

Closure of the patent arterial duct

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AEPC Interventional course

Linz 03-2014

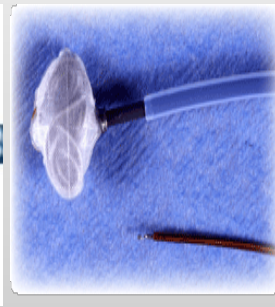
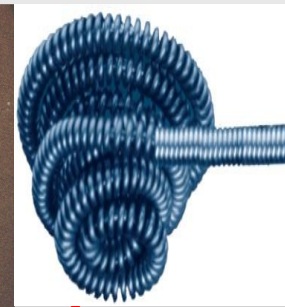
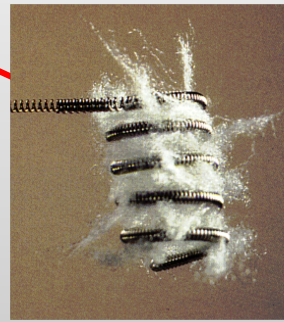
PDA Closure

No disclosures

AEPC Interventional course

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90's: detachable coils



Gianturco-Grifka Vascular Occlusion Device

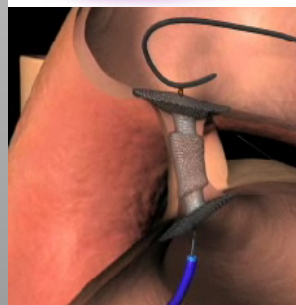


Early 80's:
Gianturco
coils

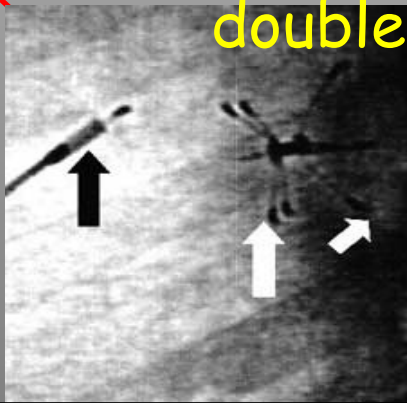
1967
Porstmann
Ivalon Plug

> 2000:
ADO I&II

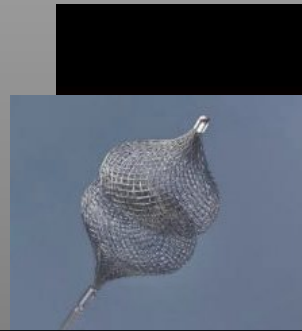
The Duct Occluder



1975: Rashkind
double umbrella



> 2010: AS & plugs



Indications for closure

(excluding preterms)

- Significant LV overload Yes
- Pulmonary hypertension
 - Infant \Rightarrow low Rp... Yes
 - Older child and adults Yes or No
 - analysis Rp & vasoreactivity
 - transient balloon occlusion

(ESC guidelines 2010)

- Endocarditis Prophylaxis ??

Small (silent) duct : no

When is catheter closure possible..?

...evolving with time...

- ~ age and weight: < 2000: > 10 kg
 - > 2000 (ADO, coils 4F): > 6kg
 - > 2010 (ADO II, AS, ...): < 6 kg possible
- ? Preterm babies ?

BUT: wait until the child is 'bigger' if the duct is well tolerated without PHT (spontaneous closure !, larger femoral vessels, larger aorta, LPA larger)

- ~ anatomy: small or conic ducts: coils and ADO
 - more complex ducts: ADO II, ADO AS
- ~ pulmonary pressures

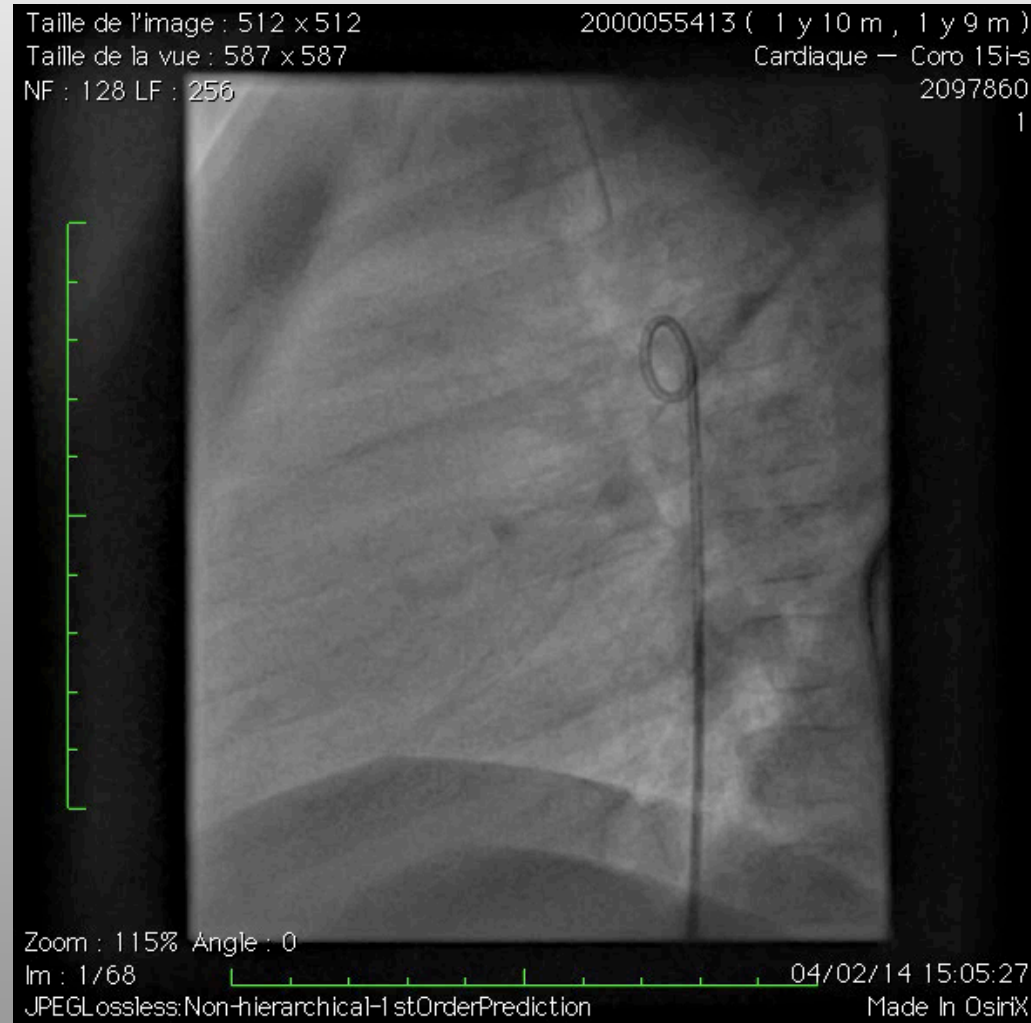
VSD devices (big children, adults)

Procedure: step by step

- Good echo analysis to anticipate procedure
- Anaesthesia: general in infants & children, local in big children and adults possible
- Antibiotics (local 'guidelines')
- Access:
 - Infants: arterial and venous (! echoguidance)
 - Children with small ducts: arterial
 - Children/adults with larger ducts: arterial and venous
- Heparin 100 UI/kg
- Choose catheter: pigtail (angio)
- Hemodynamics:
 - Aorta: diastolic pressure !
 - PA pressure (after first angio)

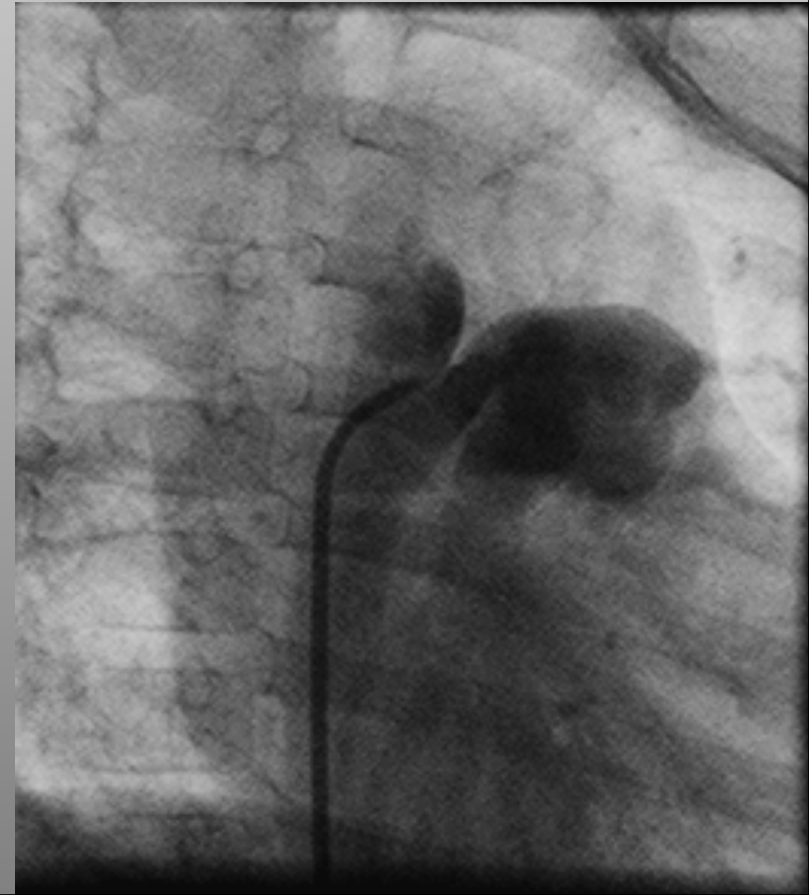
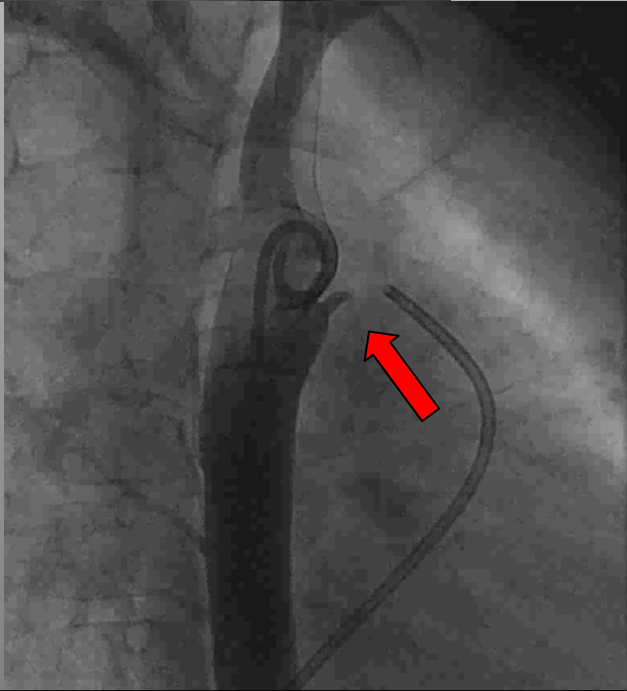
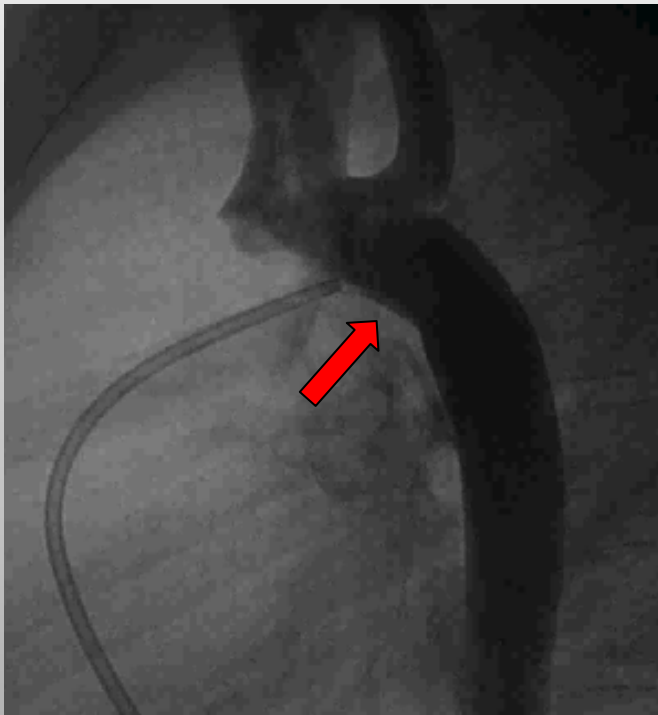
Angiography

