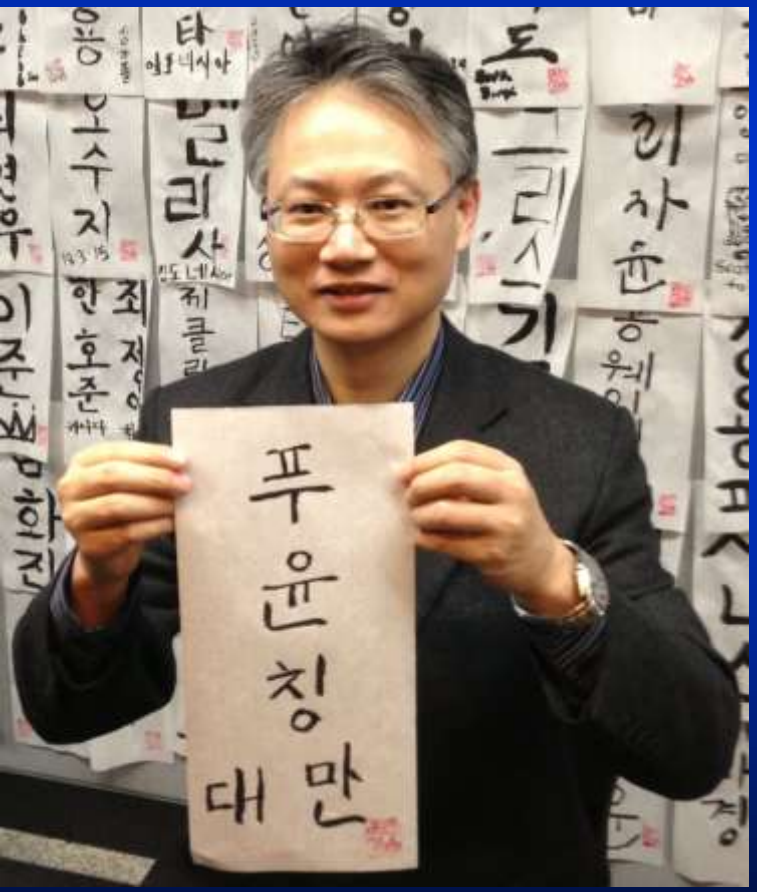
Device closure of PDA in premature neonates



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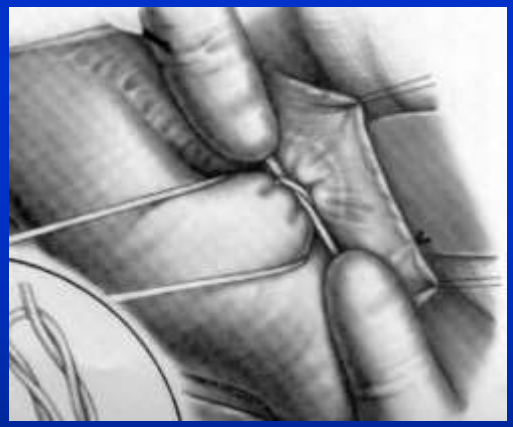
Incidence of patent ductus arteriosus (PDA)

- 1/1000 in full term neonates
- Up to 30% in extreme premature neonates

Methods to close PDA

- Medical
  - NSAID (Nonsteroidal anti-inflammatory drugs)

- Surgical



- Device ?

Considerations of device closure

- Problems
  - Venous access up to ? F
  - Arterial access?
  - Aortic or pulmonary obstruction?
  - Cath room or ICU?
  - How to keep body temperature
  - Echo guidance?
- Solutions
  - 4 or up to 5F
  - No
  - Device with small retention discs
  - Cath room
  - Incubator and warmer
  - TTE

Devices in Taiwan for PDA closure

- Coil (1995)

<2.5 mm

- Amplatzer occluder (St Jude Medical)
  - ADOI (2004)

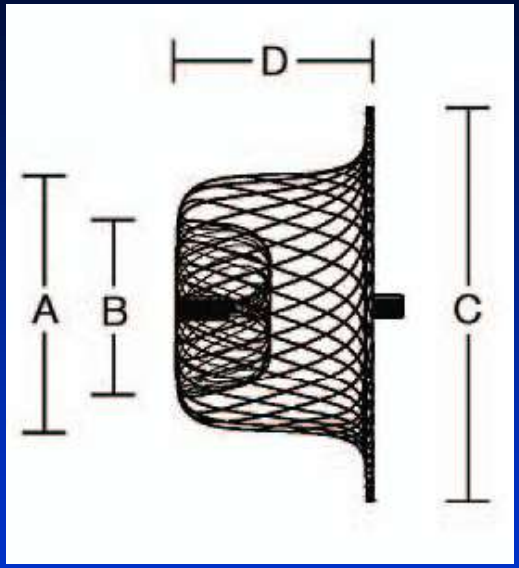
>5 kg

  - ADOII (2012)

3~5 kg

  - ADOIIAS (2013)

<3 kg



Amplatzer duct occluder I (ADOI)

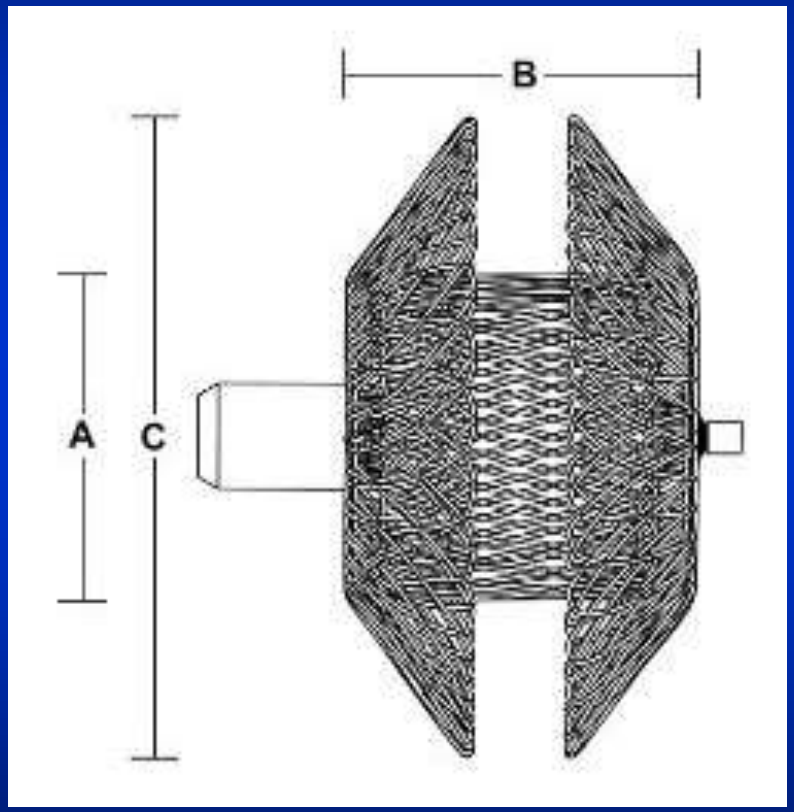
5-7 F delivery sheath

A[a] Device Diameter at Descending Aorta (mm)	B[a] Device Diameter at Pulmonary Artery (mm)	C[a] Retention Skirt (mm)	D[a] Length (mm)
5	4	9	5
6	4	10	7
8	6	12	7
10	8	16	8
12	10	18	8

Amplatzer duct occluder II (ADOII)

4 or 5F delivery catheter

3
4
5
6
mm



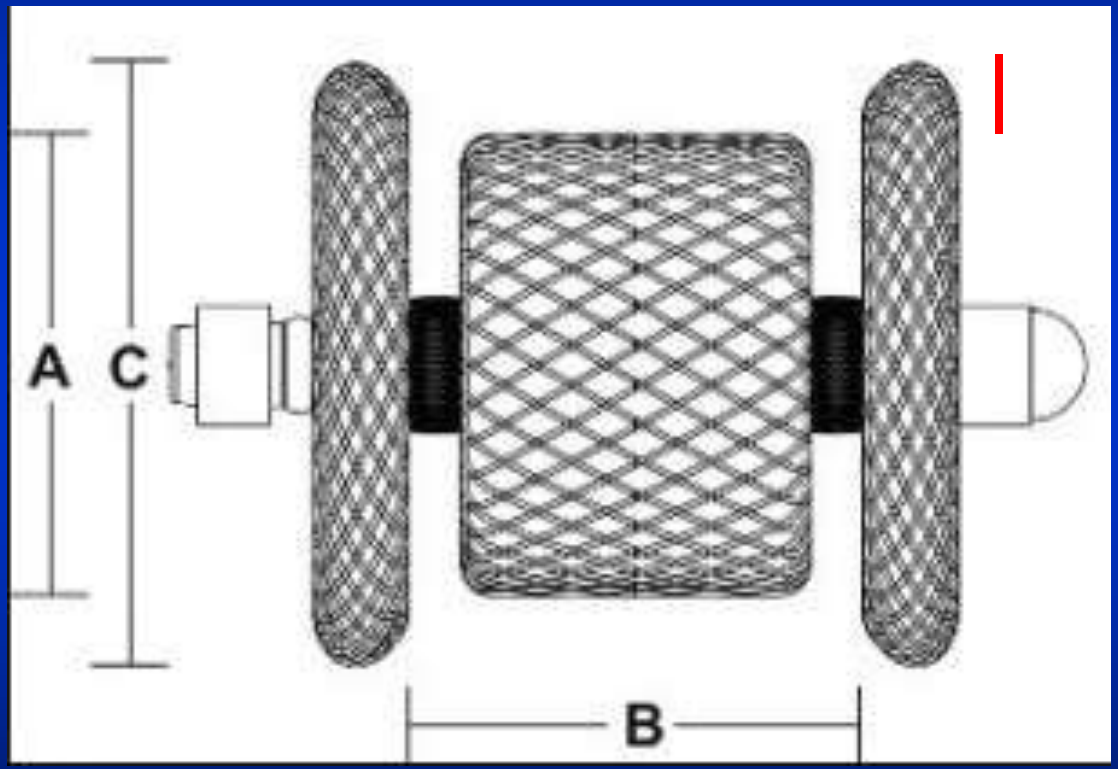
3 mm

4, 6 mm

Amplatzer duct occluder II additional sizes (ADOIIAS)

