Embolisation of vessels

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Disclosures

- Consultancy:
  - NuMED Inc
  - Medtronic Inc
  - Lifetech
  - Venus Medtech

Embolisation of vessels

Indications for treatment

- Shunts with significant volume load
- Right to left shunting lesions
- Bleeding from a vessel
- Unwanted vessel

Embolisation of vessels

- Coronary artery fistulas
- Aortopulmonary collaterals
- Veno-venous collaterals
- Pulmonary arteriovenous malformations
- Unwanted Blalock-Taussig shunts
- Sequestrated lung segments
- Abnormal pulmonary venous drainage

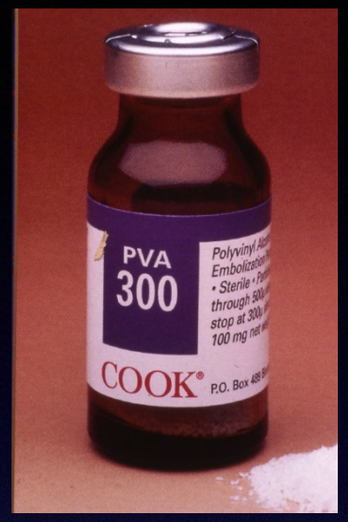
Embolisation of vessels
Technical aspects

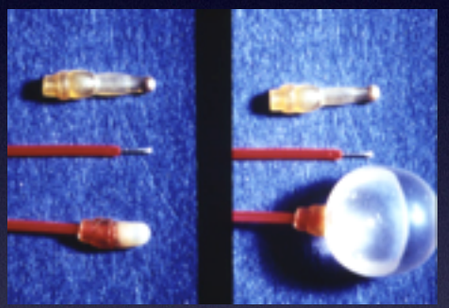
- Anticoagulation with heparin
- Aim for complete occlusion
  - If using coils, many coils may be needed
  - Consider vascular plug in larger vessels (>3-4 mm in diameter)
- Vessel access
  - Plugs require larger sheaths
- Tortuous routes and acute angles
  - Soft tip catheters, wide range of curves
  - Various wires both soft and stiff

Embolisation of vessels
Technical aspects

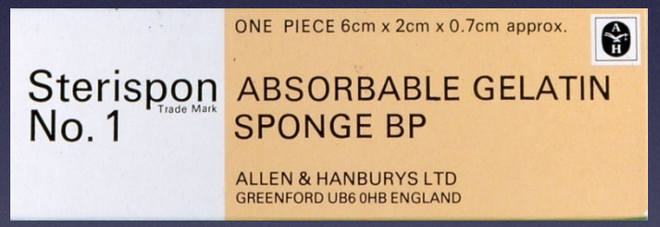
- Controlled release devices (coils or plugs) should be used
- Device choice is determined by
  - Vessel diameter
  - Vessel length
  - Vessel tapering or stenosis (embolisation risk)
  - Risk of unwanted occlusion of side branches
- Device/vessel size ratio (usually 1.3-1.5)

Embolisation of vessels
Materials





- Particulate – Gelfoam, PVA, Embospheres
- Liquids – Alcohol, Alcohol/Lipiodol, Glue
- Sclerosants – STD, Polidocanol

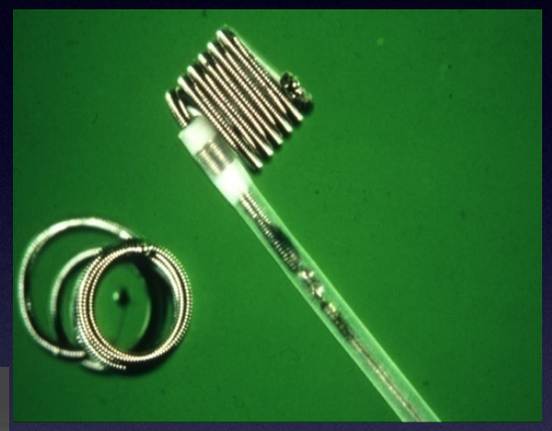


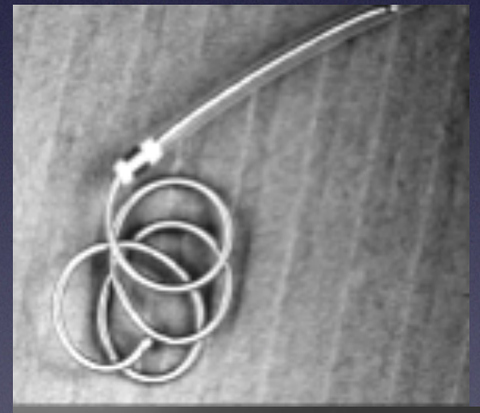
- Detachable balloons - rarely used
- ***Coils – 035”, 018”, 0.14” calibre***
- ***Occlusion devices – plugs of different sizes and shapes***
- Need range of materials to cover different situations

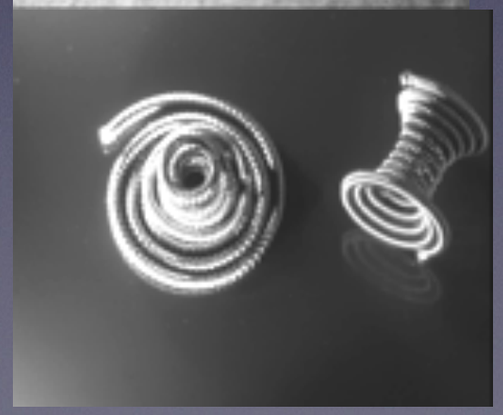
Embolisation of vessels

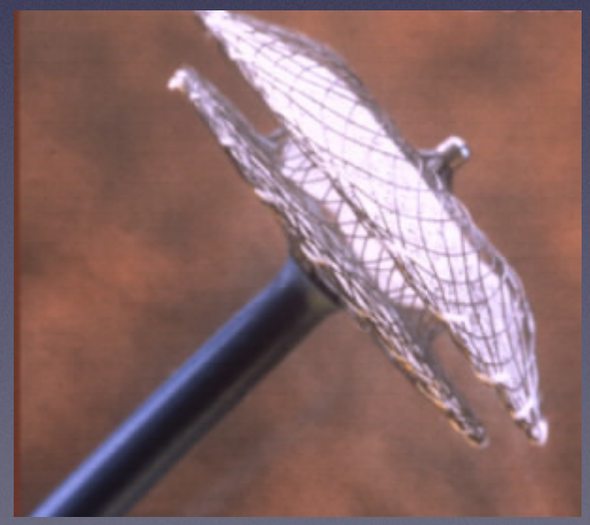
- Using gelfoam, PVA or glue through small 3-4 Fr catheters is domain of vascular radiologists. Ask for their help rather than get into trouble
- Using these for vessel embolisation may be dangerous in high flow shunts such as A-V fistulas, as microemboli may cross the lesion and return to the heart or other parts of the body

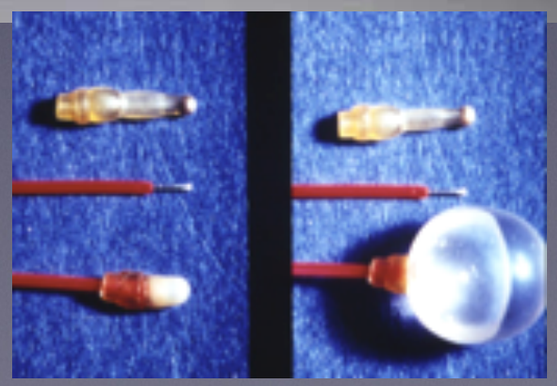
Embolisation equipment and devices





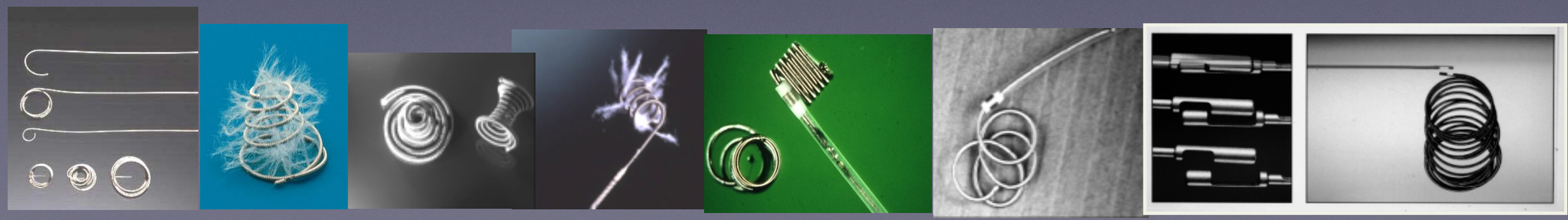






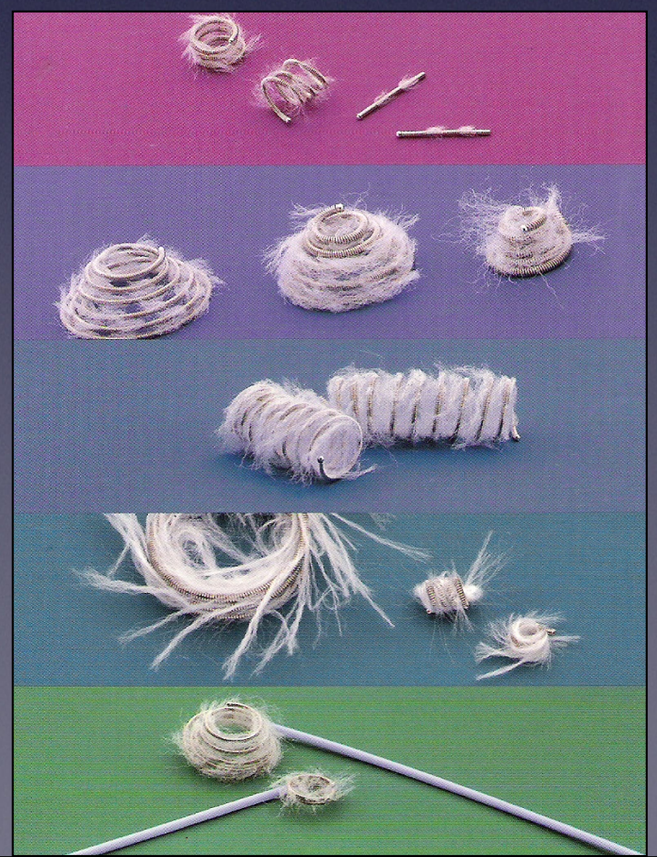
Coils for embolisation

- Standard coils (0.035 - 0.052”) - (Cook)
  - Gianturco (various sizes/lengths)
  - Tornado
- Controlled release coils (0.035”)
  - Jackson and Flipper or PDA coils (Cook)
  - Nit-occlud (PFM) coils
- Micro coils* (0.014” - 0.018”)
  - Target GDC/IDC coils (F3 catheter)

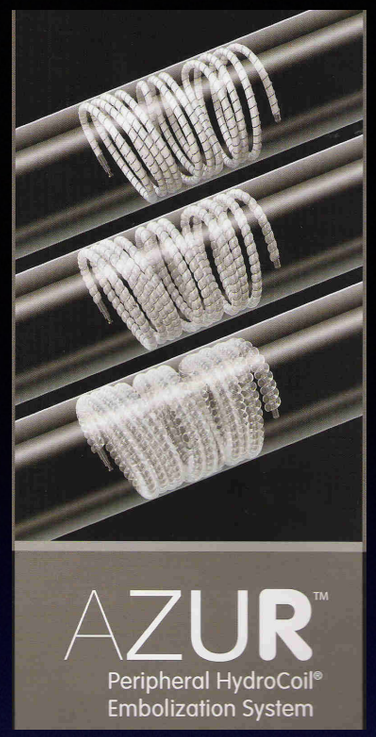


Coils for embolisation

- Versatile and controllable embolisation materials
- Advantageous because they fit through small catheters – e.g 3 Fr for platinum microcoils, 5Fr for standard coils
- Standard coils are made of steel, with Dacron strands, which are thrombogenic
- Conventional or controlled-release coils
- Different shapes of coils



Coils



- Azur (Peripheral hydrocoil embolisation system from Terumo)
- Platinum coil with hydrogel polymer coating – **expands when in contact with blood**
- Fewer coils needed as they have volume filling, packing density
- Coil expands partly within first 3 minutes and fully in 20 minutes
- Available as detachable or pushable coils
- Have been used in cerebral aneurysms, GI bleeds, PAVMs

