



# **Transcatheter closure of collaterals & fistulae: Coils, Vascular plugs & others**

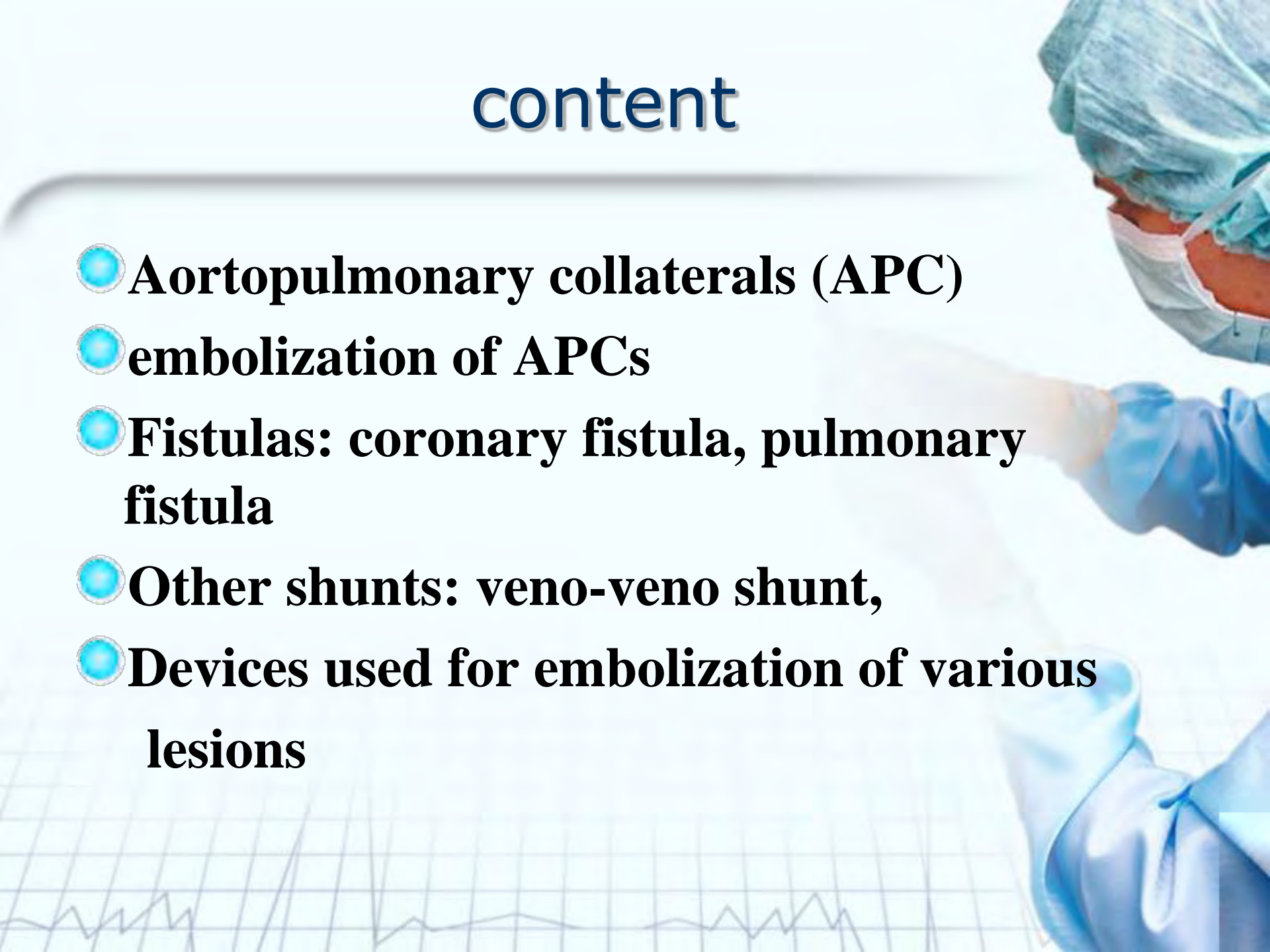
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National Taiwan University Hospital,  
Taipei, Taiwan**

**TCTAP, April 25, 2013**



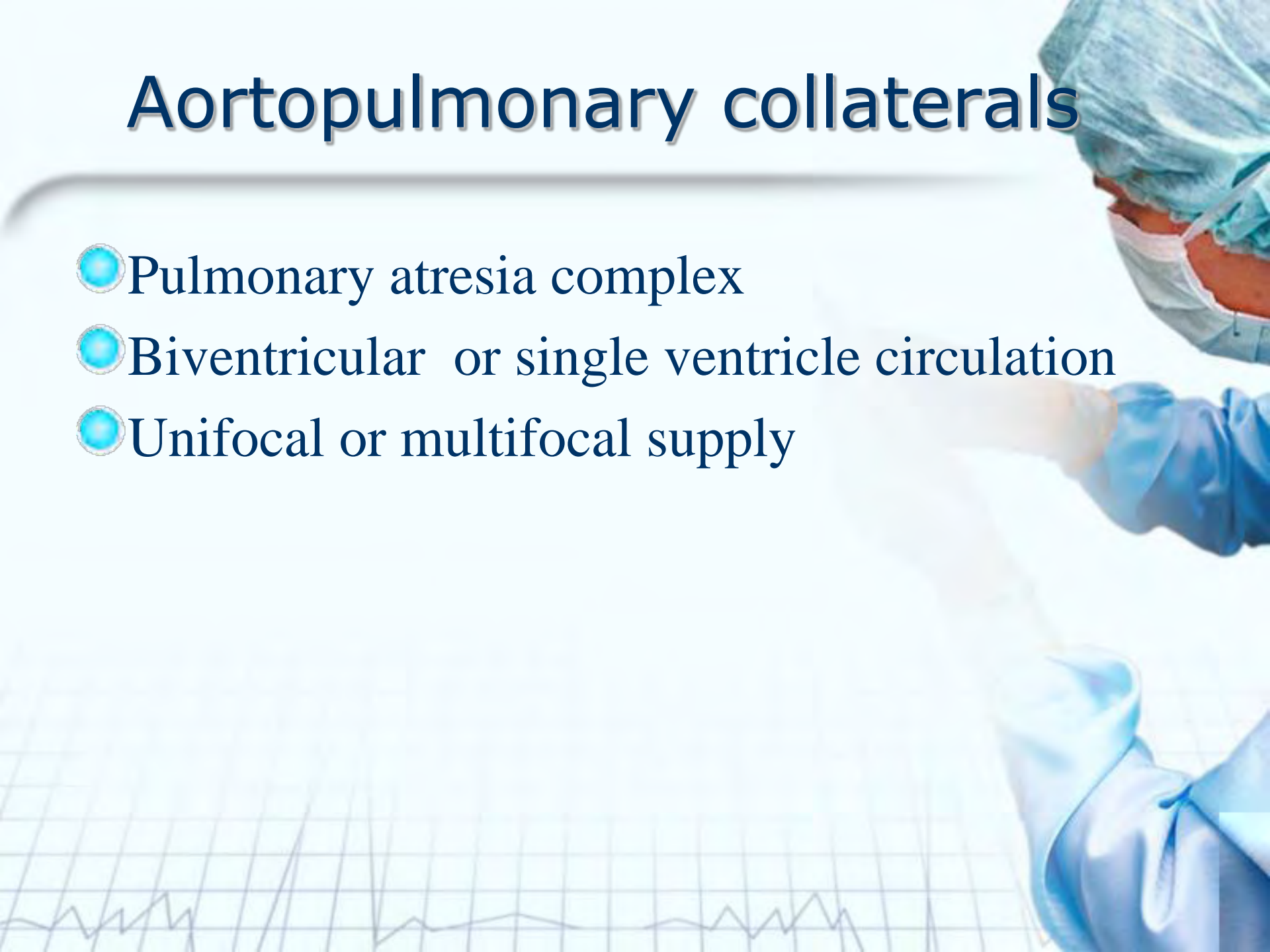
# content

- **Aortopulmonary collaterals (APC)**
- **embolization of APCs**
- **Fistulas: coronary fistula, pulmonary fistula**
- **Other shunts: veno-veno shunt,**
- **Devices used for embolization of various lesions**

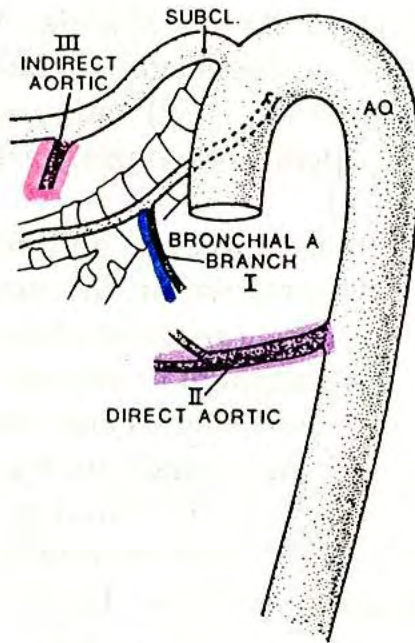


# Aortopulmonary collaterals

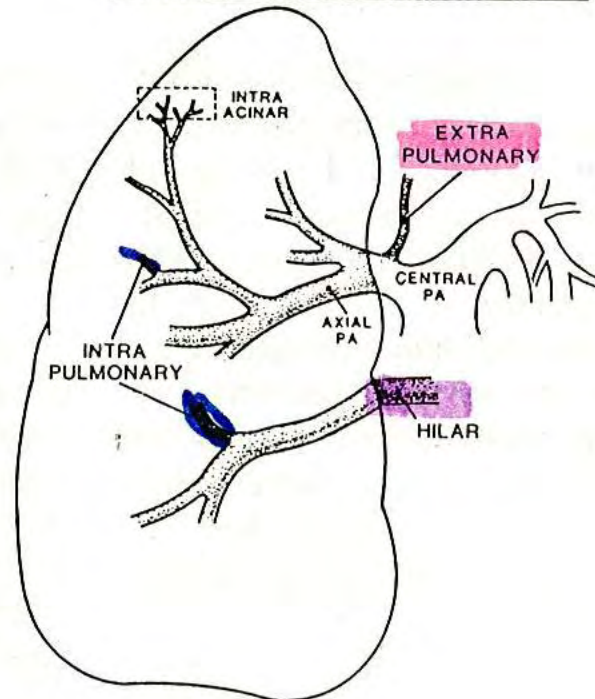
- Pulmonary atresia complex
- Biventricular or single ventricle circulation
- Unifocal or multifocal supply



### 3 TYPES OF SCA



### 3 TYPES OF ANASTOMOSIS



SCA TYPE I  
(BRONCHIAL ARTERY BRANCH)

⇔ INTRAPULMONARY ANASTOMOSIS

SCA TYPE II  
(DIRECT AORTIC BRANCH)

⇔ HILAR ANASTOMOSIS

SCA TYPE III  
(INDIRECT AORTIC BRANCH)

⇔ EXTRAPULMONARY ANASTOMOSIS

**Figure 2.** Three types of systemic collateral arteries (SCA) (direct and indirect aortopulmonary collateral arteries and bronchial collaterals) and three types of anastomoses with the pulmonary artery (PA) (hilar, intrapulmonary and extrapulmonary). SUBCL = subclavian; AO = aorta. (Reproduced with permission from Rabinovitch et al., 1981.)

# Aortopulmonary collaterals (APC) embolization--benefits

- Part of pulmonary artery rehabilitation to enhance the growth of normal branch pulmonary arteries in TOF with PA
- Reduce PA pressure in Fontan candidates
- Increase in SVC flow & Qs in patients with Glenn shunt
- Reduce volume overload

Circ Cardiovasc Interv 2013;6 Dori et al.

Pediatr Cardiol 2010;31:449 Stern et al.

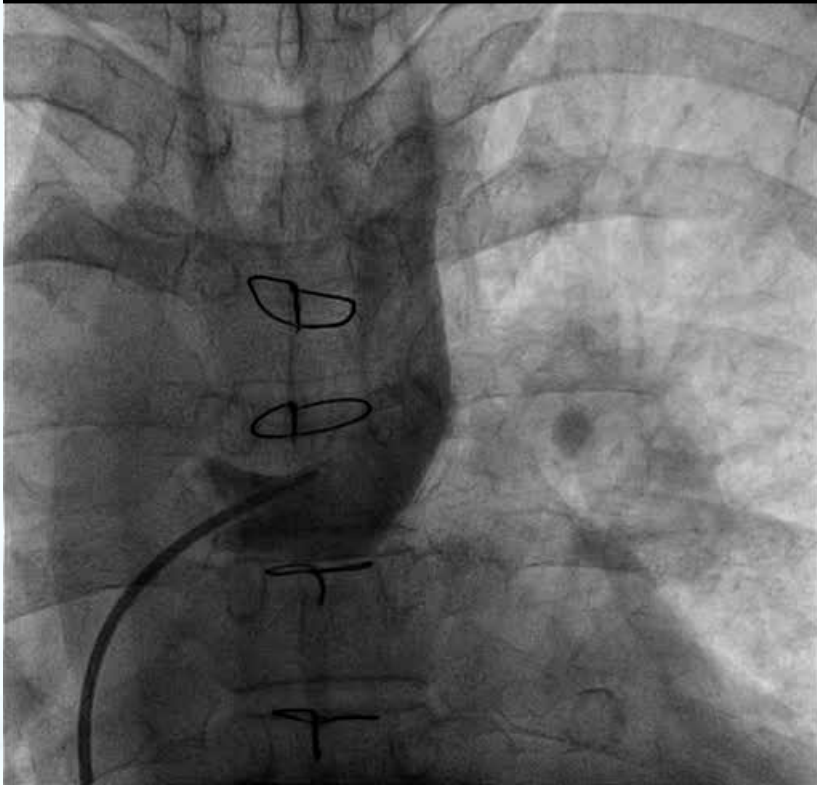
JTCS 2011;142:1374 Dragulescu et al.

