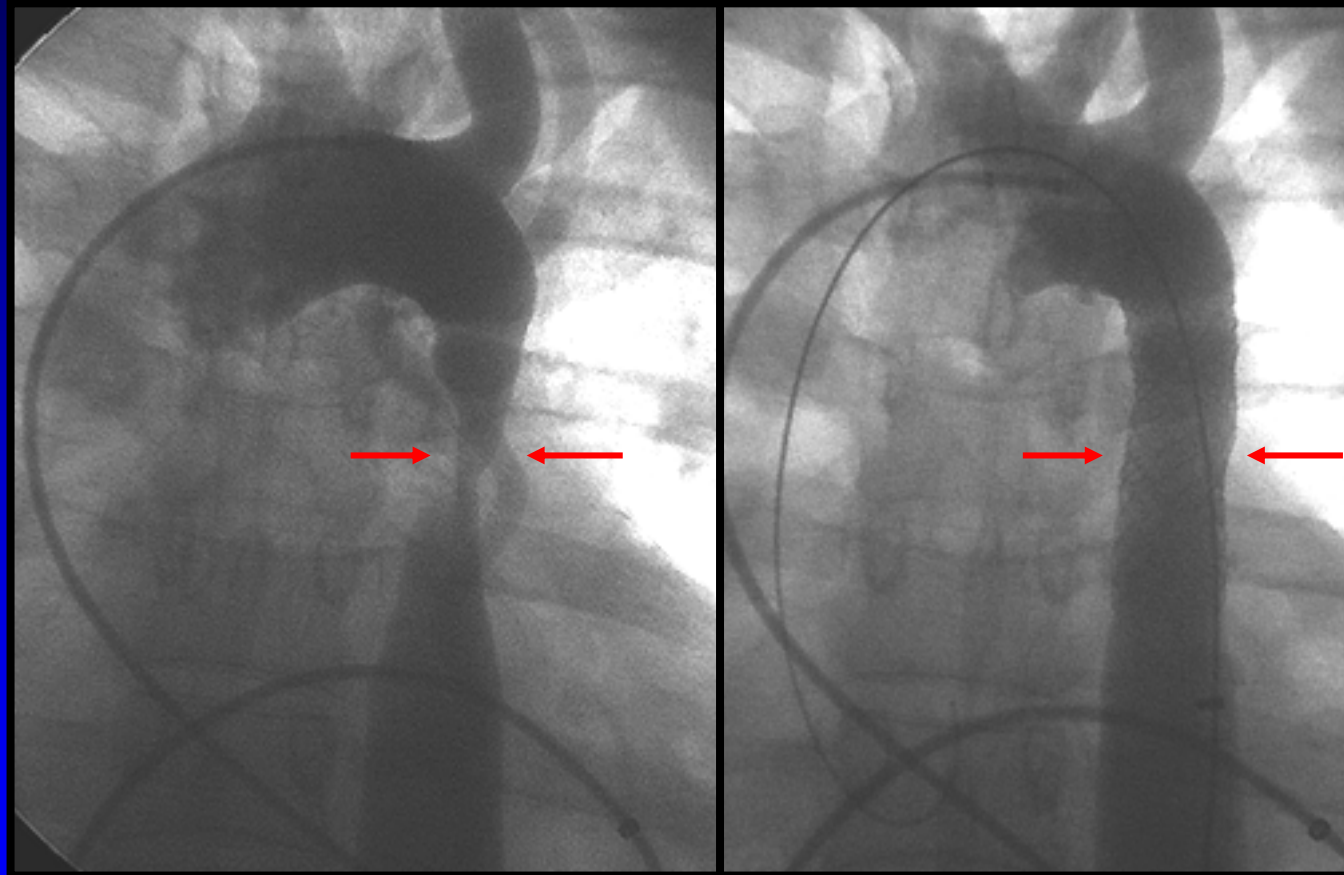
With snare



Stent implanted in safe position; 2nd stent implanted at COA site



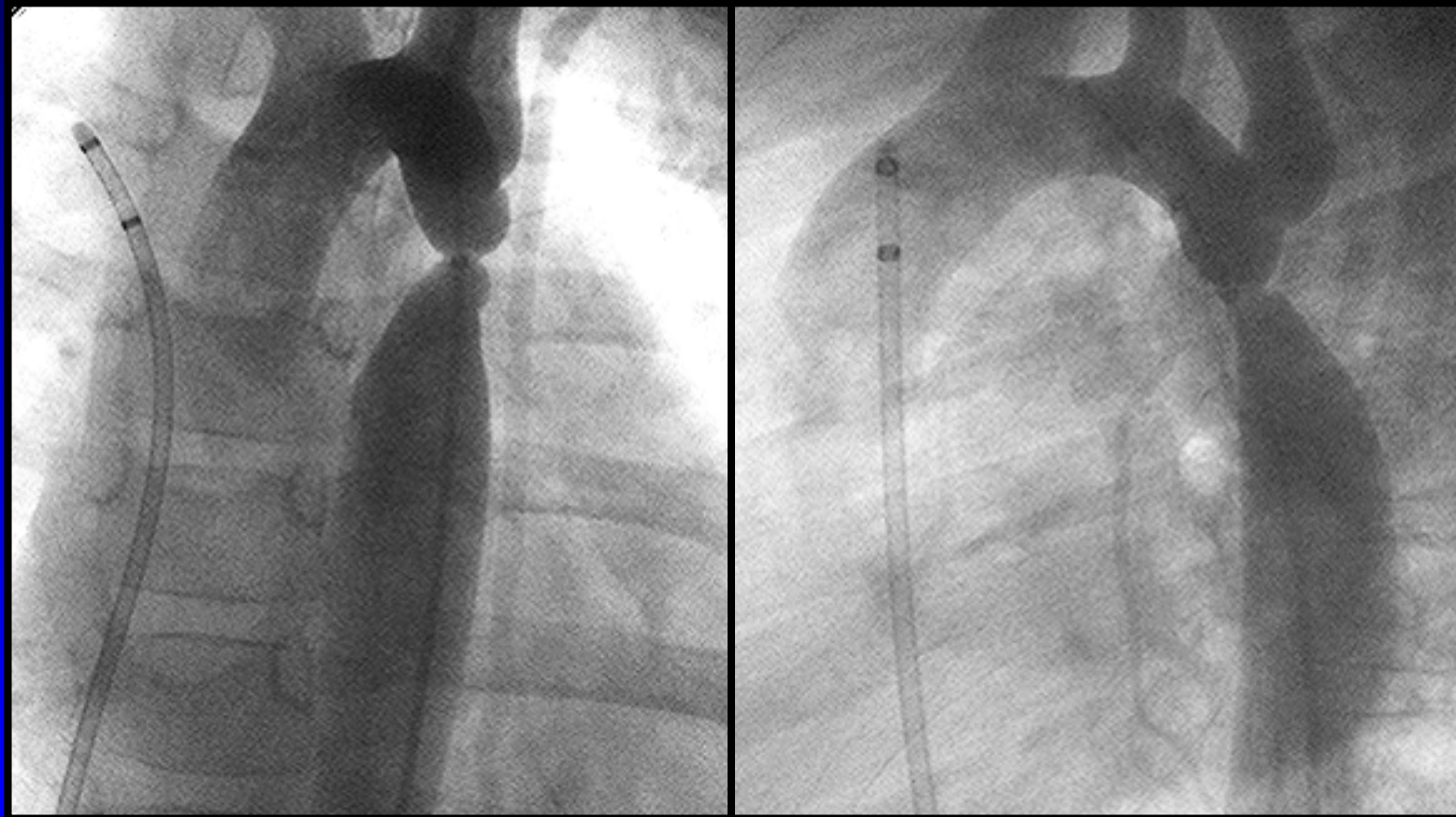
COA stenting can be technically difficult