4F delivery catheter

3
4
5
mm

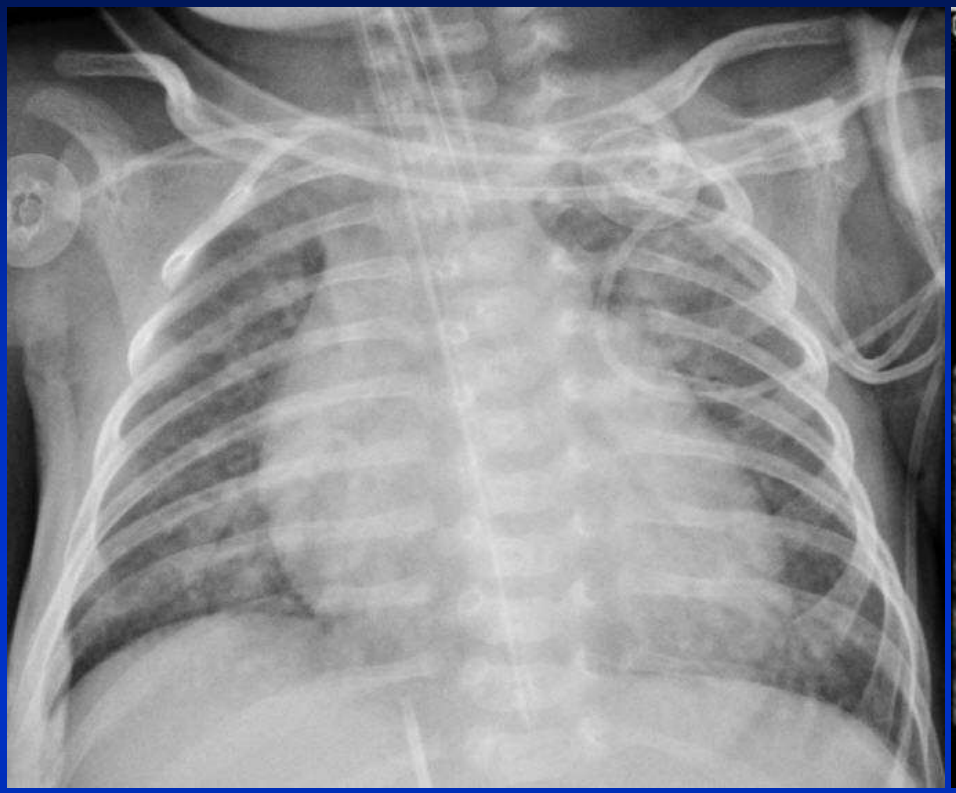


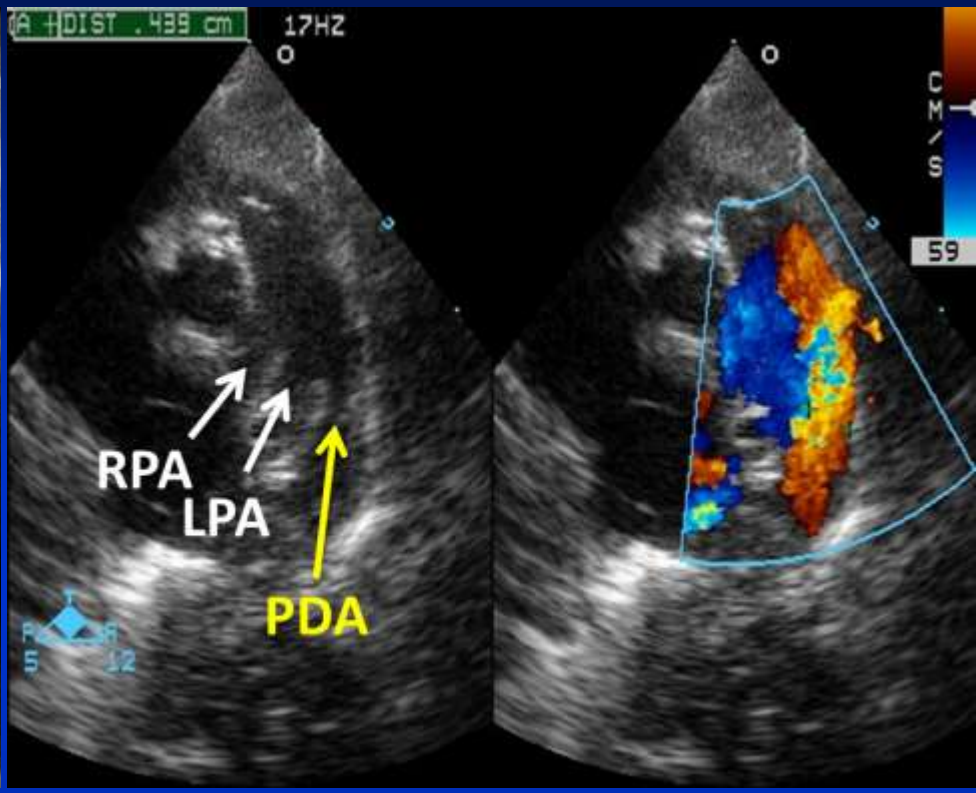
0.5
0.625
0.75
mm

2, 4, 6 mm

	ADOI	ADOII	ADOIIAS
			
Diameter	4-10 mm	3-6 mm	3-5 mm
Delivery profile size	5-7 F delivery sheath	4-5 F delivery catheter	4 F delivery catheter
Problem	Too hard device, too big profile	Too large retention discs	Can close up to <4mm PDA
Suitability	**Poor**	**Poor**	**Good**

1st case: 22 d/o female neonate





- Birth history: Triplet C, GA 34 4/7 wks, BBW 1556 g
- Congestive heart failure and failure to thrive
- Large PDA despite of two courses of Ibuprofen

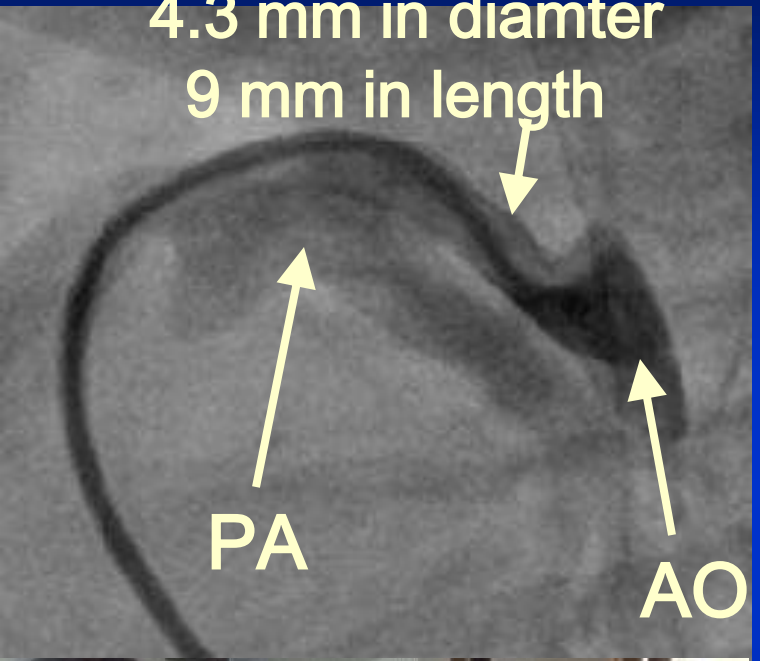
Cardiac catheterization at 24 d/o with 1610 g

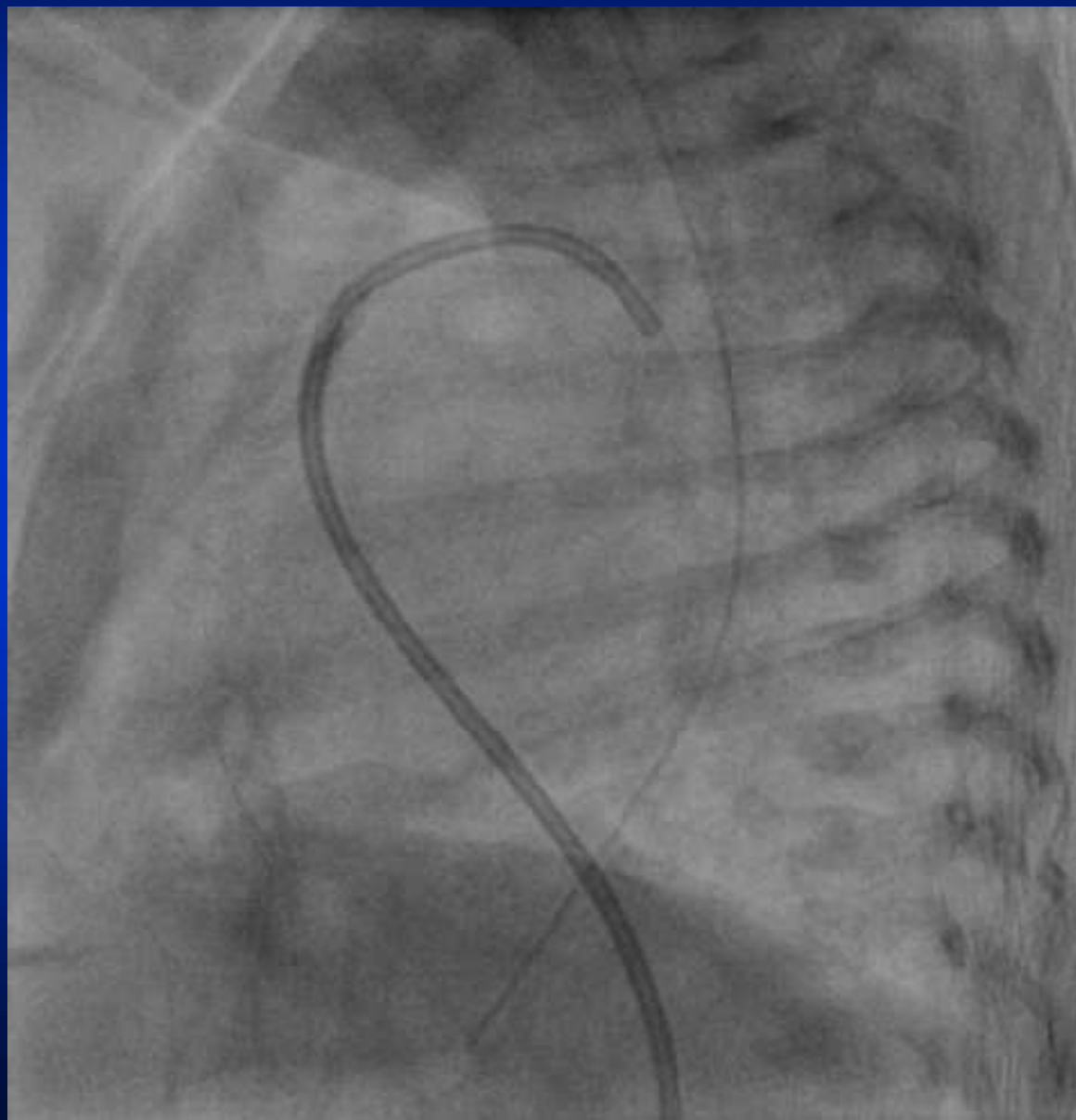
PDA

4.3 mm in diamter

9 mm in length

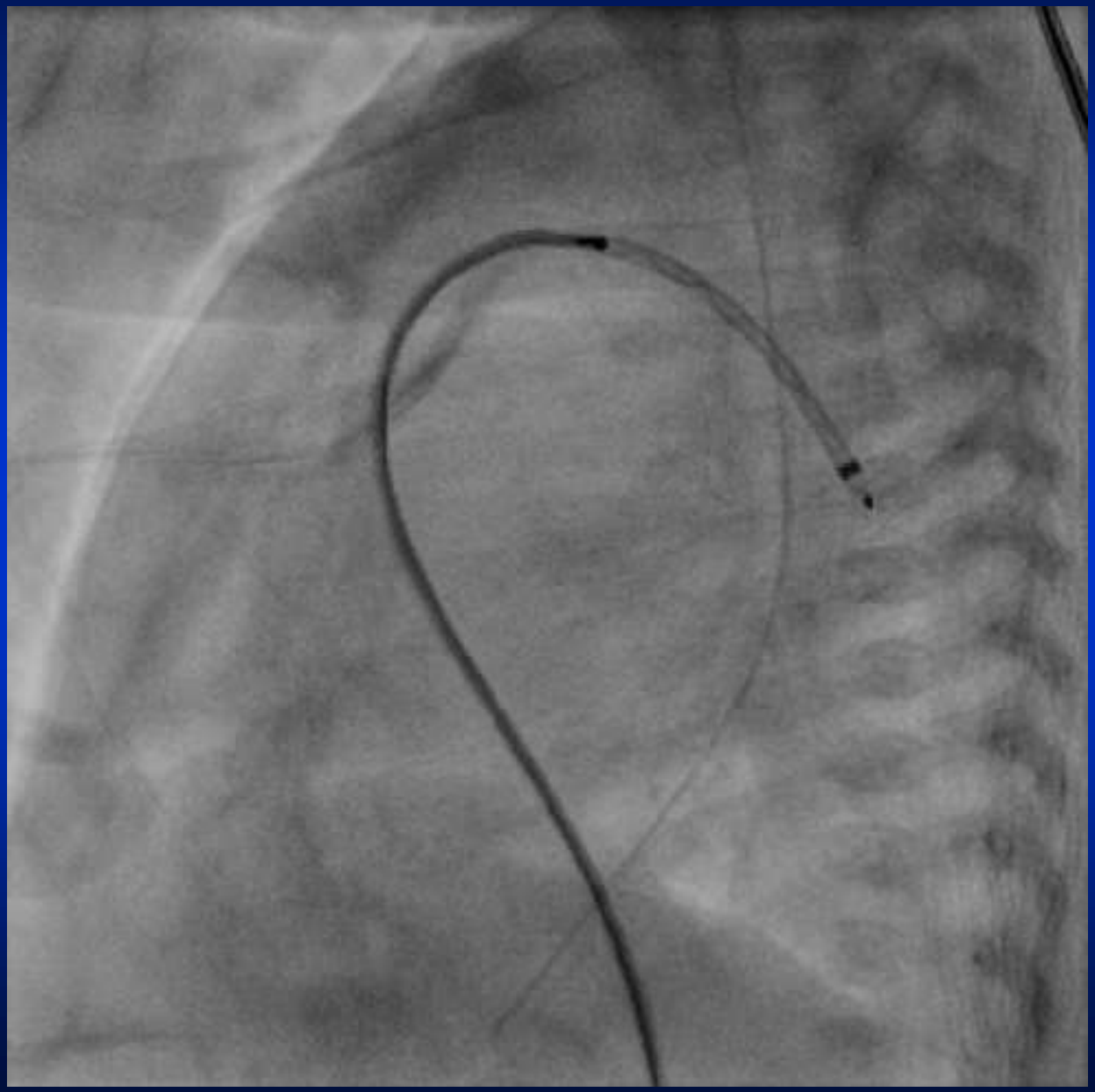
4F JR catheter antegradely





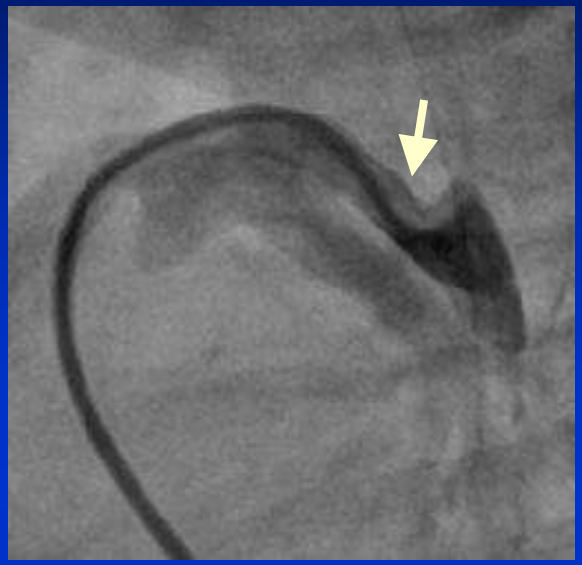
ADOIIAS (5 mm waist, 6 mm length)