- ◇ Lateral projection
+/- RAO 30°
- ◇ Pigtail catheter (4F)
- ◇ Holes of pigtail just below duct (! varies according to manufacturer)
- ◇ Contrast: 1-1.5 cc/kg
 - Ex: 10 kg: 10-15 cc,
12 cc/sec



Lateral aortography...+

RAO 30°



Toronto angiographic classification

Type A: conic

Krichenko, Am J Cardiol 1989

Type B: short, window like

Type C: tubular

Type D: complex

Type E: elongated

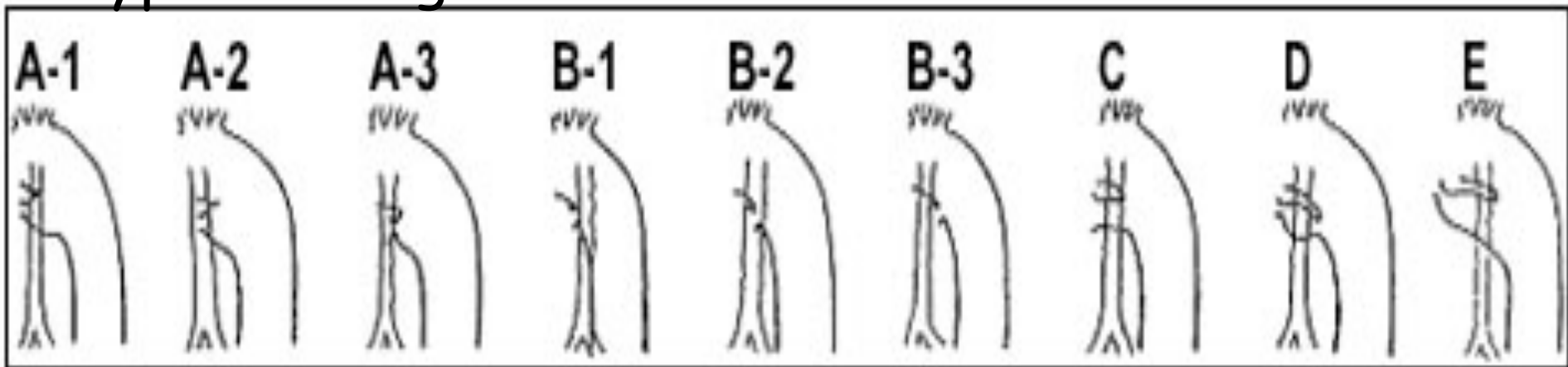


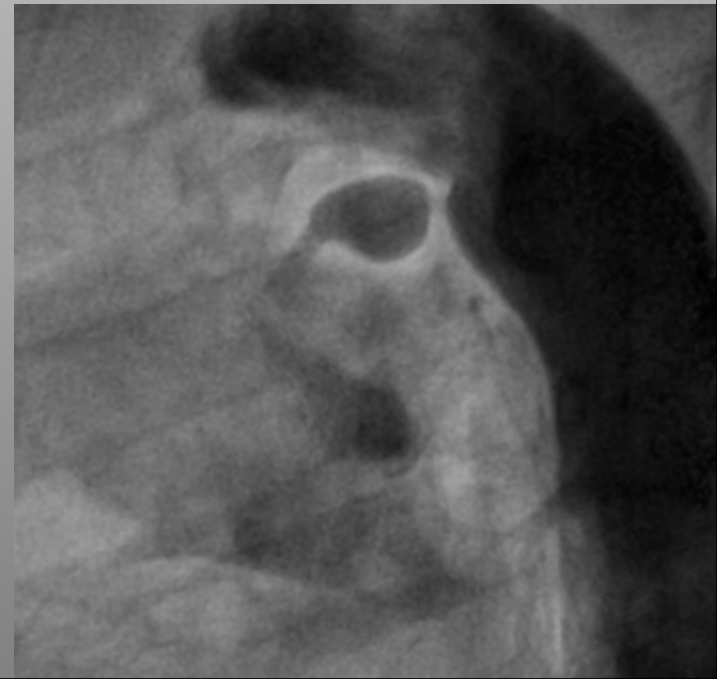
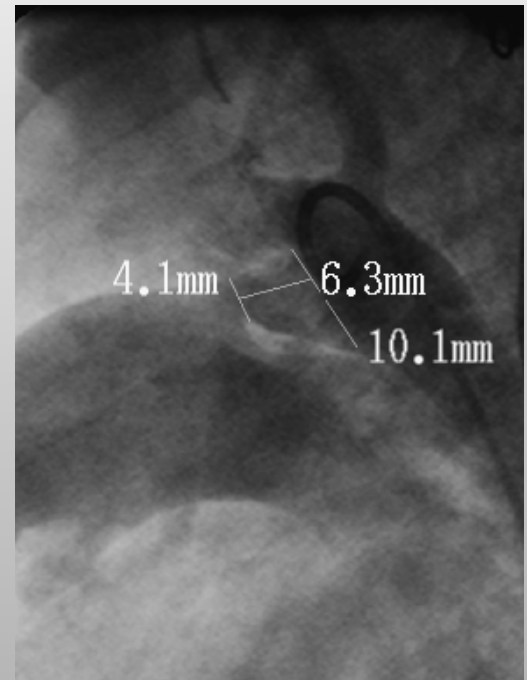
Figure 3

Useful measurements

1. narrowest diameter
2. diameter of aortic ampulla
3. duct length
4. aortic ampulla mid diameter

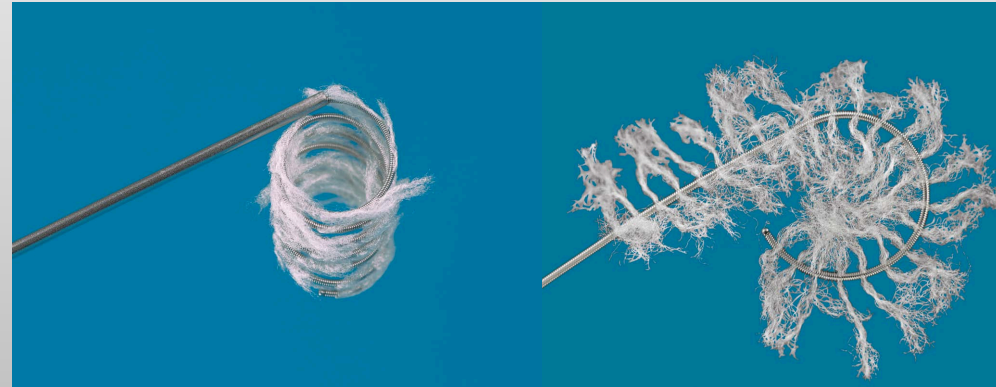
! Vasoreactivity of ducts in small children

- Mechanical stimulation
- anesthesia

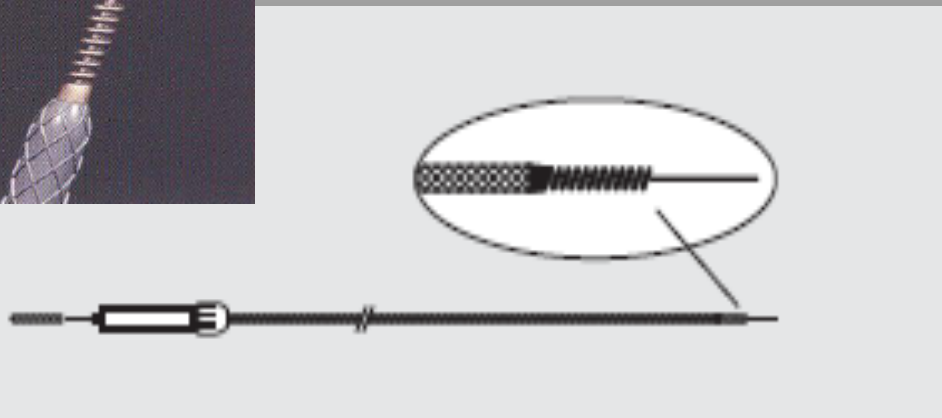
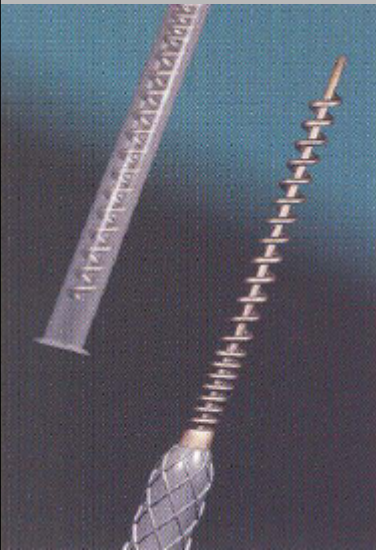