Principles of coil embolisation

5mm

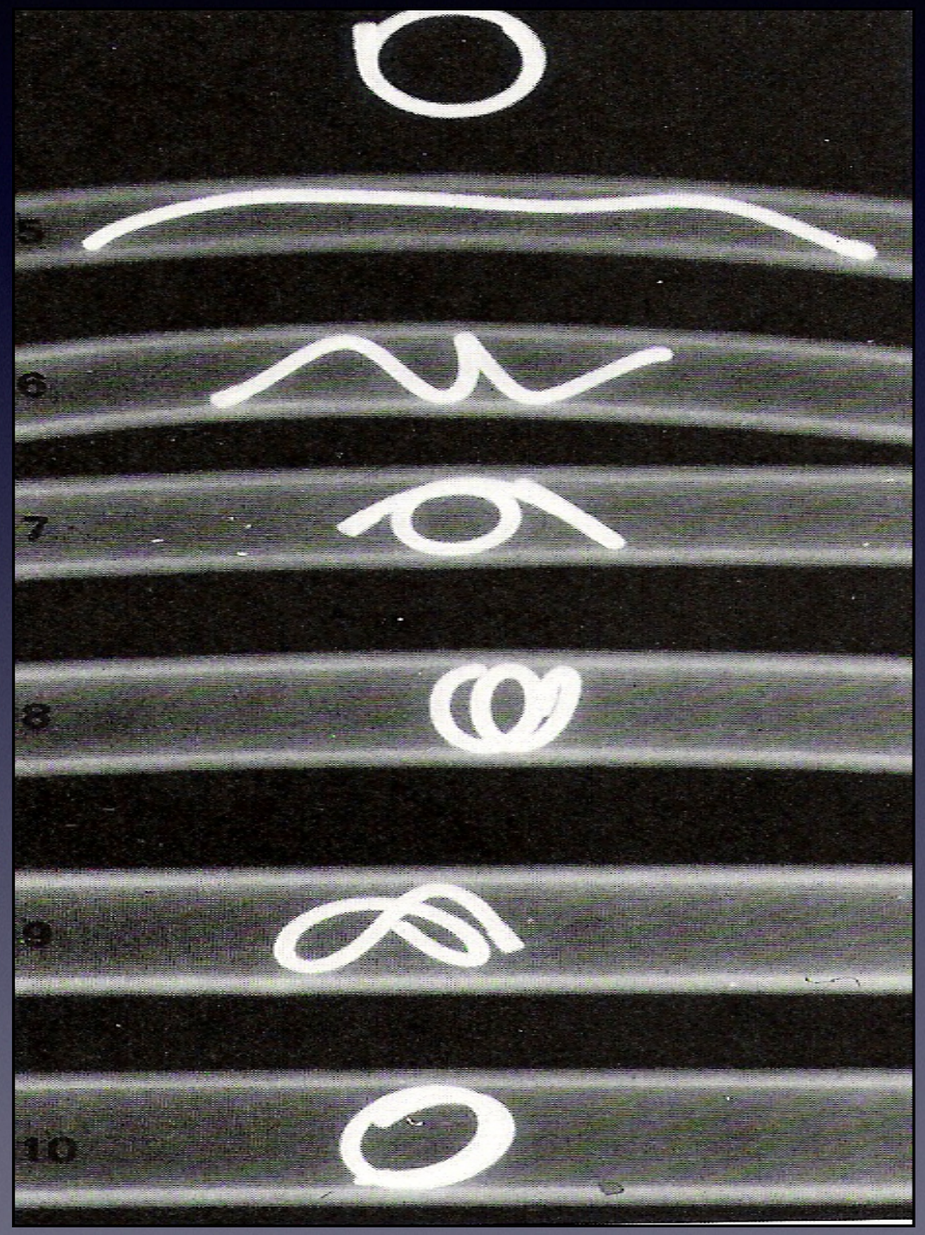
6mm

7mm

8mm

9mm

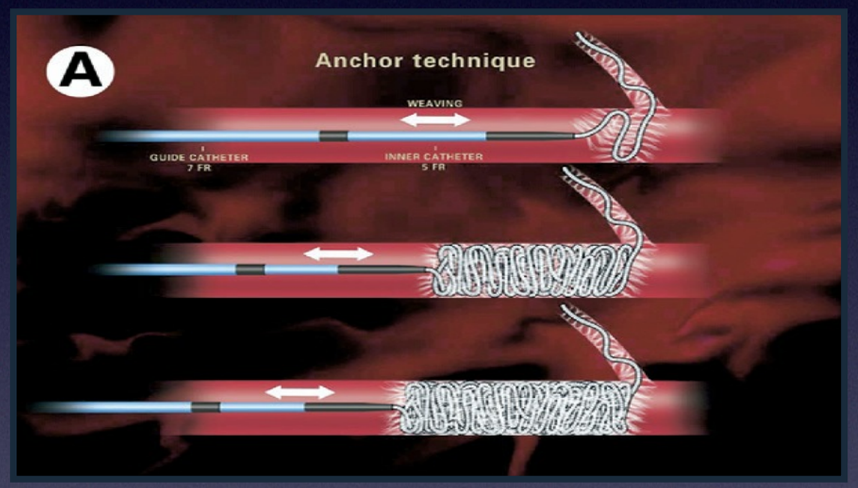
10mm



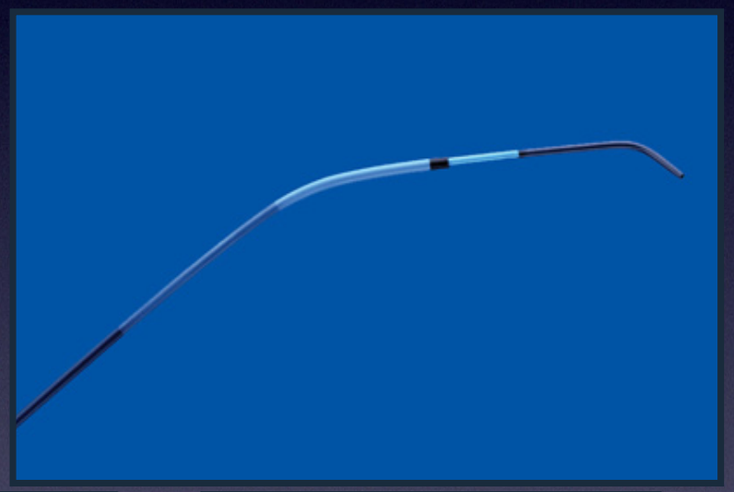
10mm coil in tubing of different diameters

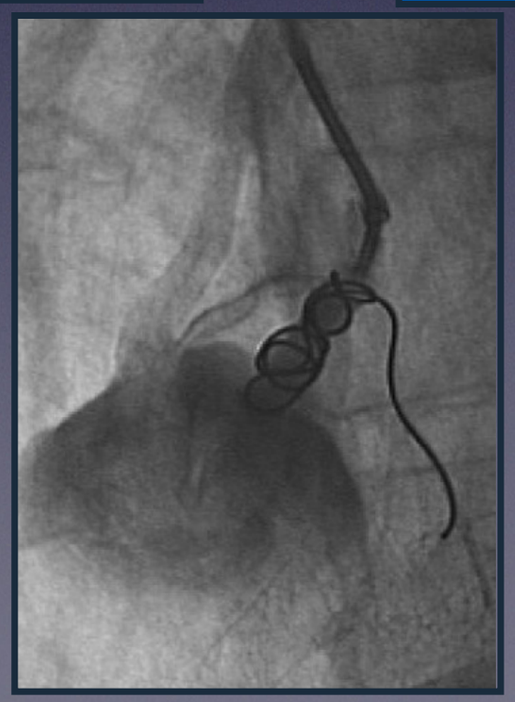
Principles of embolisation with coils

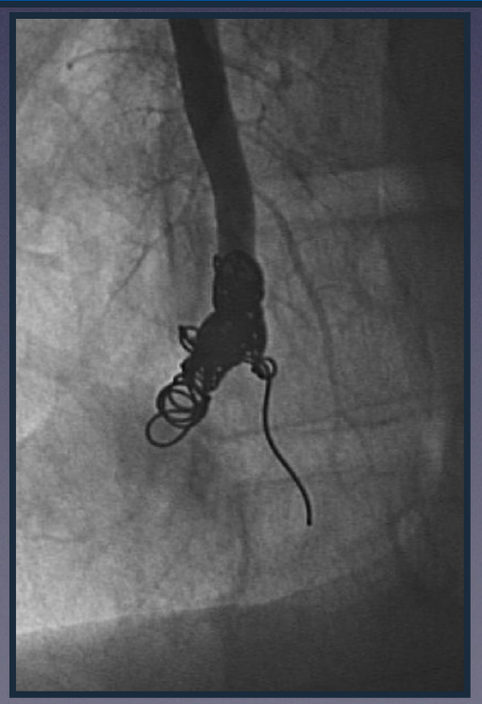
- *Anchor technique* useful when there are concerns about migration of a pushable fibered coil during placement
- First few coils should be 2 mm larger than the artery & may be anchored in a side branch if there is concern about fixation



Non-tapered catheter for coil delivery

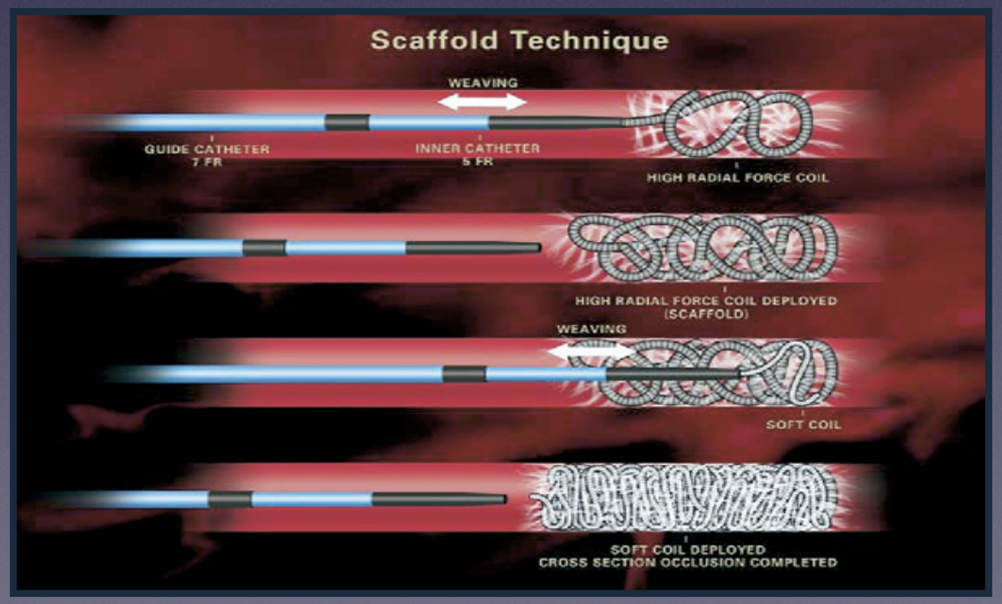


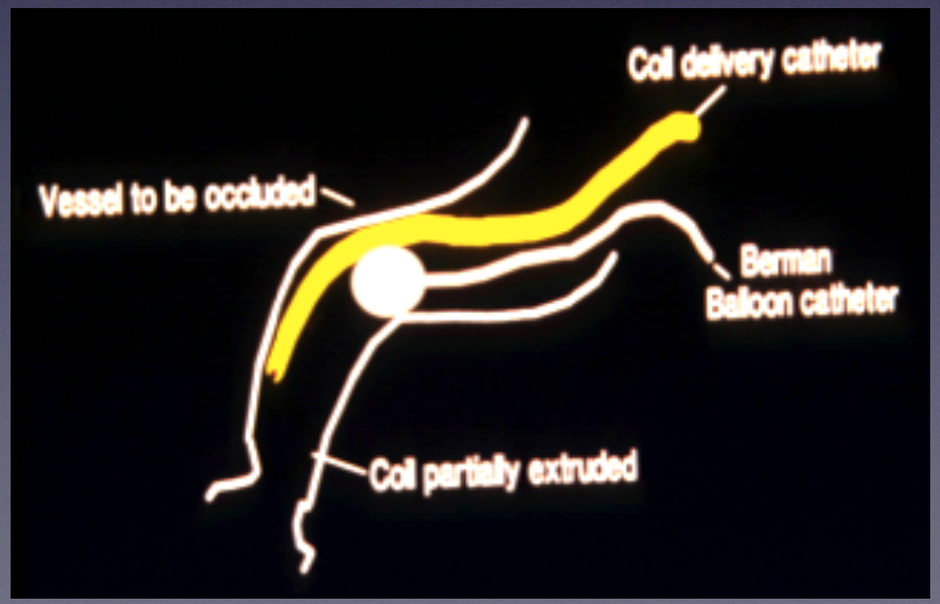




Principles of embolisation with coils

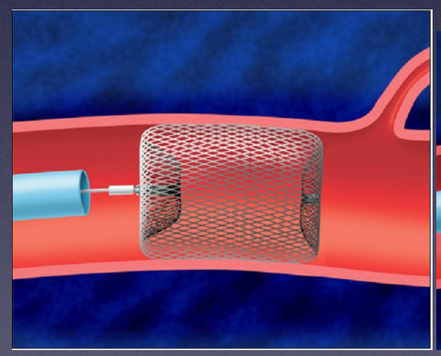
- *Scaffold technique* In high-flow fistulas with large arteries, cross-sectional occlusion can be achieved by first creating a matrix of a long high radial force fibered stainless steel
- With high-flow arteries or very large diameter arteries, embolisation procedure controlled by an occlusion balloon (eg Berman) temporarily inflated to stop flow

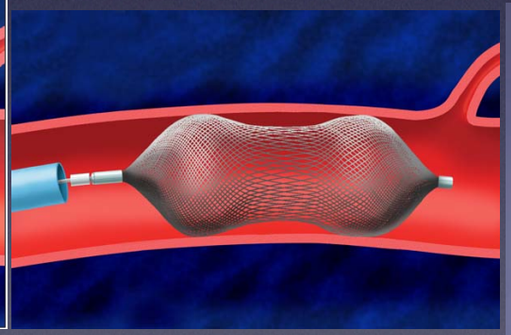




Embolisation devices

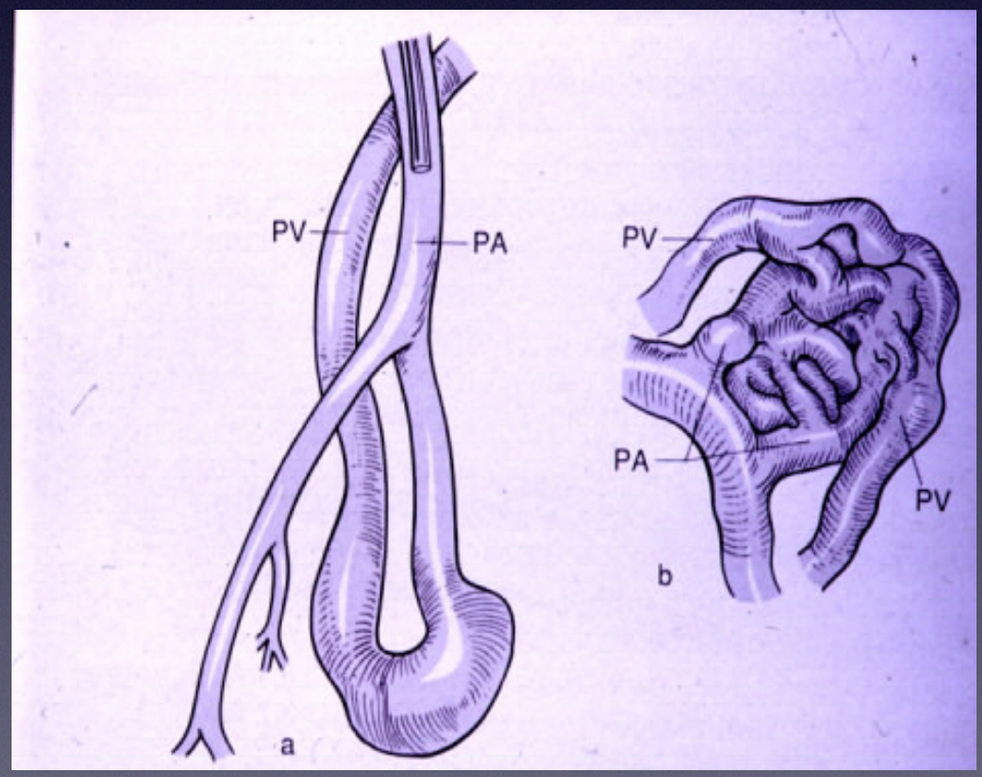
- ADOs and vascular plugs are useful for some vessels
- Nitinol mesh plug with radio-opaque marker bands at each end, stainless steel microscrew attached to one of the marker bands
- Precise placement but residual flow is common and takes some time to occlude
- Diameter 4 mm to 16 mm (AVP I), 3 – 22 mm (AVP II)
- Need 5 Fr to 9 Fr introducing catheter
- Stiff delivery cable/sheath may cause difficulties in tortuous routes





PAVMs

- Rare and may be associated with:
- Congenital (hereditary haemorrhagic telangiectasia - HHT) – incidence 30-40%
  - Diffuse
  - Localised
- Acquired
  - After Glenn shunt
  - Liver disease



Single, simple
Commonest type 80%

White's classification

Multiple complex
less common

PAVMs

Presentation

- Asymptomatic until adult life
- Dyspnoea, fatigue, increasing cyanosis (on exercise)
- Neurological complications (stroke, TIA). In 1 study, strokes in 18%, TIA's in 37%
- Rarely, haemoptysis
- Most commonly in lower lobes or RML
- More frequently in R lung
- Generally do not increase in size, although may increase during pregnancy

PAVMs

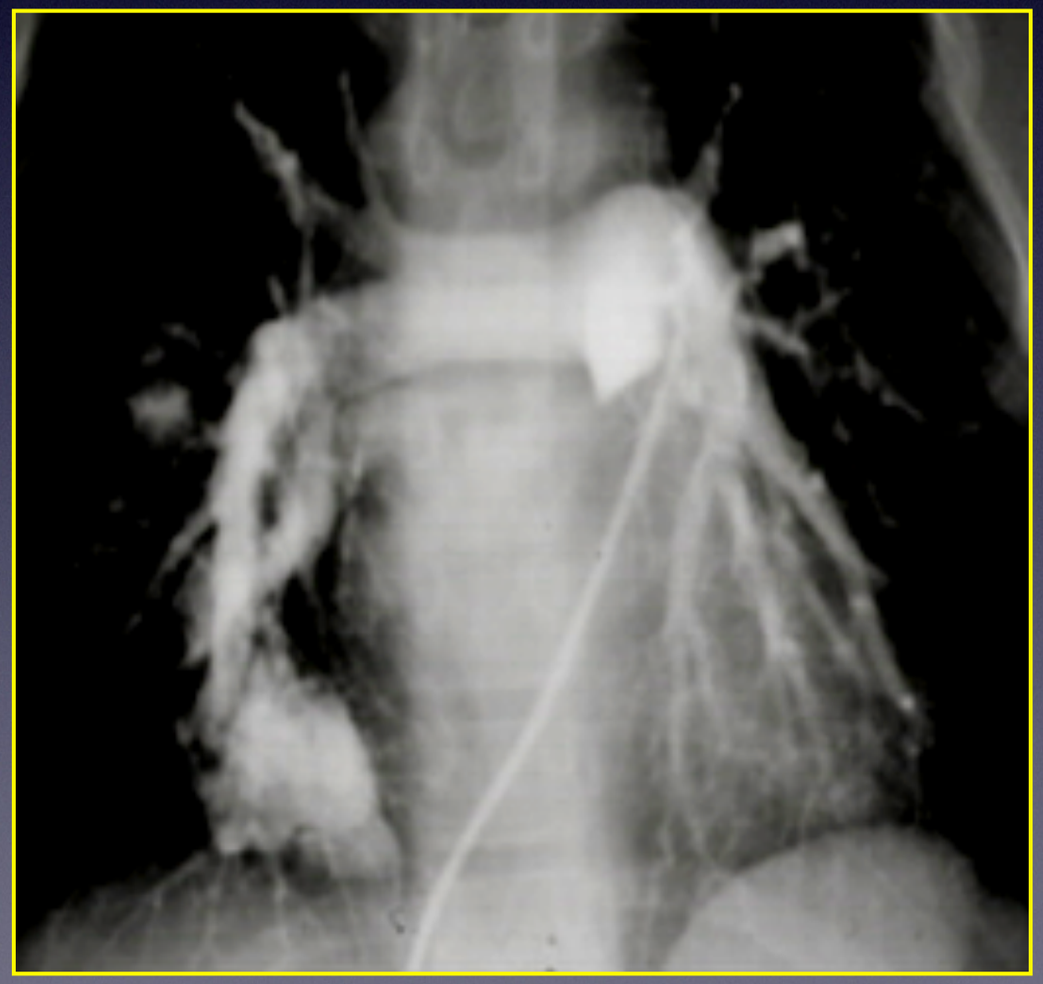
Embolisation

- Occlude feeding artery or occlude malformation
- Techniques should avoid material passing through to left atrium
- Small risk of systemic embolism
- Occlude the artery just before the aneurysmal portion
- If occlude too proximally, may produce lung infarction
- Coil should be larger than feeding artery
- Controlled-release coils superior to balloons and Gianturco coils
- Large arteries need multiple coils for occlusion
- Occlusion devices are better