Pre
3.8 mm

Post
16mm

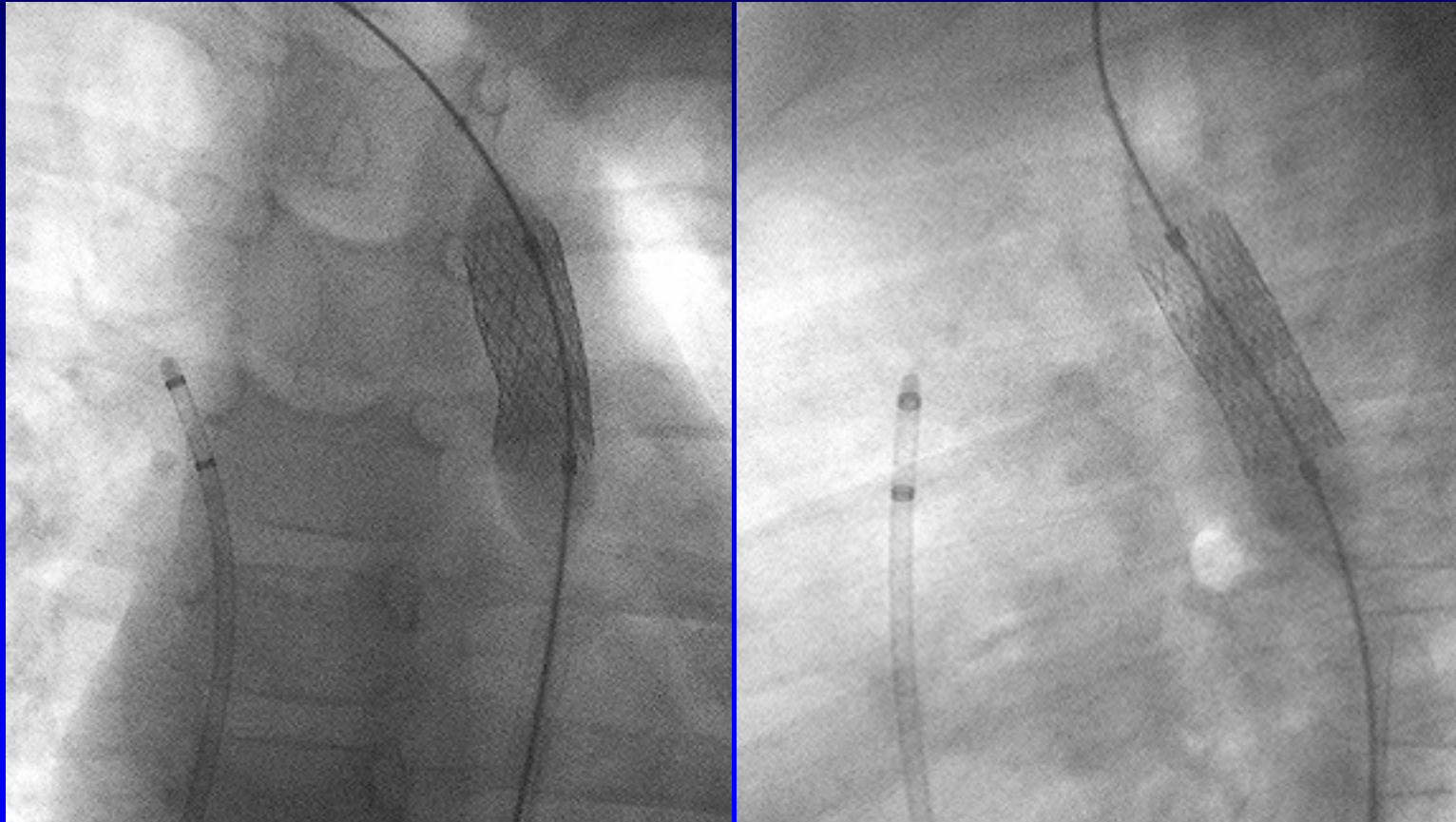
Discrete COA



AP

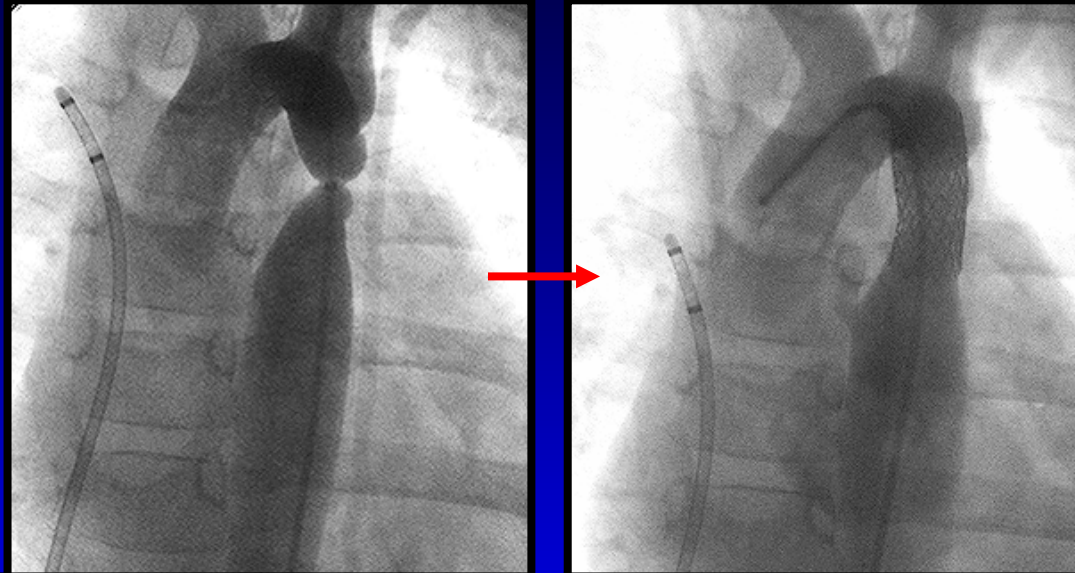
Lat