MREYE® FLIPPER® Detachable coils (COOK)

- Inconel (≈ stainless steel)
- synthetic fibers (Dacron)
- MRI compatible
- Retrievable
- 0,035"



diameter of loop (mm)	3	3	3	5	5	5	6.5	6.5	6.5	8	8	8
n° of loops	3	4	5	3	4	5	3	4	5	3	4	5

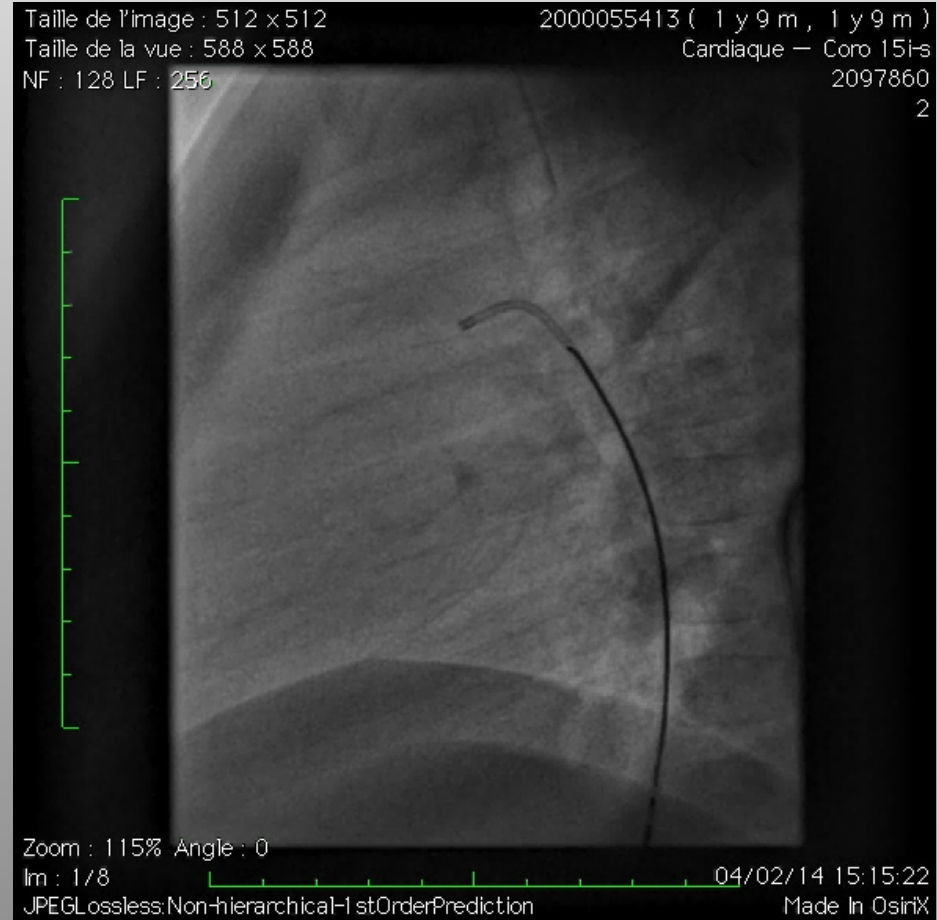
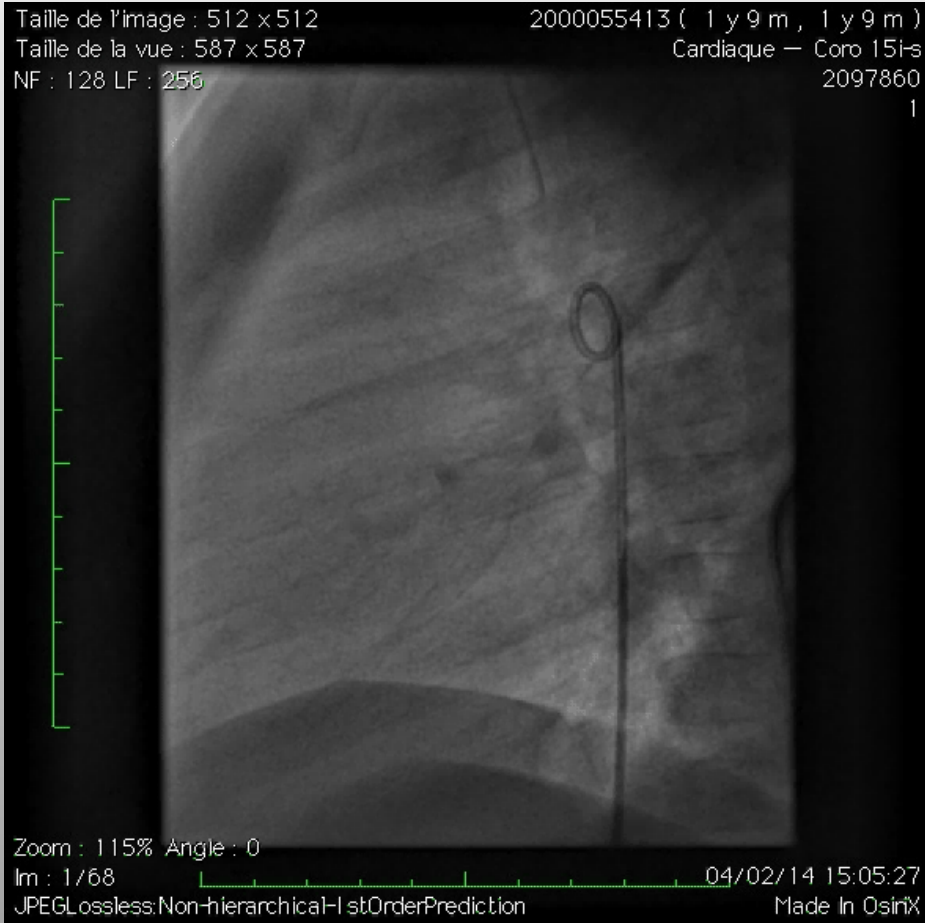


- delivery catheter 0,035" (80 cm, 110 cm)
- 0,041" catheter recommended but 0,038" is OK (4F)
- straitening mandril

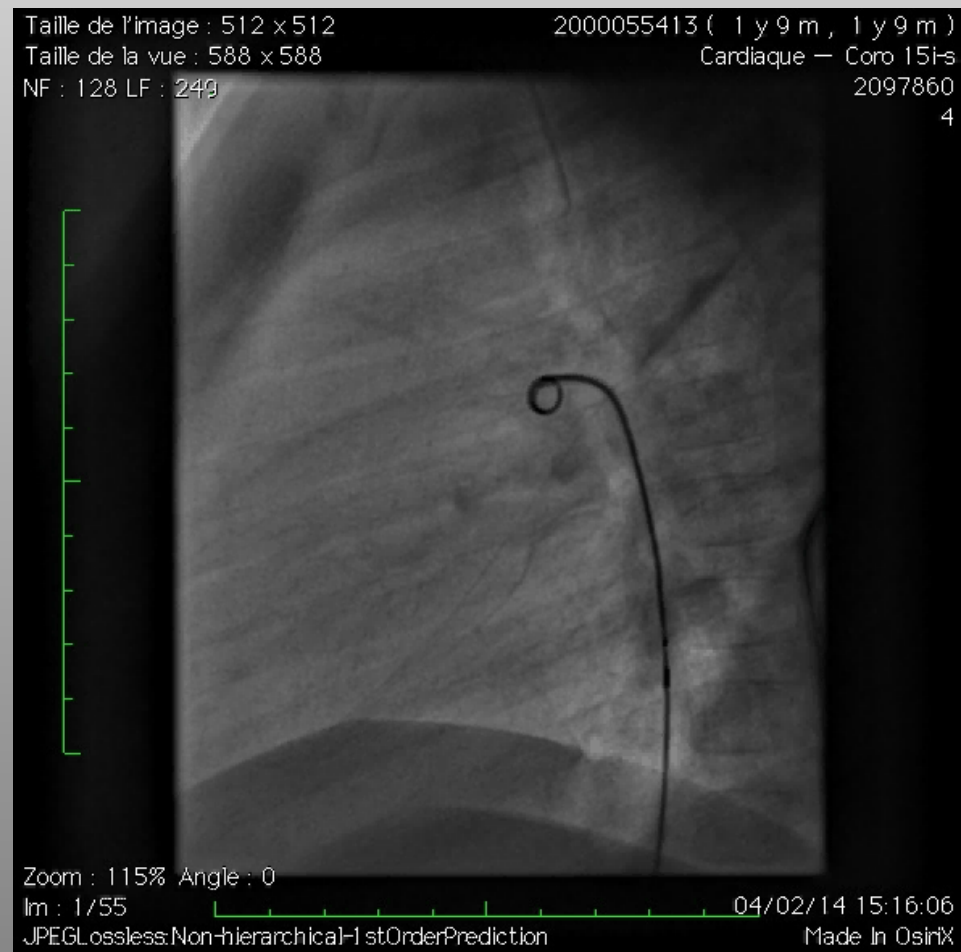
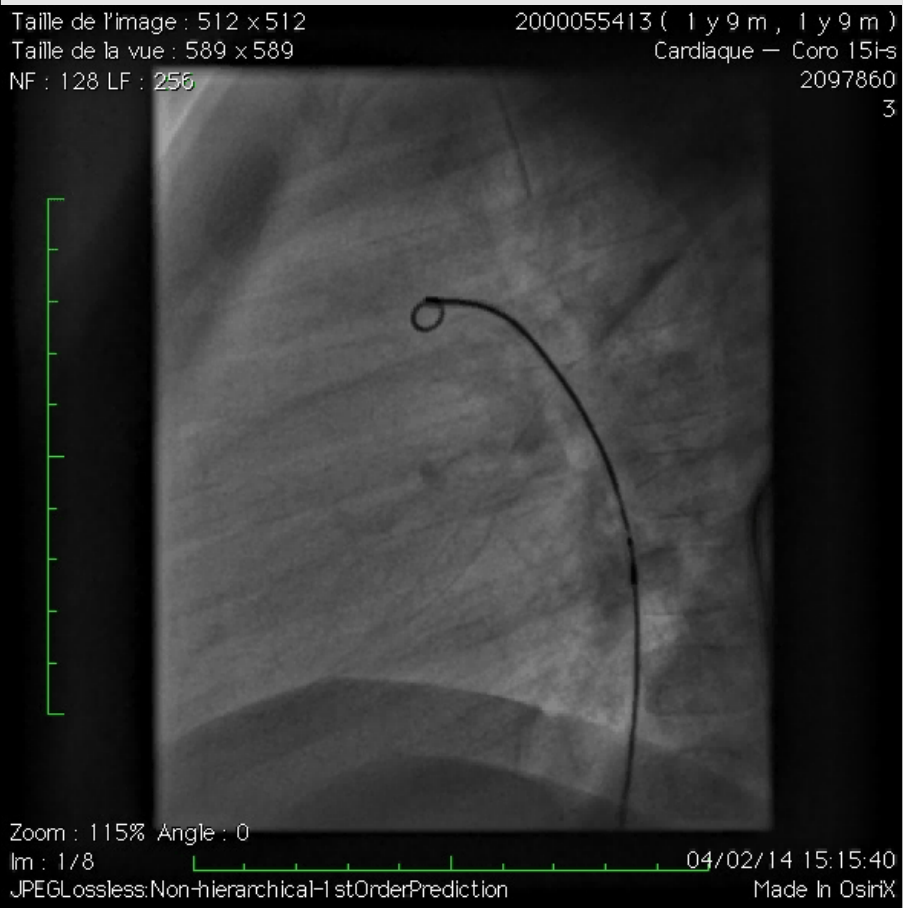
- Detachable coils