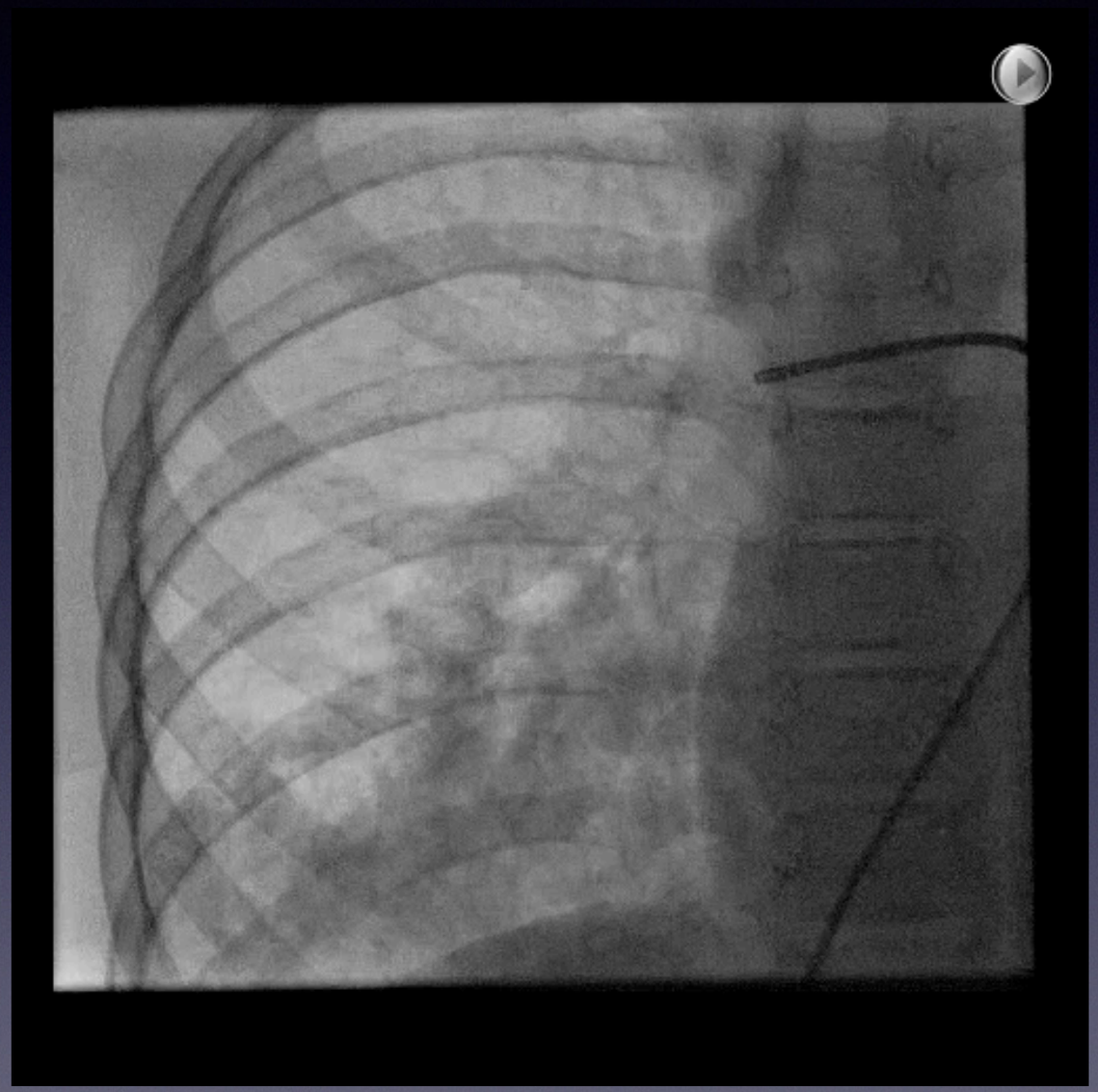
PAVM

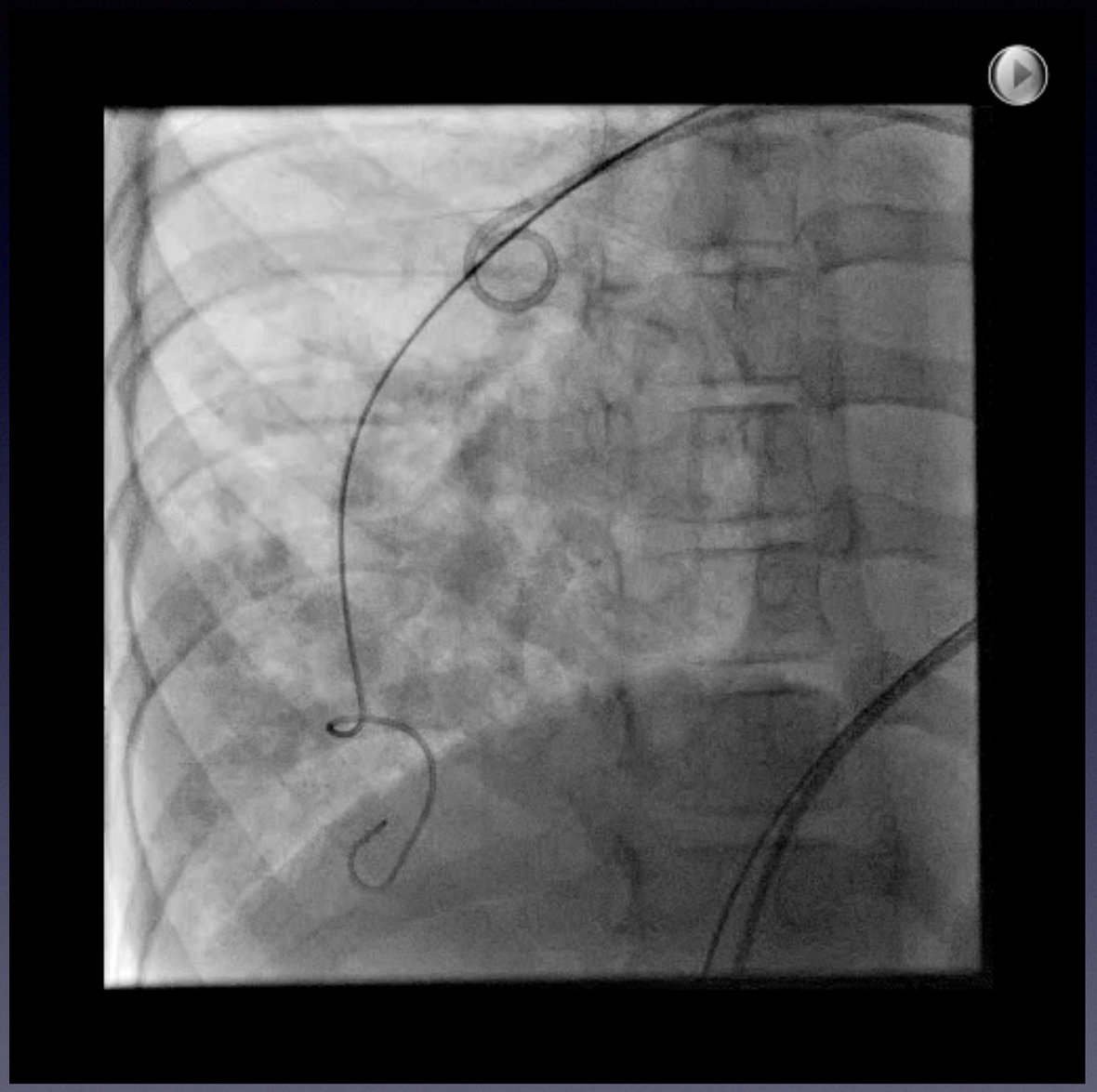
Coil occlusion

- Attempt to coil selectively

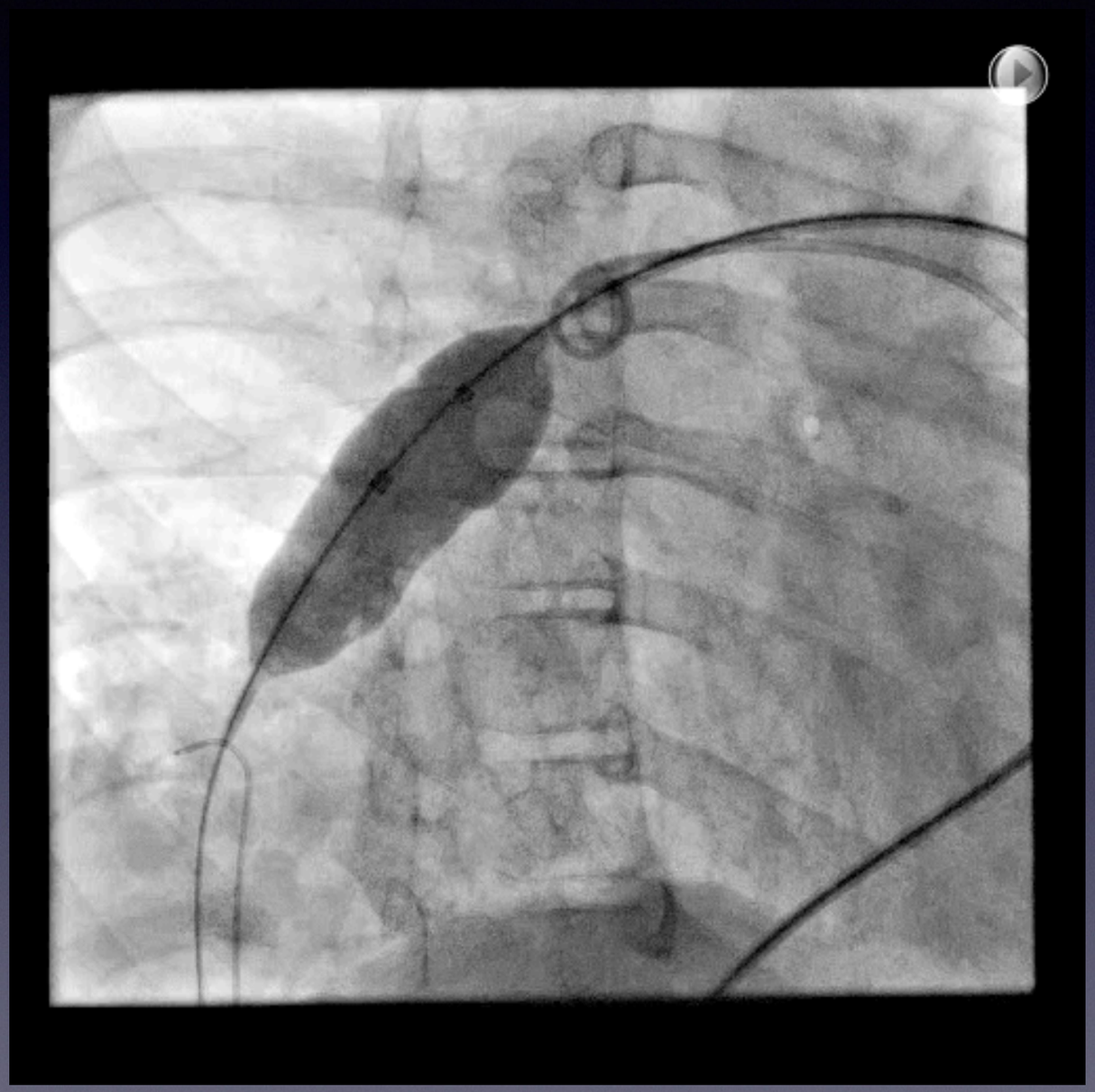


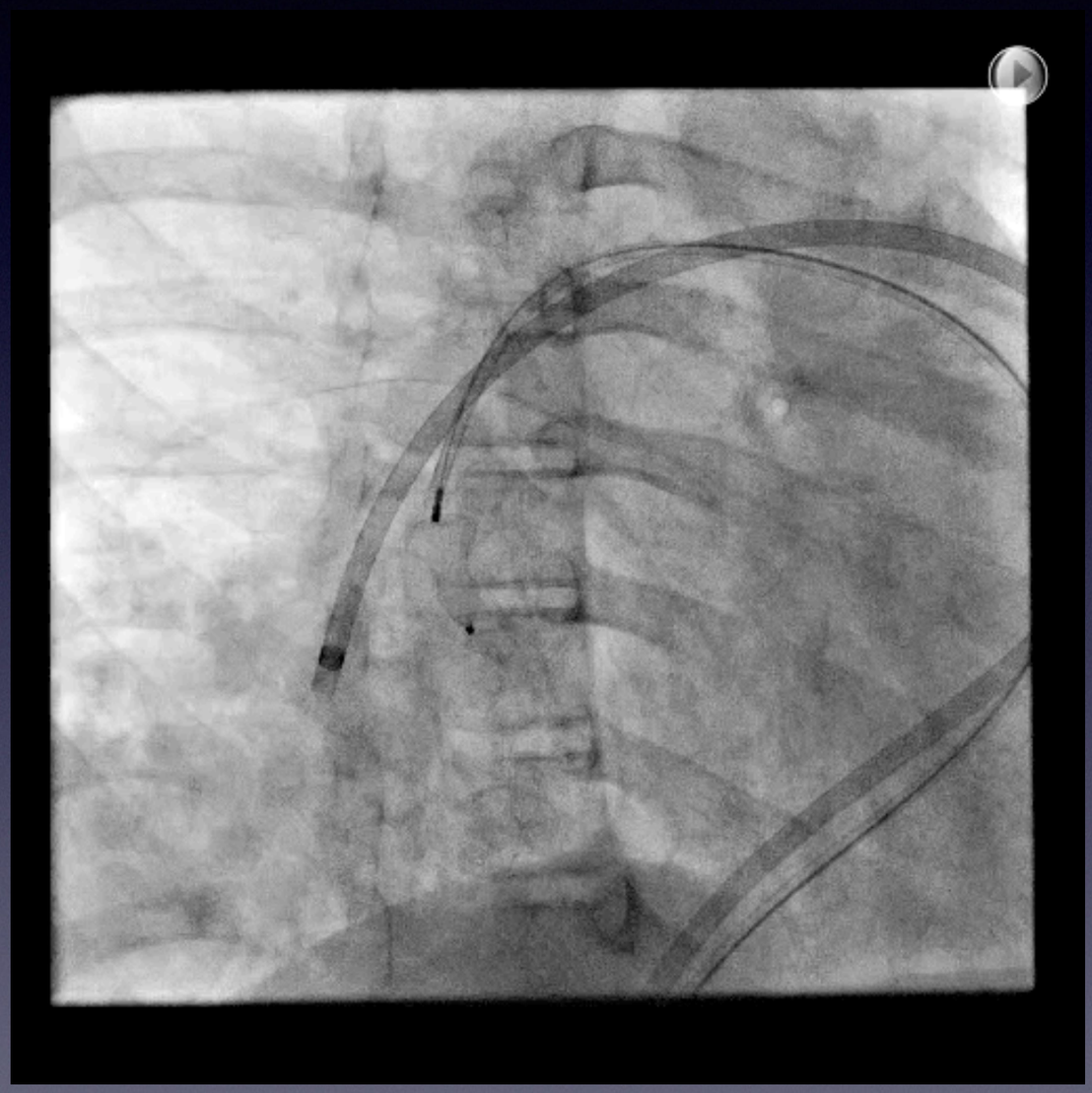
PAVM occlusion with vascular plugs





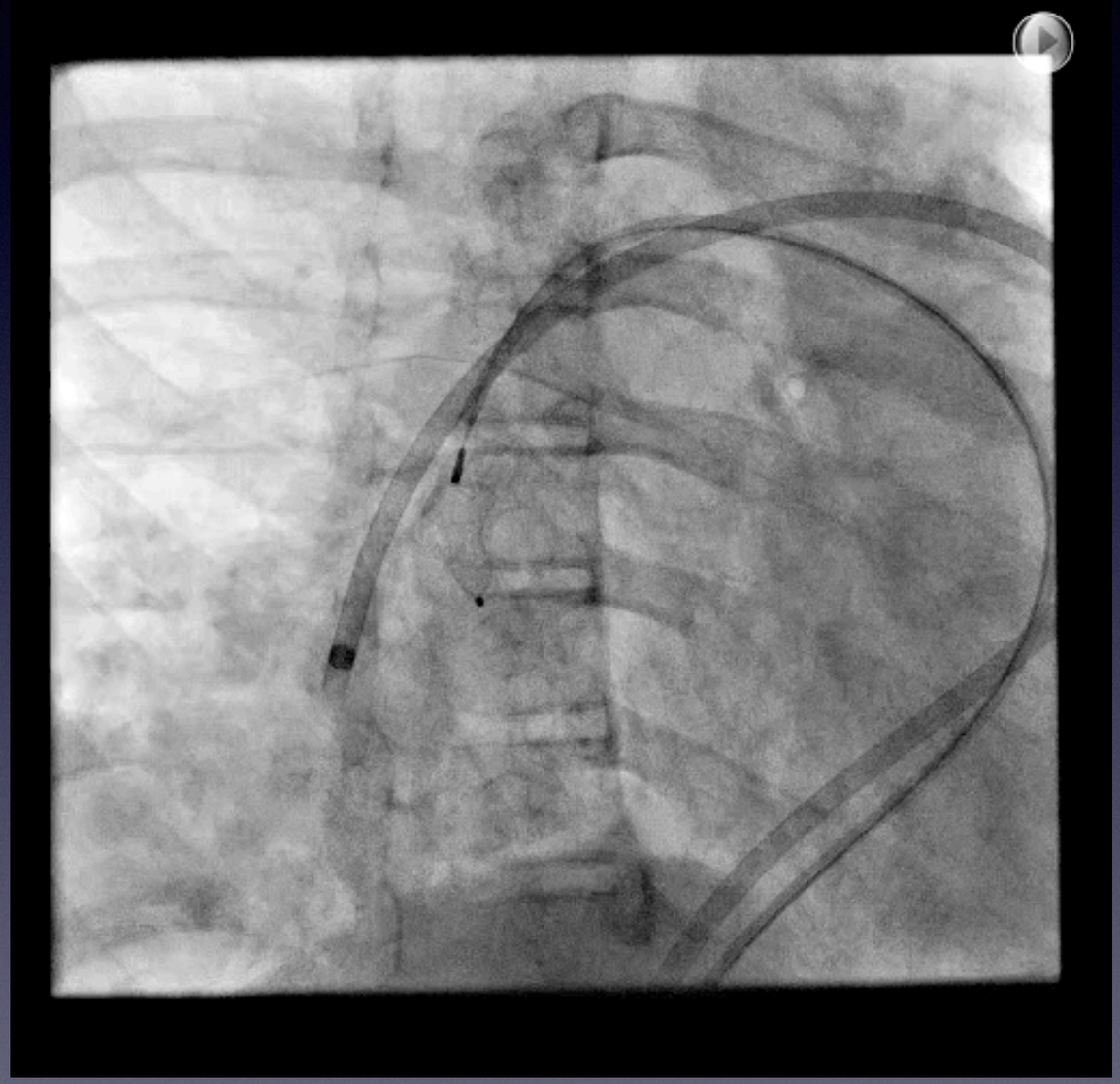
PAVM occlusion with vascular plugs

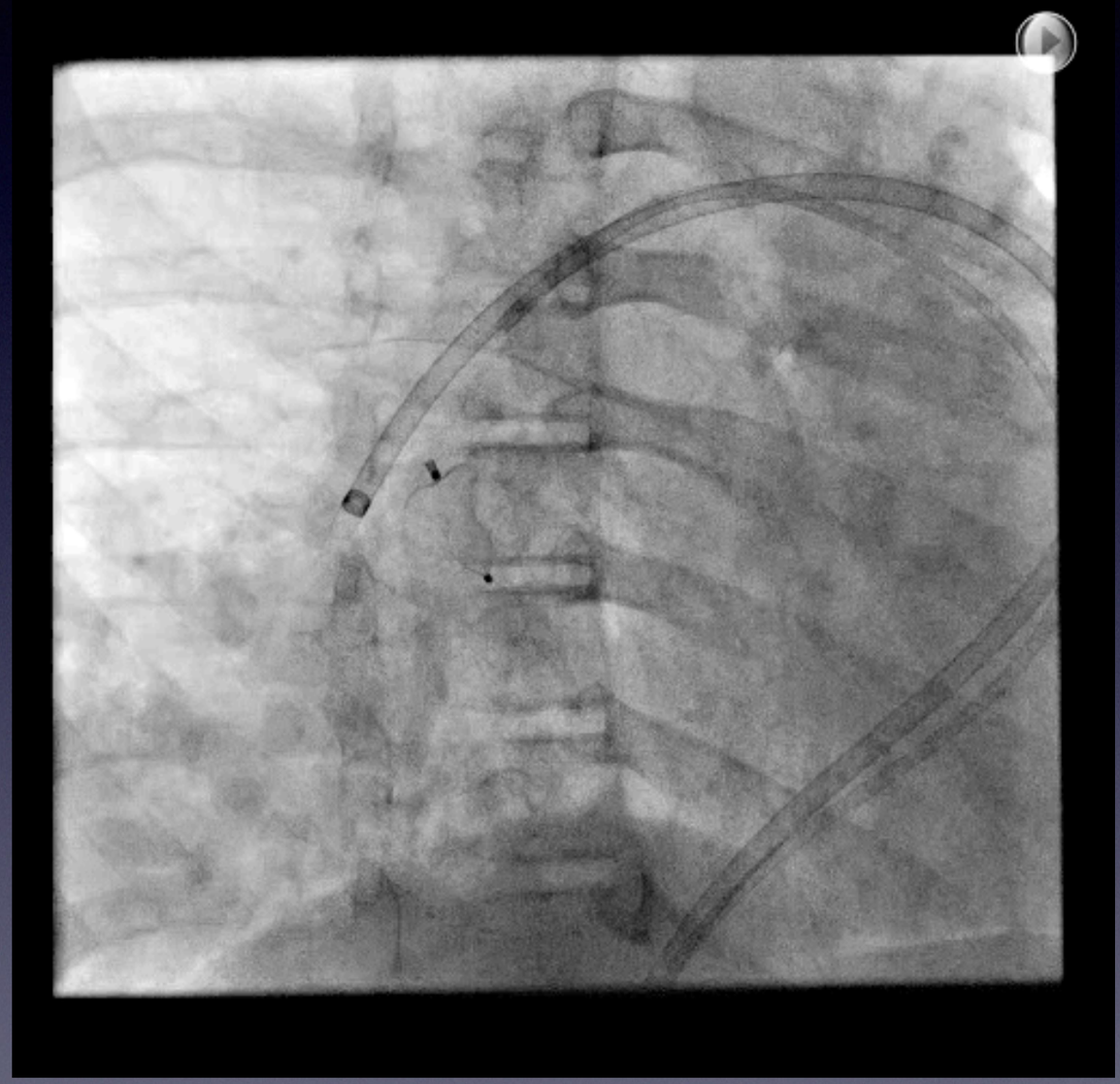




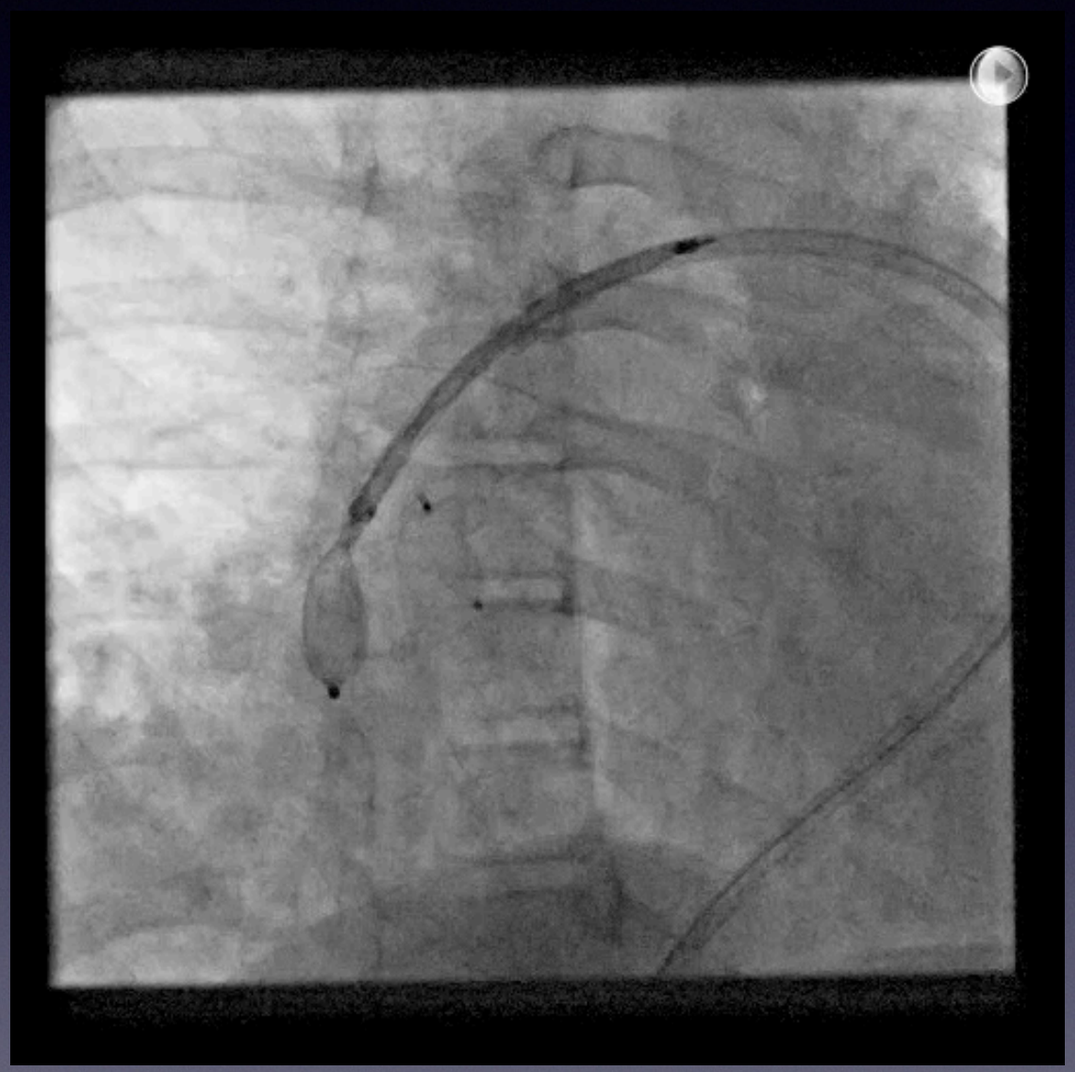
- Assessment with balloon occlusion

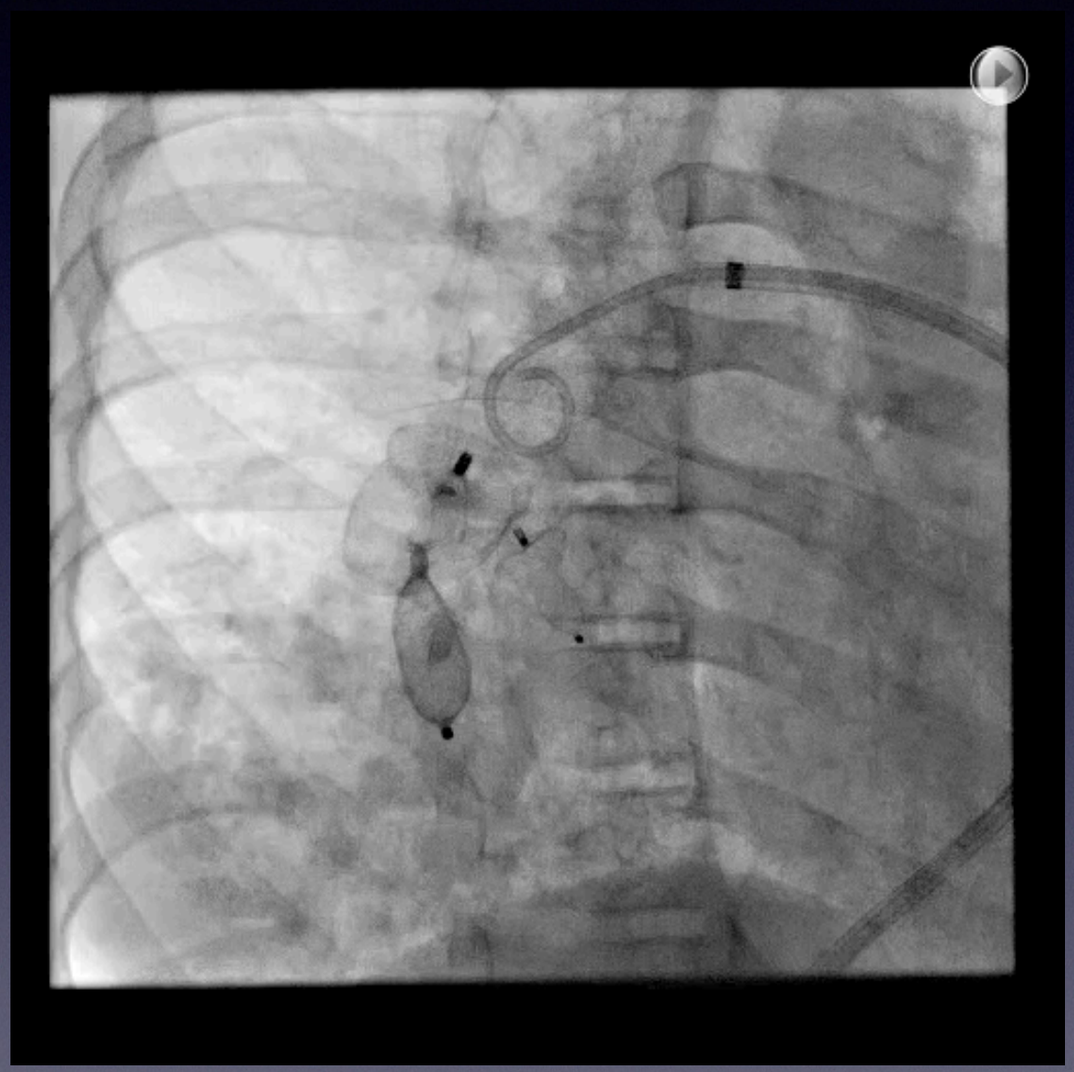
PAVM occlusion with vascular plugs





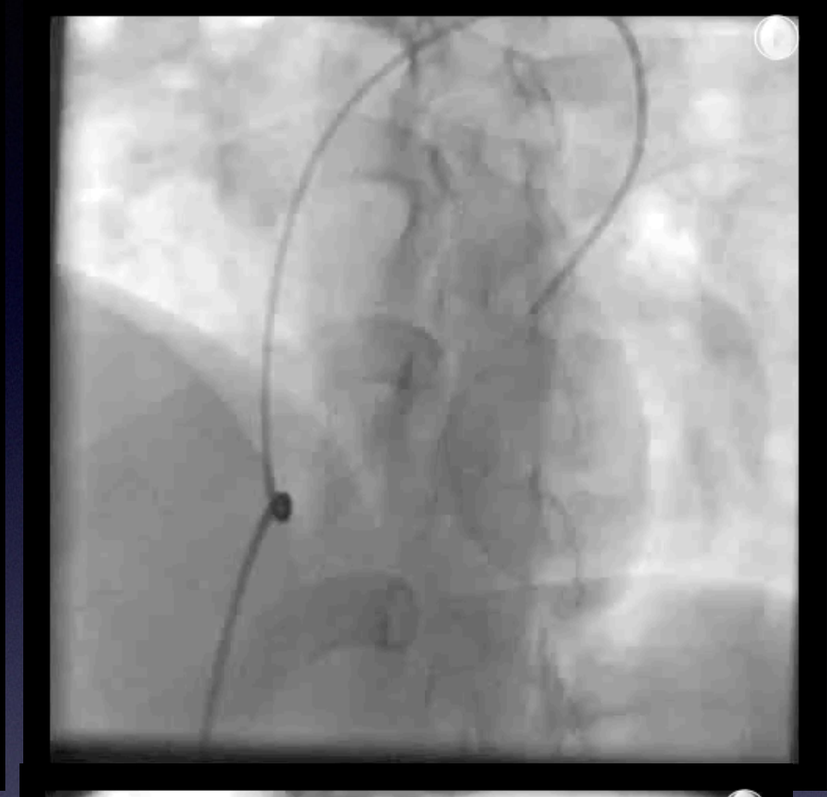
PAVM occlusion with vascular plugs

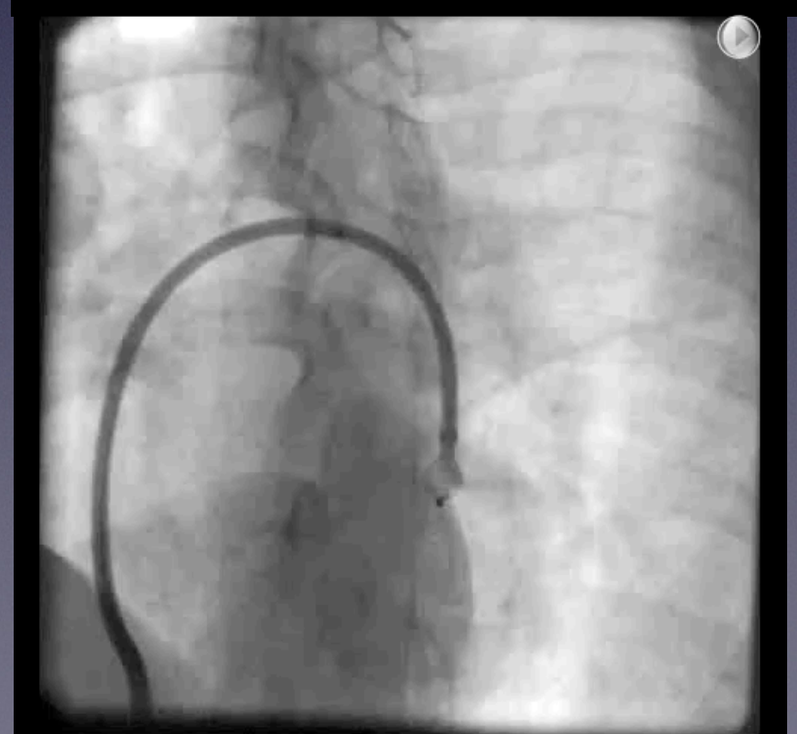


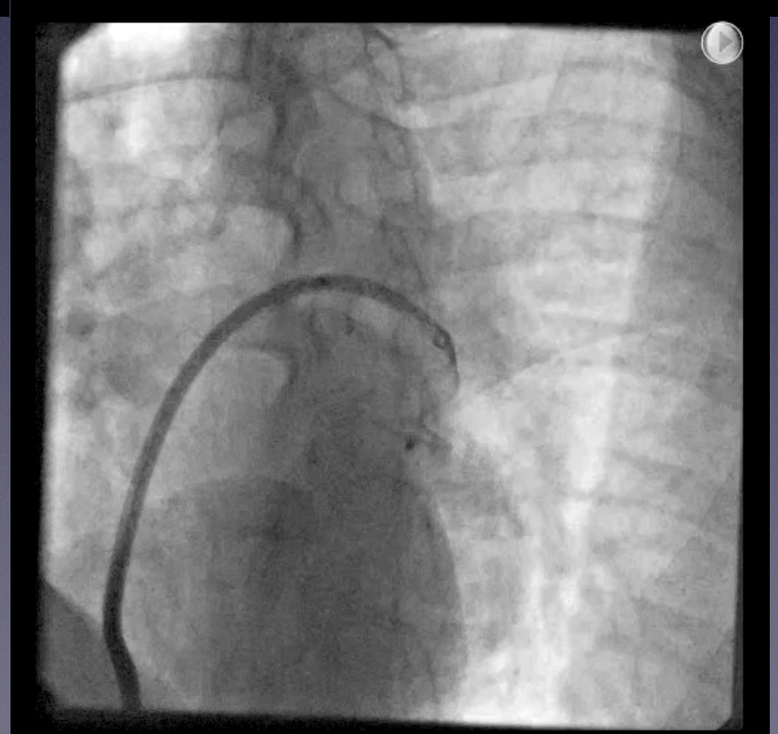


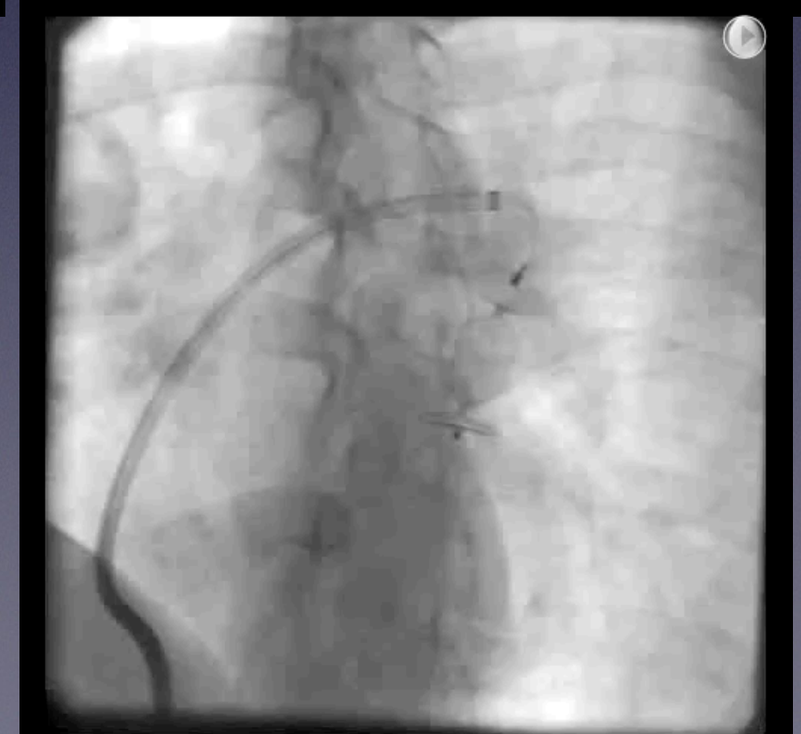