AHJ 1996;131:1164 Spicer et al.

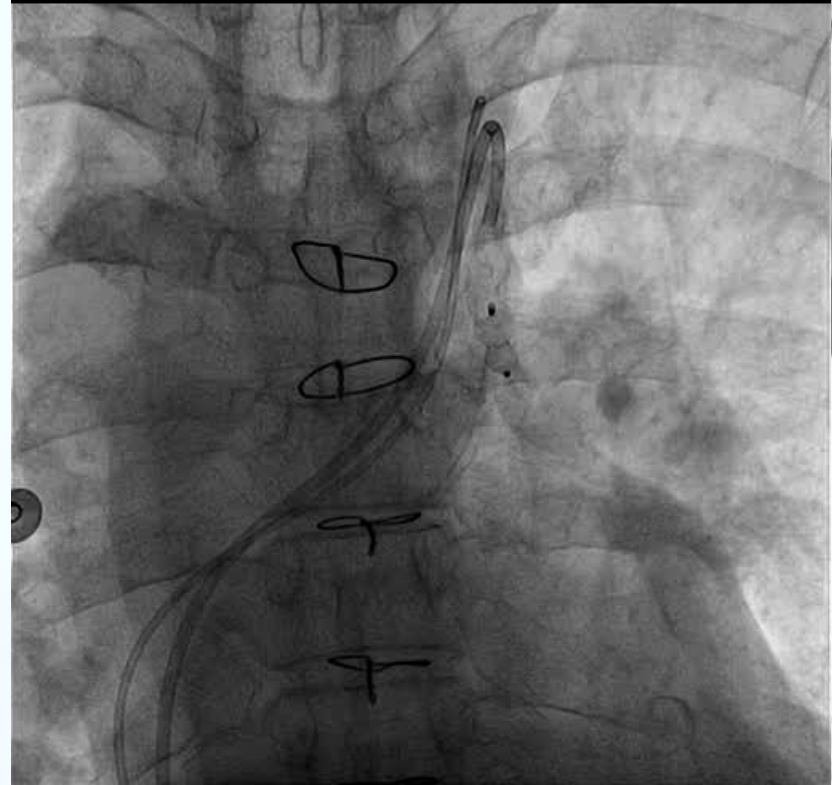
Pediatr Cardiol 2005 Nakanishi et al.

# MAPCA embolization

Lossy compression - not intended for diagnosis



Lossy compression - not intended for diagnosis



# Aortopulmonary collaterals (APC) embolization in Fontan candidates--controversies

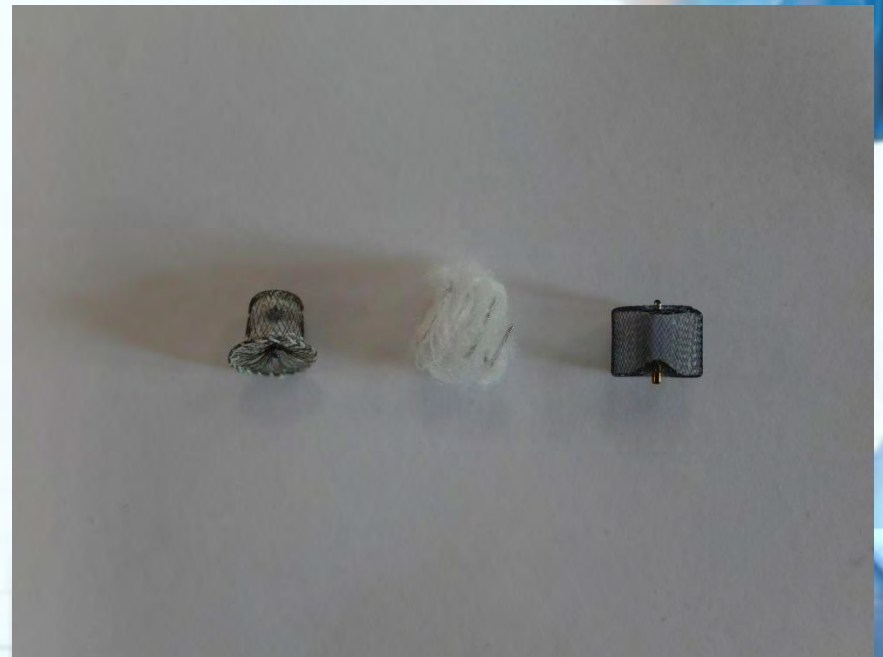
- No significant difference between coiling APC & non-coiling group in hospitalization days, postoperative venous pressure, pleural effusion days, postoperative complications etc.
- Embolization of APC is reserved for those with complications without correctable lesions.

Banka et al. AM Heart J ;2011:162:125



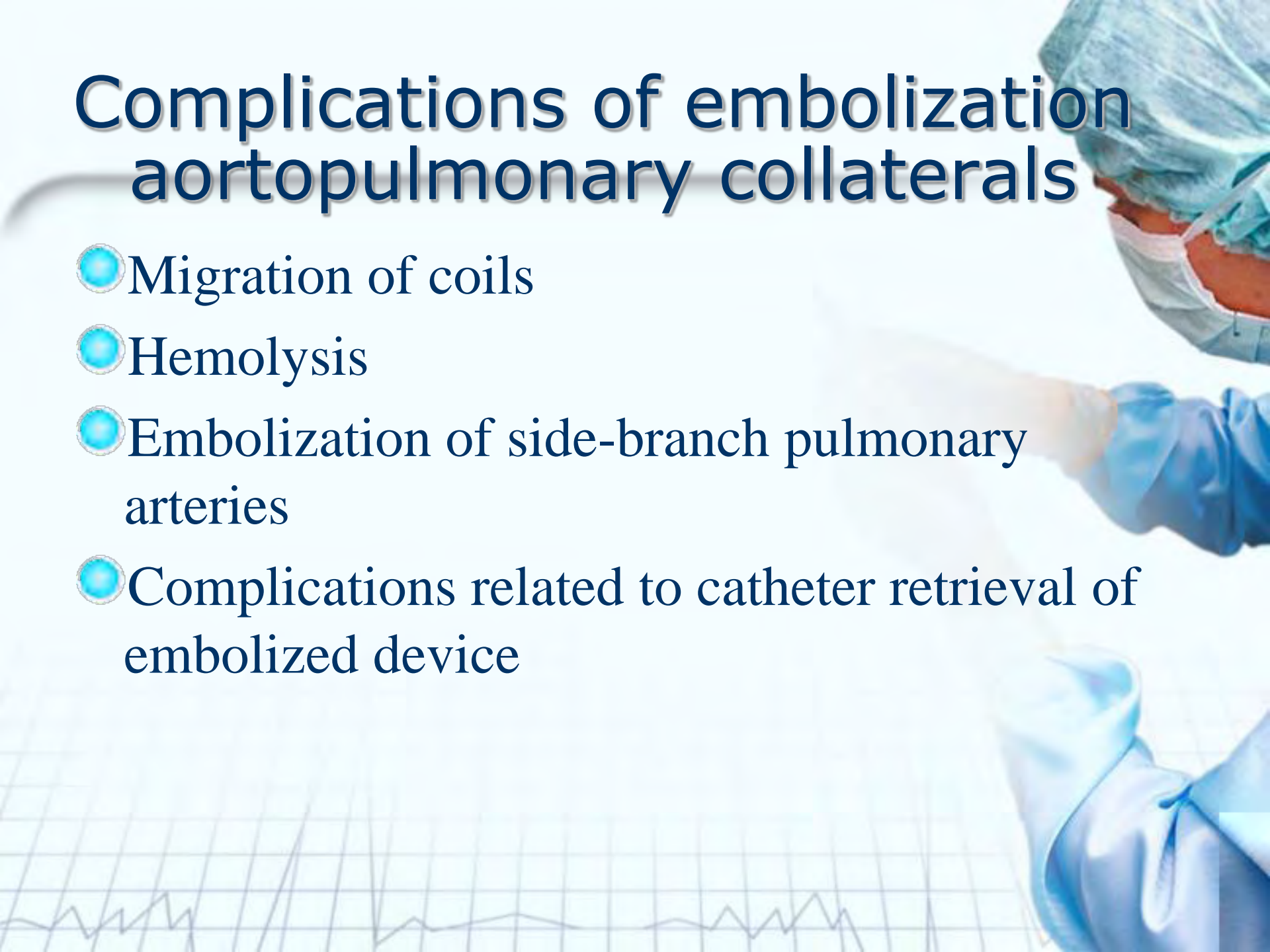
# Devices available for embolization of APCs

- Coil
- Amplatzer duct occluder
- Vascular plus
- Embolization particles
- Grifka bag



# Complications of embolization aortopulmonary collaterals

- Migration of coils
- Hemolysis
- Embolization of side-branch pulmonary arteries
- Complications related to catheter retrieval of embolized device



# AV fistula

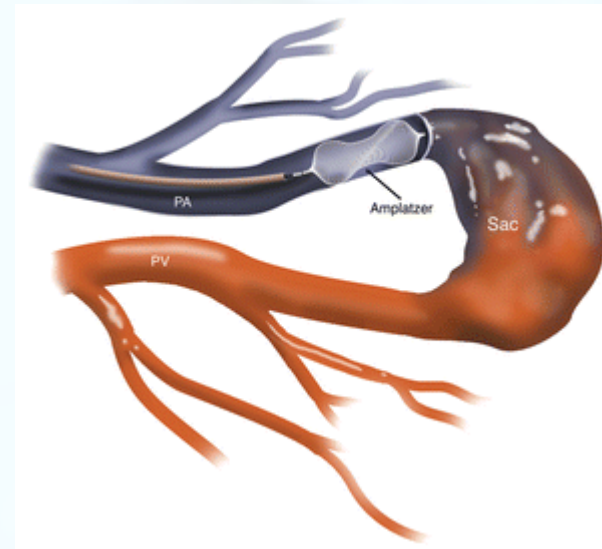
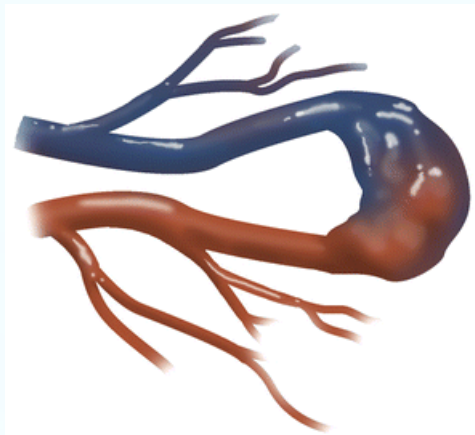
- **cerebral**
- **pulmonary**
- **coronary**
- **hepatic**
- **others & BT shunt**



# Morphology of AV fistula

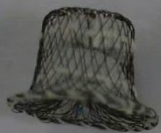
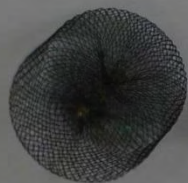


# Vascular plug embolization of AV fistula

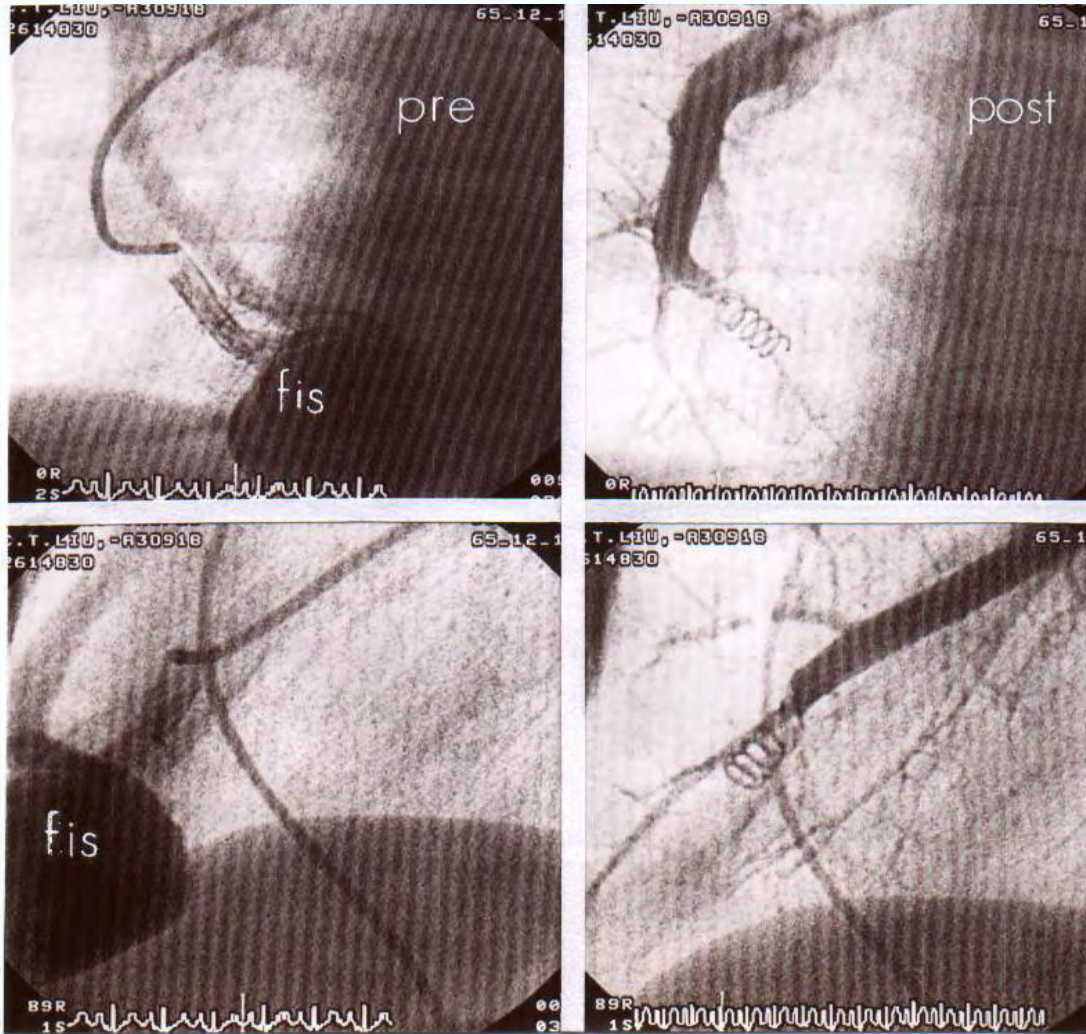


# Devices available for embolization of AV fistulas

- **Coil: relatively smaller feeding artery or venous collaterals**
- **duct occluder, mVSD occluder--- large caliber vessel or high velocity flow**
- **vascular plugs**
- **stent graft**
- **embolization particle**