4F delivery catheter

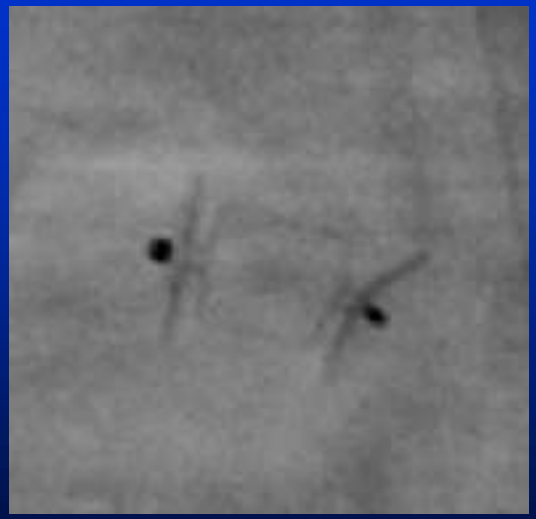


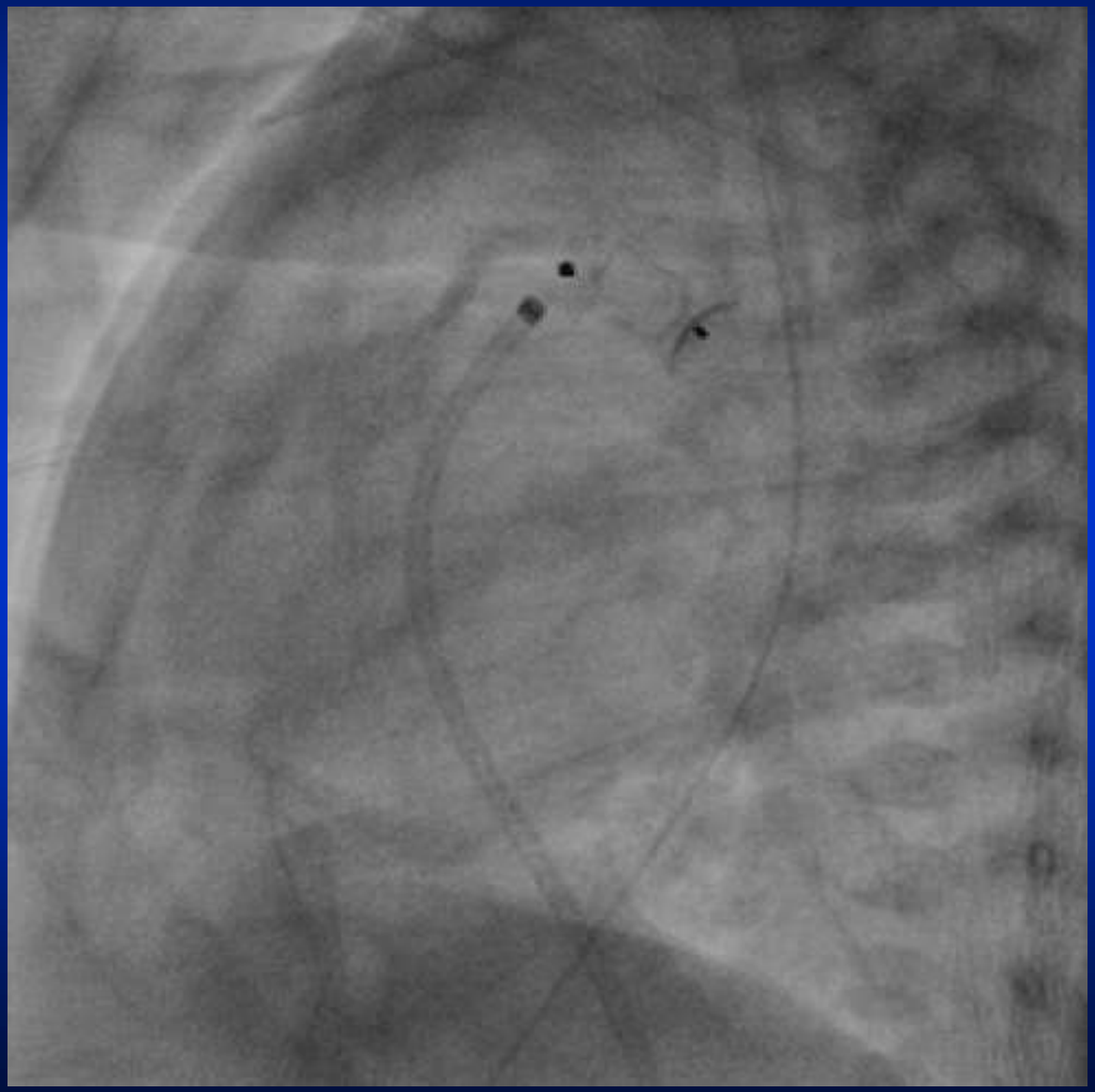
Pulmonary artery angiogram

Pre

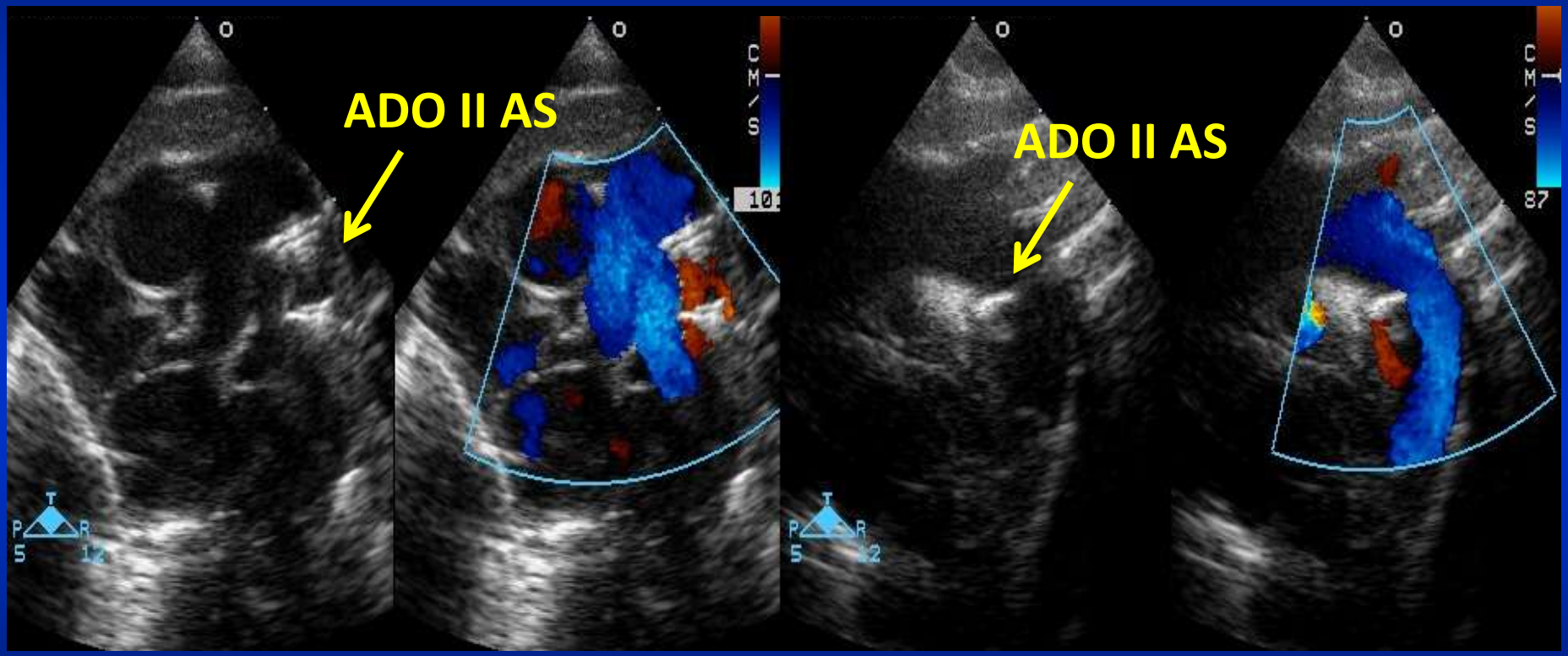


Post





Echo: no residual ductal shunt, absence of aortic or pulmonary obstruction

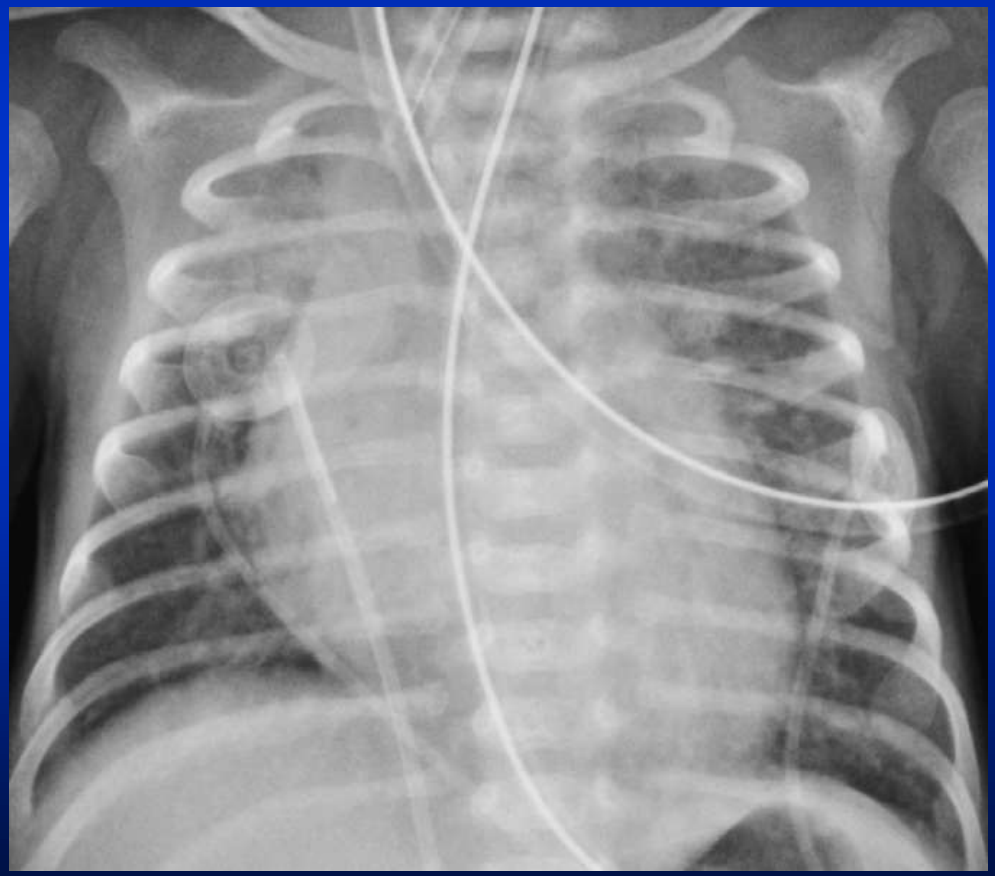


Extubation on the next day

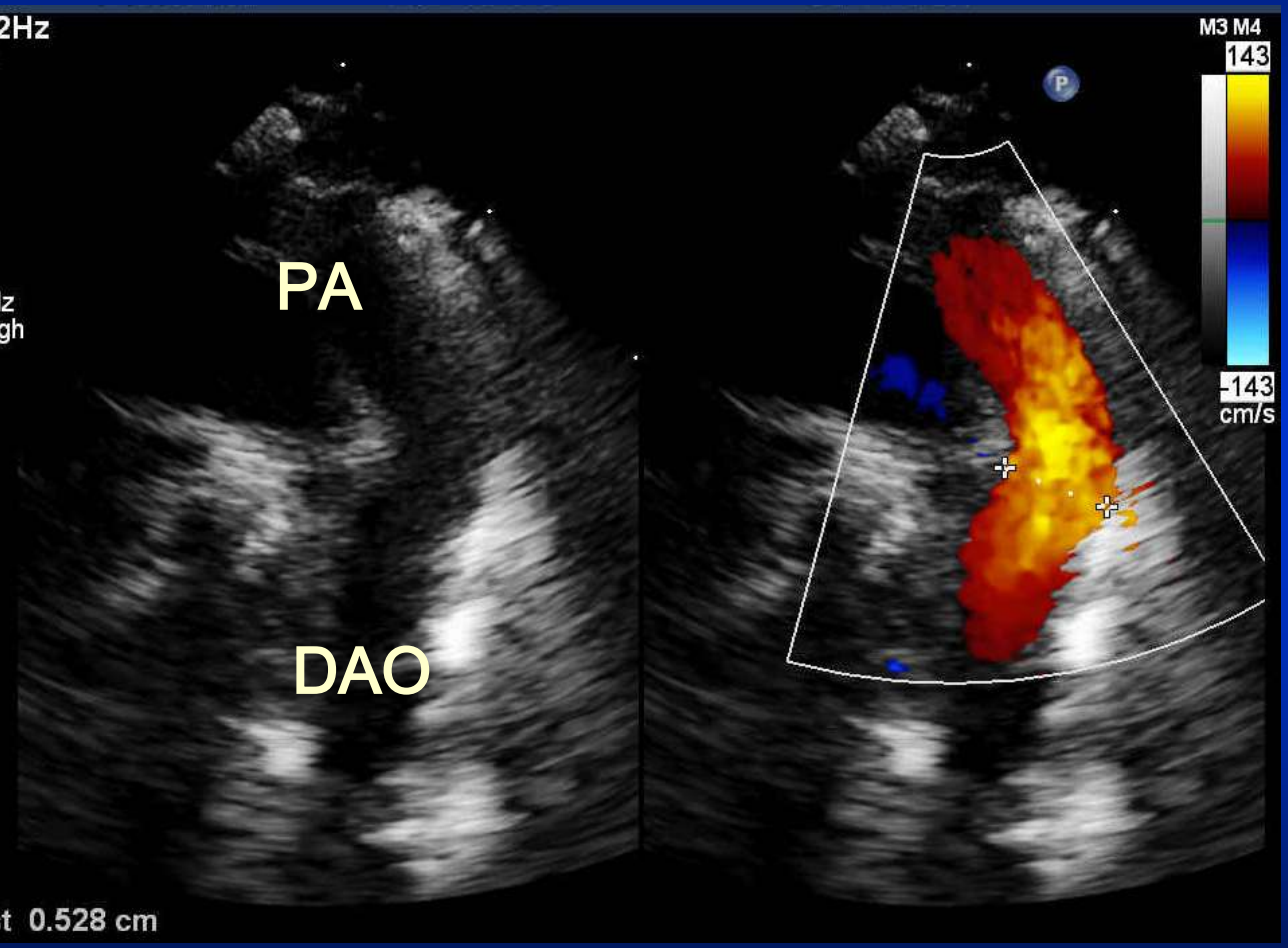
and the weight gained rapidly