It took 3 days for the saturations to increase to 93%

PAVM occlusion with vascular plug







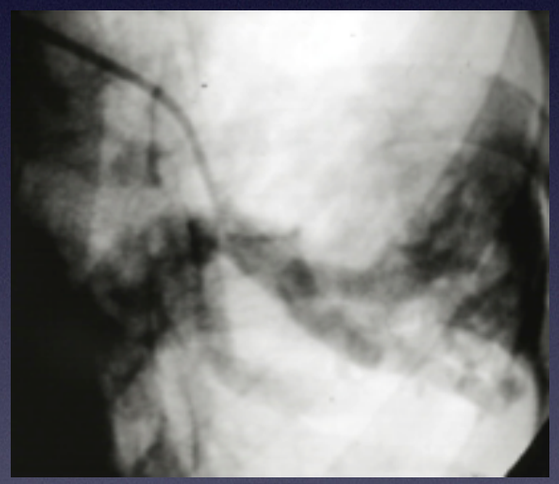


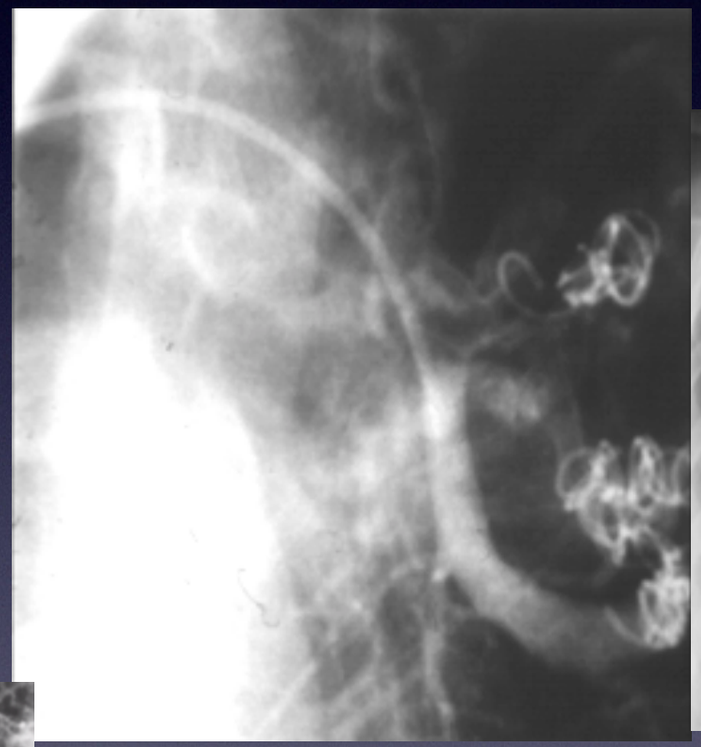
Multiple PAVMs

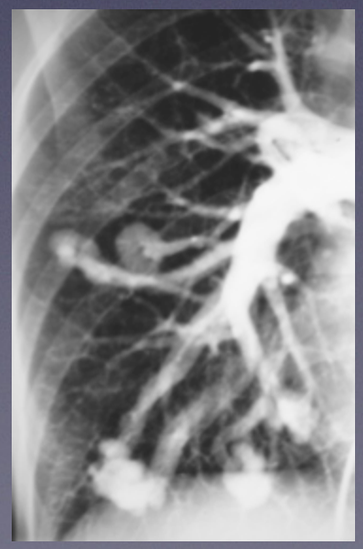
- By embolising larger PAVMs, clinical improvement may occur
- Pts may develop pleurisy or pleural effusion after the procedure
- O2 saturations may deteriorate later because of recurrence or residual small PAVMs
- May need repeat embolisation when other PAVMs have become larger

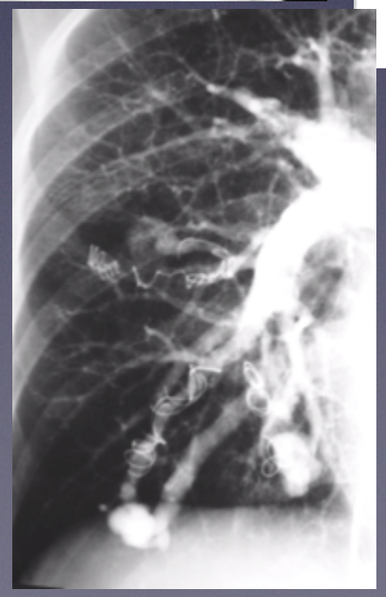
Multiple PAVMs

- Selective embolisation is important









Aortopulmonary collaterals

- Associated with pulmonary atresia/VSD or tetralogy of Fallot, occasionally with others e.g HLH, Scimitar syndrome