Balloon inflation only after stent re-centered on balloon

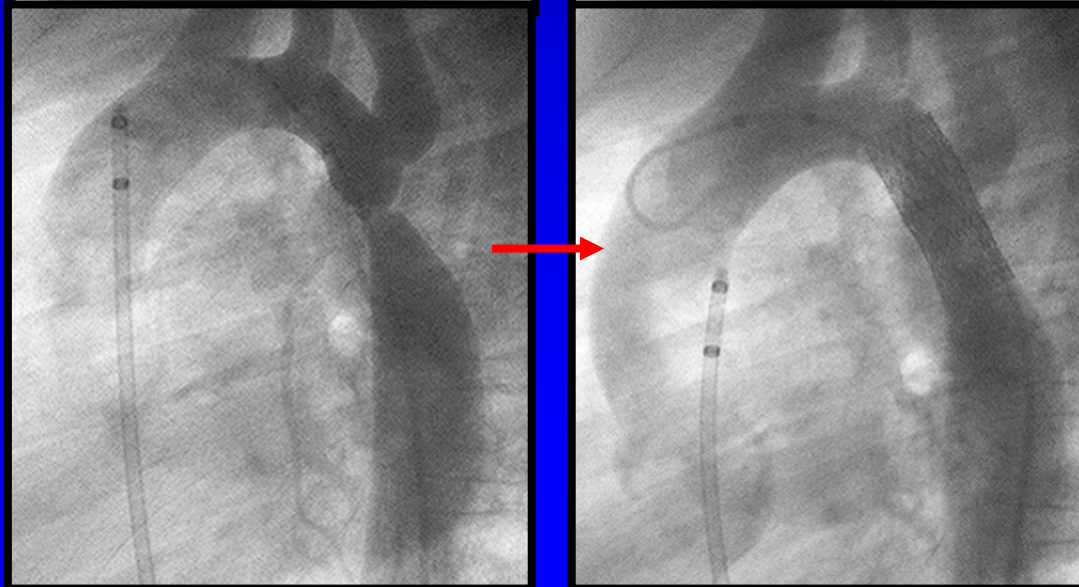


Pre and post stent angiograms

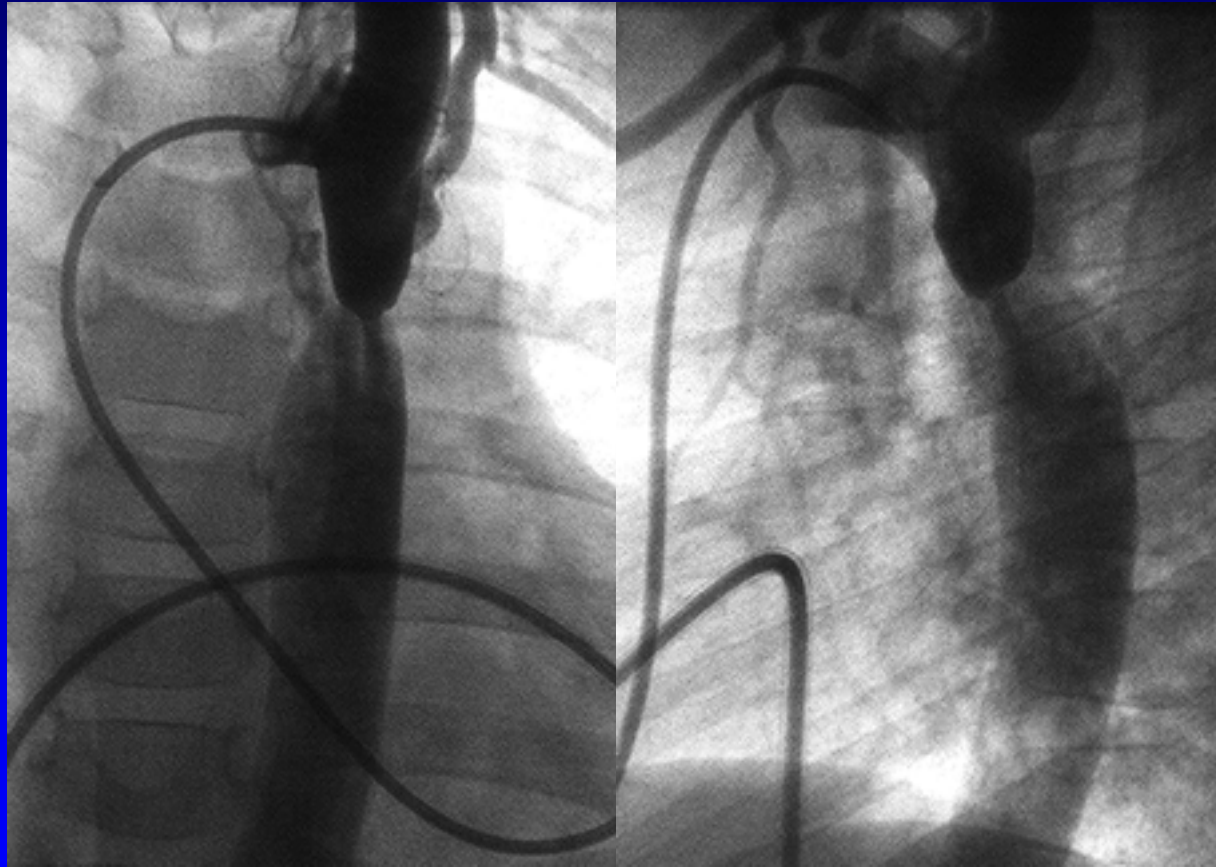