- Used for conic ducts, pulm 'neck' < 2 to 2.5 mm
- Rule: diameter of coil: at least 1.5 to 2x 'neck' diameter, should fit the ampulla
- Usually advanced from aortic side, end-hole catheter
 - 1 to 1.5 loop in PA
- If 'significant' residual shunt, better to go immediately for second coil (to avoid hemolysis)
- Possibility of inserting simultaneously 2 coils, one from aortic, the other from pulmonary side
- Avoid 3 or more coils (LPA !)

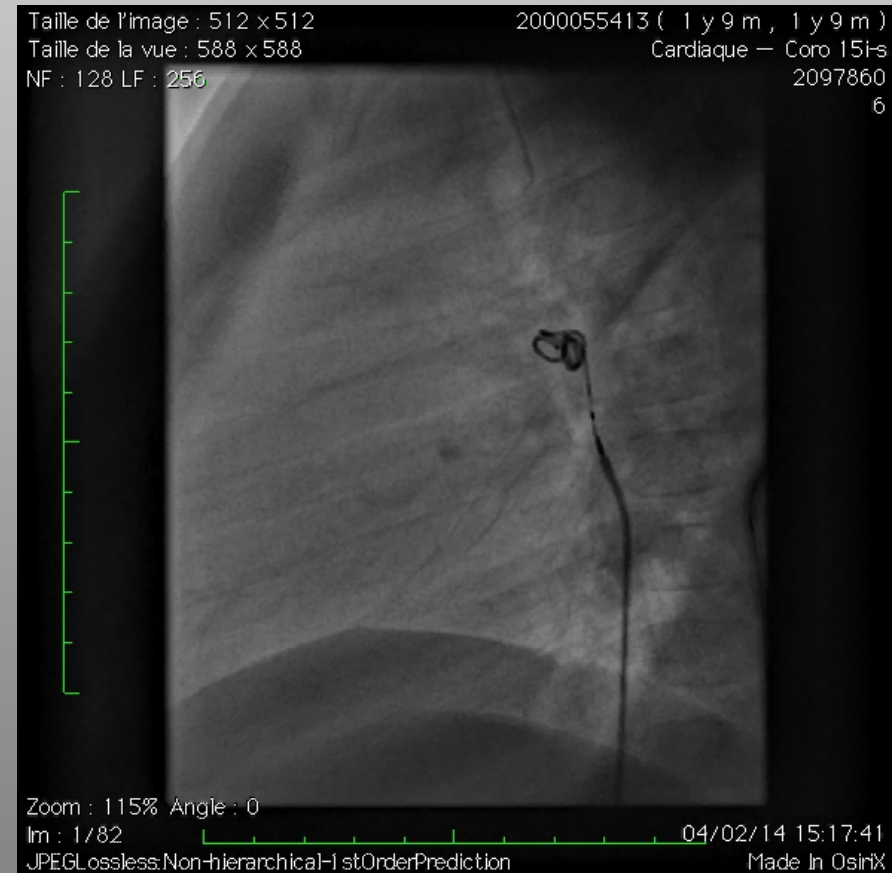
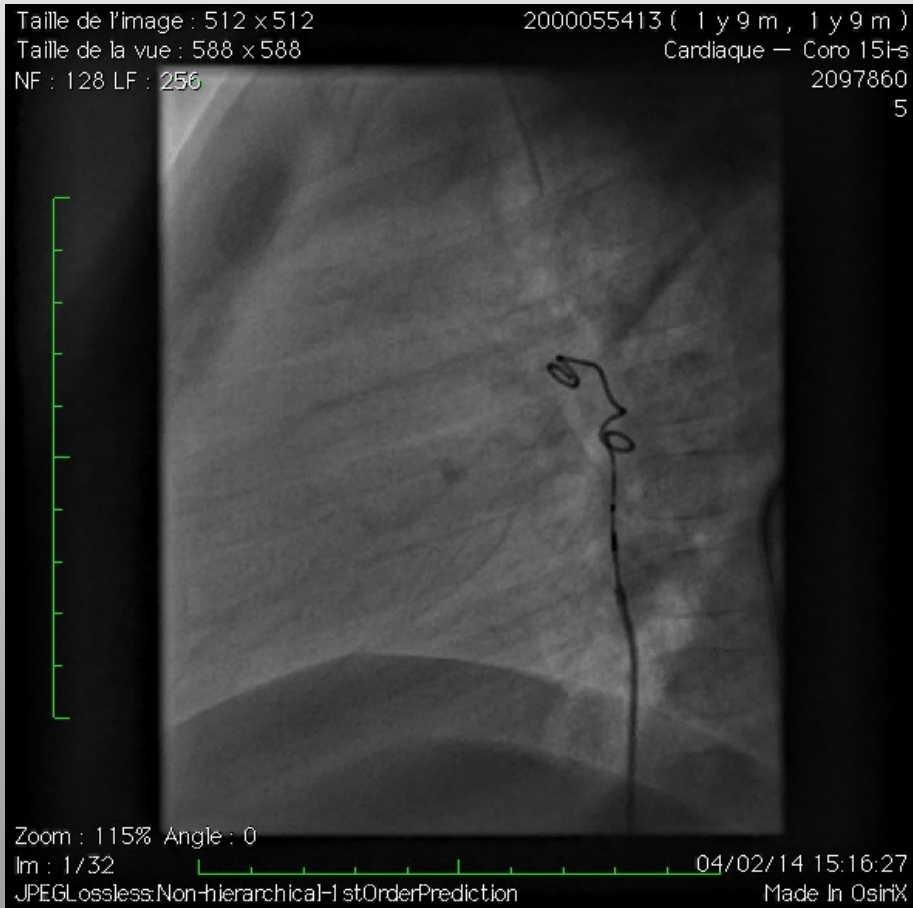
Step by step



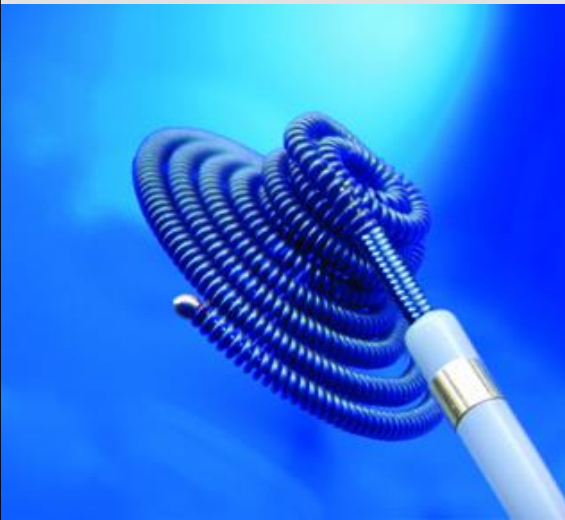
Step by step



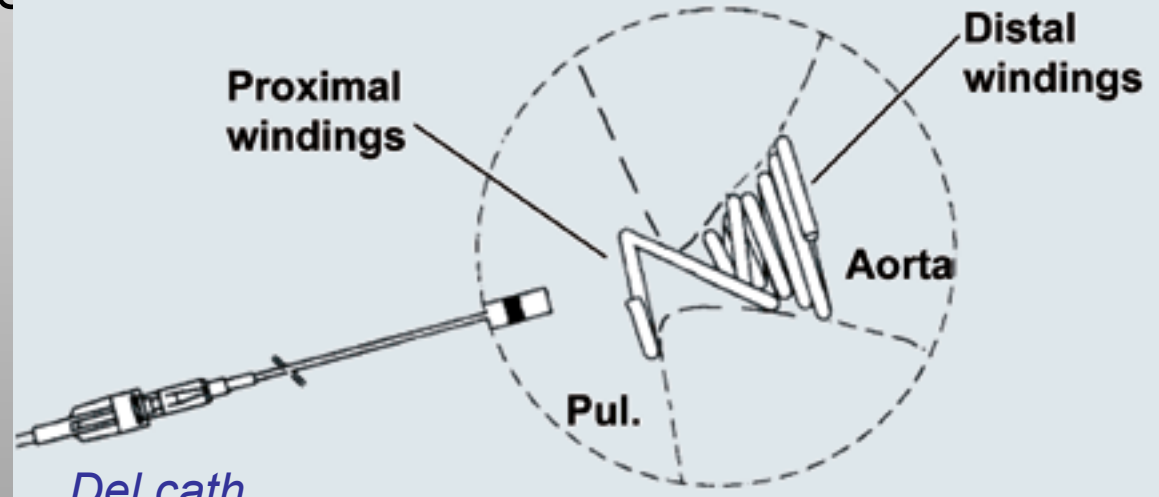
Step by step



PFM coil



- Nitinol premounted coil, graduated stiffness
- Strong distal windings to avoid pull-through
- Delivery from pulmonary side
- Delivery 4/5F