- May need closure:
  - Prior to surgery
  - After surgery

Aortopulmonary collaterals - closure

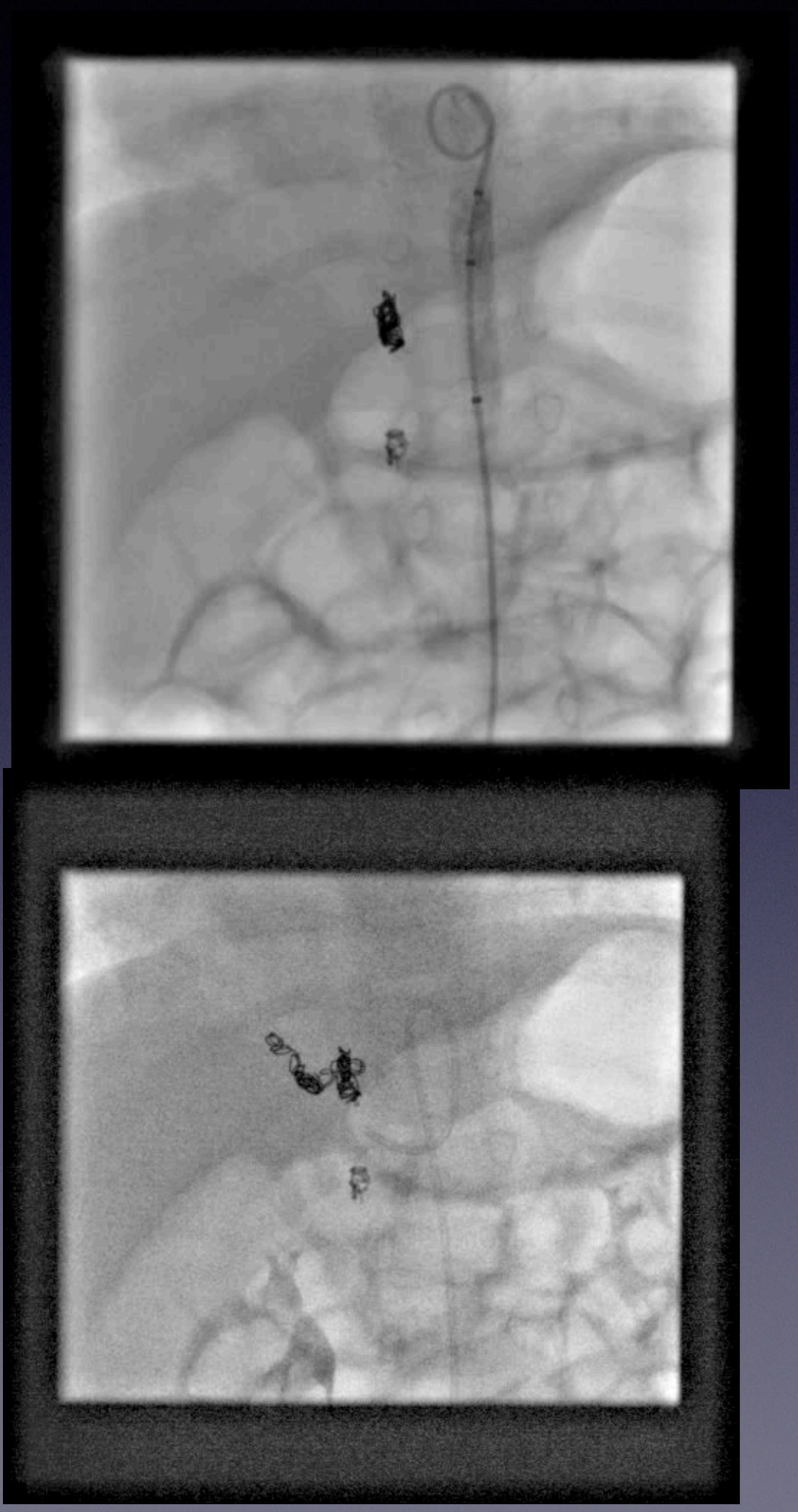
- Ensure alternative blood supply to the lung segment supplied by MAPCA
- Occasionally test occlusion with a balloon is needed
- Unusual origin and tortuosity may cause difficulties in positioning guidewires and guiding catheters
- Tracker 18 or Micro-Ferret 3 Fr catheters may be needed for very tortuous vessels
- Vascular plugs preferable if the course is favourable

Aortopulmonary collaterals - closure

- Femoral artery access and full heparinisation
- Cannulation of collateral should provide the straightest and least complicated course
- Coil diameter 30% larger than diameter of the vessel to be occluded.