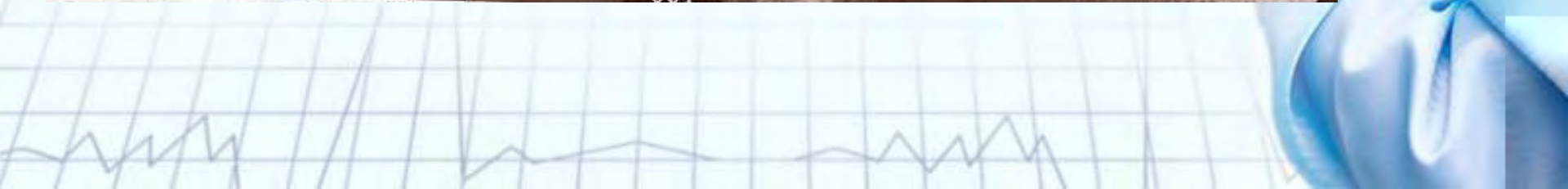
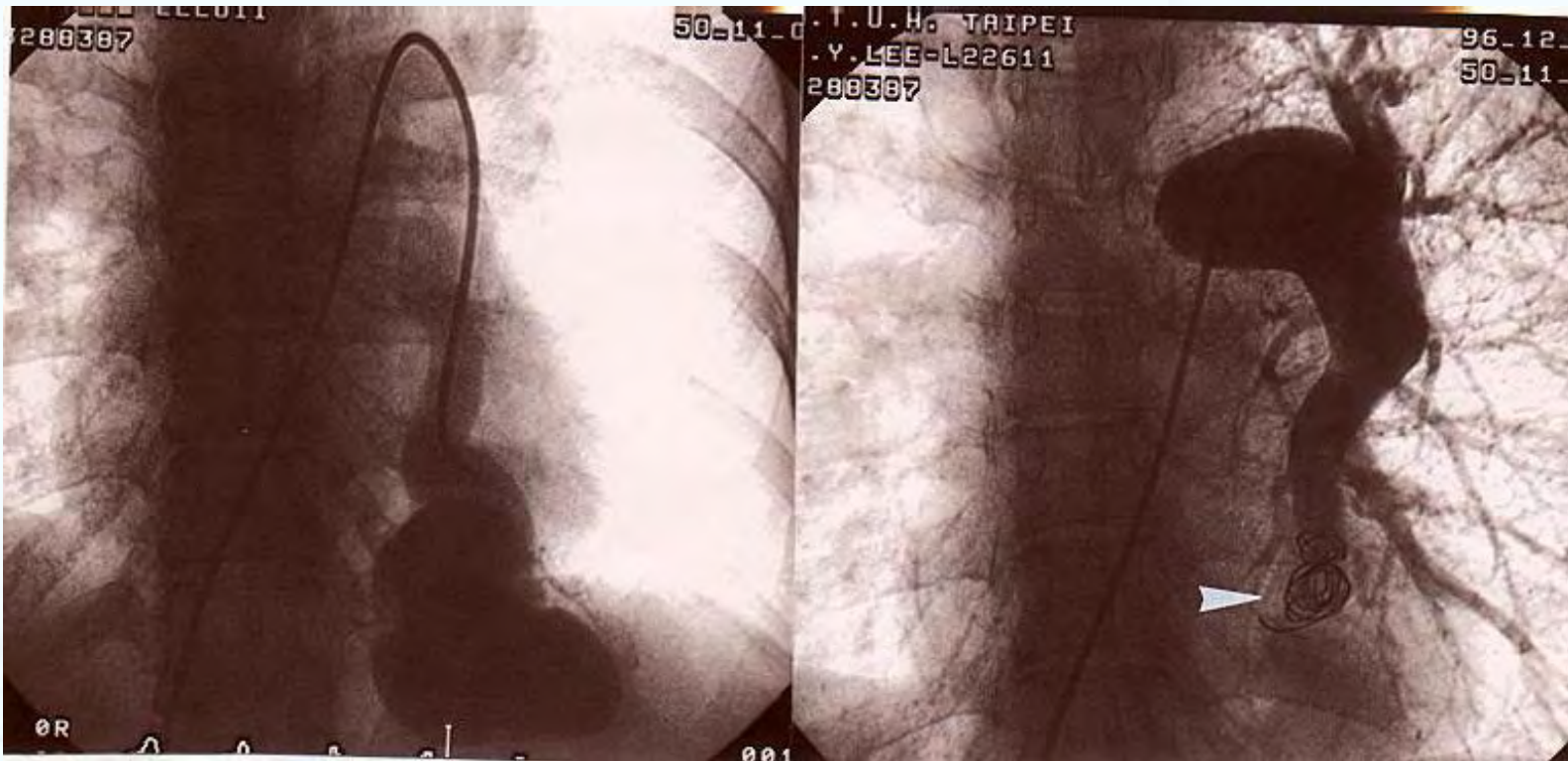


# Pulmonary AV fistula coil embolization





# Pulmonary AV fistula



# Pulmonary AVM s/p coil embolization with recurrence

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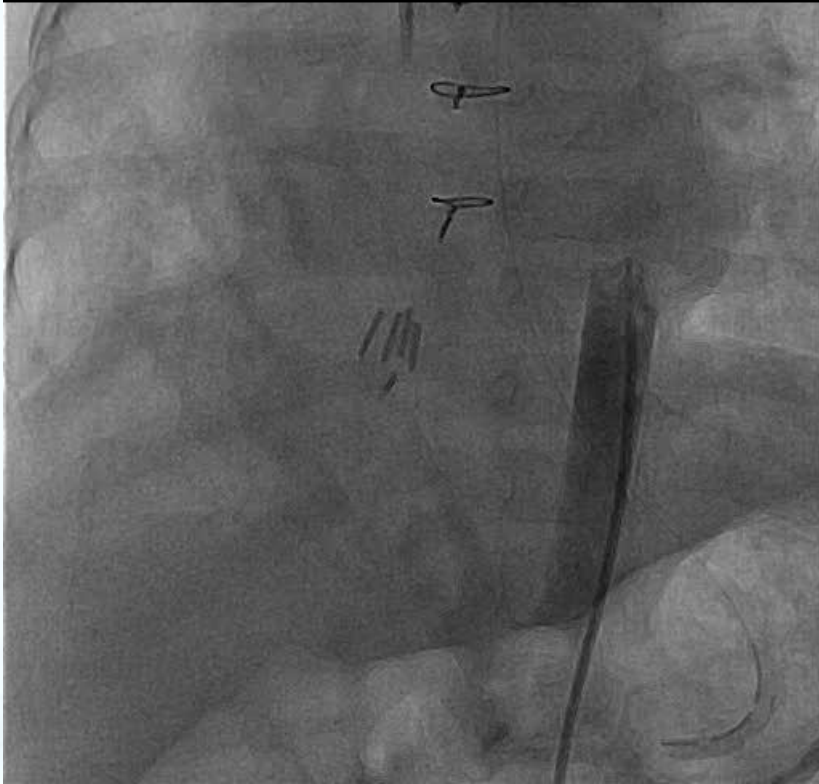


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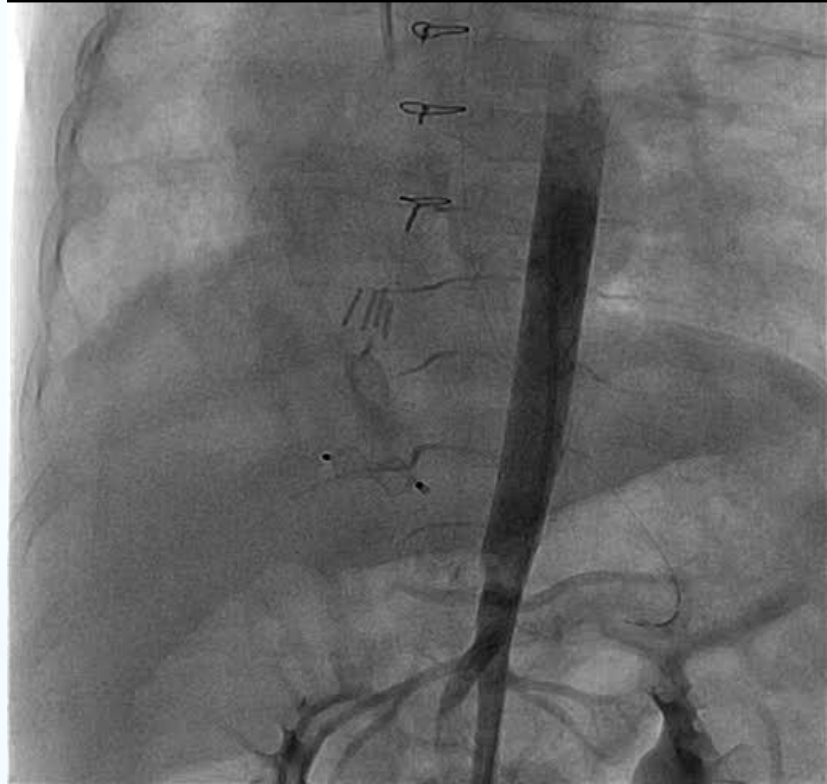


# Pulmonary sequestration embolization

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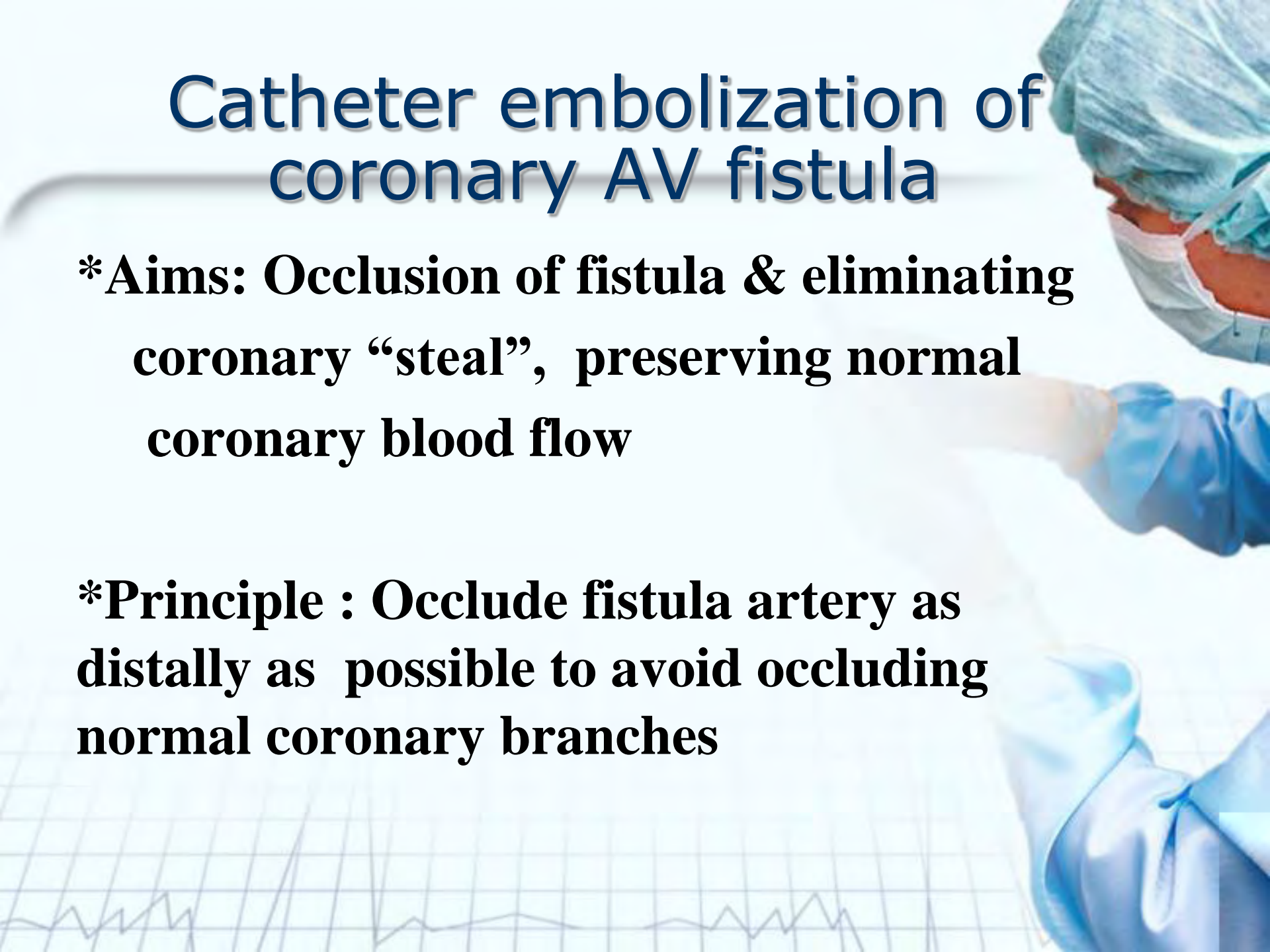
Lossy compression - not intended for diagnosis