<i>Dist&prox diam</i>	<i>Length</i>
<i>4x4 mm</i>	<i>8,5 mm</i>
<i>5x4 mm</i>	<i>9,5 mm</i>
<i>6x5 mm</i>	<i>11 mm</i>
<i>7x6 mm</i>	<i>12 mm</i>
<i>9x6 mm</i>	<i>13,5 mm</i>
<i>11x6 mm</i>	<i>12 mm</i>

Del cath

4F

4F

4F

5F

5F

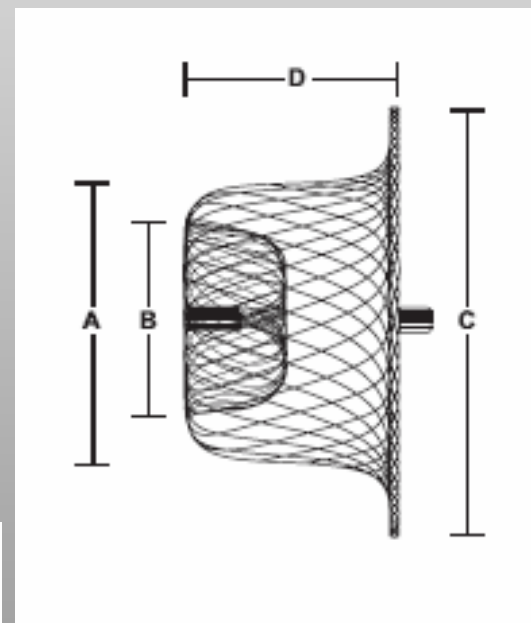
5F



Amplatzer Duct Occluder (ADO)[®] AGA



- Nitinol wire + Polyester fabric
- retrievable
- delivered from the pulmonary side
- latex free, MRI compatible



AMPLATZER DUCT OCCLUDER - ORDERING INFORMATION

Order No.	A - Device Diameter at Descending Aorta	B - Device Diameter at Pulmonary Artery	C - Retention Skirt	D - Length
9-PDA-003	5 mm	4 mm	9 mm	5 mm
9-PDA-004	6 mm	4 mm	10 mm	7 mm
9-PDA-005	8 mm	6 mm	12 mm	7 mm
9-PDA-006	10 mm	8 mm	16 mm	8 mm
9-PDA-007	12 mm	10 mm	18 mm	8 mm
9-PDA-008	14 mm*	12 mm	20 mm	8 mm
9-PDA-009	16 mm*	14 mm	22 mm	8 mm

AMPLATZER[®]
TorqVue[®] Delivery System*

5 French, 180° Curve
 6 French, 180° Curve
 6 French, 180° Curve
 6 French, 180° Curve
 7 French, 180° Curve
 7 French, 180° Curve
 7 French, 180° Curve

- Amplatzer Duct Occluder (ADO)[®] AGA

- suits many large conic ducts
 - delivered from pulmonary artery side
 - diameter of device: (1)-2 mm larger than narrowest duct point, ! length
 - very high closure rate, low complication rate in experienced hands
 - in small children: possible aortic protrusion (angle) or pulmonary artery protrusion
- ? Weight limit

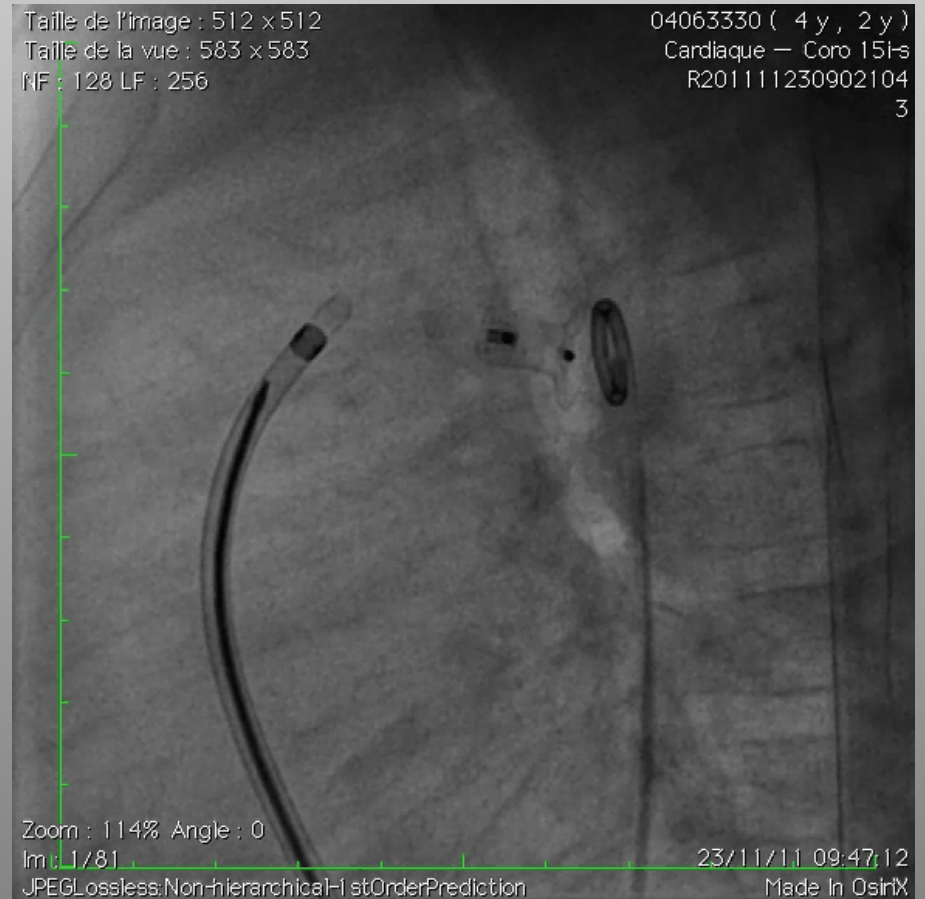
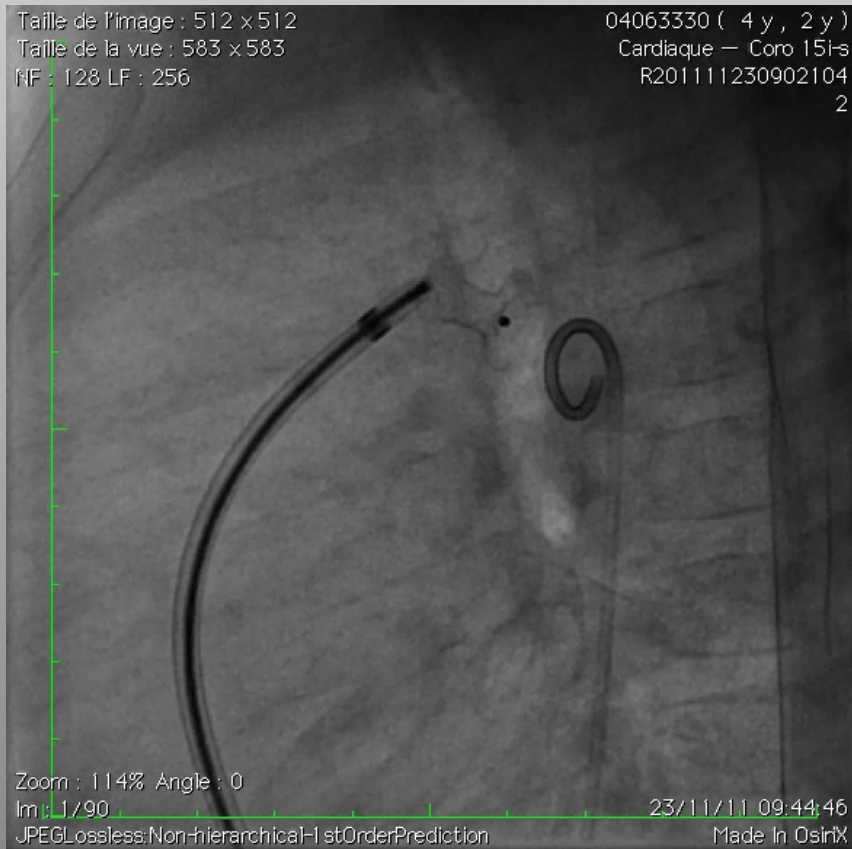
Step by step



- Choice: ADO 5/4 (5 mm long, disk 9 mm)
- MP 4or 5F into PA - PDA - desc Ao (with help terumo 0.025' or 35)
- 0,035" (exchange) wire 0.035 into desc aorta
- AGA 5F long sheath + dilator advanced into descending aorta
- Dilator removed (bleeding! valve!)