  Arteries will stretch 10-20% when plugged
- First coil is crucial and should be the largest to prevent distal embolisation
- Subsequent coils delivered to form a nest at occlusion site
- Vascular plugs - should be about 2 mm larger than the vessel

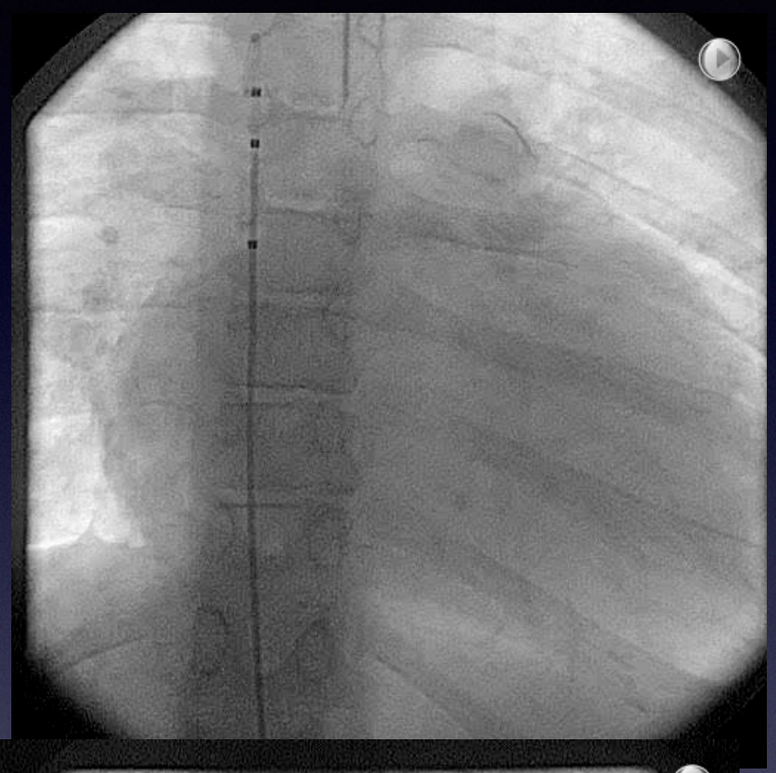
Aortopulmonary collaterals

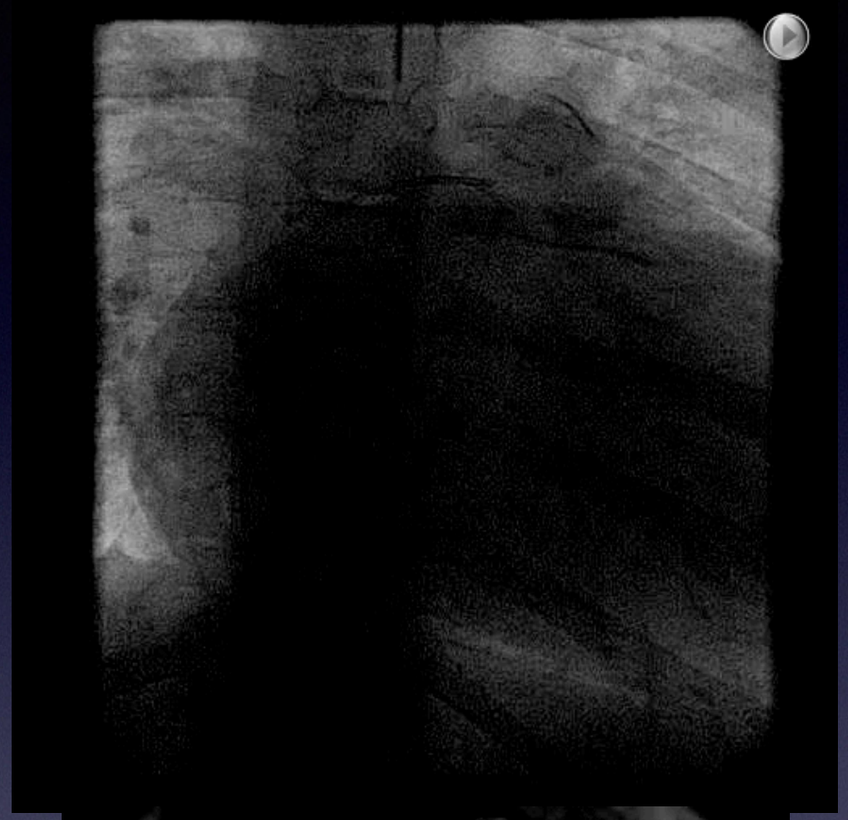


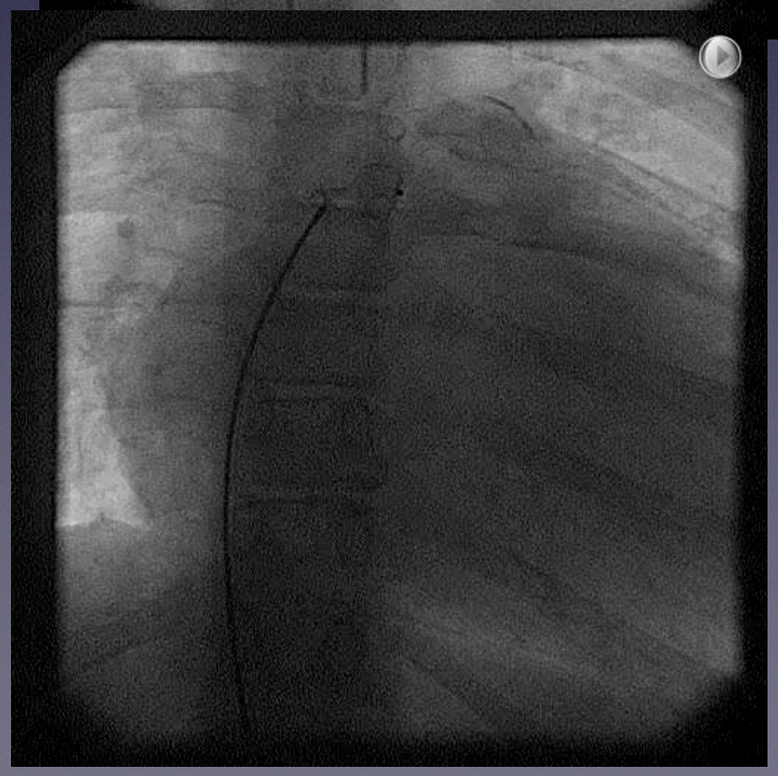
Tortuous course for closure

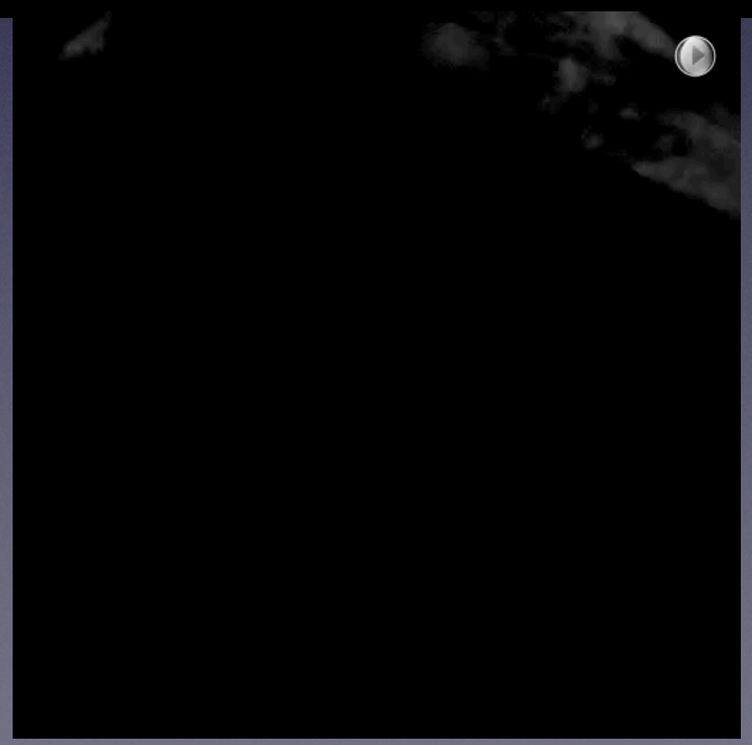
After more DCS coils

Aortopulmonary collaterals
Multiple techniques may be needed









Coronary arteriovenous fistulas

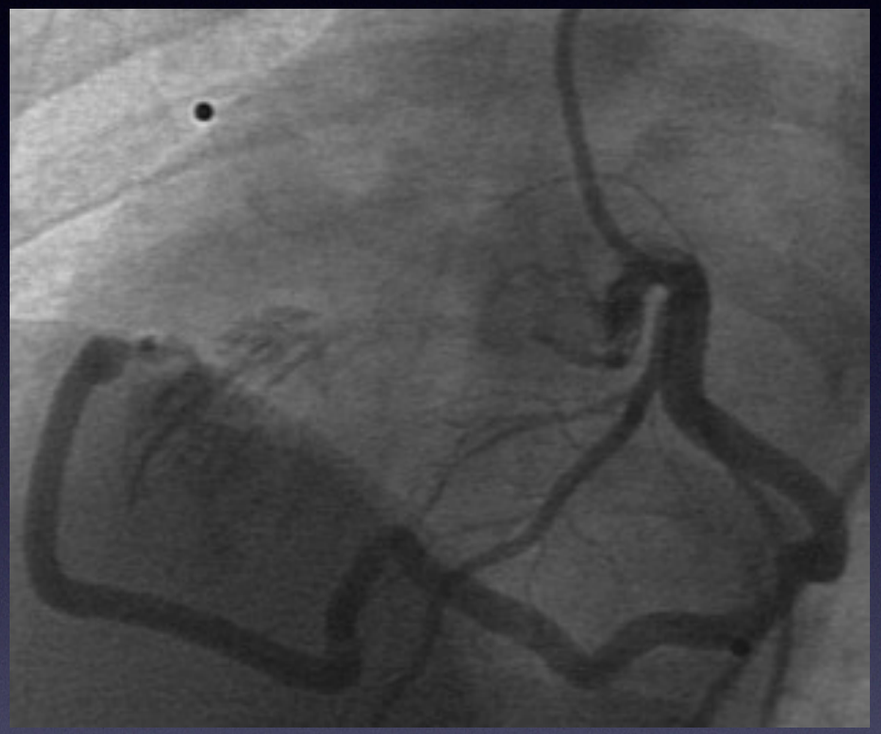
- Symptoms occur at the extremes of life
- Symptoms due to CCF in newborn or early infancy < 1 year of age
- In older patients beyond 3rd and 4th decades – symptoms of angina, breathlessness, palpitations
- In between, asymptomatic murmur may be the only finding

Coronary arteriovenous fistulas

- *Complications*

- Myocardial ischaemia
- Myocardial infarction
- Arrhythmias
- Endocarditis/endarteritis
- Aneurysm rupture
- Thrombus formation

Would you close this CAVF?



Coronary arteriovenous fistulas

Indications for closure

- Increased/increasing L ->R shunt
- LV volume overload
- Myocardial ischaemia
- LV dysfunction
- CCF
- *Prevention of endocarditis*

Coronary arteriovenous fistulas

Indications for closure

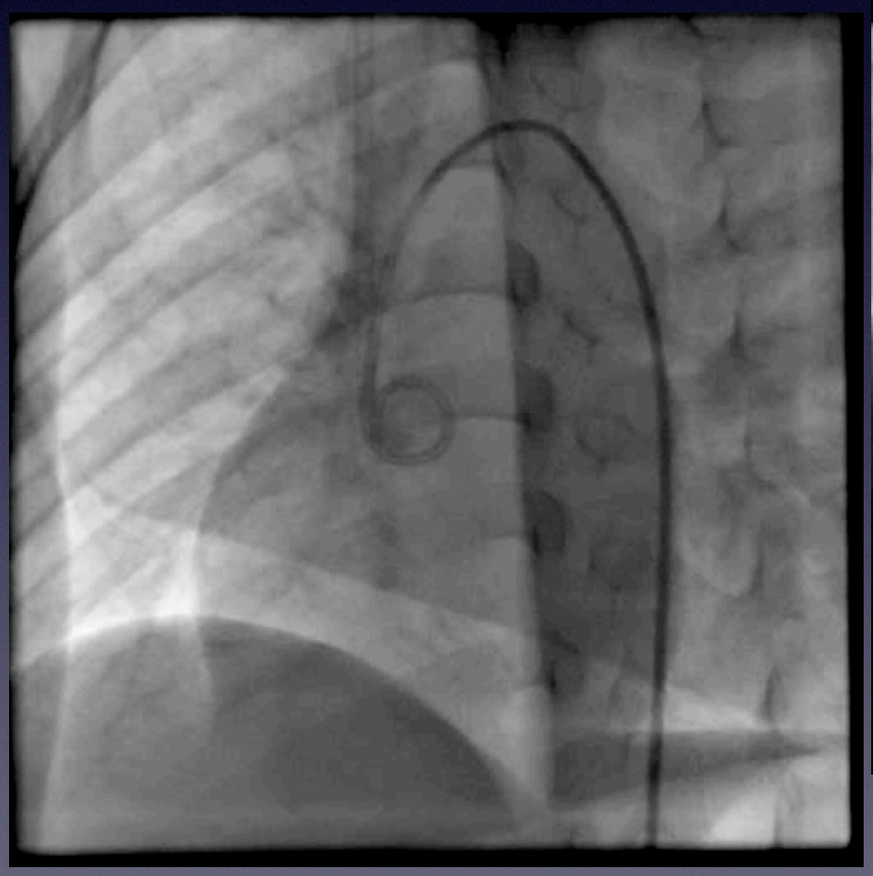
- Selection of non-tapered catheters
- Berman/Swan-Ganz balloons
- Tracker or Ferret catheters
- Guidewires (0.014” and 0.018”)
- Coils – conventional and controlled-release (e.g DCS, or PDA)
- Balloons - detachable - rarely used
- Disc type of occlusion devices - vascular plugs, PDA and ASD devices

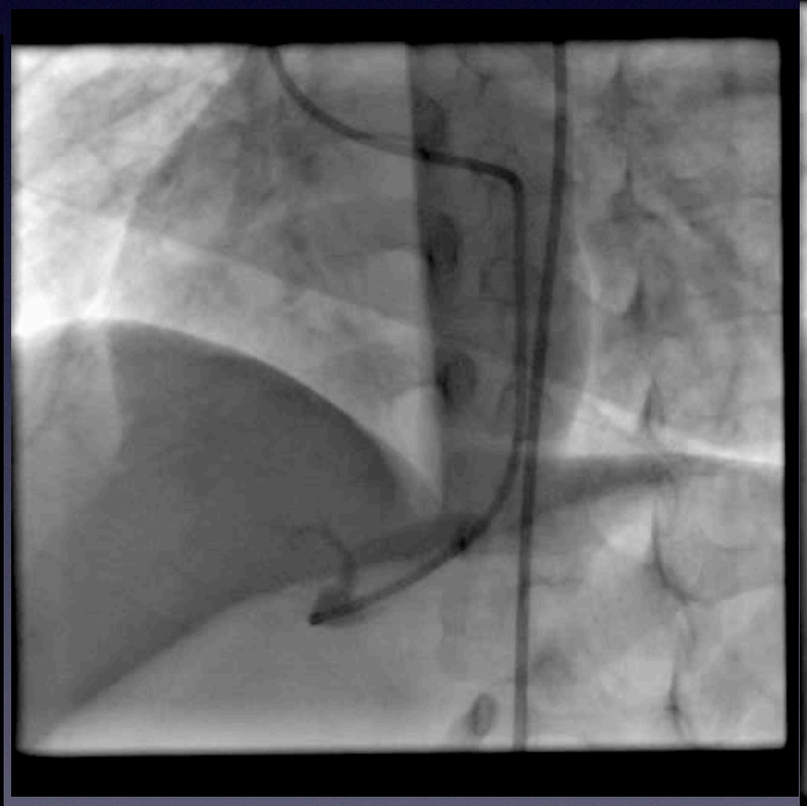
Coronary arteriovenous fistulas
Technique