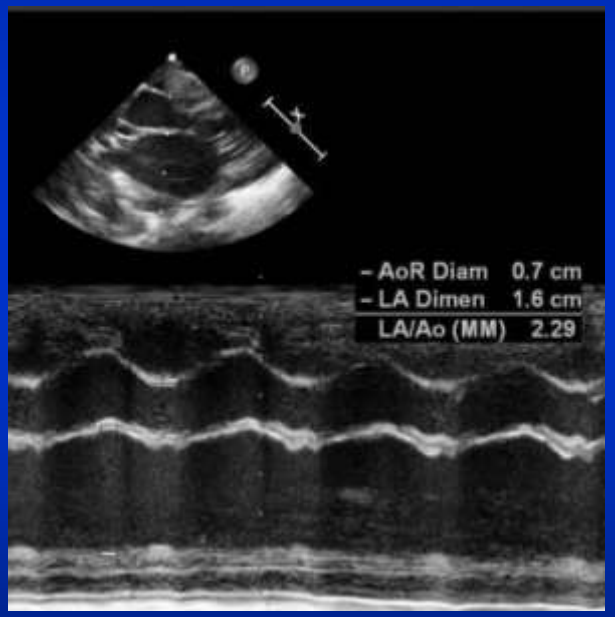
2nd case: 30 d/o female neonate

- Birth history: GA 30 2/7 wks, BBW 1282 g
- Congestive heart failure and failure to thrive



Echo: large PDA 5.3 mm
despite of two courses of Ibuprofen

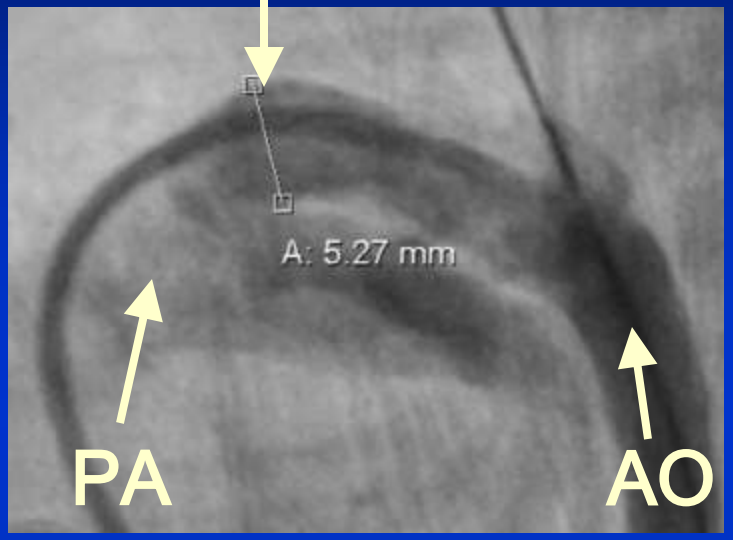




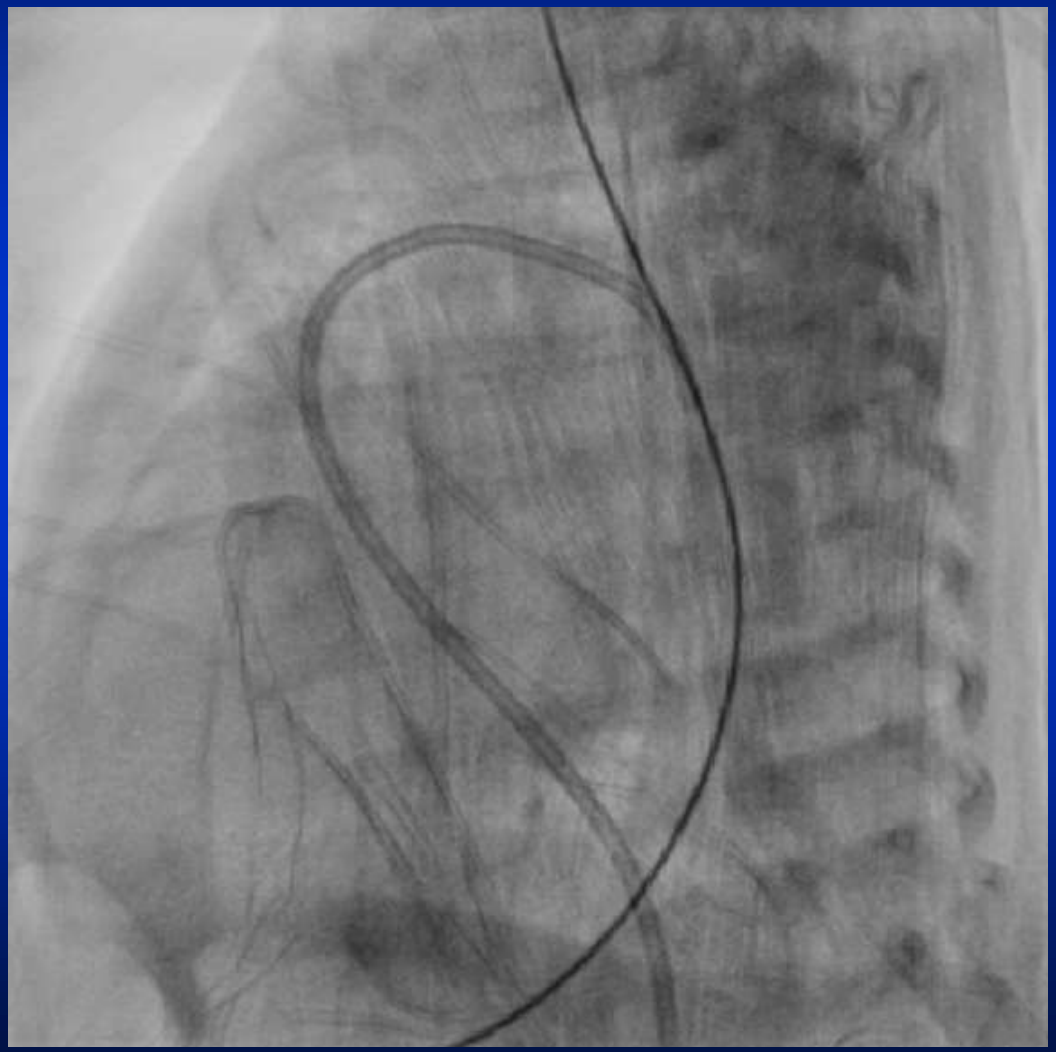
LA/AO 2.29

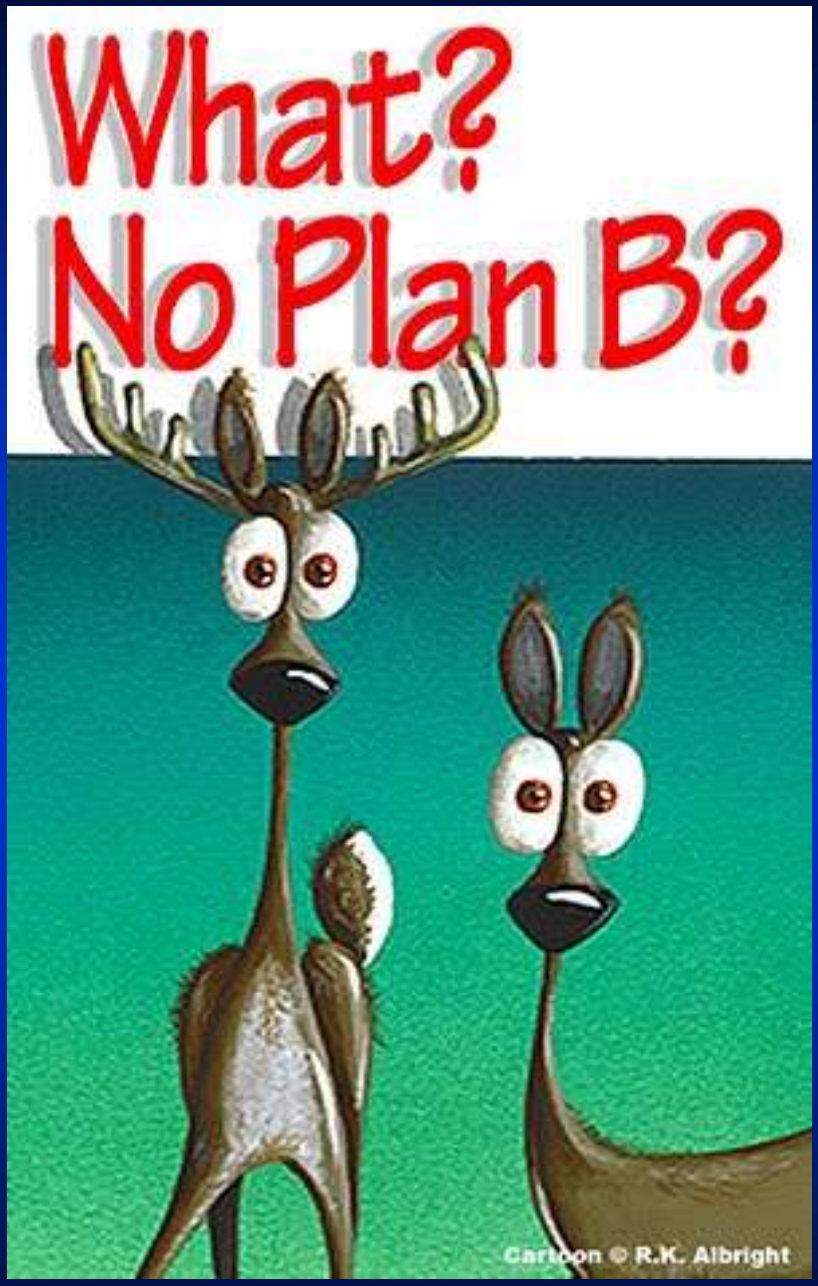
Cardiac catheterization at 30 d/o、BW 1350 g