AP



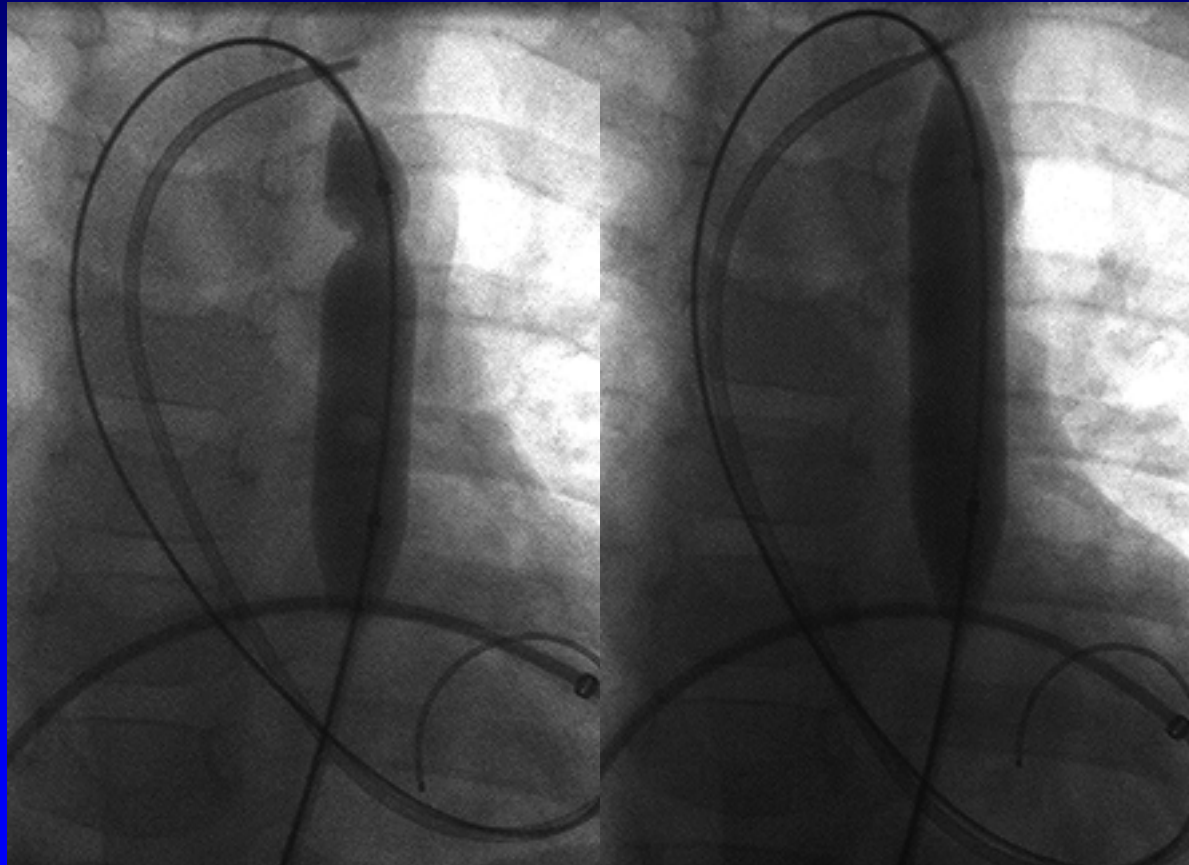
Lat



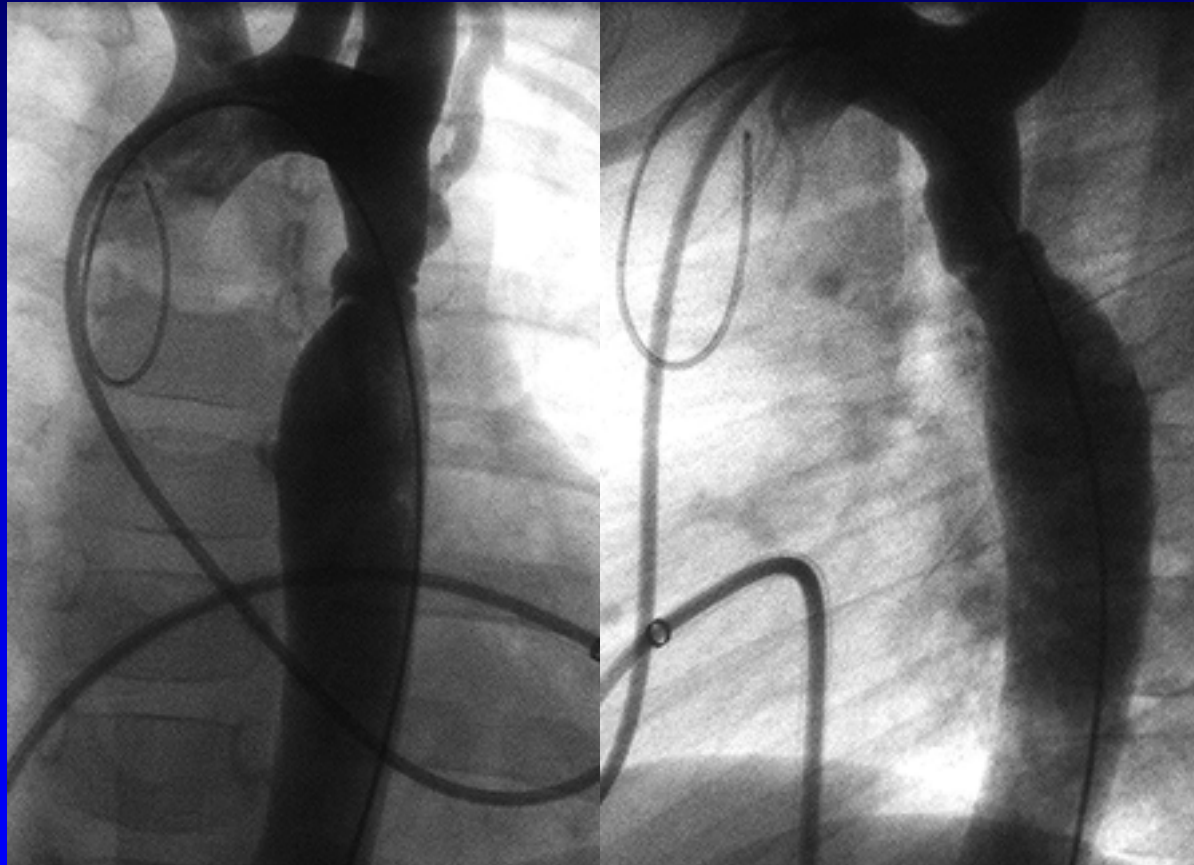
Coarctation of the aorta