# Catheter embolization of coronary AV fistula

**\*Aims: Occlusion of fistula & eliminating coronary “steal”, preserving normal coronary blood flow**

**\*Principle : Occlude fistula artery as distally as possible to avoid occluding normal coronary branches**

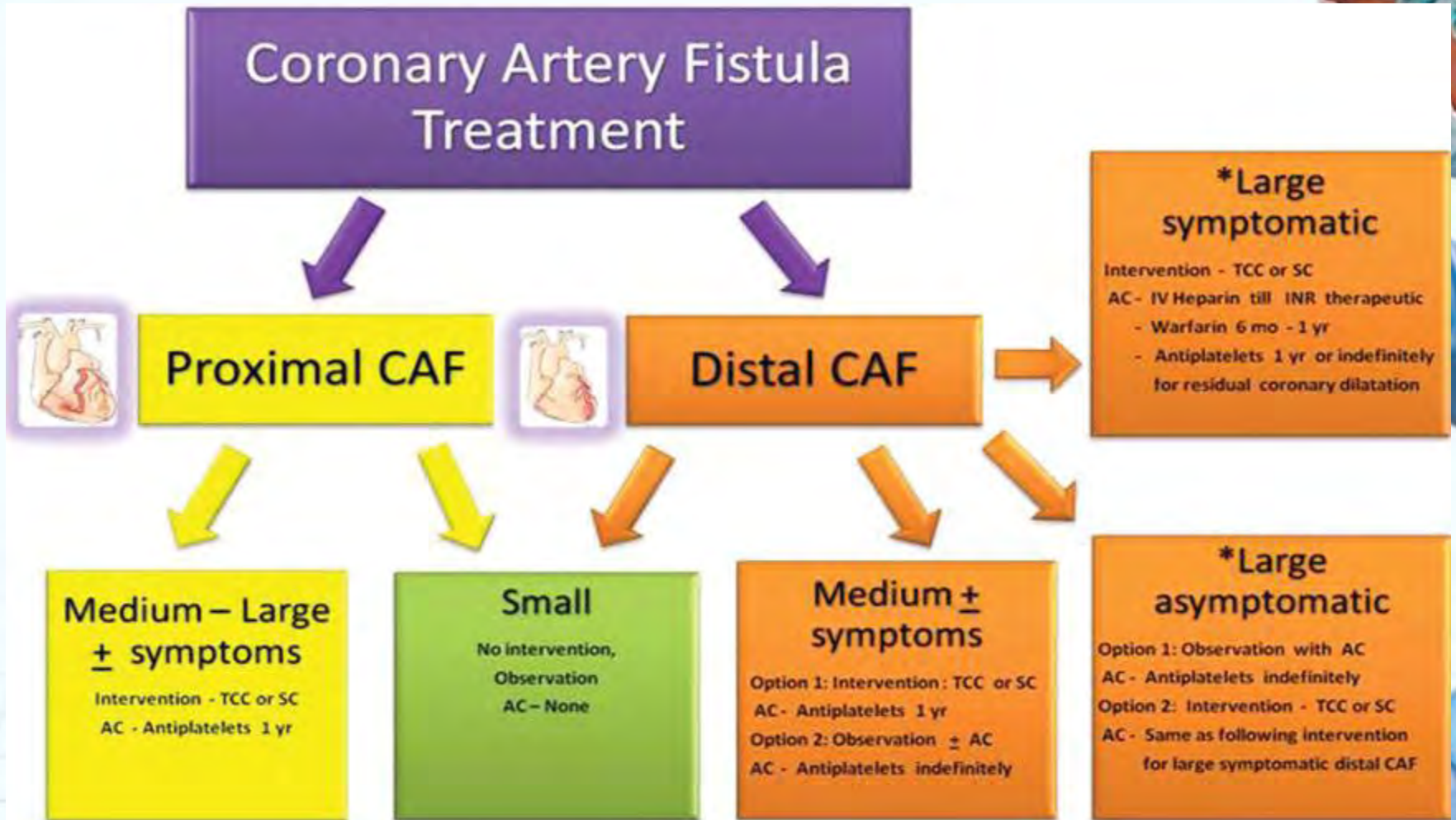


# Indications for treatment of coronary AV fistula

- **significant shunt**
- **LV overload**
- **myocardial ischemia**
- **LV dysfunction**
- **CHF**
- **prevention of IE**
- **prevention of progressive coronary artery dilation & aneurysm rupture**



# CCI 2012 Gowda et al



# Detailed anatomy of coronary fistula

- origin of feeding artery
- Proximal type or distal type
- no. of feeding artery
- size of feeding artery, aneurysm?
- course & length of feeding artery
- drainage site(s)
- presence of stenosis

**MRI & CT images with 3-D reconstructions**



# Technique of catheter closure

- **Both femoral arteries (delivery device & check angio & balloon occlusion) & 1 femoral vein cannulated**
- **Balloon test occlusion for 5-10 minutes**
- **Select appropriate device**



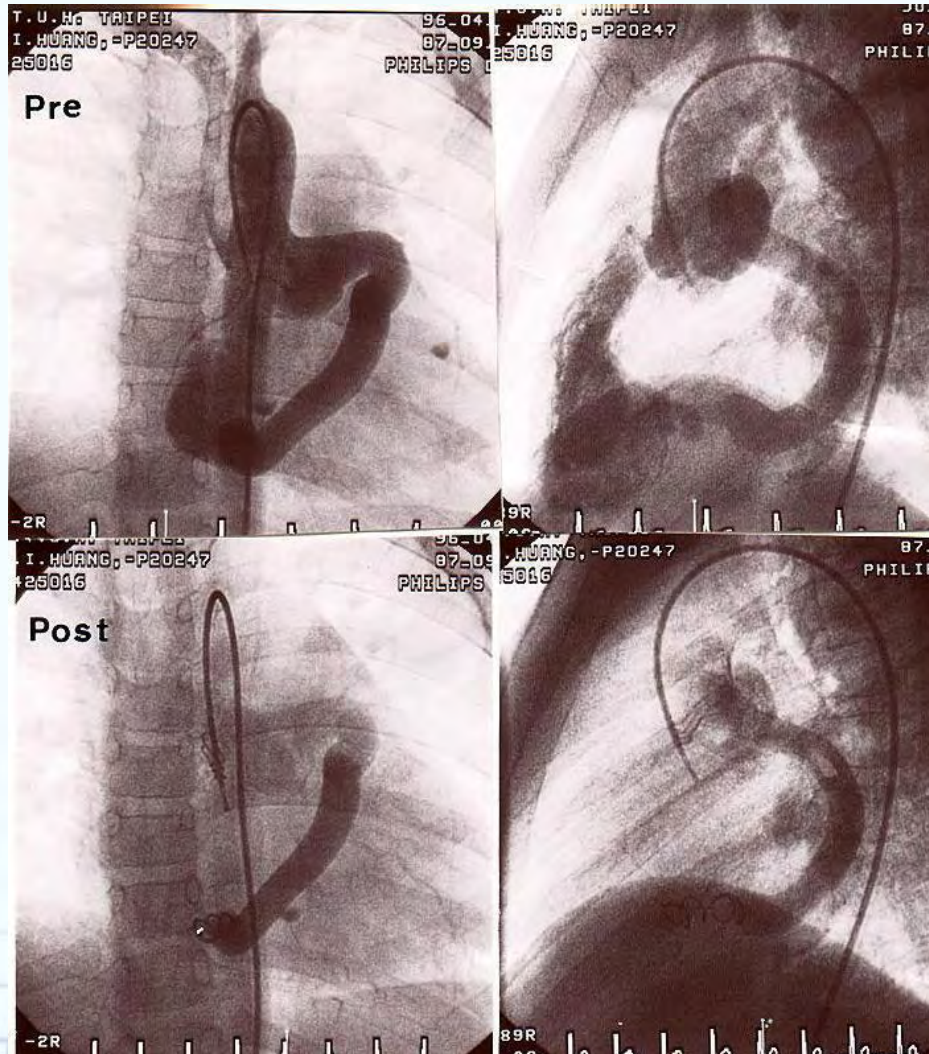


# Device selection in catheter closure of coronary AV fistula

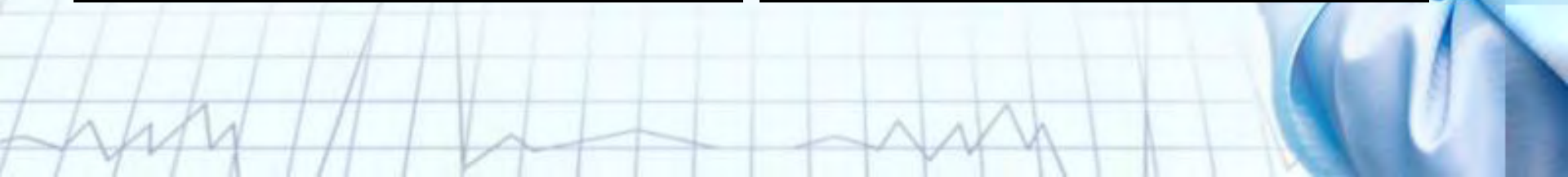
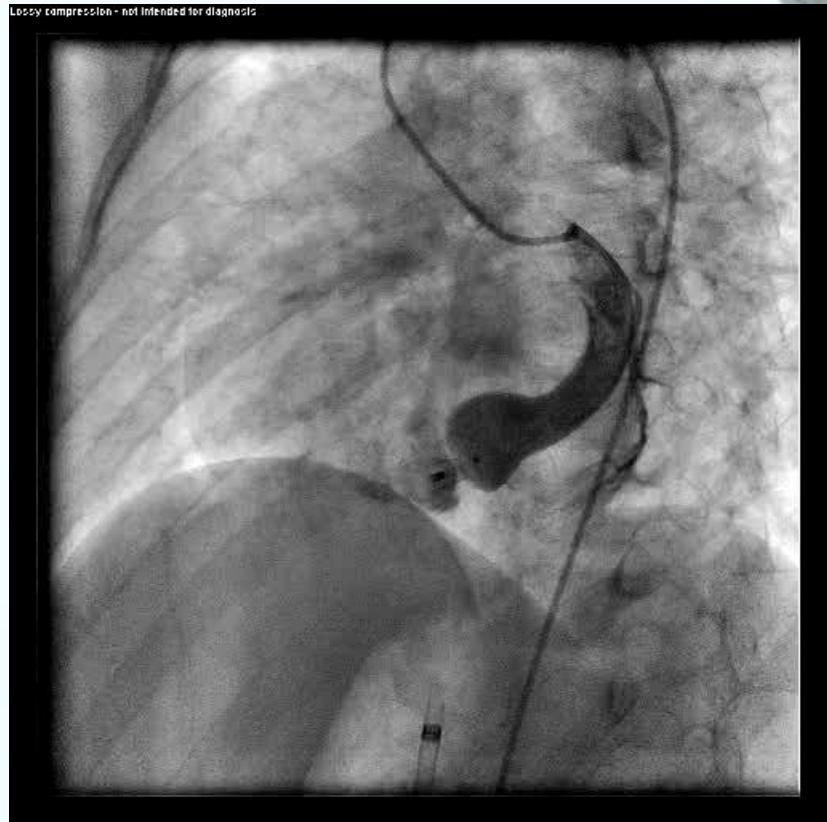
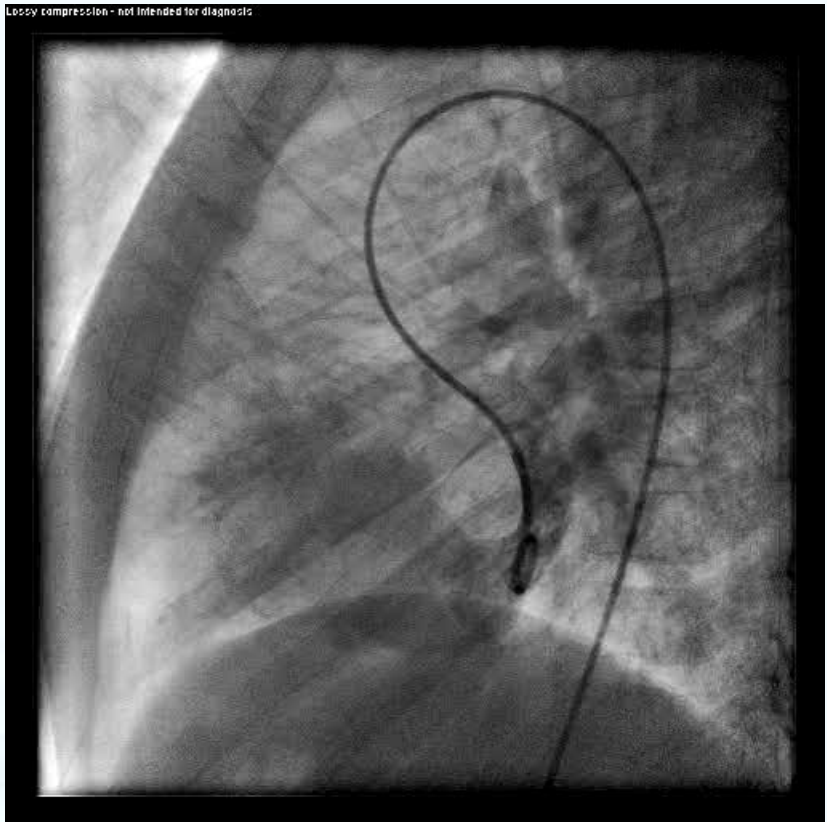
- **Coil 40 % larger than narrowest diameter of fistula, multiple coils frequently required tips: temporary occlusion with a balloon during deployment in patients with a large shunt**
- **ADO, 2-3 mm larger, AV loop required**
- **Vascular plug: 50% larger than narrowest diameter**
- **mVSD device**