Step by step

- Device loaded on delivery cable, advanced to descending aorta
- Retention disk opened and advanced against the PDA
- Body of device opened within duct

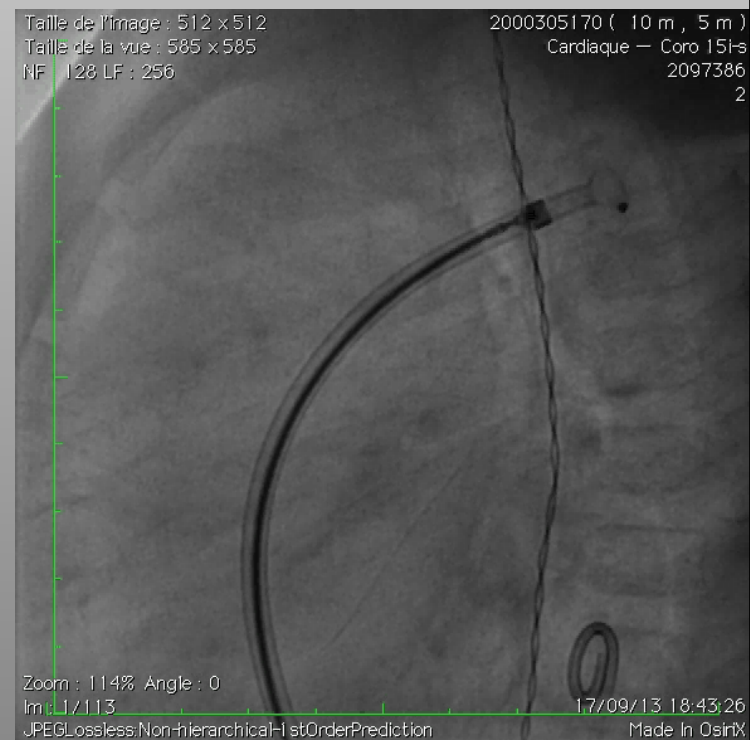
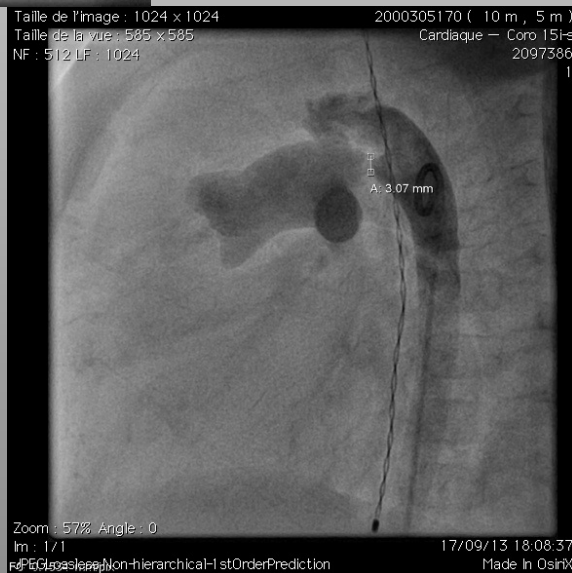




Mistakes

ADO 5/4

6 kg, 5 months



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Taille de la vue : 584 x 584
NF : 128 LF : 256

2000305170 (10 m , 5 m)
Cardiaque — Coro 15i-s
2097386
3

Zoom : 114% Angle : 0
Im : 1/6

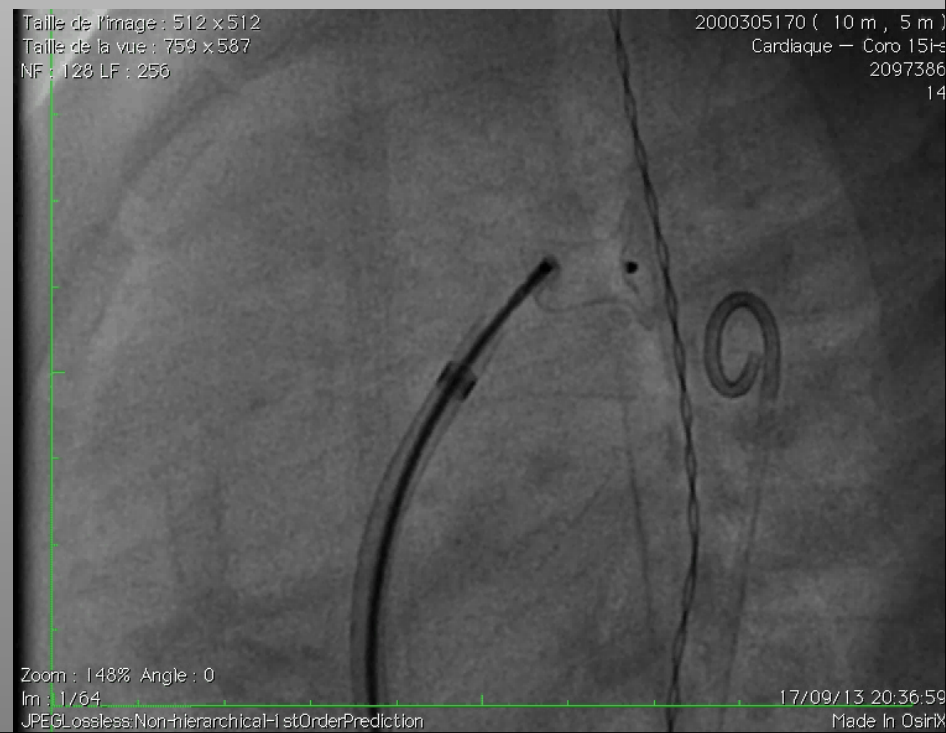
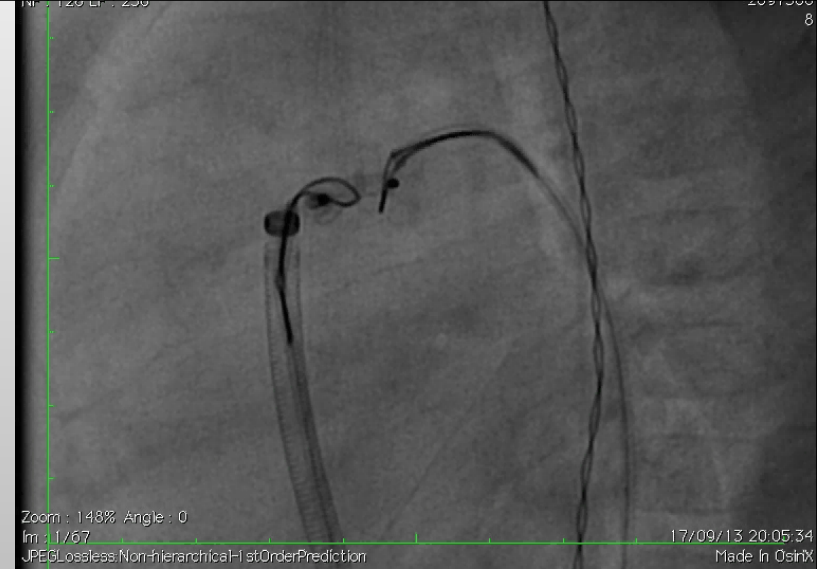
JPEGLossless:Non-hierarchical-1stOrderPrediction

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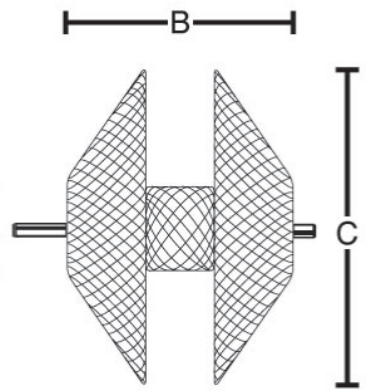
ADO 6/4

ADO 8/6



- ADO II® AGA

- nitinol wire, no fabric
- very flexible, elongates easily, adapts to different angles of aortic or PA insertion
- retrievable
- latex free, MRI compatible



DUCT OCCLUDER II - ORDERING INFORMATION

Order No.	A - Waist Diameter (mm)	B - Length (mm)	C - Disc Diameter (mm)	Delivery Catheter Minimum Size
9-PDA2-03-04	3 mm	4 mm	9 mm	4 Fr
9-PDA2-03-06	3 mm	6 mm	9 mm	4 Fr
9-PDA2-04-04	4 mm	4 mm	10 mm	4 Fr
9-PDA2-04-06	4 mm	6 mm	10 mm	4 Fr
9-PDA2-05-04	5 mm	4 mm	11 mm	5 Fr
9-PDA2-05-06	5 mm	6 mm	11 mm	5 Fr
9-PDA2-06-04	6 mm	4 mm	12 mm	5 Fr
9-PDA2-06-06	6 mm	6 mm	12 mm	5 Fr

Delivery system: Torqvue LP (low profile)

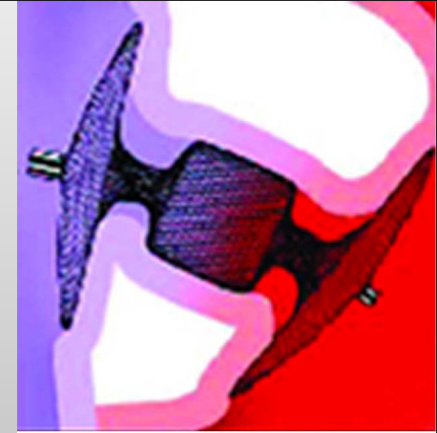
- Flexible distal catheter segment - low profile
easy **aortic or pulmonary artery** approaches
- Braided delivery wire with flexible Nitinol tip
easy device positioning and deployment within various configurations

AMPLATZER TORQVUE LP - ORDERING INFORMATION

Order No.	Catheter Size	Catheter Length (cm)	Tip Angle	Delivery Cable Length (cm)
9-TVLP4F90/060	4 Fr	60	90°	160
9-TVLP4F90/080	4 Fr	80	90°	195
9-TVLP5F90/060	5 Fr	60	90°	160
9-TVLP5F90/080	5 Fr	80	90°	195

- ADO II® AGA

- children ≥ 6 kg
- various morphologies BUT NOT window type
- Diameter; measure where central waist will reside
 - not if > 5.5 mm diameter
 - aortic diameter must be \geq retention disk
- Length: from retention disk to retention disk



General rule: start SMALL and S
 duct length typically overestimated,
 aortic retention disk often
 within ampulla

AMPLATZER® Duct Occluder II Sizing Chart

Measured Ductus Diameter	Measured Ductus Length				
	< 5mm	5.1 - 8.0mm	8.1 - 10.0mm	10.1 - 11.0mm	11.1 - 12.0mm
< 2.5mm	03-04	03-06	04-06	05-06	06-06
2.5 - 3.5mm	04-04	04-06	05-06	06-06	06-06
3.6 - 4.5mm	05-04	05-06	05-06	06-06	06-06
4.6 - 5.5mm	06-04	06-06	06-06	06-06	06-06