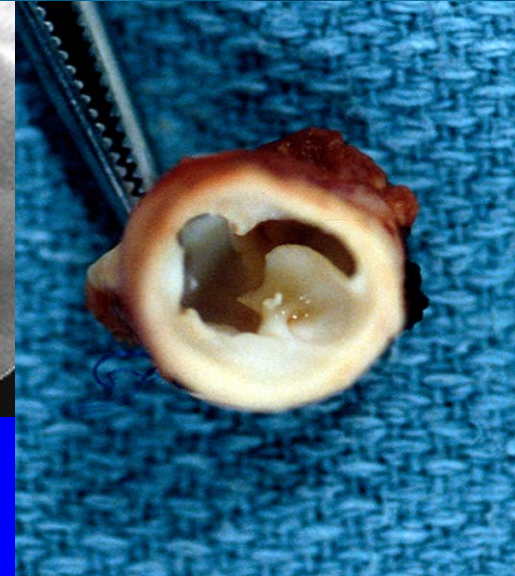
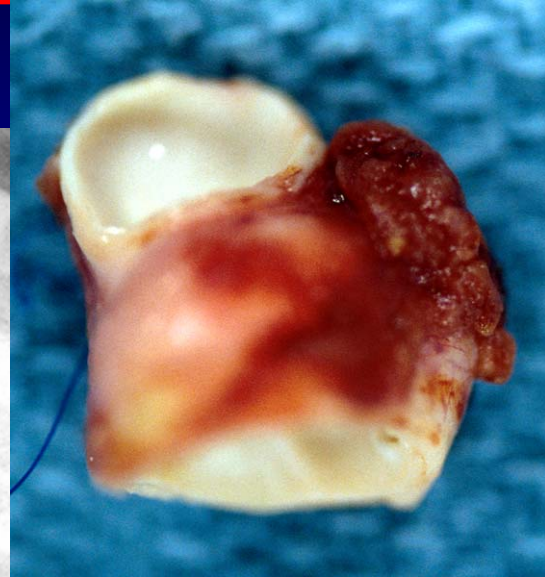
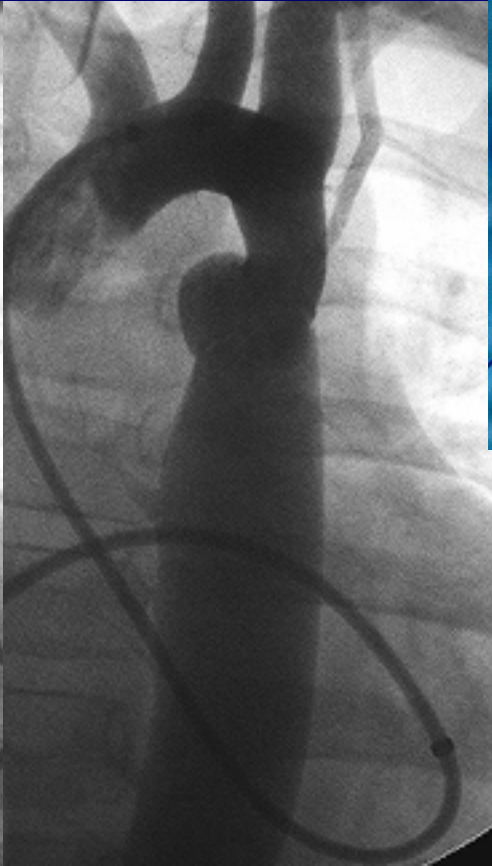
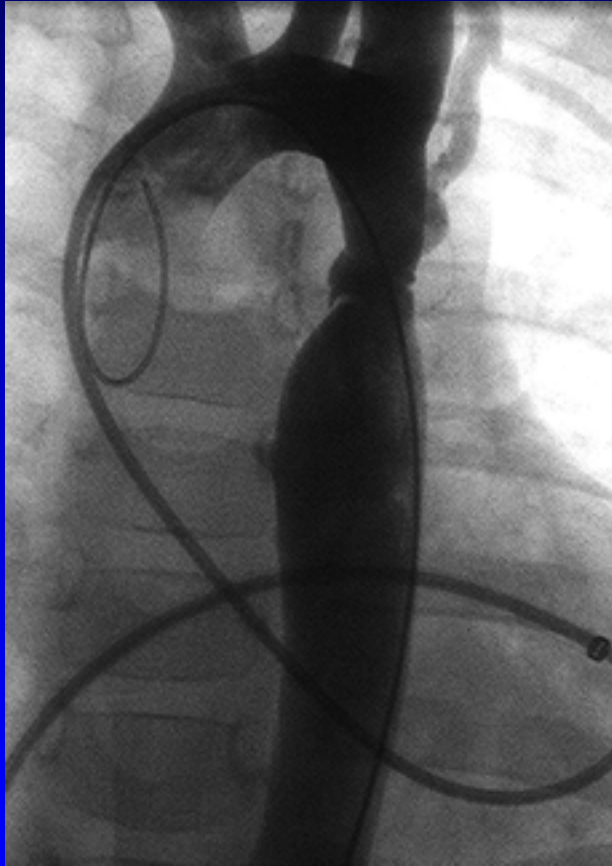