# CAF s/p OP residual balloon occlusion

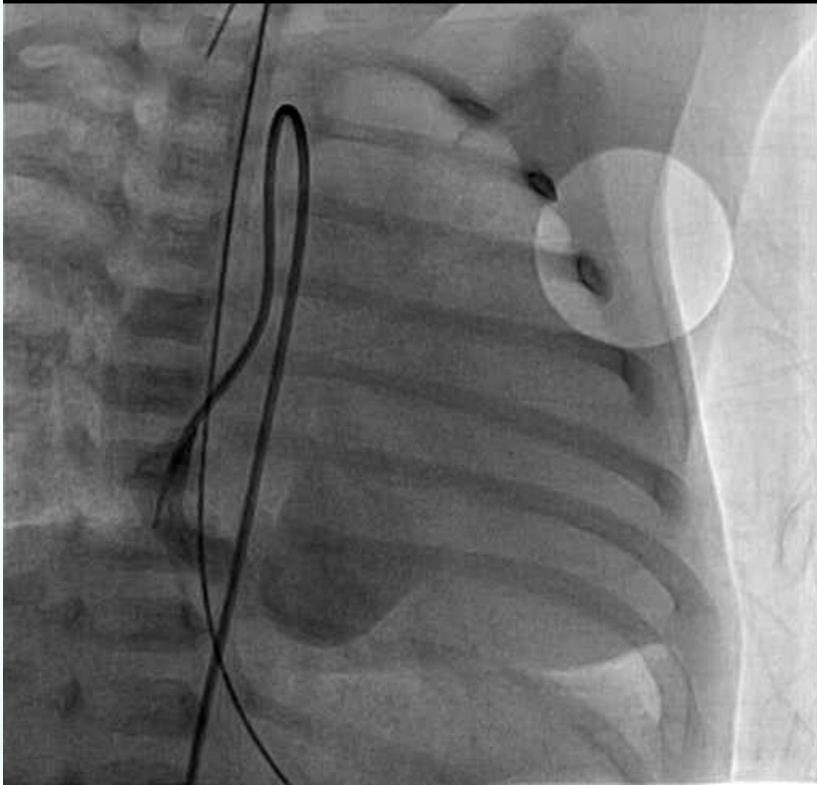


# LCx to CS fistula : mVSD device closure

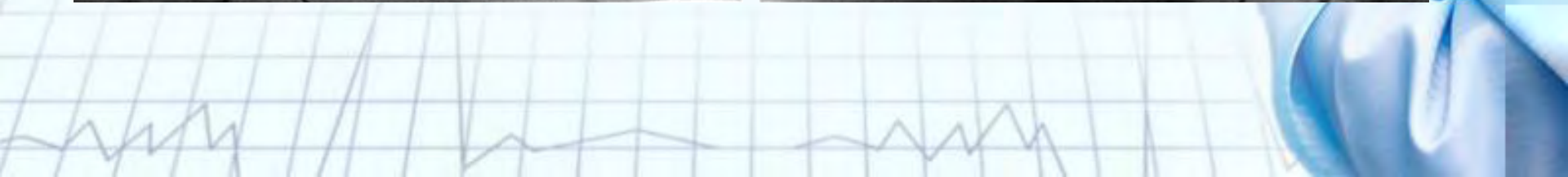
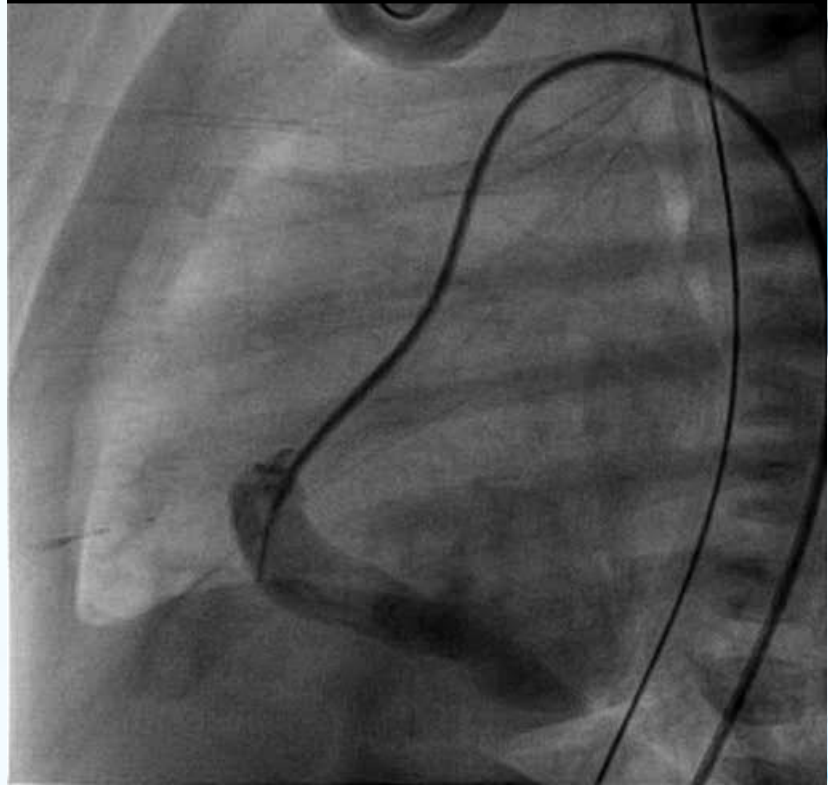


# Large Coronary fistula in a neonate with CHF

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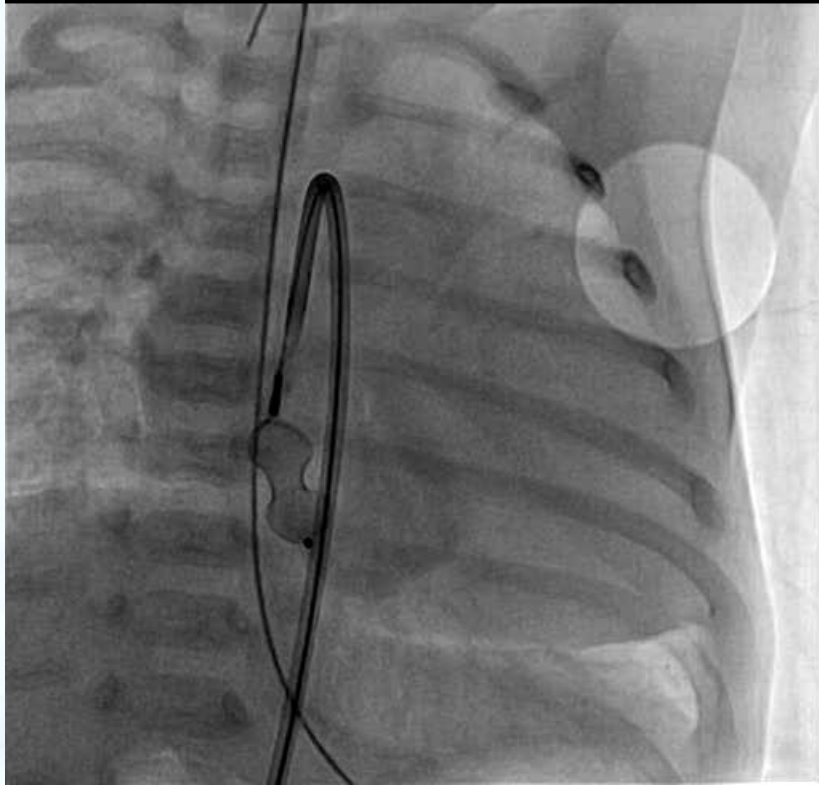


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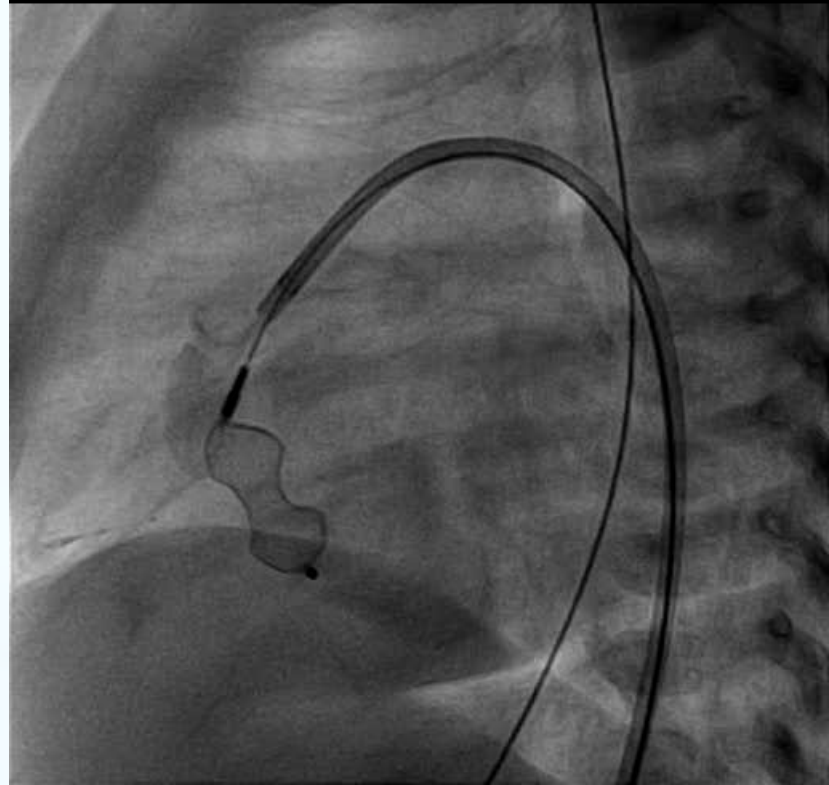


# Plug deployment in a neonate with coronary AV fistula

Lossy compression - not intended for diagnosis

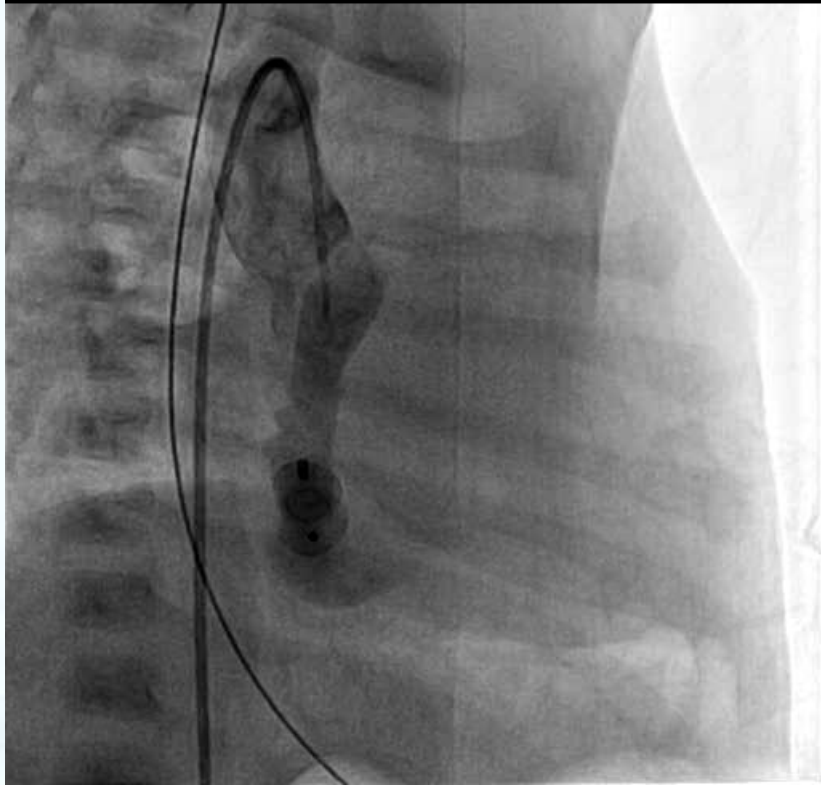


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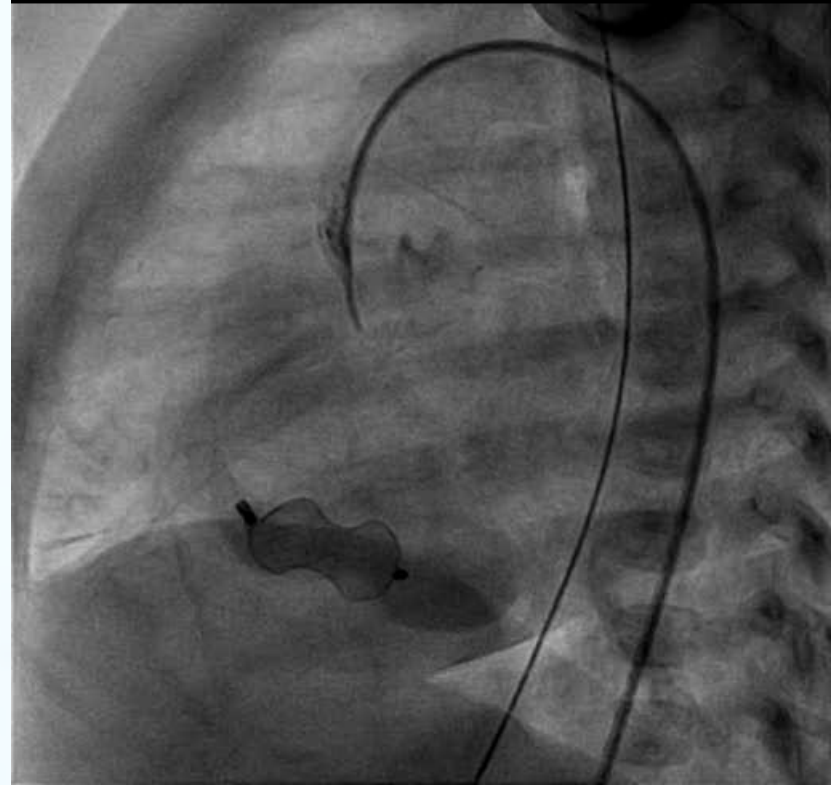