PDA 5.3 mm diameter
18 mm long



4F JR catheter antegradely

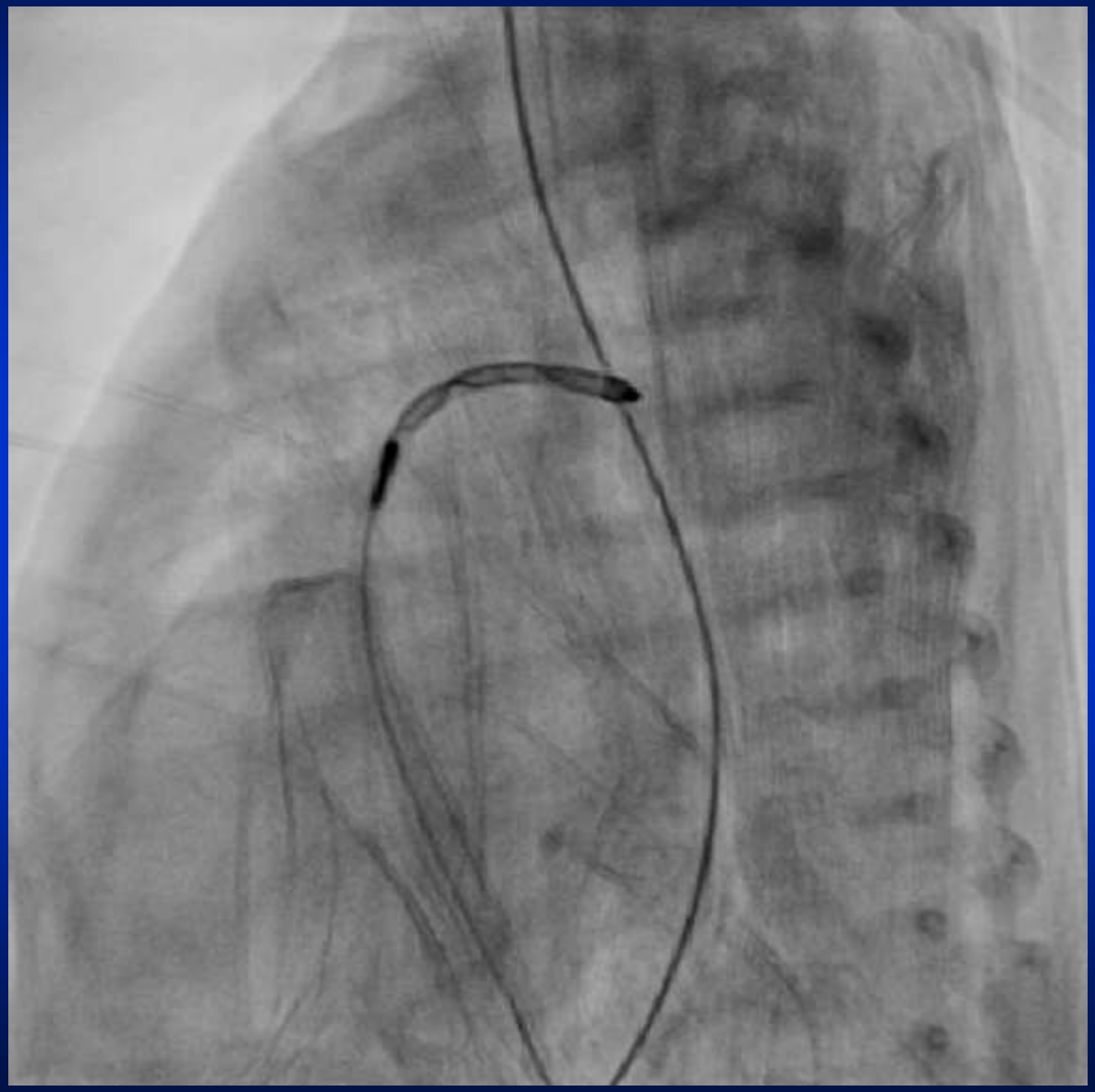



What?
No Plan B?
Cartoon © R.K. Albright

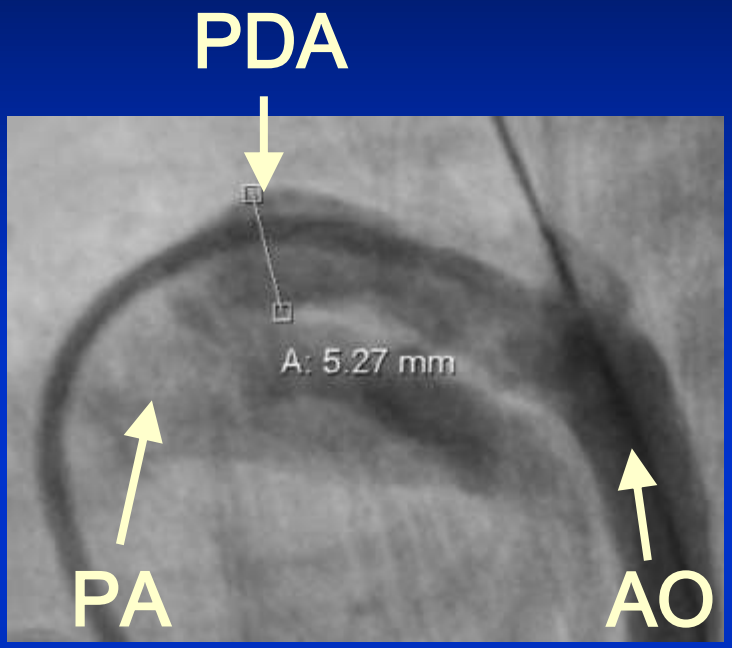
I need bigger device with small delivery profile!

Amplatzer vascular plug II (6 mm)