Angioplasty of Coarctation



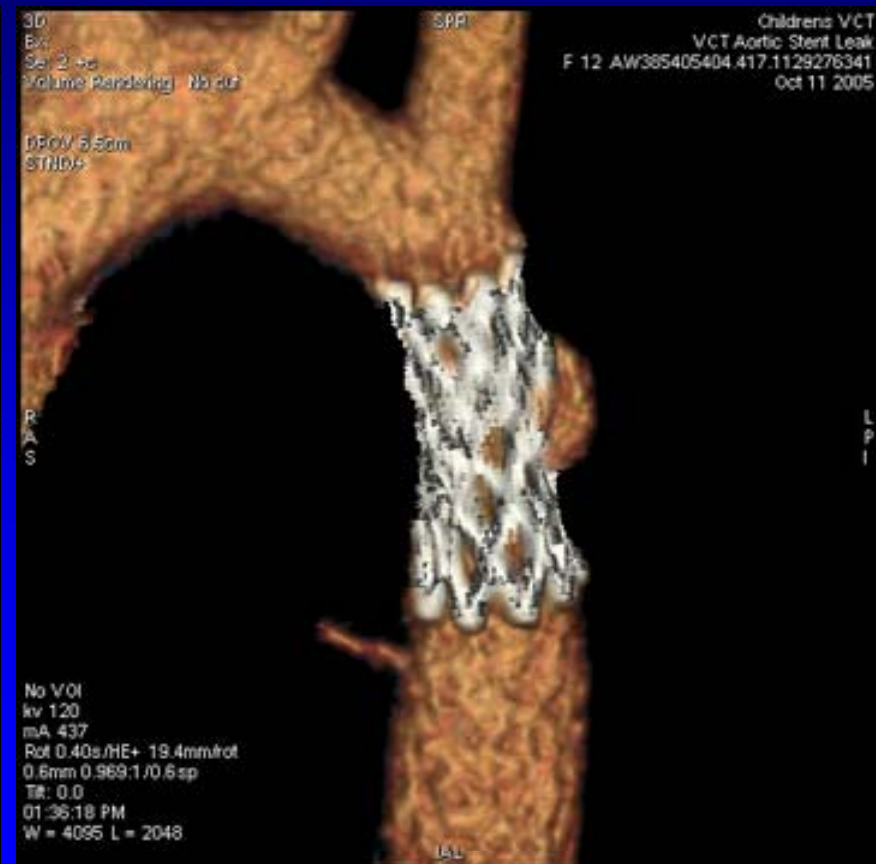
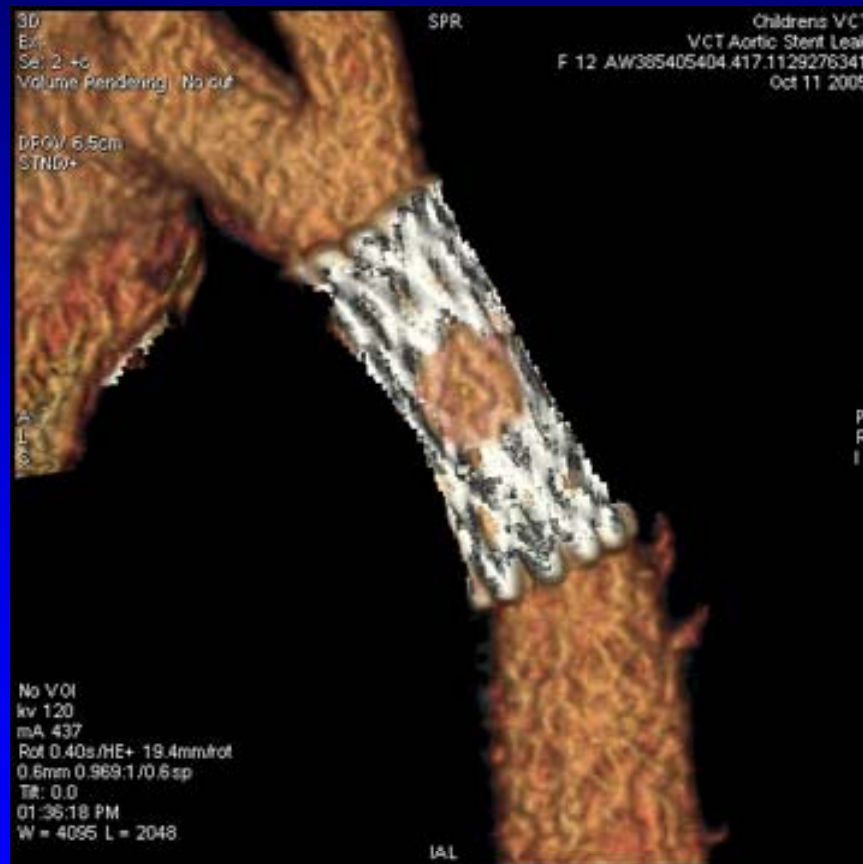
Post-dilation of Coarctation