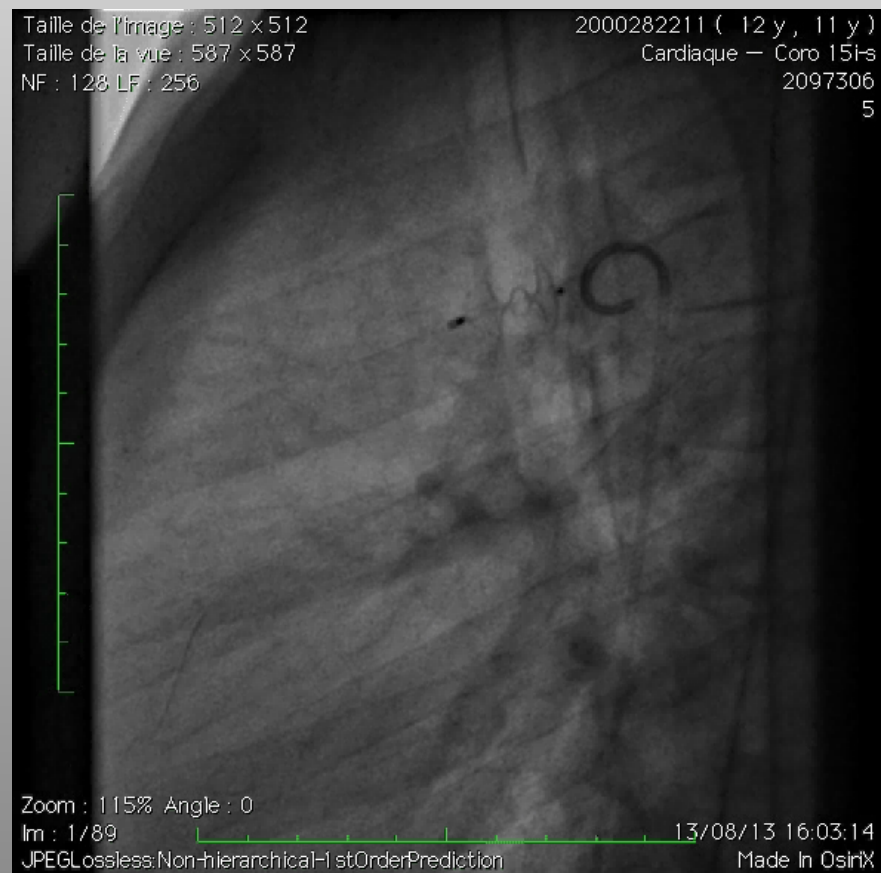
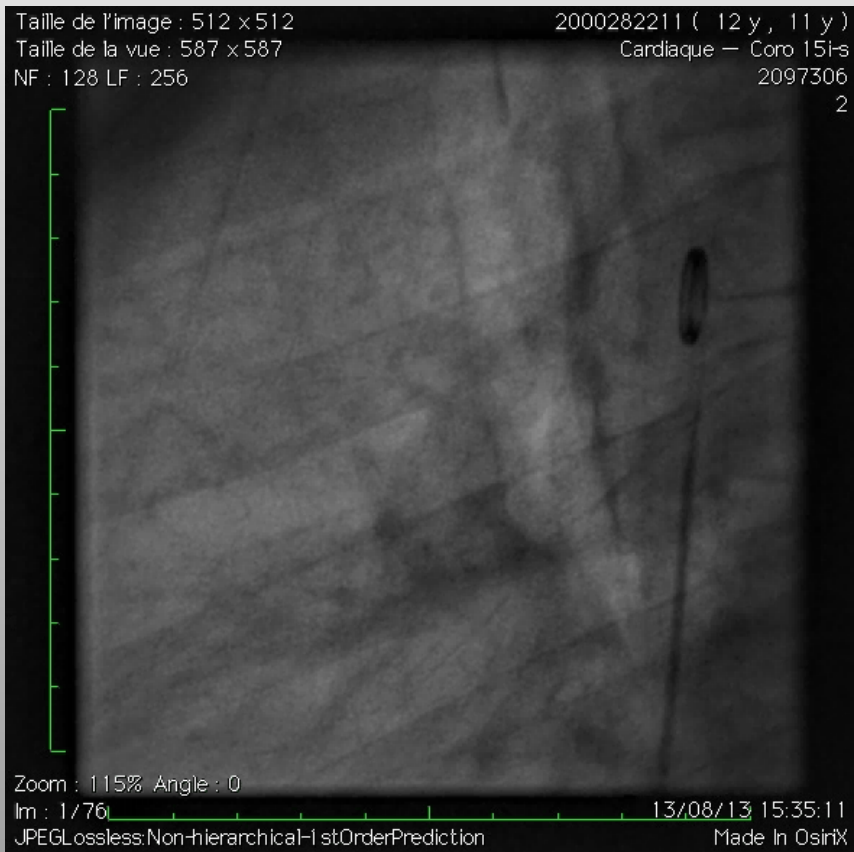
Order Number: 9-PDA2-xx-yy

xx: Waist

yy: Length



Delivered from aortic end



Delivered from pulmonary end

Taille de l'image : 512 x 512
Taille de la vue : 584 x 584
NF : 128 LF : 256

04226022 (2 y , 4 m)
Cardiaque — Coro 151-s
R201111090924153

1

Zoom : 114% Angle : 0
Im : 1/77

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JPEGLossless:Non-hierarchical-I stOrderPrediction

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Taille de l'image : 512 x 512
Taille de la vue : 584 x 584
NF : 128 LF : 256

04226022 (2 y , 4 m)
Cardiaque — Coro 151-s
R201111090924153

4

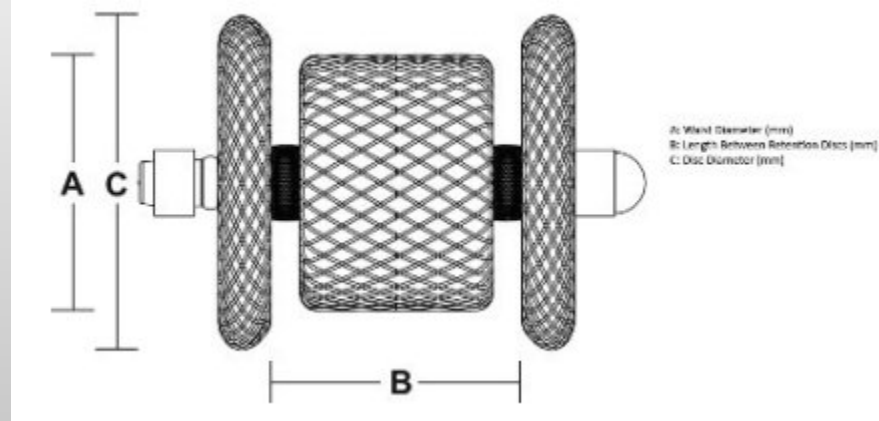
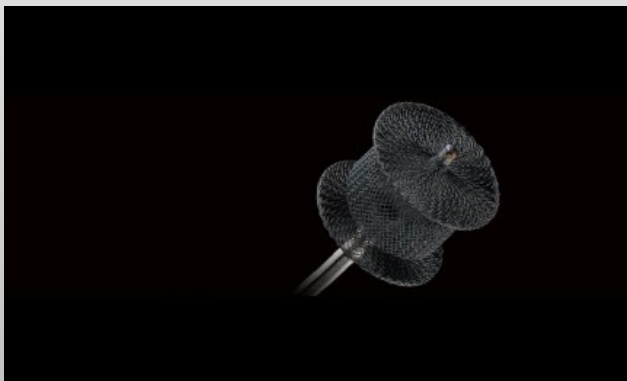
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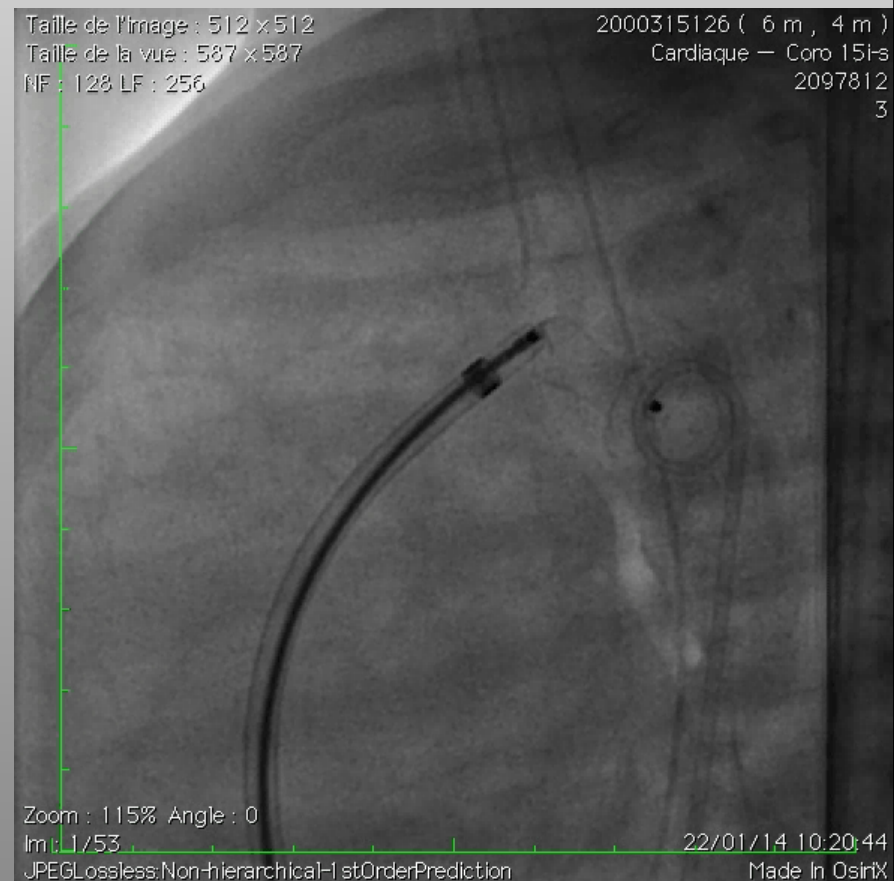
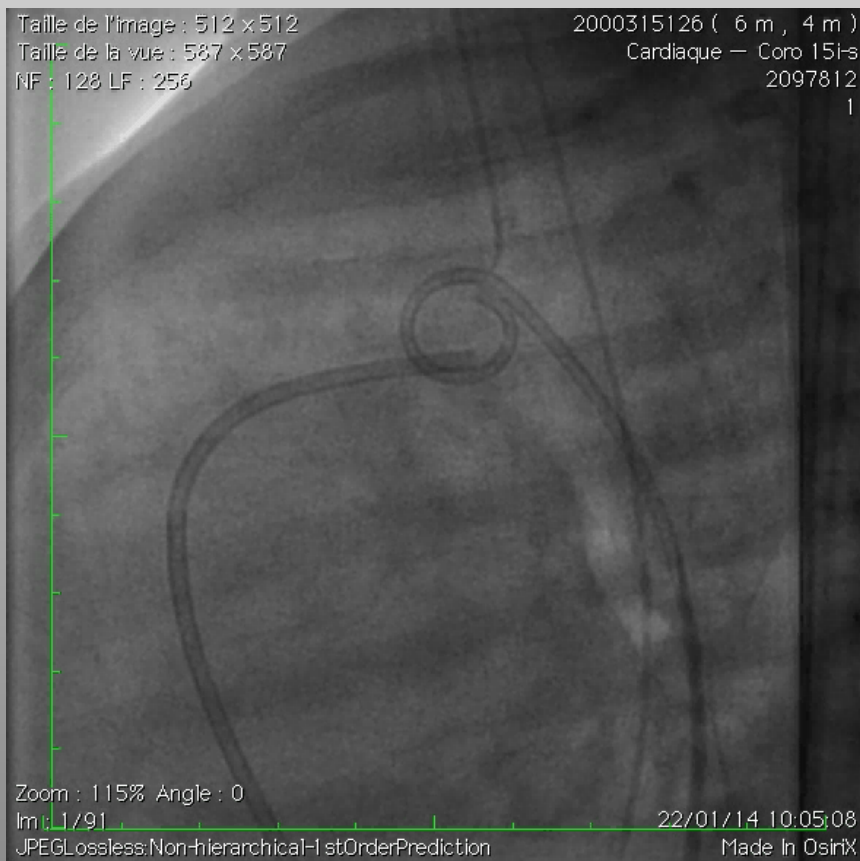
- ADO AS