# Embolization of coronary AV fistula in a neonate

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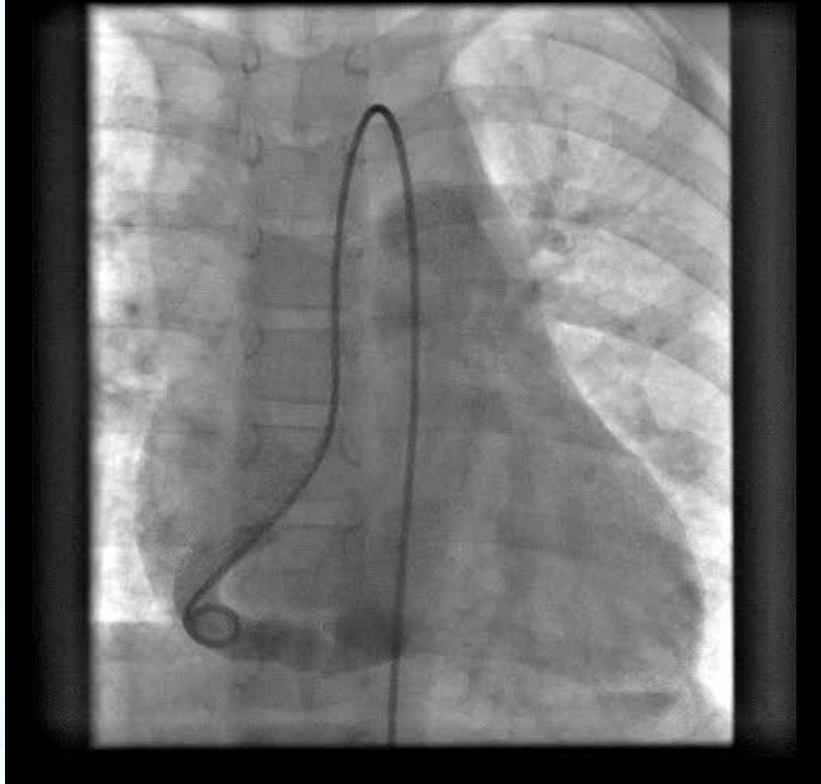


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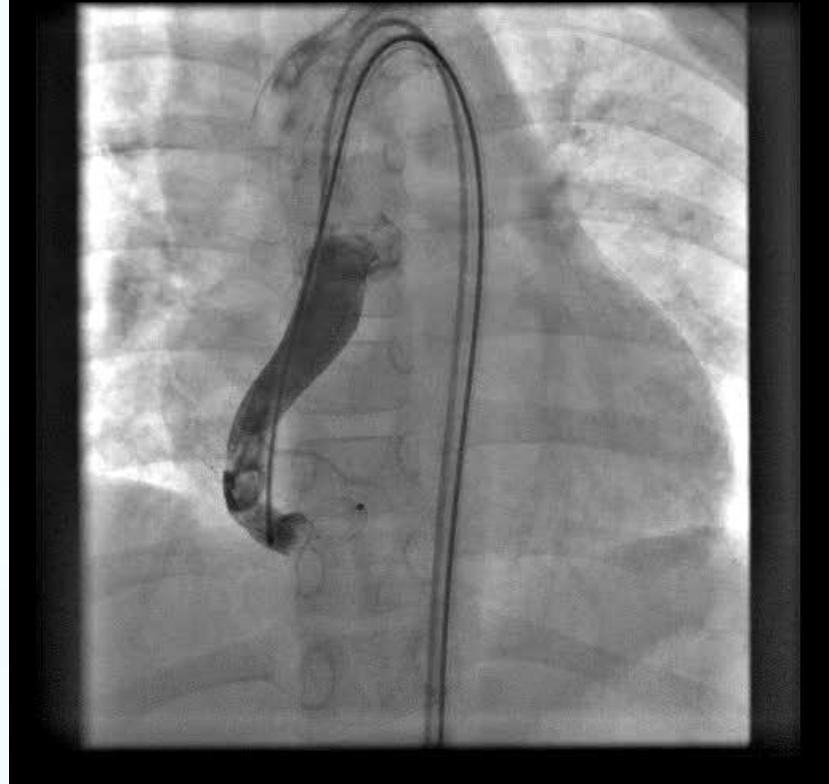


# Coronary AV fistula embolization with an ADO

Lossy compression - not intended for diagnosis

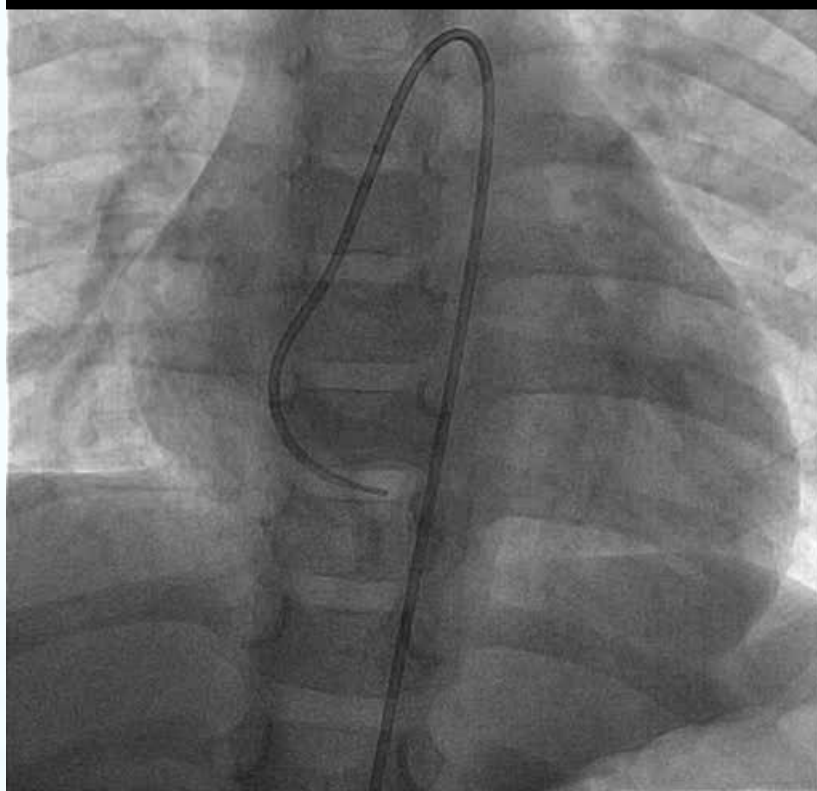


Lossy compression - not intended for diagnosis



# Coronary AV fistula catheter closure not feasible

Lossy compression - not intended for diagnosis



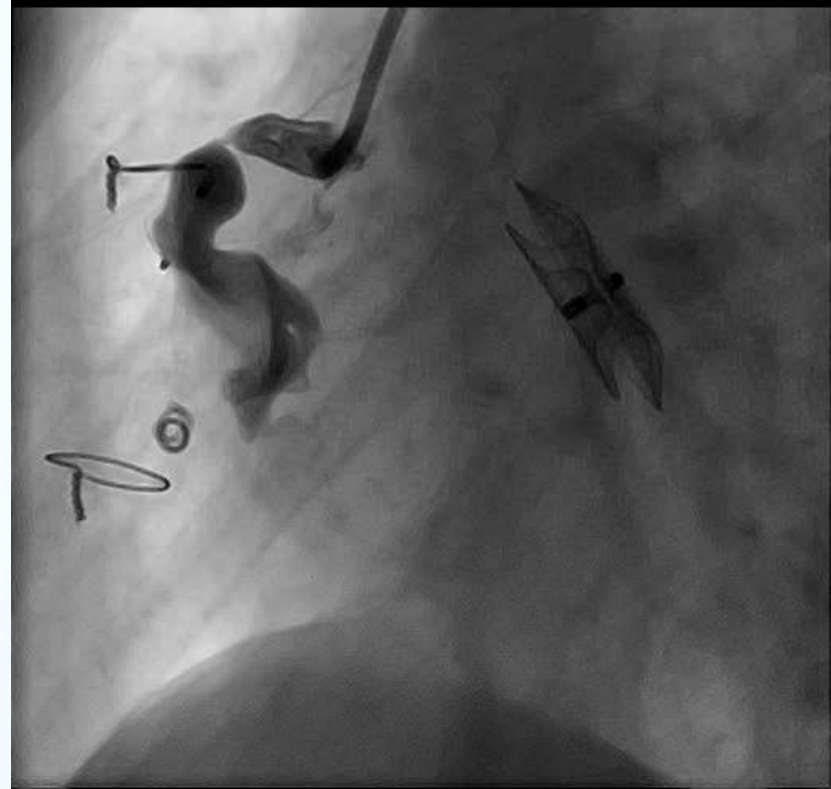


# Coronary AV fistula in a patient with PAIVS

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Lossy compression - not intended for diagnosis



# Acute complications of catheter closure of CAF

- Device migration
- Coronary spasm
- Hemolysis
- Coronary thrombosis
- Myocardial infarction
- Dissection
- arrhythmia



# Anticoagulant after embolization of CAFs

- Late thrombosis
- How long
- What medications?



# Long term outcome of closure of coronary artery fistula

- Thrombosis in parent coronary arteries—blind pouch with limited flow
- Myocardial infarction
- Recanalization
- cardiomyopathy

Said et al. JTCS;145:455

Gowda et al. AJC;107:302

Jama et al. JACC Interv 2011;4:814

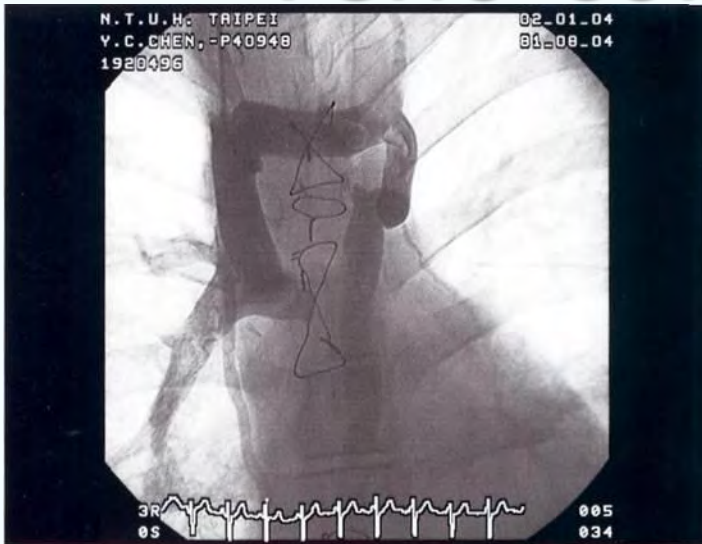
Valente AM et al. Circ Cardiovasc Interv 2010;3:134

# Veno-veno fistula

- Porto-systemic shunt
- Venous collaterals after Glenn or Fontan type surgery
- Others such as LSVC to LA