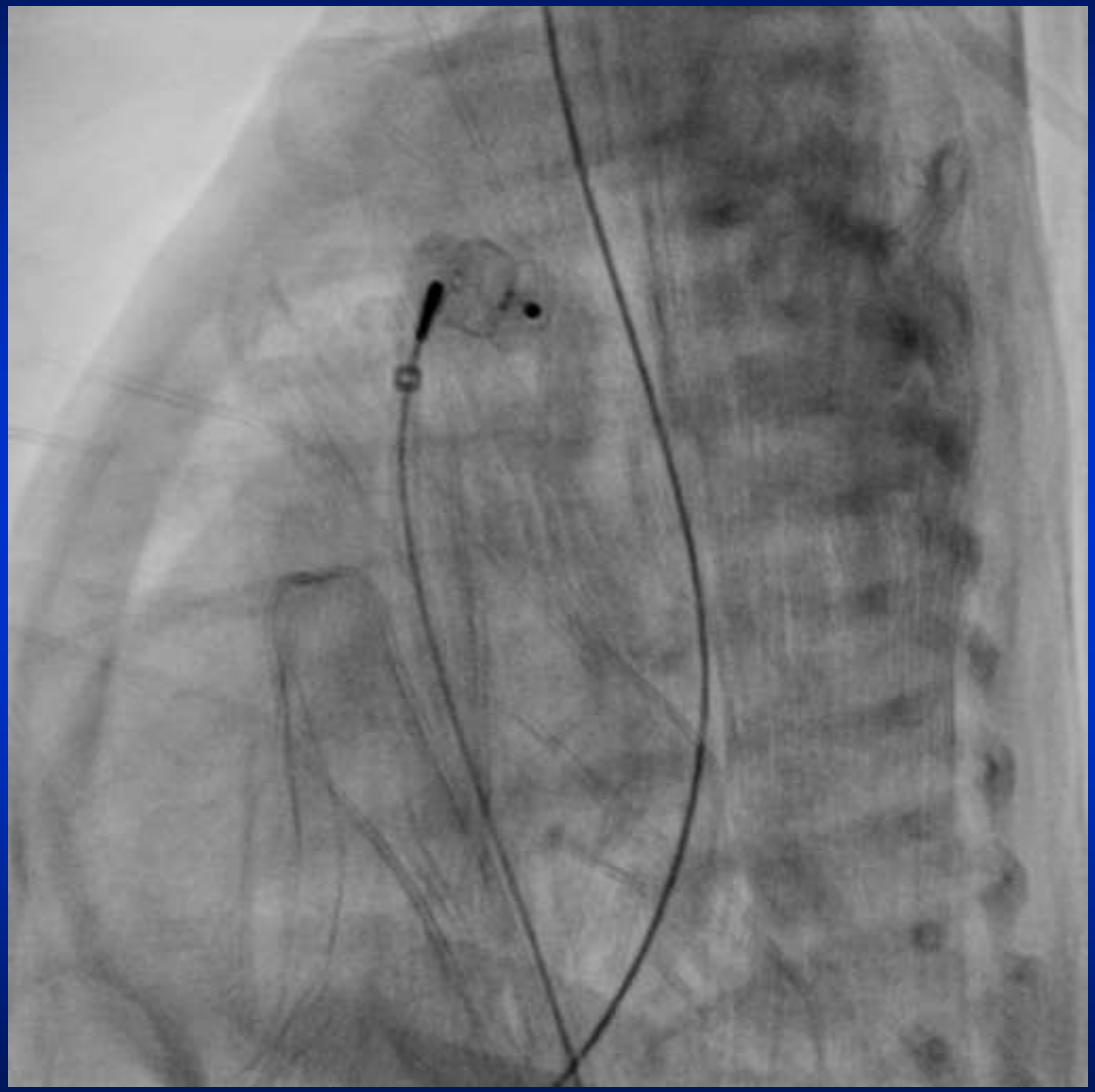
5F
delivery
catheter



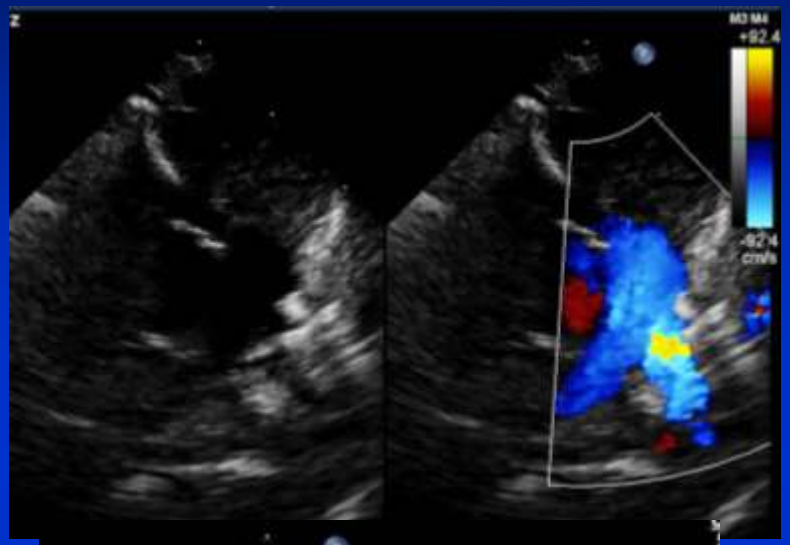
Before

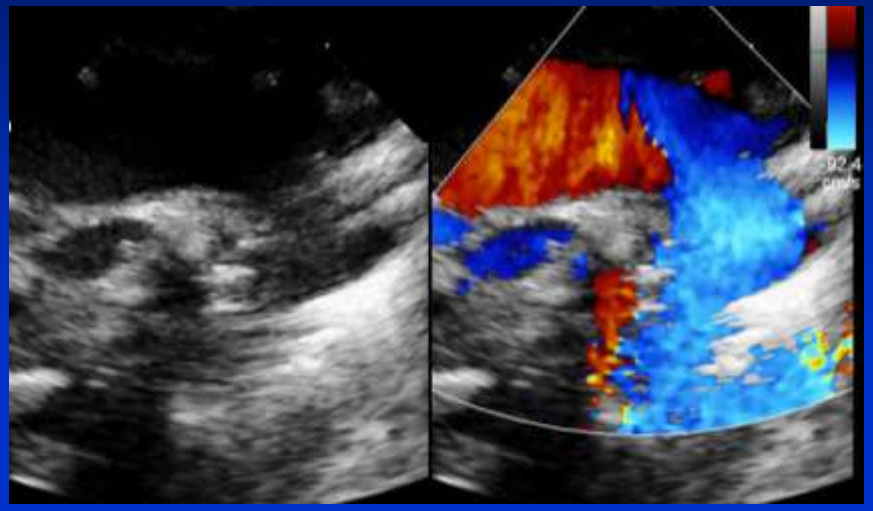


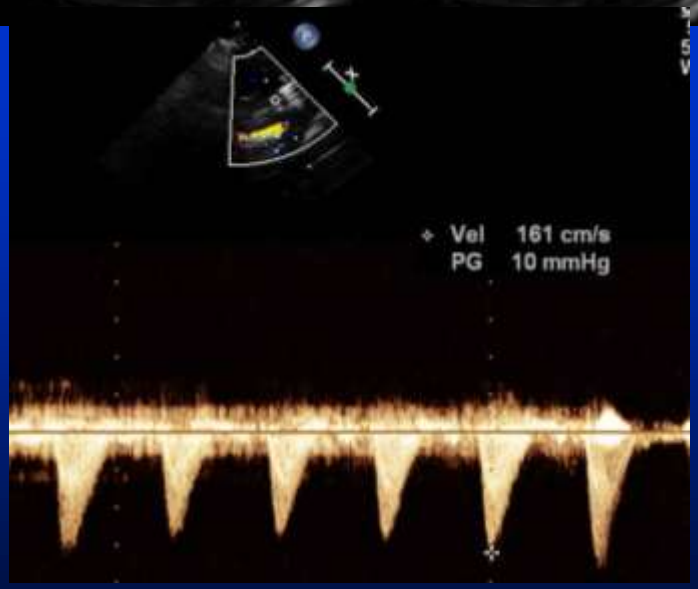
After

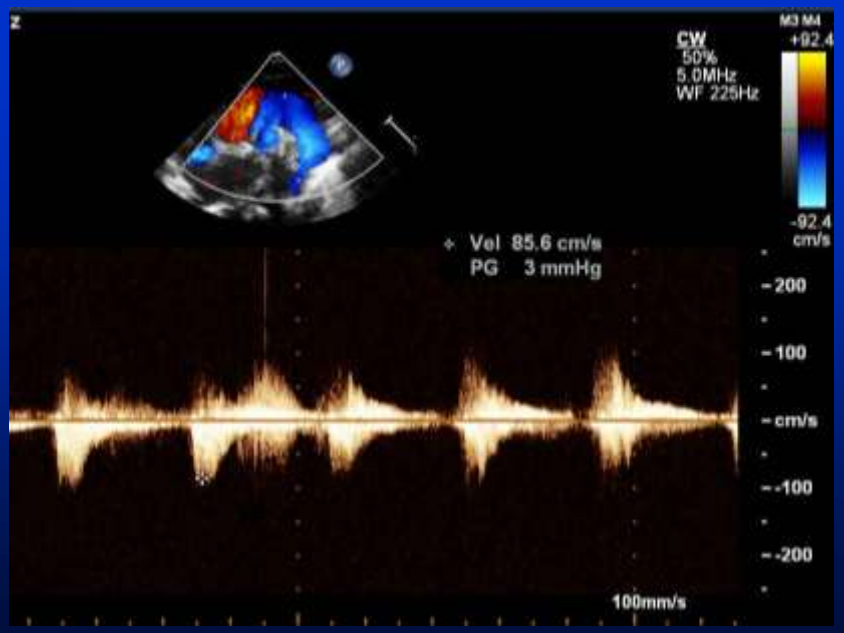


Echo: no residual ductal shunt, absence of aortic or pulmonary obstruction



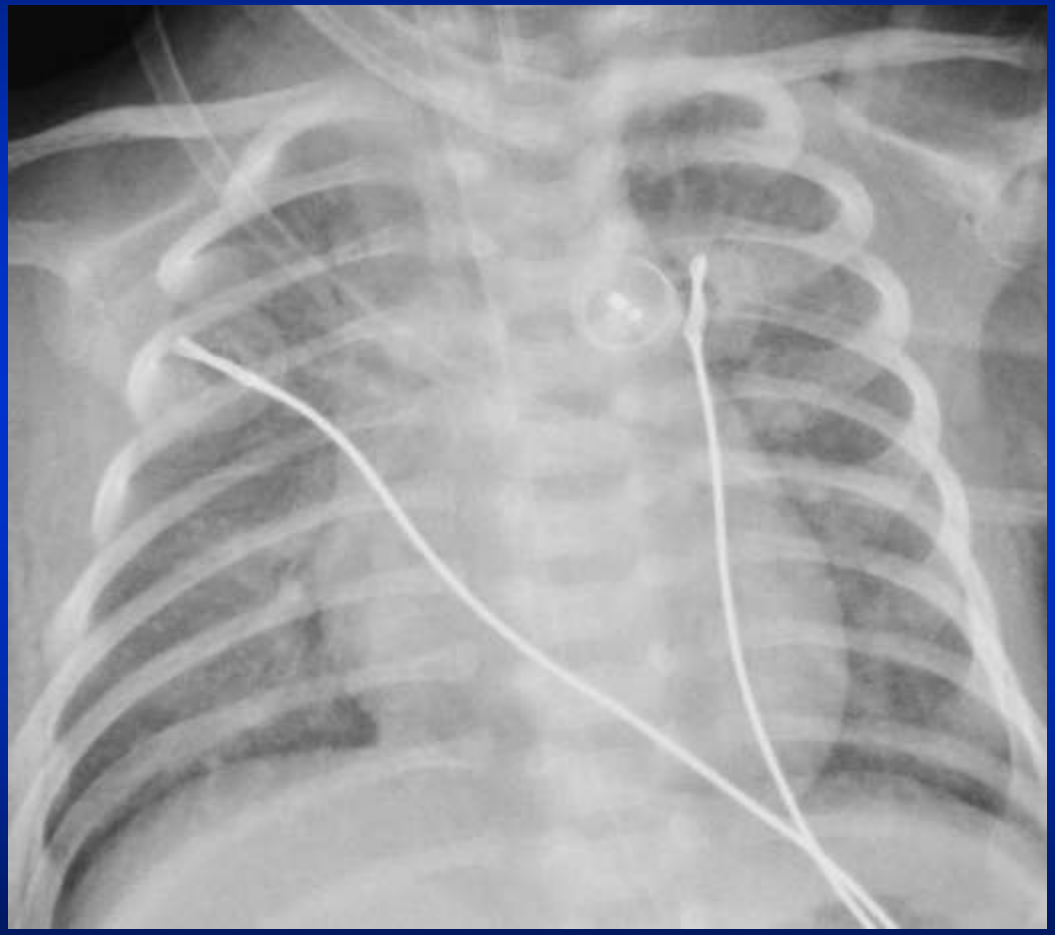






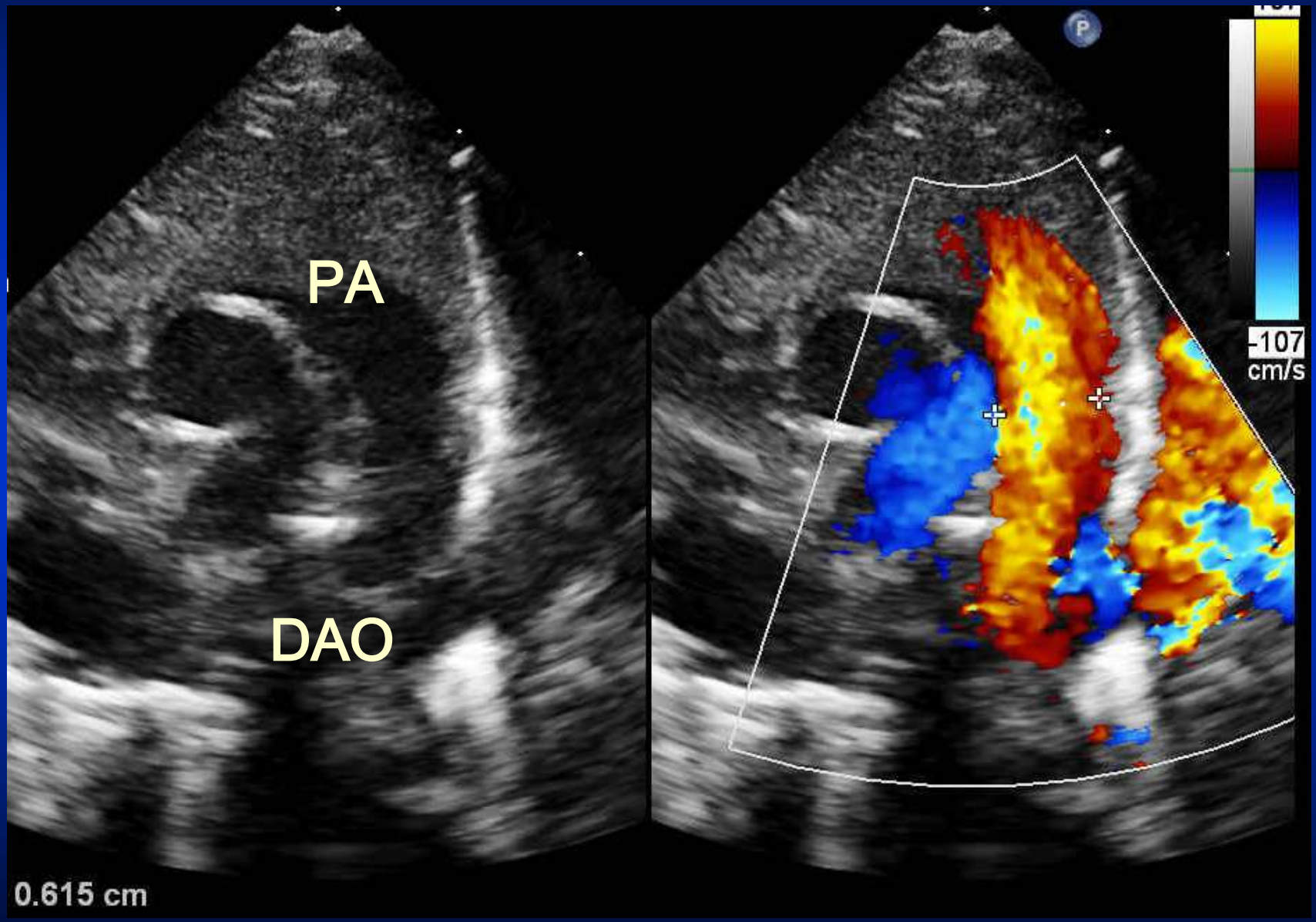
Weight gained up to 2295 g and was discharged