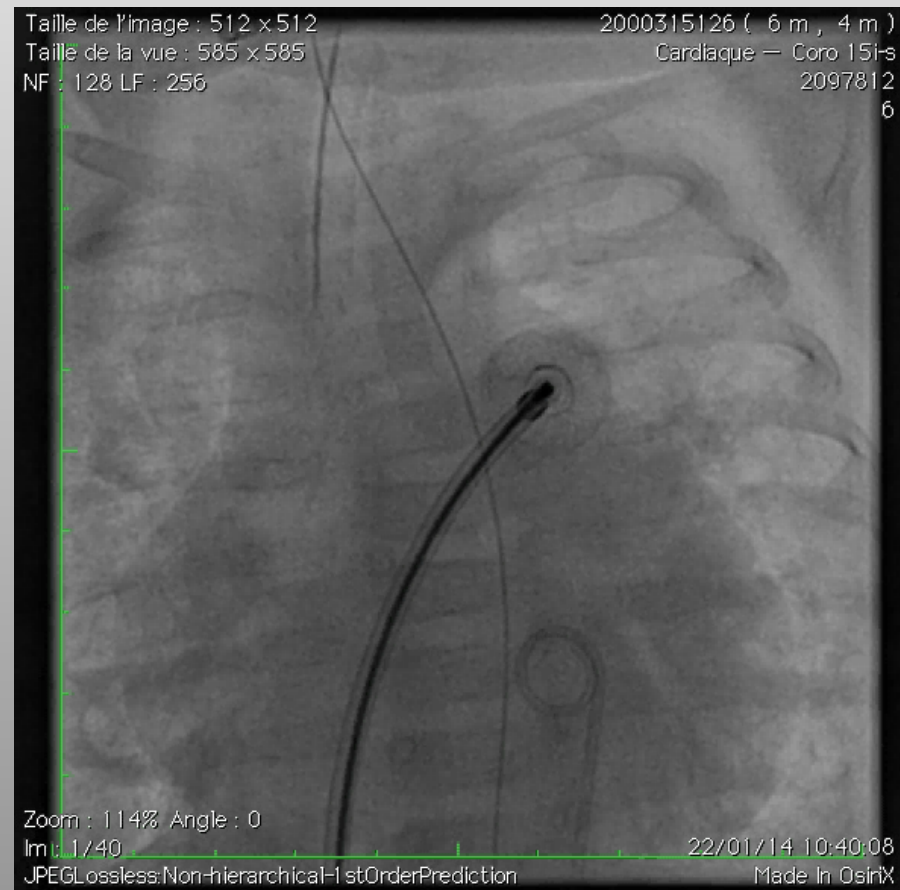
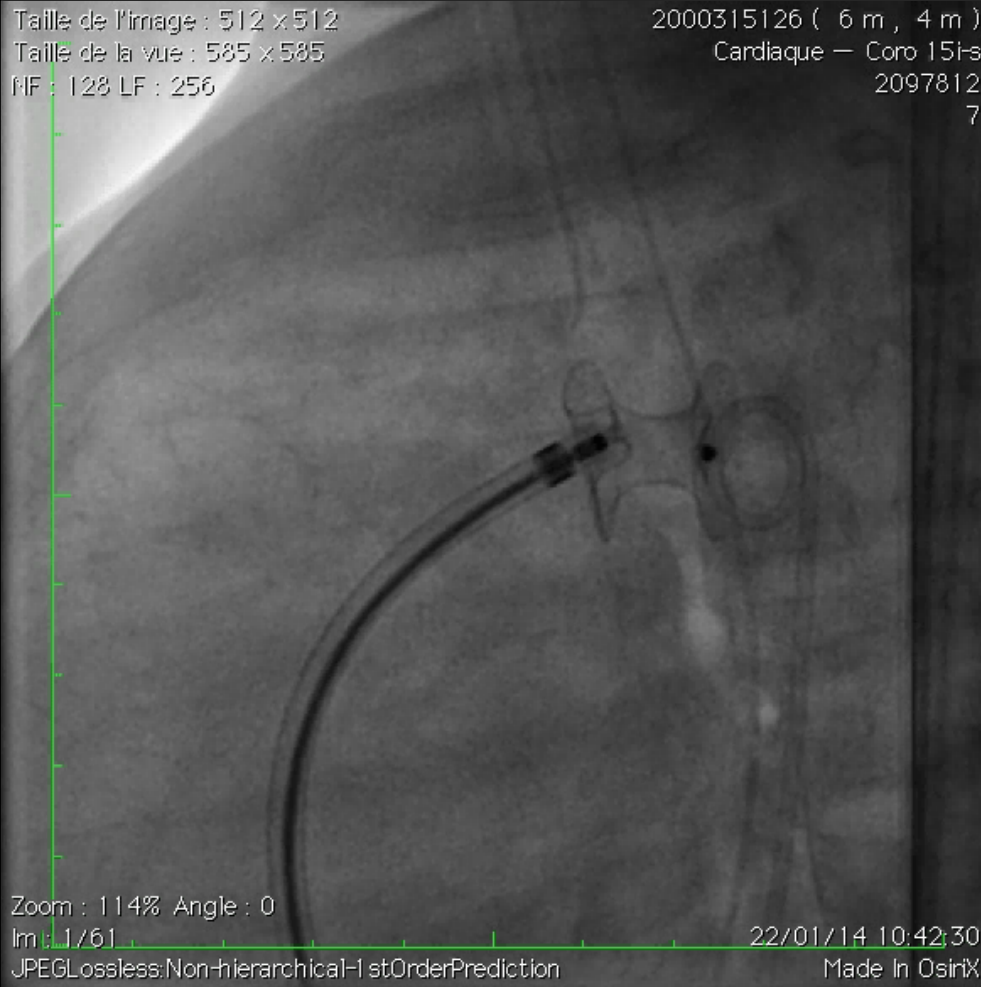
Reorder Number	Waist Diameter (mm)	Length Between Retention Discs (mm)	Disc Diameter (mm)	Recommended Catheter Size (AMPLATZER™ TorqVue™ LP Catheter)
9-PDA2AS-03-02-L	3	2	4.00	4 F, 90° Curve
9-PDA2AS-03-04-L	3	4	4.00	4 F, 90° Curve
9-PDA2AS-03-06-L	3	6	4.00	4 F, 90° Curve
9-PDA2AS-04-02-L	4	2	5.25	4 F, 90° Curve
9-PDA2AS-04-04-L	4	4	5.25	4 F, 90° Curve
9-PDA2AS-04-06-L	4	6	5.25	4 F, 90° Curve
9-PDA2AS-05-02-L	5	2	6.50	4 F, 90° Curve
9-PDA2AS-05-04-L	5	4	6.50	4 F, 90° Curve
9-PDA2AS-05-06-L	5	6	6.50	4 F, 90° Curve

Other devices

- Vascular plugs
- VSD devices: large ducts with PHT (adults, children?)



6 months



! Aortic protrusion`

! PA protrusion

Have to be put in balance with surgery

Algorithm for 2014?

- Small (< 2.5 mm), conic: coils, ADO II
- Larger conic: ADO, ADO II
- Atypical morphology: ADO II, AS ...
- Large tubular: AS, VSD ??

'à la carte'

Surgery is sometimes also a good option

Efficacy of technique

- All techniques are very efficient if properly used, low complication rates
- New studies analysing 'strategies' rather than single techniques are very promising

Gudausky et al, CCI 2008

Strategy A: only coils

90% successful implantation

73% complete closure at FU

Strategy B: coils if small, ADO if > 1 mm

100% successful implantation

98% complete closure at FU

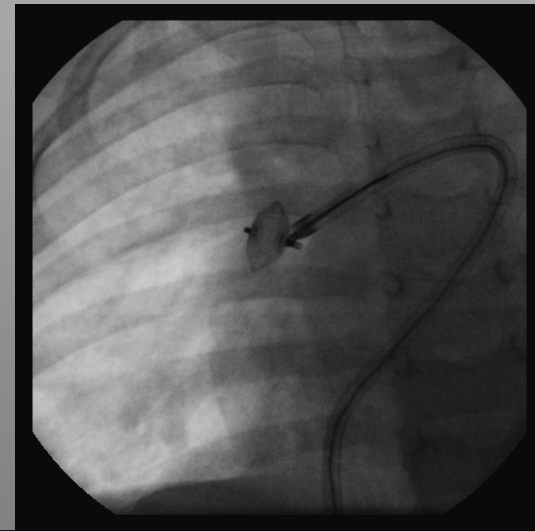
Complications

- Embolization:
 - To PA's: more easy to manage
 - To the aorta (PHT): ! Complications

! Always heparinize your patient if device embolizes and proceed as quick as possible

! Have your material for fishing ready

! Always retrieve the coils or devices into catheter/sheath prior to passing into the RV



Complications

- Hemolysis
 - ⇒ Aim for complete or nearly complete closure
- LPA stenosis
- Descending aorta stenosis
- Femoral artery occlusion
- Death