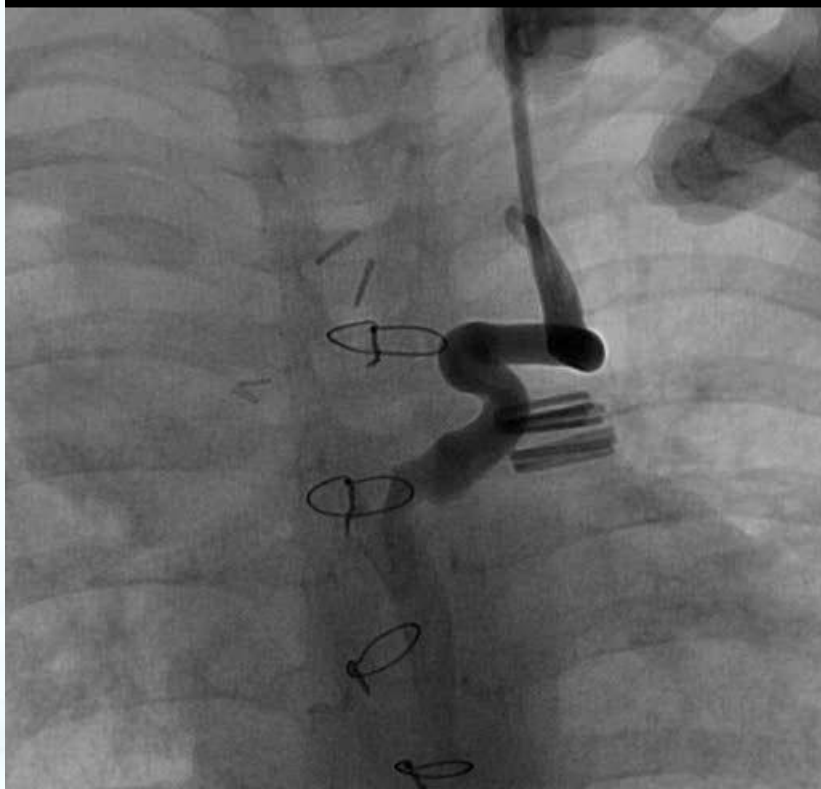


# Coil embolization for veno- veno collaterals

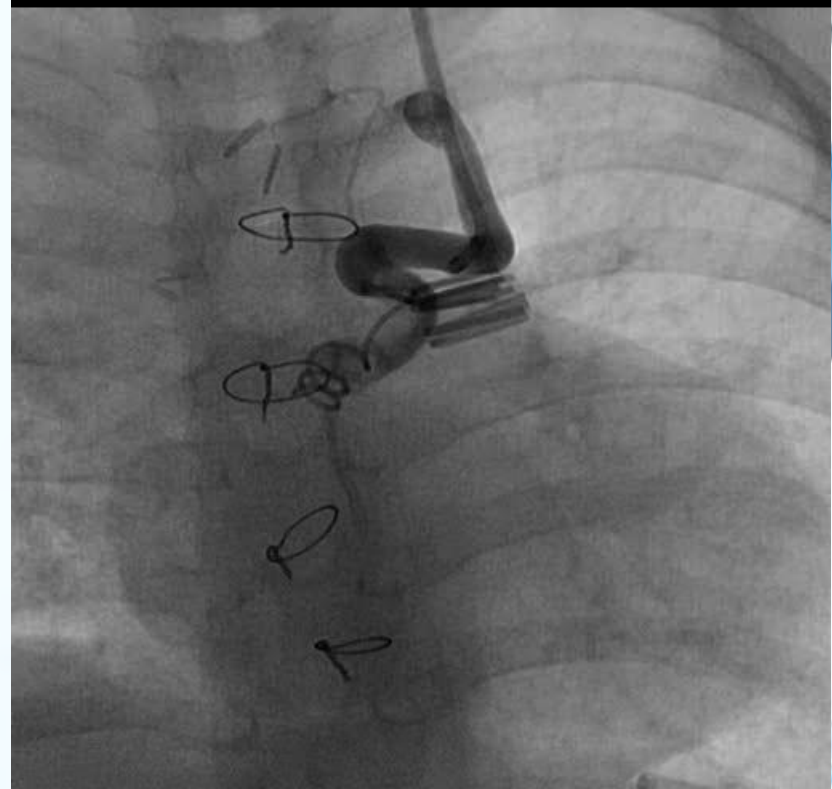


# Venous collaterals in HLHS s/p Glenn

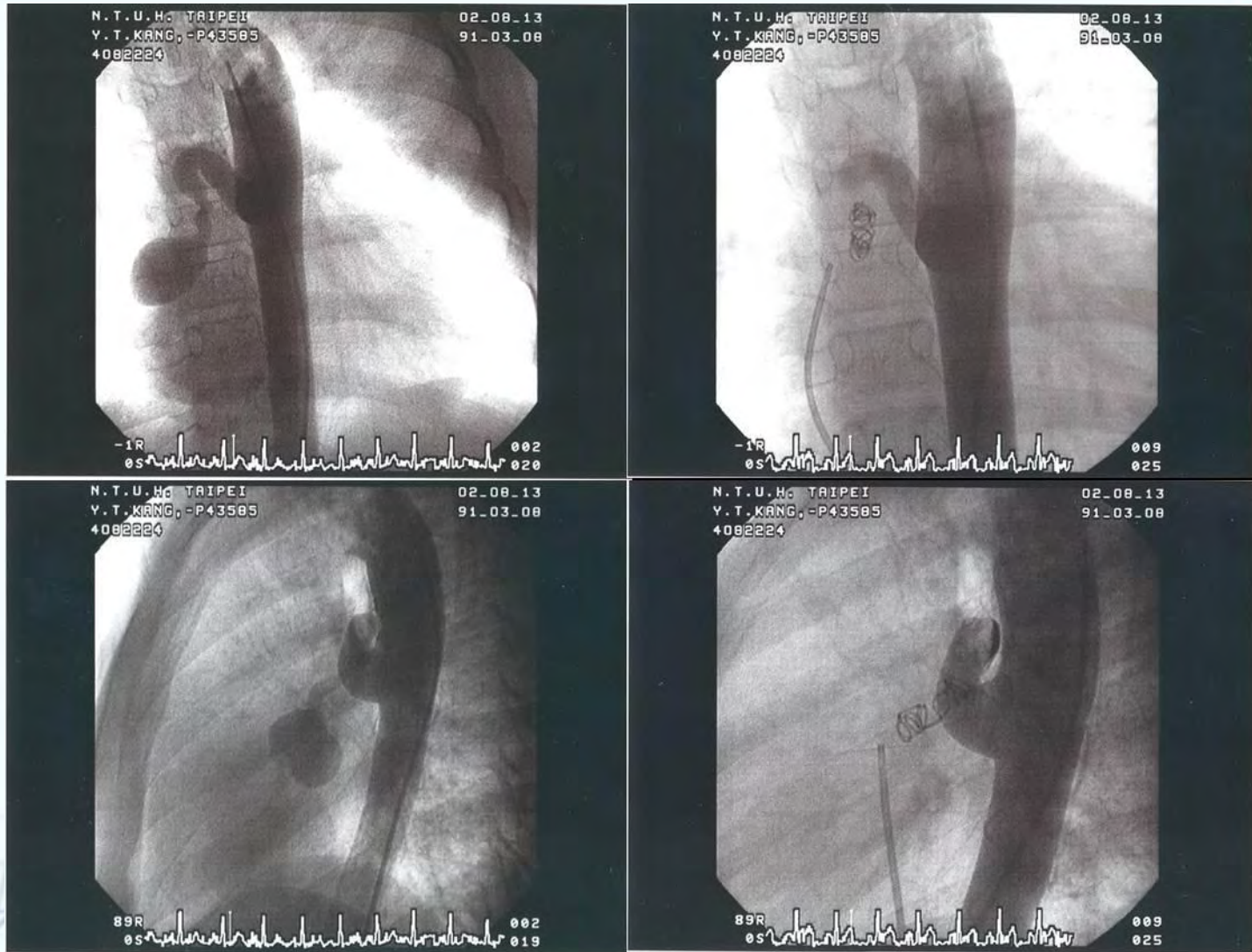
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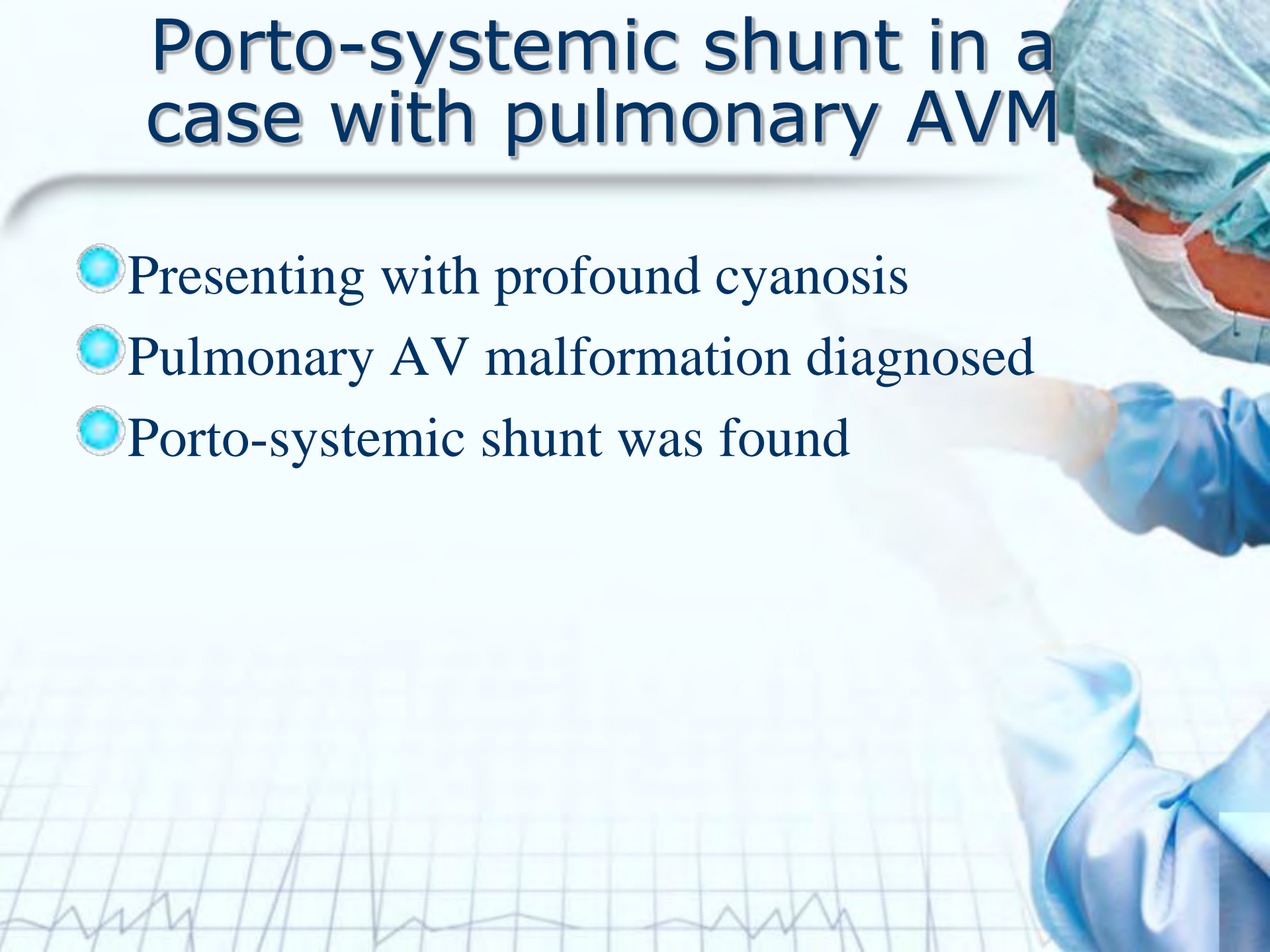
# Occlusion of AO-RA tunnel





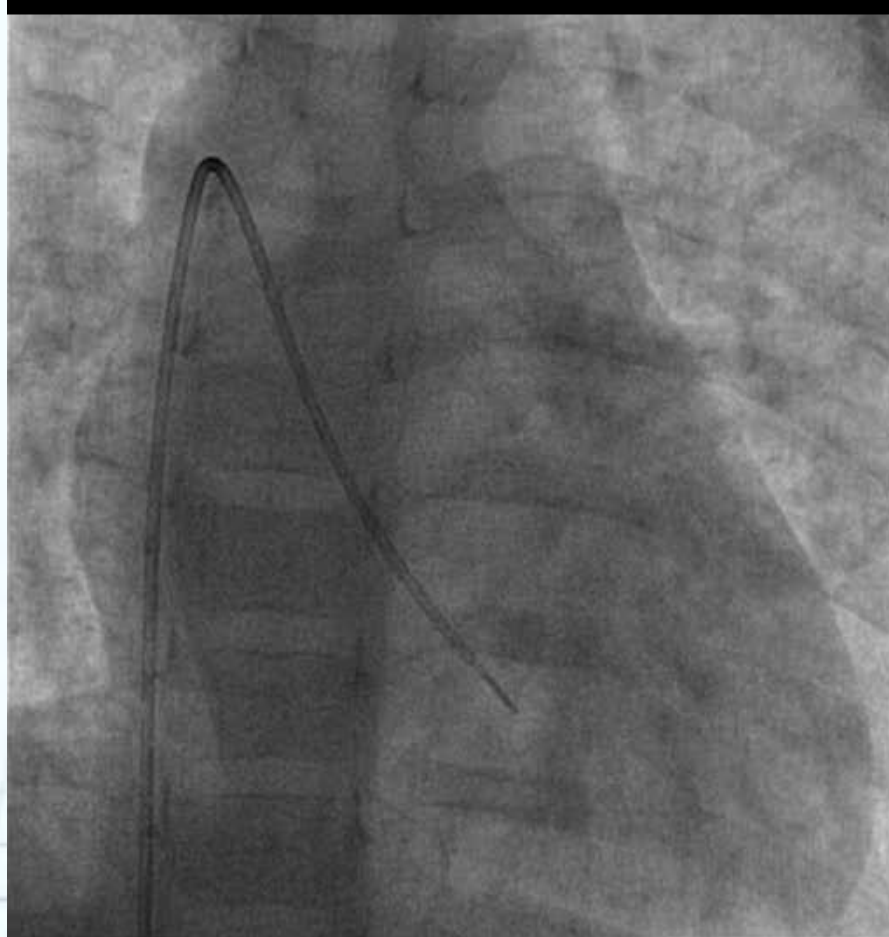
# Porto-systemic shunt in a case with pulmonary AVM

- Presenting with profound cyanosis
- Pulmonary AV malformation diagnosed
- Porto-systemic shunt was found



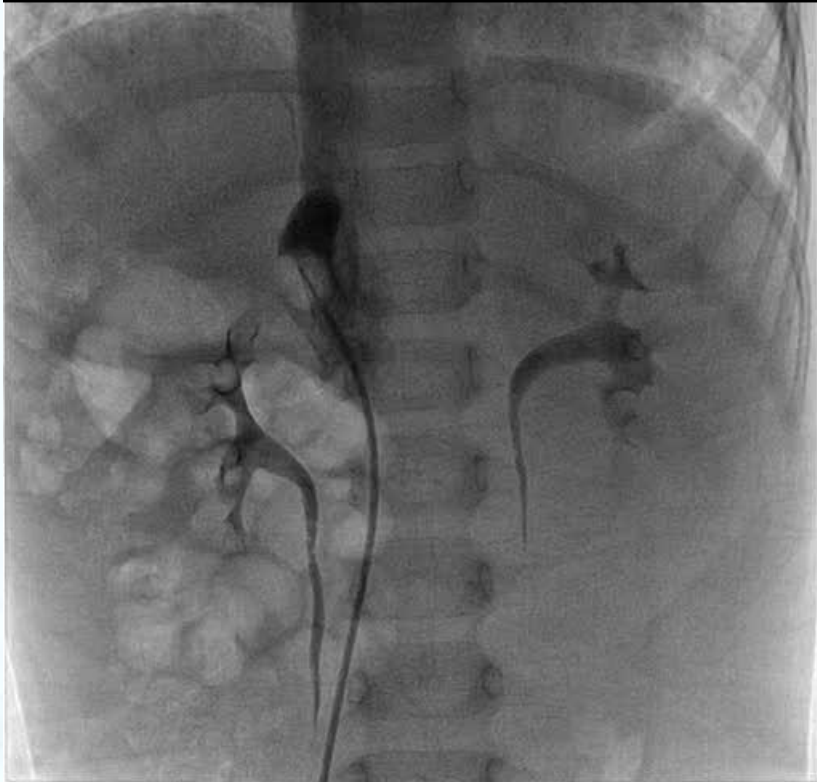
# Interrupted IVC & pulmonary AVM in a child with porto-systemic shunt