3rd case: 23 d/o 1990 g female neonate



- Birth History: twin A, GA: 35 wks, BBW 1946 g
- Congestive heart failure

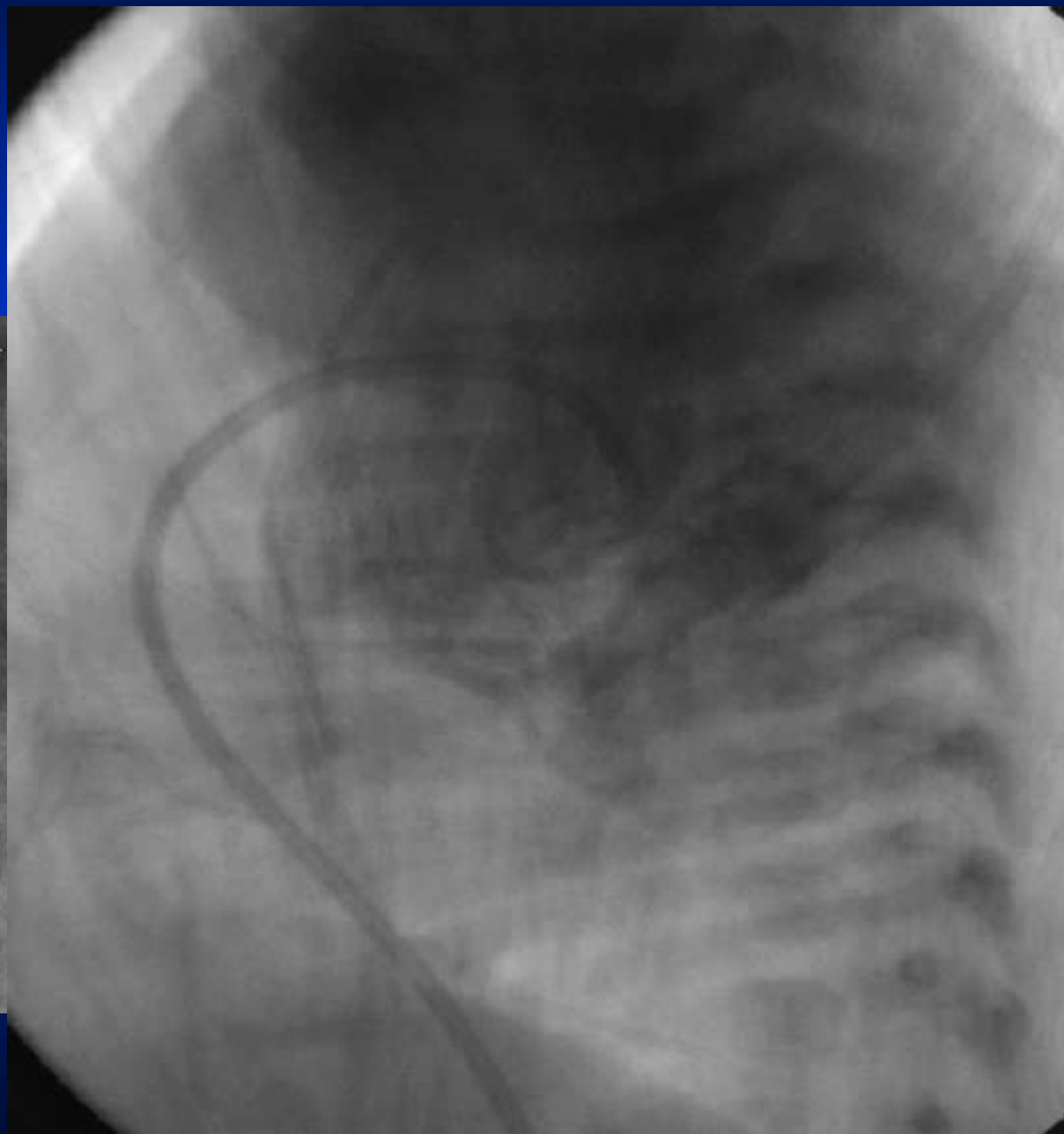
Echo: large PDA 6.2 mm



Aortogram

PDA
5.9 mm in diameter
15 mm long

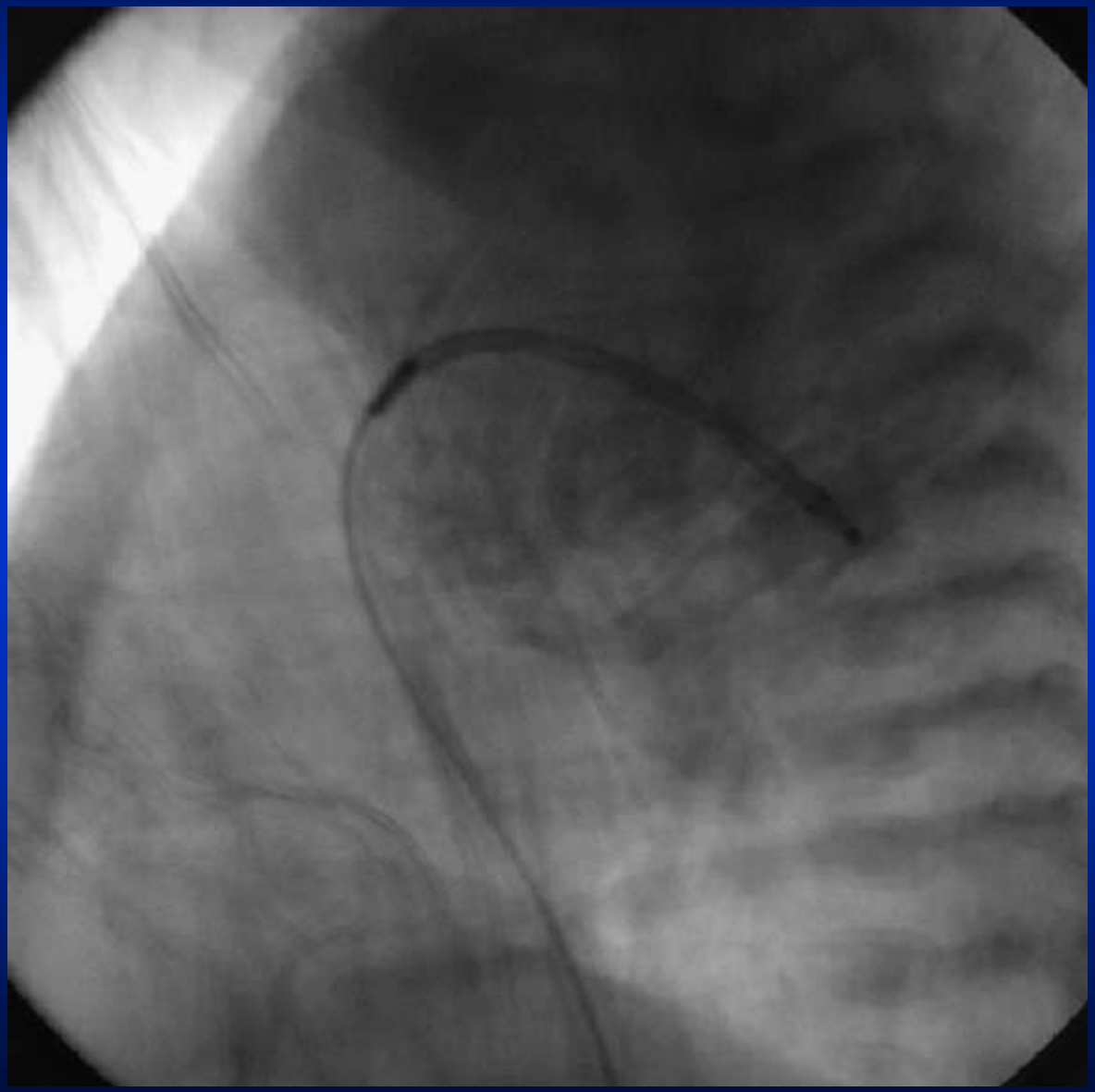
4F JR catheter antegradely



Vascular plug II (8 mm)

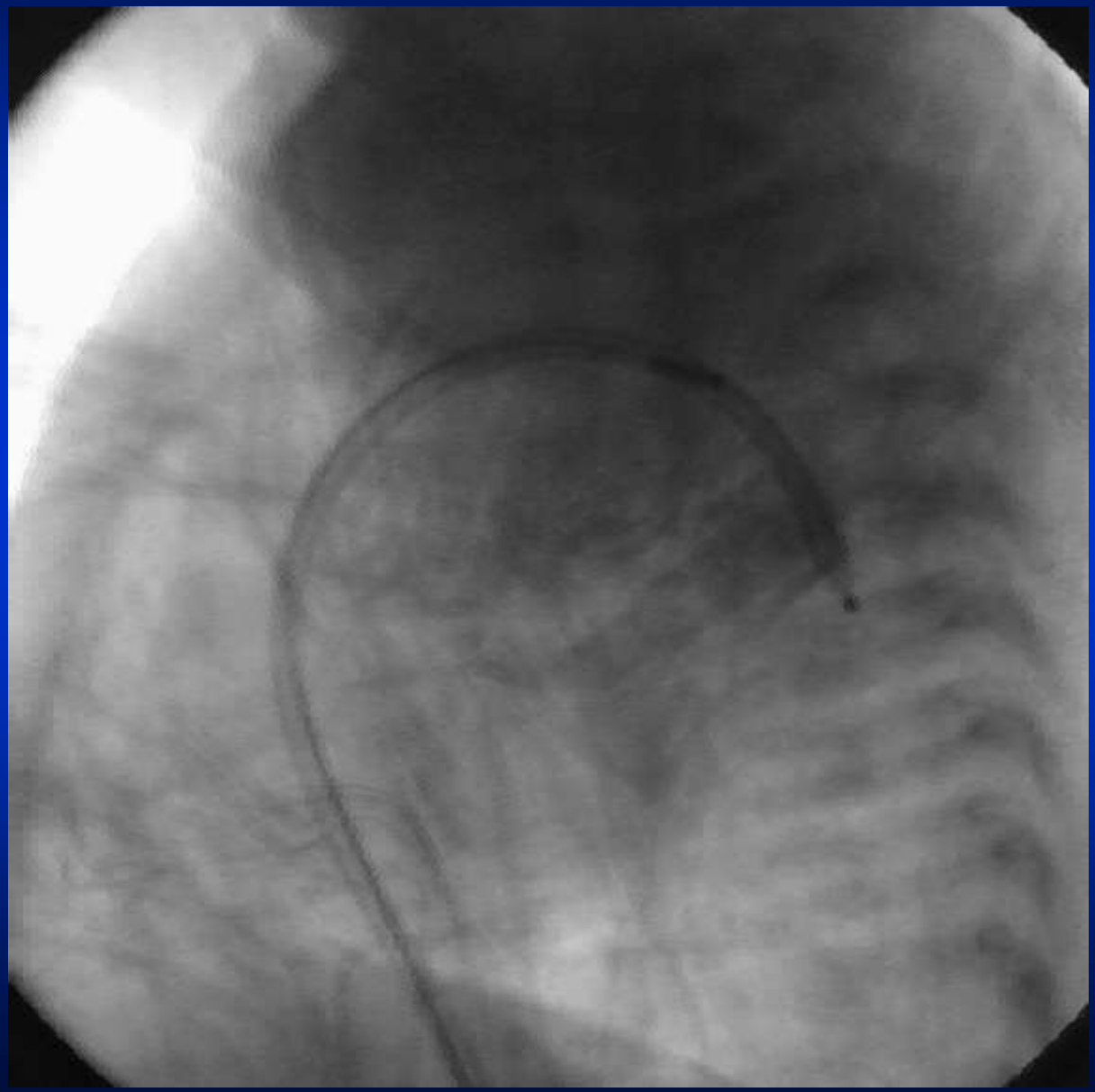
- 5F delivery catheter

Failed due to protrusion to PA



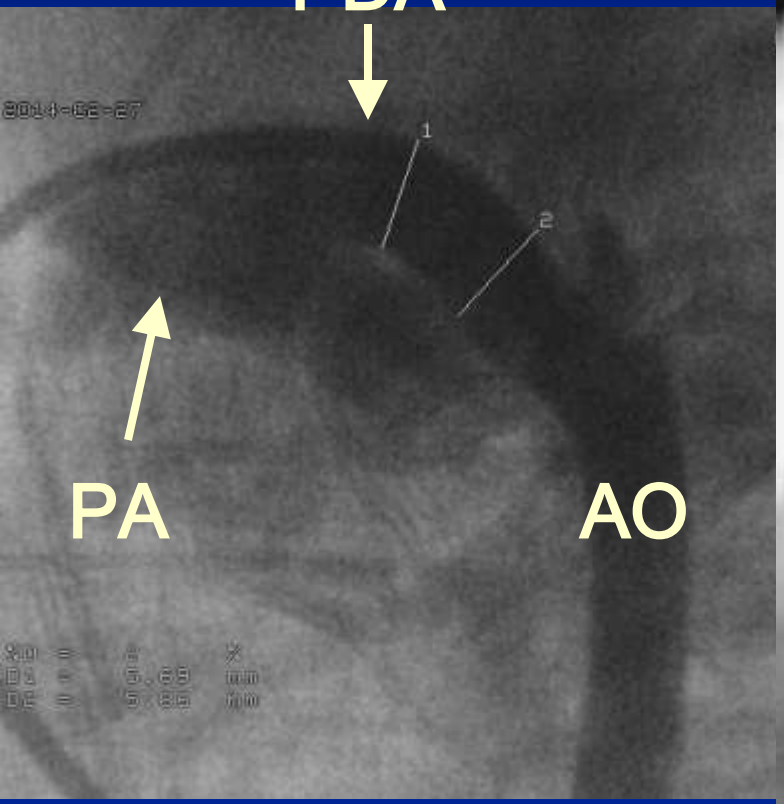
Vascular plug I (8 mm)