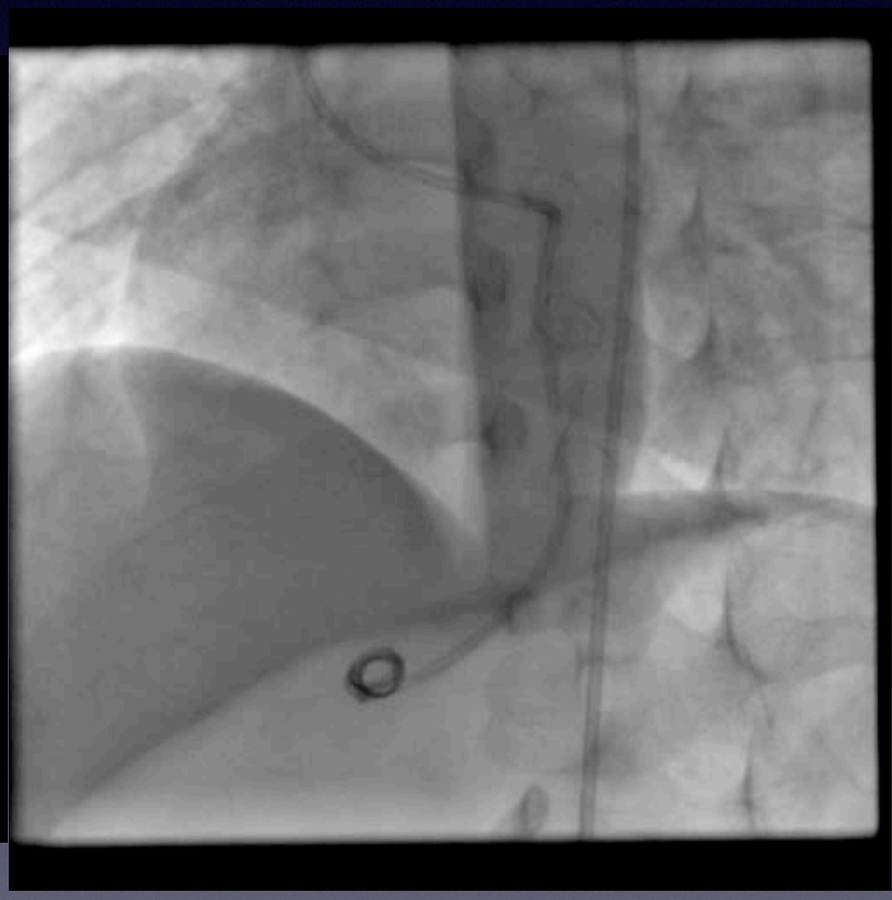
- Patient:
  - Age and size of patient
  - Catheter size that can be used in patient
- Fistula:
  - Size of the vessel to be occluded
  - Tortuosity of vessels and catheter course
  - High flow in the fistula
  - Aneurysmal fistulas
  - Multiple feeding vessels

Coronary arteriovenous fistulas
Technique

- If the route is tortuous and there is high flow with a distal stenosis, then controlled-release coils can be used





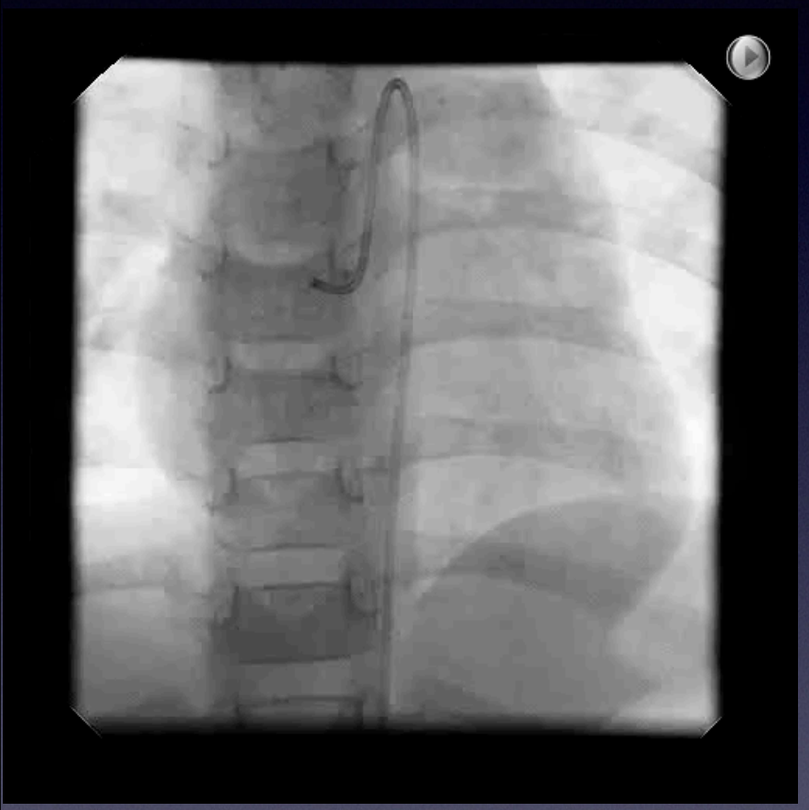


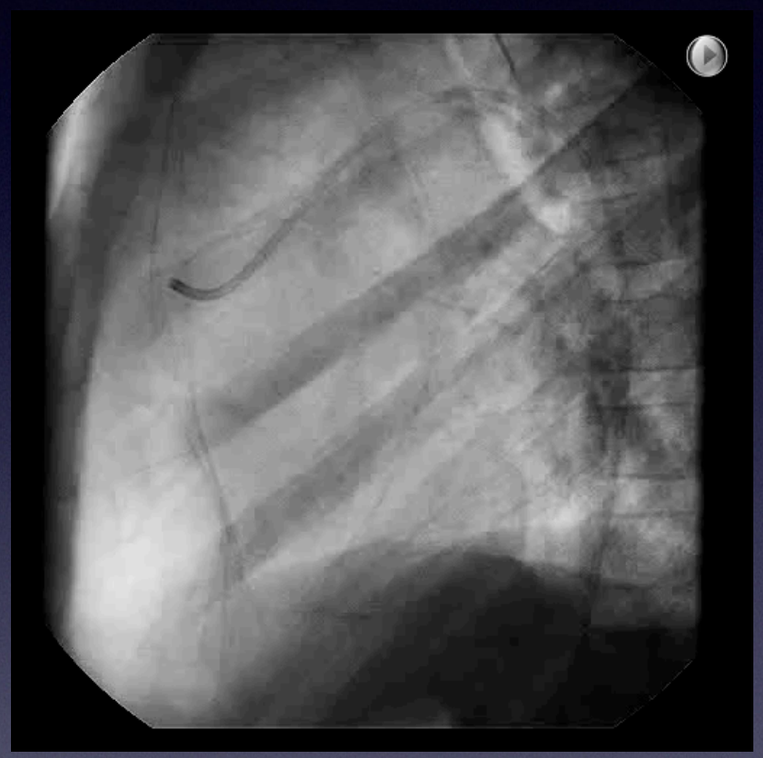
Coronary arteriovenous fistulas
Technique

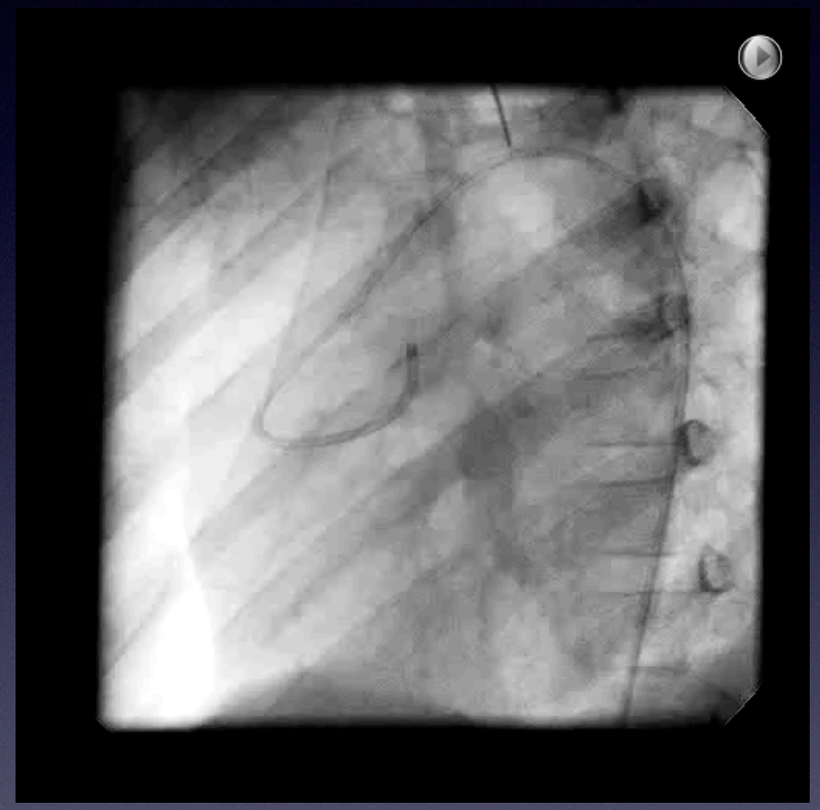
- If the route is tortuous and there is high flow with a distal stenosis, then controlled-release coils can be used

Coronary artery fistula closure

- Define morphology beforehand to plan the technique



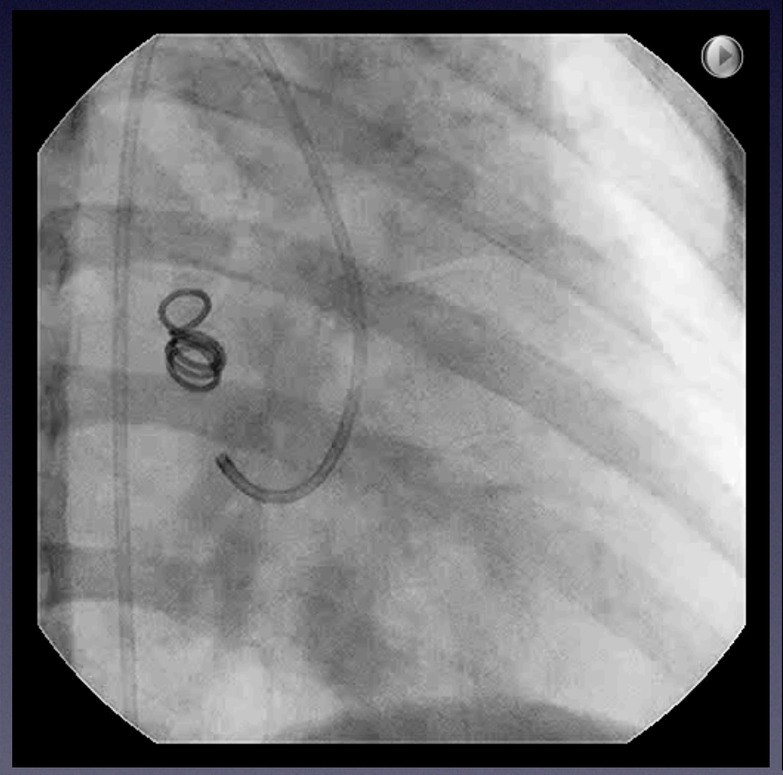


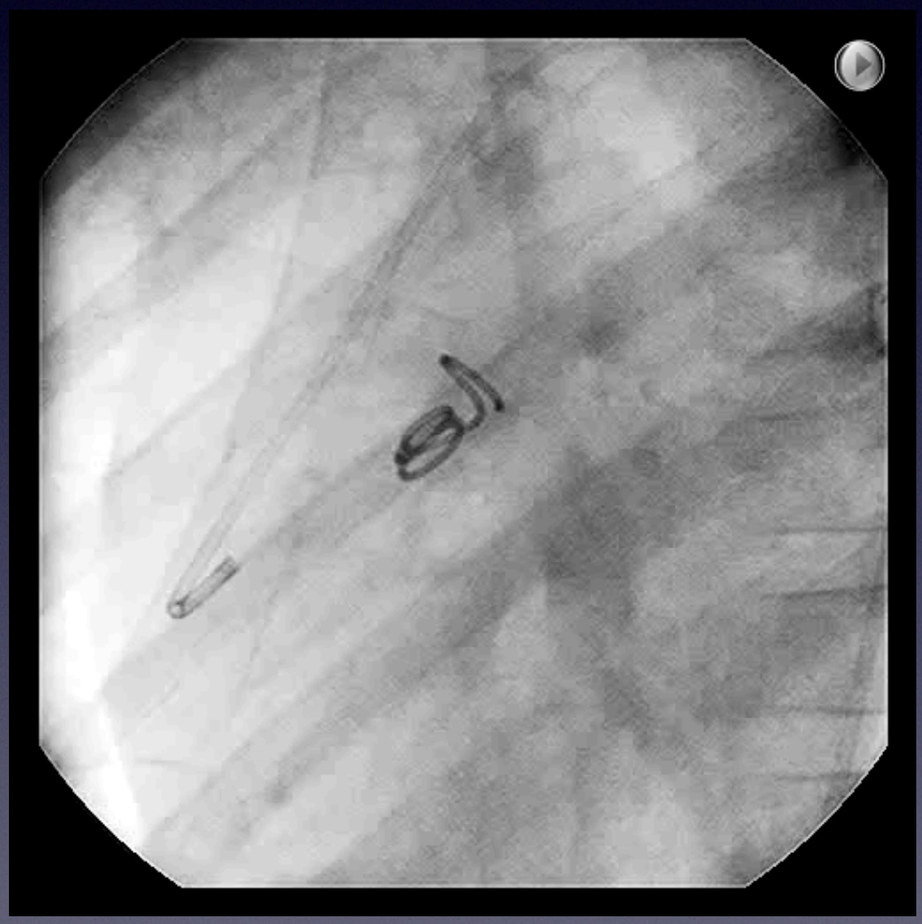


How would you close this CAVF?