Lossy compression - not intended for diagnosis



# Test occlusion of porto-systemic shunt

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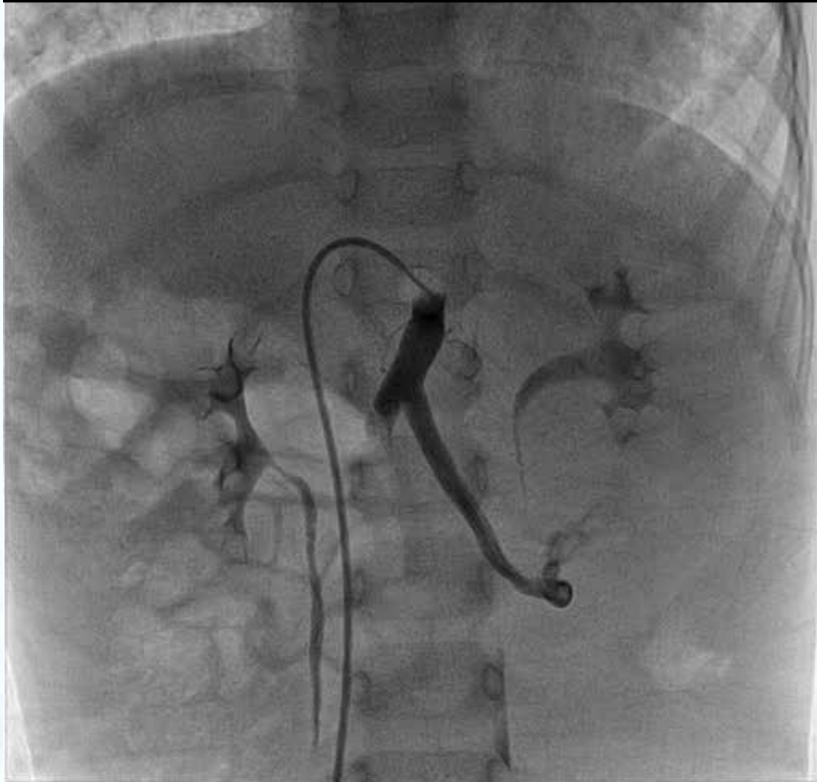


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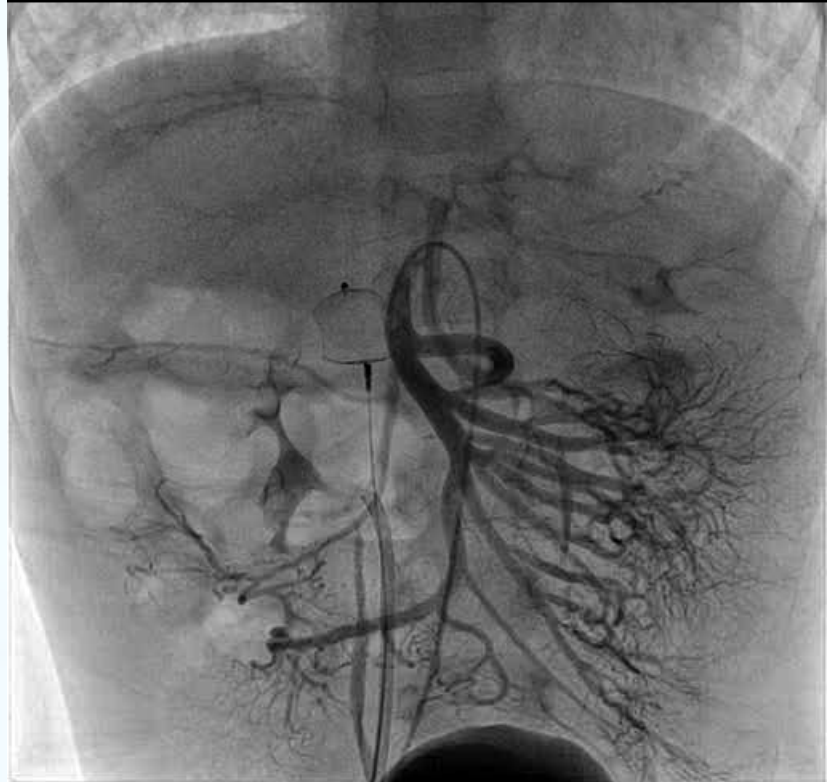


# Occlusion porto-systemic shunt with a plug

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Lossy compression - not intended for diagnosis

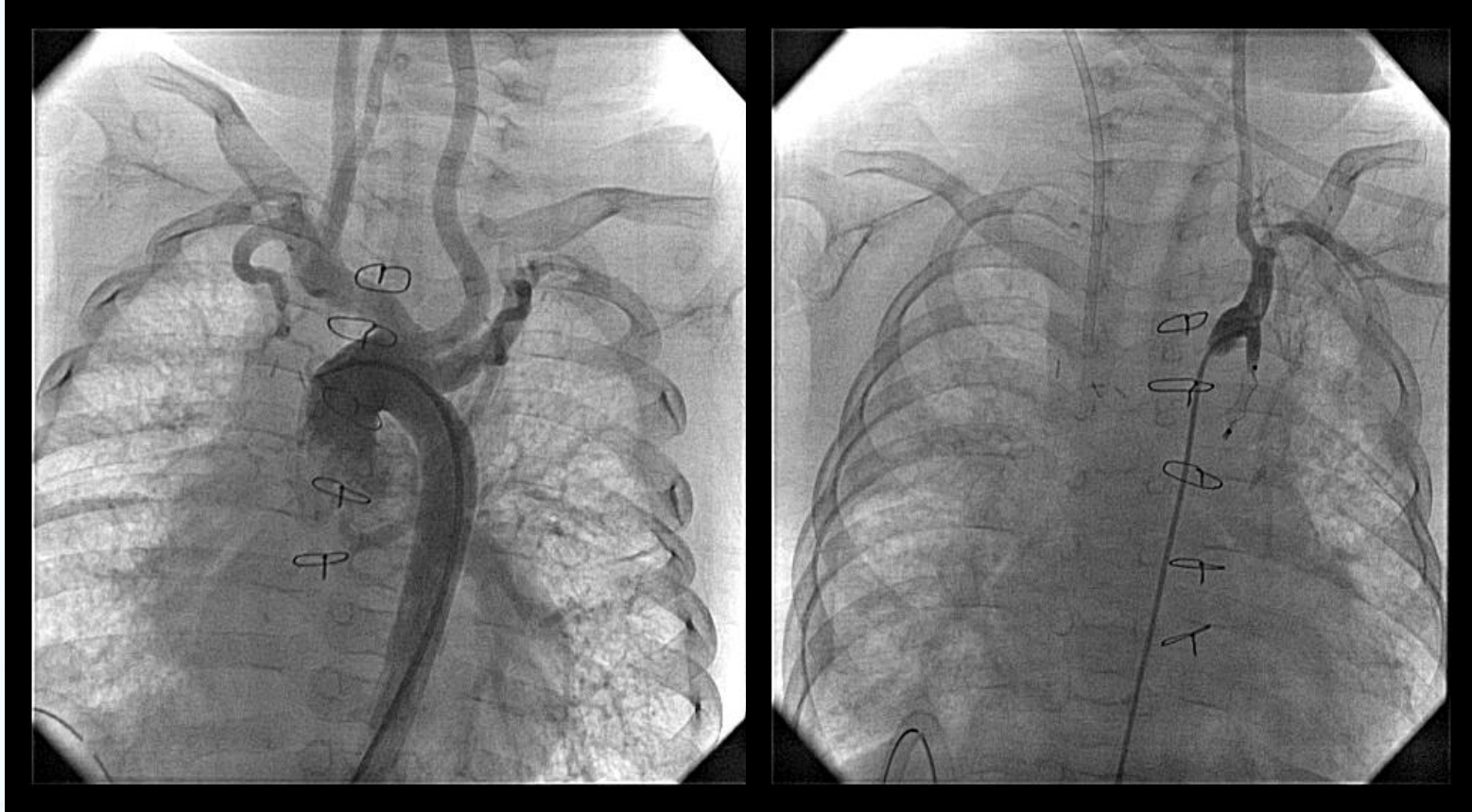


# Blalock-Taussig shunt embolization

- Embolization using coils: a higher risk of distal embolization
- Vascular plug is preferred
- Amplatzer duct occluder

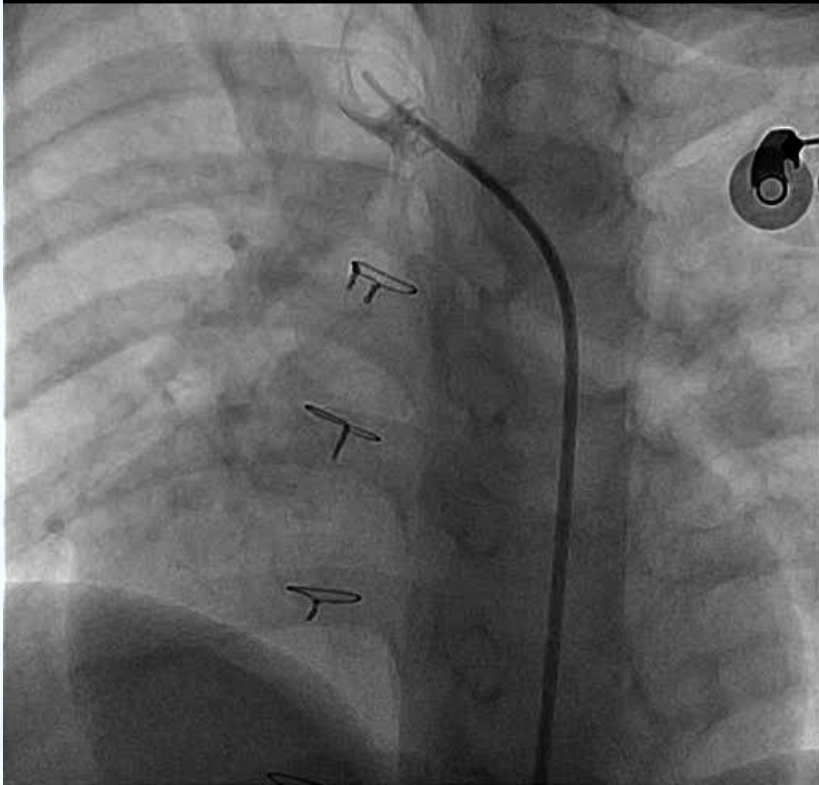


# BT shunt closure with Amplatzer vascular plug

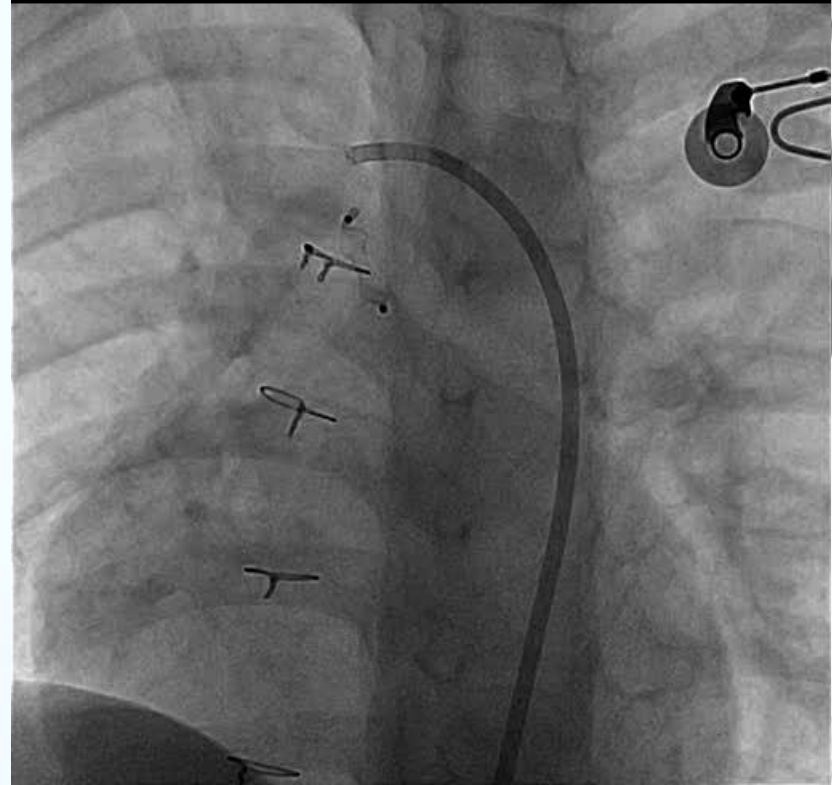


# Modified BT shunt embolization

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Lossy compression - not intended for diagnosis



# conclusions

- Aortopulmonary collaterals (APC) embolization can be achieved in most patients. However, embolization of APCs before Fontan type surgery remains controversial.
- Transcatheter closure of coronary AVF can be safely performed using a variety of devices in majority of patients but long term follow-up is mandatory.