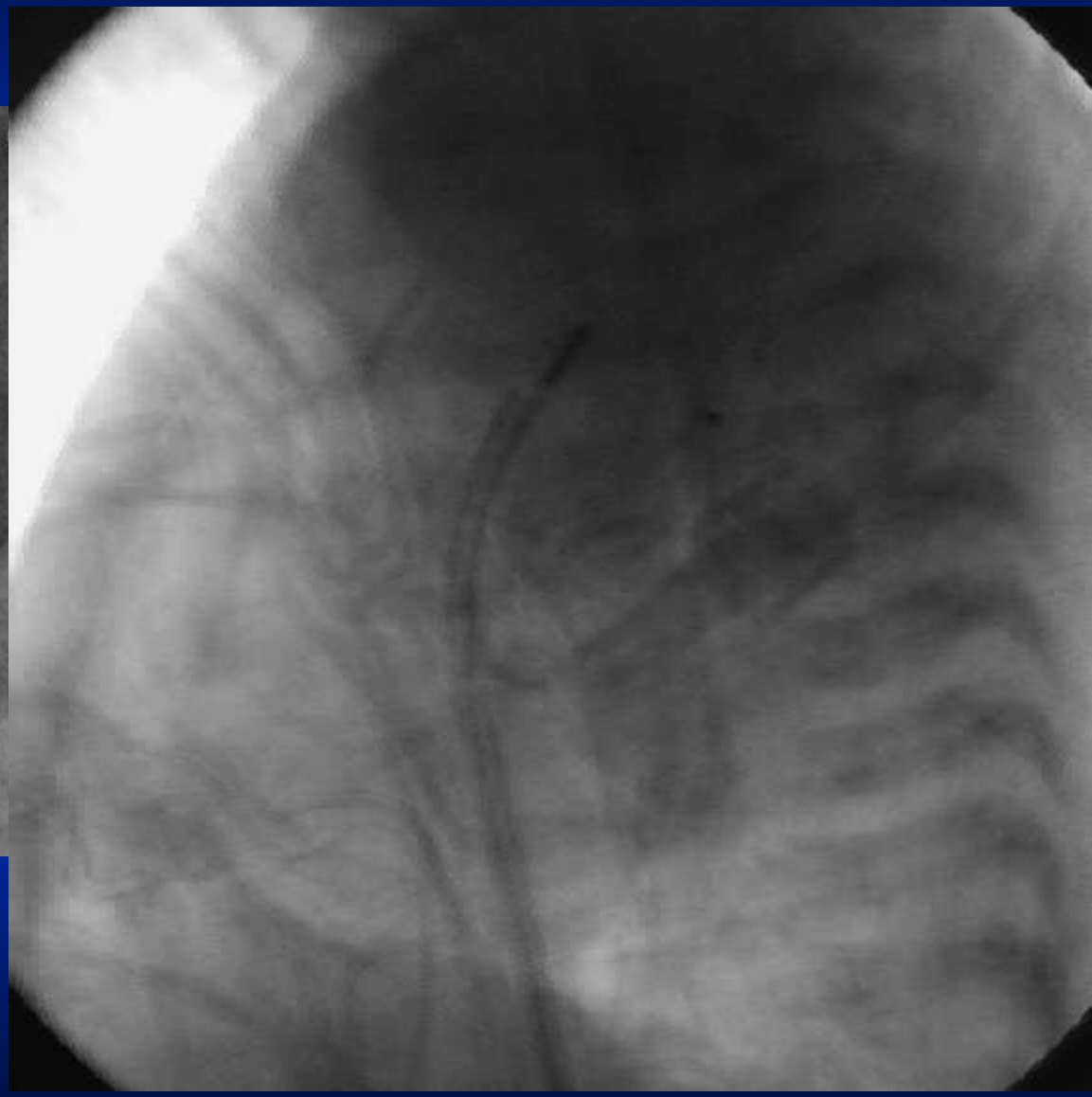
- 5F delivery catheter



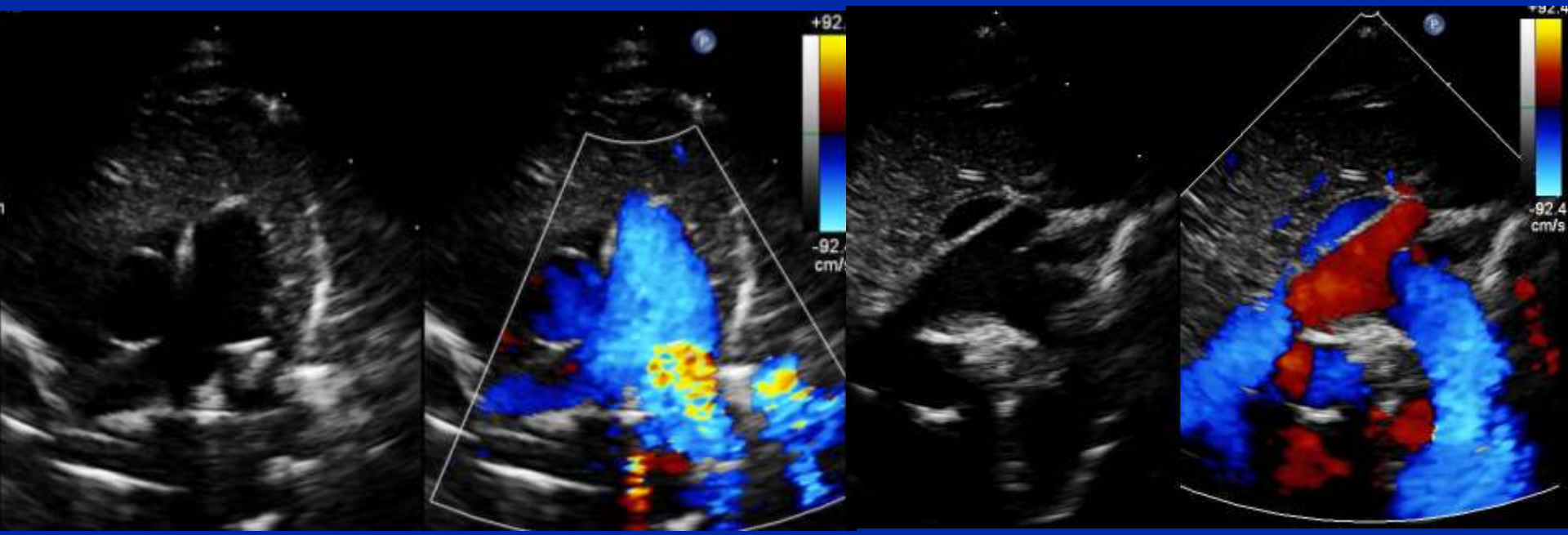
Before

After



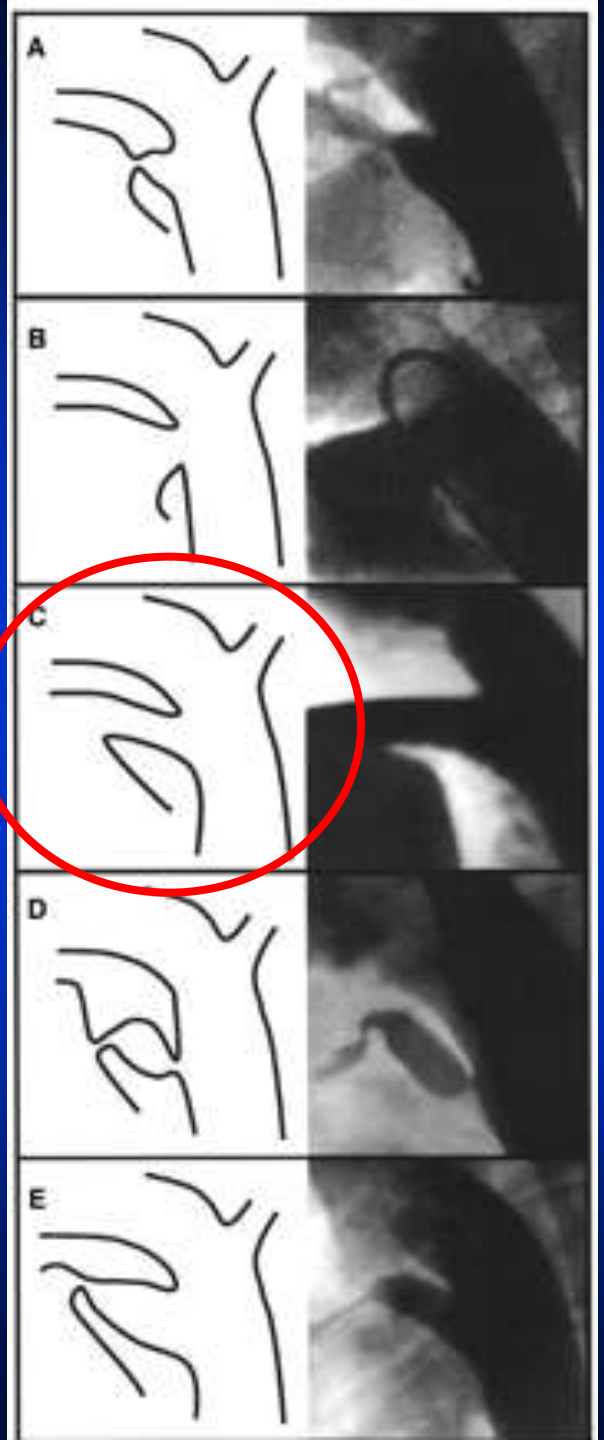


Echo one month later: no residual ductal shunt, absence of aortic or pulmonary obstruction



Case Summary

Case	Age (d)	Weight (g)	PDA diameter (mm)	PDA length (mm)	Device	Device Size (mm)
1	22	1610	4.3	9	ADOIIAS	5 x 6
2	30	1350	5.3	18	VPII	6
3	23	1990	5.9	15	VPI	8



Discussion

- A: Conical type
- B: Window type
- C: Tubular type
- D: Complex: multuple constriction sites
- E: Elongated type

Closure of Patent Ductus Arteriosus in Children, Small Infants, and Premature Babies with Amplatzer Duct Occluder II Additional Sizes: Multicenter Study

Metin Sungur,[1*] MD, Cemsit Karakurt,[2] MD,
Nazan Ozbarlas,[3] MD, and Osman Baspinar,[4] MD

Objectives: To evaluate safety and efficacy of closure of patent ductus arteriosus (PDA) with Amplatzer duct occluder II Additional Sizes (ADO II AS) and to report early and midterm results of the device in children and very young symptomatic infants. Methods: Retrospective analysis of angiographic data of 60 children from four pediatric cardiology centers. Results: The median patient age and weight were 6.5 (0.5–168) months and 6.8 (1.19–57) kg, respectively. In the study, 26 children had a body weight of ≤6 kg. Of these 26 children, 9 had a body weight of ≤3 kg. The median narrowest diameter of PDA was 2 (1.2–4) mm. Ductal anatomy was Type A in 29, Type B in 2, Type C in 11, Type D in 1, and Type E in 16 patients, and a residual PDA after surgery in 1 patient. Closure with ADO II AS was achieved in 58 (96.6%) of 60 attempted cases. In two infants, the device was not released because of significant residual shunt. ADO II was used in one, and the other was sent to surgery. Complete closure was observed in all ADO II AS deployed children by the next day on echocardiography. Median follow-up was 12 (1–18) months. Neither death nor any major complications occurred. Conclusions: Our study shows that closure of medium and small sized PDA by using ADO II AS device is effective and safe in children. The use of the device will expand the field of application of PDA closure in small infants.

TABLE I. Clinical Characteristics and Angiographic Data of the Patients Less Than or Equal to 6 kg

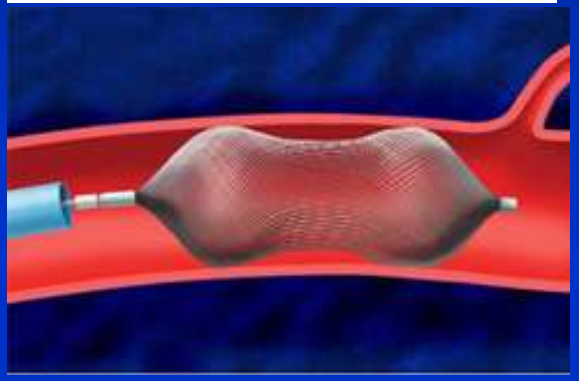
Pt. No	Sex	Age (Mo)	Weight (kg)	PDA type	Ductal measurements (mm)			Aortic diameter opposite PDA (mm)	Device size W × L (mm)	Occlusion at angiography	Closure side	FU (Mo)
					Min	L	A					
1	F	3.5	4.4	E	3.2	5	7	5.3	5 × 4[a]	Complete	Venous	12
2	F	7	4	A	1.5	4.1	3.9	4.6	3 × 2[b]	Complete	Arterial	18
3	F	3	4.1	C	4	4	4.3	5.57	5 × 2[b]	Complete	Arterial	12
4	F	2	4.4	A	1.6	4.2	2.3	5.08	3 × 2[b]	Complete	Venous	12
5	F	4	4.4	A	1.45	3.65	1.67	4.25	4 × 2[a]	Complete	Venous	12
6	F	4	5.3	C	3.8	4.3	5.8	4.7	ADO II	Complete	Arterial	-
7	F	1.5	1.9	C	2.2	4.1	4.7	4.2	4 × 2[b]	Complete	Venous	12
8	M	0.5	1.19	C	2.35	4.3	NS	3.69	4 × 2[a]	Minimal	Venous	6
9	F	4	4.2	C	2.5	12.45	6.54	6.81	5 × 4[b]	Complete	Venous	6
10	F	1	3.2	A	1.4	4.36	6.4	3.87	4 × 2[a]	Complete	Venous	6
11	F	3	2.39	A	2.3	5	NS	5.68	3 × 4[b]	Complete	Venous	6
12	M	0.75	1.5	C	3	5.8	NS	3.2	5 × 6[b]	Complete	Venous	6
13	M	1	1.6	C	2.35	7.28	NS	4.17	4 × 6[b]	Complete	Venous	6
14	F	3.5	5.1	A	1.8	4.8	6.68	6.1	4 × 4[a]	Complete	Venous	18
15	F	1.5	1.7	E	1.5	10	6	6	4 × 6[b]	Complete	Venous	18
16	F	7	5.5	A	1.66	4.73	6.8	6.9	3 × 4[b]	Complete	Venous	12
17	F	2	2.9	E	2.97	7.54	4.98	5.8	4 × 6[b]	Minimal	Venous	6
18	F	2.5	4.5	B	2.68	4.41	5.62	5.9	5 × 2	Complete	Venous	6
19	F	5.5	5.5	E	1.3	7.22	5.47	6.6	3 × 4[b]	Complete	Venous	6
20	F	3.5	3	A	2.28	4.78	5.1	6.9	3 × 4[b]	Moderate	Venous	6
21	F	1.5	4.3	A	1.99	12.99	6.56	5.8	4 × 6[b]	Complete	Arterial	6
22	M	2.5	4.5	A	1.6	5.5	7.2	6.3	3 × 4[a]	Complete	Arterial	6
23	F	3	3.6	E	1.5	7	3.5	5.4	3 × 6[a]	Complete	Venous	12
24	F	2	2.2	C	3	5.5	5	5.1	5 × 4	Surgery	Venous	-
25	F	4	5.5	A	2	5	6	5.9	4 × 6[a]	Complete	Arterial	3
26	F	8	6	A	3.1	9.7	6.2	6.9	5 × 4[b]	Complete	Arterial	1

L: Length; A: Ampulla; W: Waist; NS: Not stated; FU: Follow-up duration.
[a]The aortic disc of the device against the aortic wall.
[b]The aortic disc of the device pulled into ampulla.

Good for PDA < 4 mm

Experience sharing

- Consider PDA as a fistula



- Don’t puncture femoral artery
- Keep baby warm

Protocol to close PDA in premature babies

PDA diameter

< 4 mm

> 4 mm

long

short

ADOIIAS

VPII

VPI