Coronary artery fistula closure

- Define morphology beforehand to plan the technique

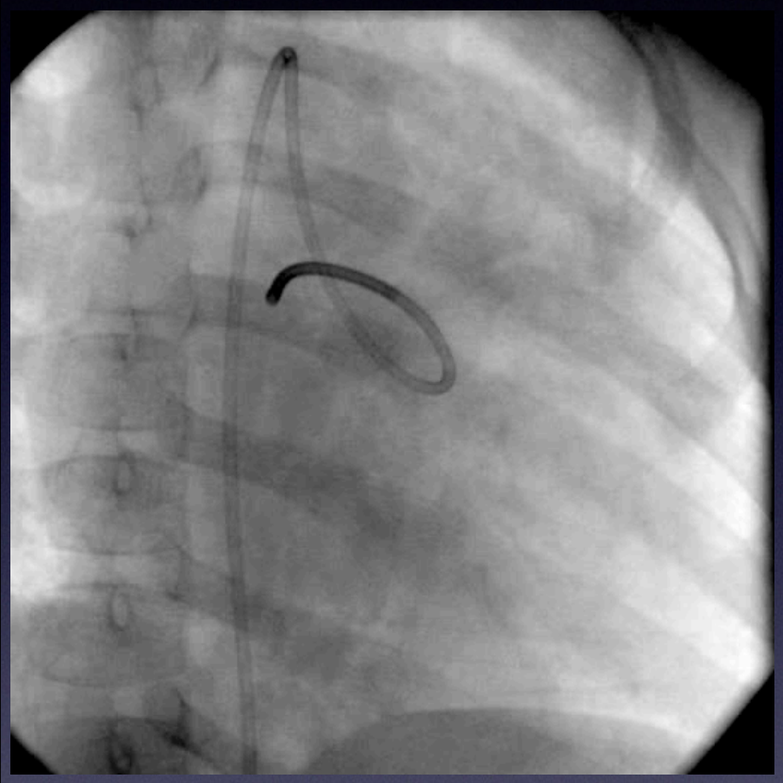


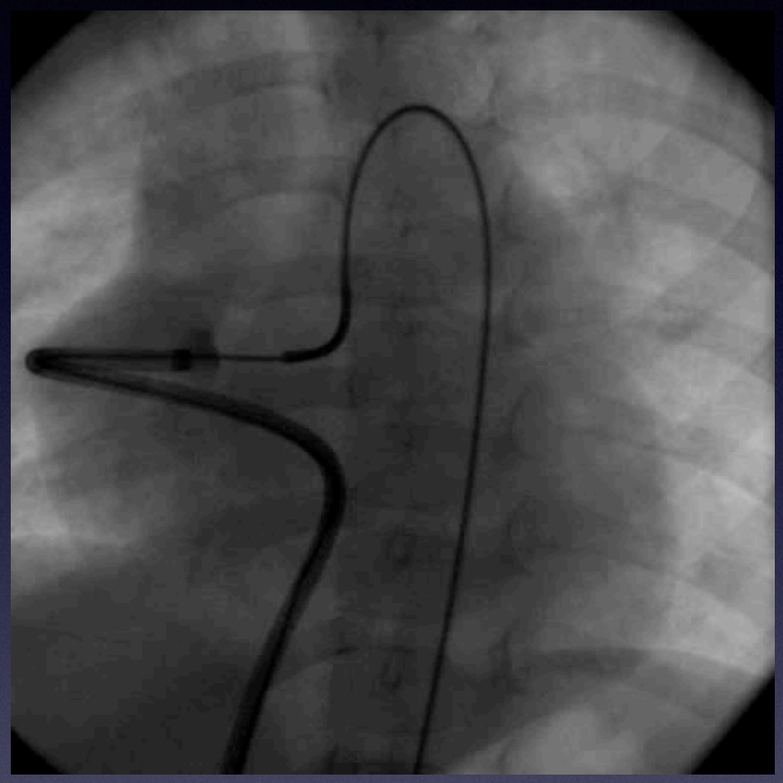


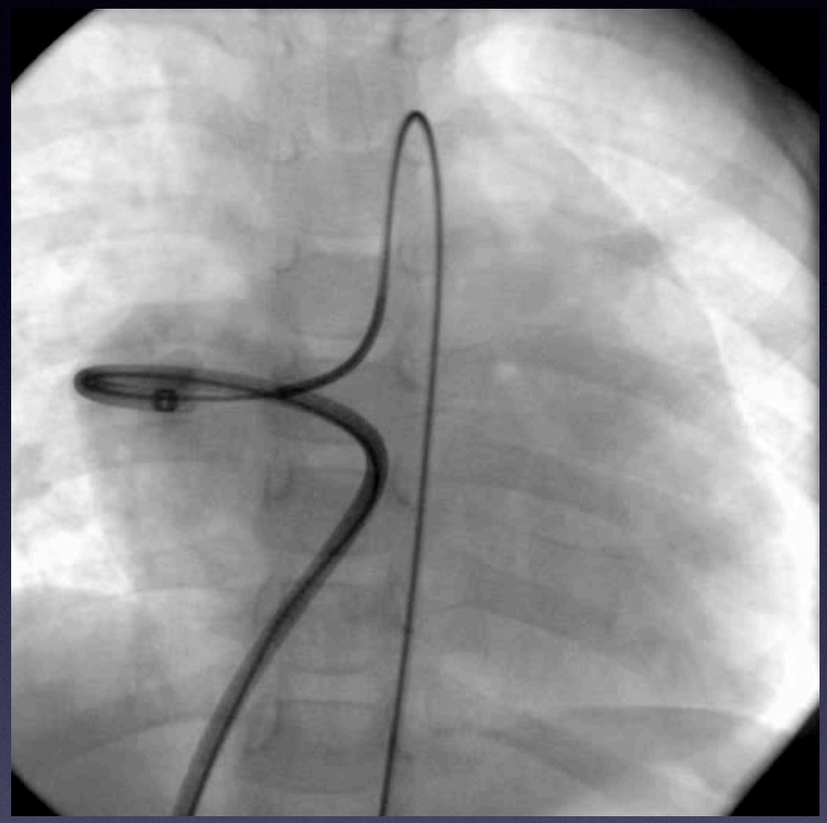
Cook PDA coil

Coronary artery fistula closure

- Different devices can be used for similar fistulas



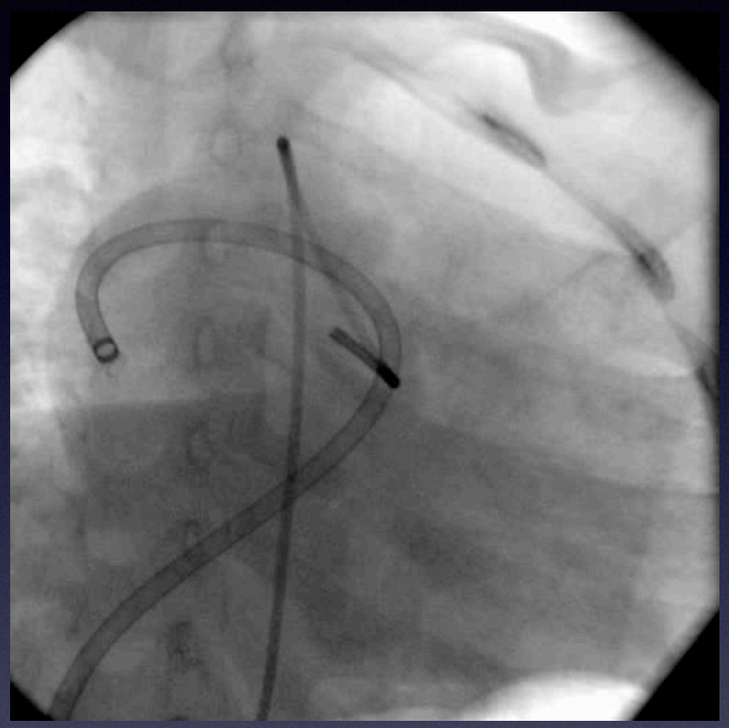


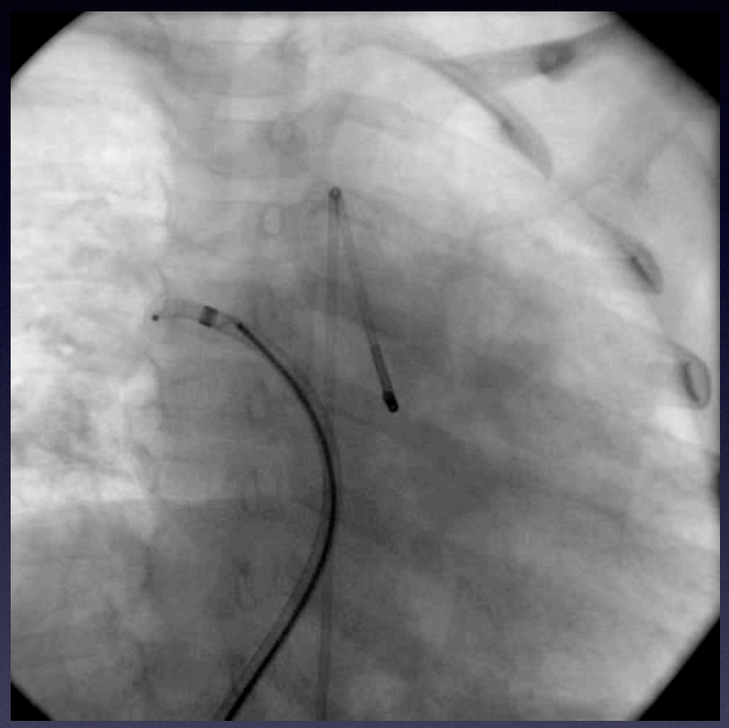


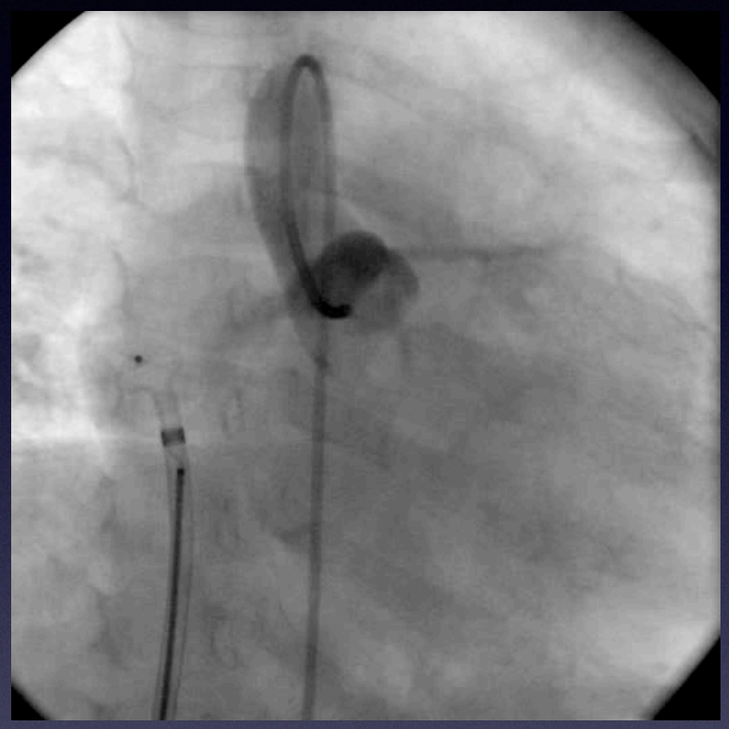
For devices, circuit is mostly needed

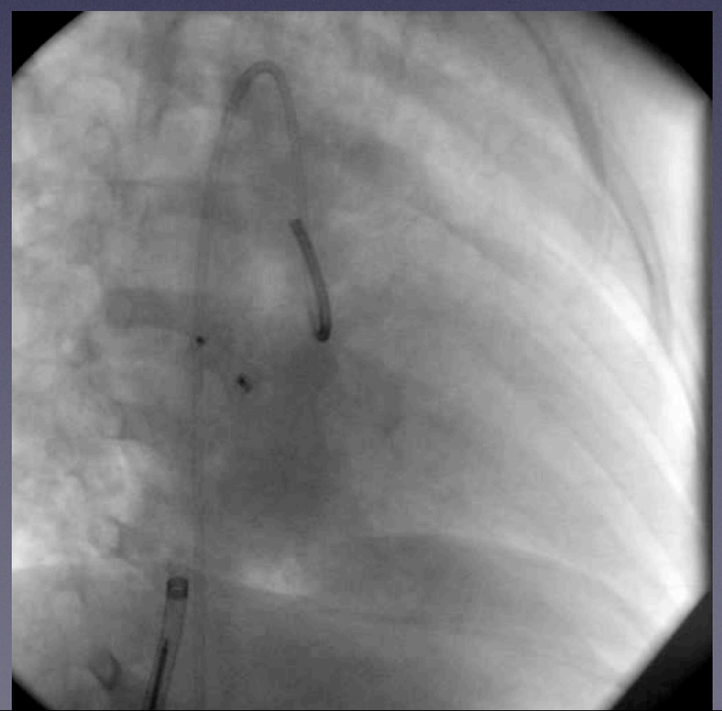
Coronary artery fistula closure

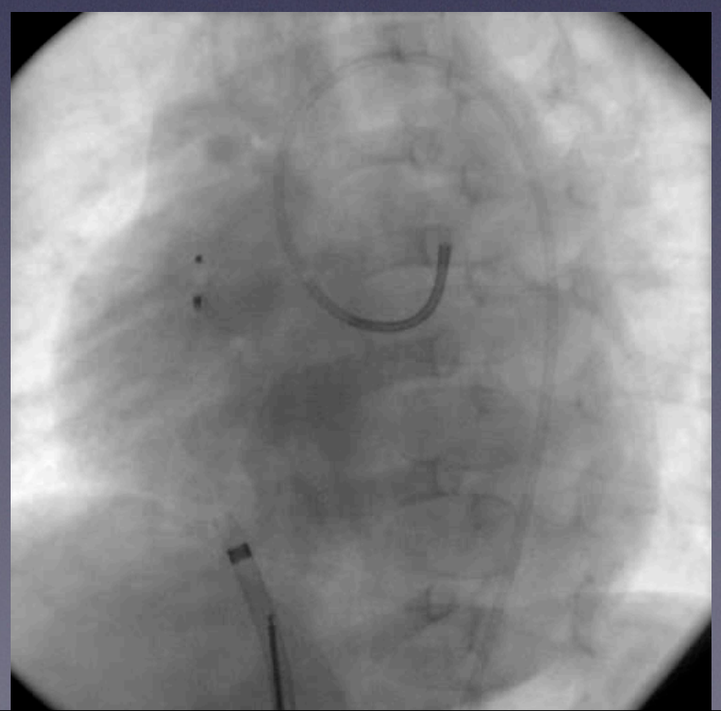
- Different techniques can be used for similar fistulas



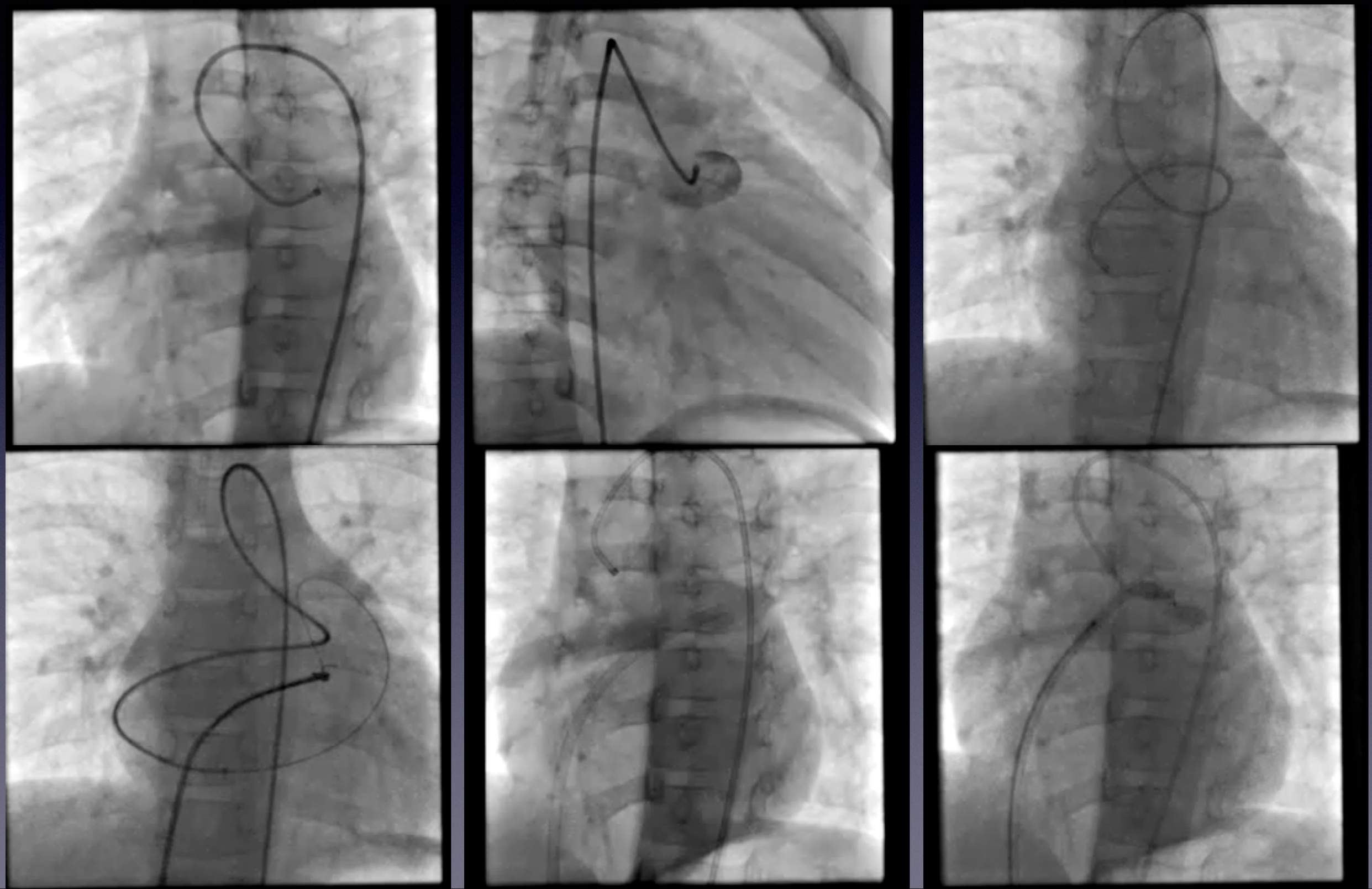








What about coronary fistulas with aneurysms?



What about coronary fistulas with aneurysms?

What about coronary fistulas with aneurysms?

Closing fistula at entry and exit points may have some merit

Embolisation of vessels

- Detailed assessment of pulmonary artery blood supply before closure of MAPCAs
- Occlusion of MAPCAs may be needed before or after surgery and multiple procedures required
- MAPCA and coronary fistula occlusion is technically demanding
- Wide selection of equipment in the catheter laboratories
- In large fistulas with easy access, variety of plug or closure devices have important role
- In tortuous vessels, coils still have important role