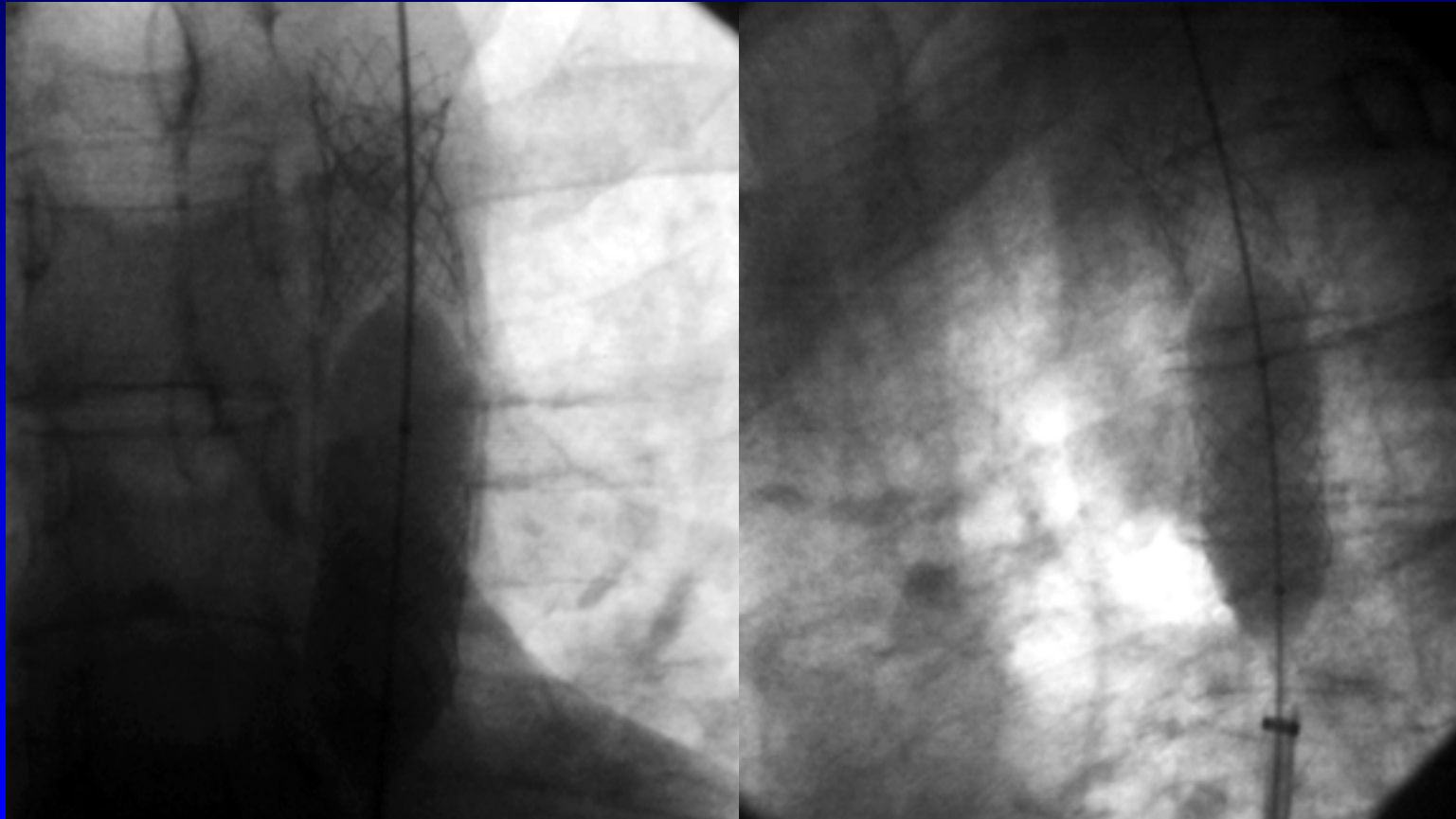
2 year F/U angiogram: Aneurysm



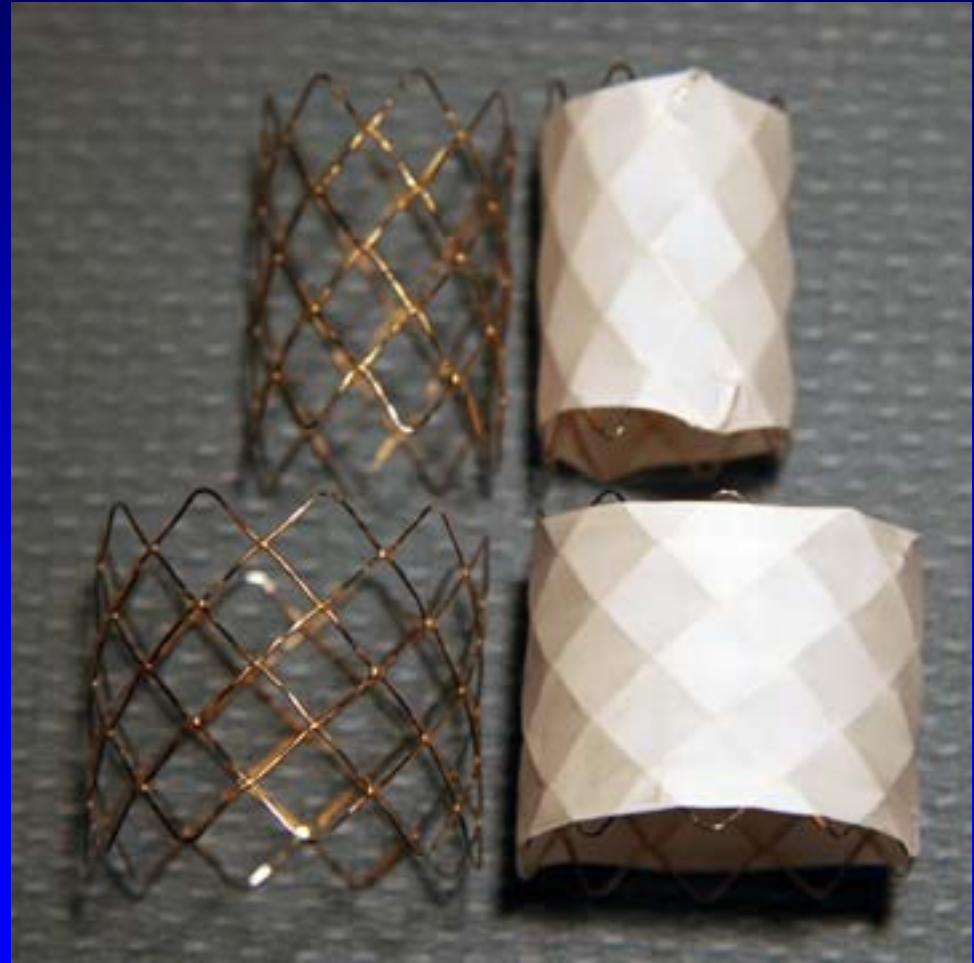
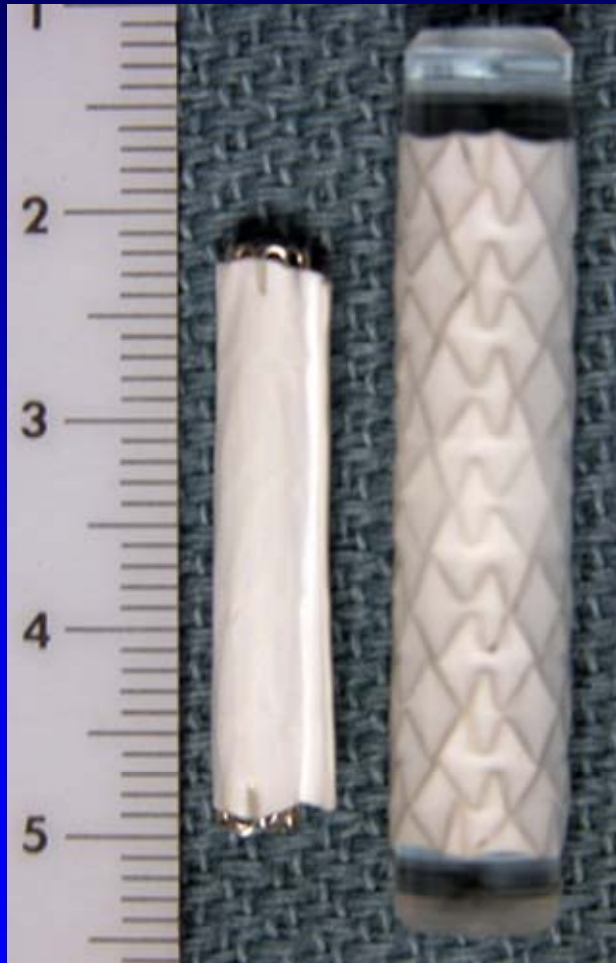
5 year F/U CT angio Aneurysm at side of stent



Second stent implanted



Covered stents



Summary

- COA presents with variable morphologies
- Discrete stenosis can be treated with angioplasty
- Stent implantation is more effective in relieving gradients in COA but technically more challenging
- Complications are few, but can be catastrophic
- The interventionalist need to become fully familiar with how to deal with stent complications
- Surgical backup should be available for all cases