

# Shunt résiduel après fermeture percutanée de FOP

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Caen

# Disclosures

- Institutional research grants or congress fees
  - Medtronic
  - Boston Scientific
  - Biosensors
  - Boehringer Ingelheim
  - Terumo

# Détection

- Doppler ETT/ETO: faux négatifs++
- Test aux bulles
  - ETT: Sensibilité: 68-100%; Spécificité: 93-100%; *Faux négatif 30 %*
  - ETO: Sensibilité: 80-100%; Spécificité: 80-99%, *Faux négatif 15-20 %*
    - **Shunt variable en fonction de**
      - Moment du test: post procédure immédiat vs plus tard
      - Conditions de l'examen: au contact de la prothèse, VCI, V Périphérique,
      - Valsalva et sa qualité

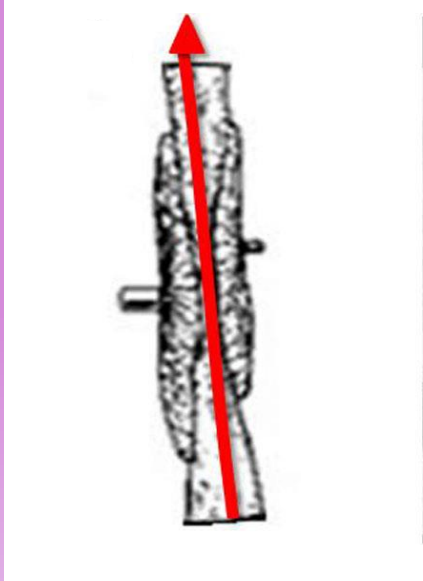
	minime	moyen	important
Braun	3-10	10-20	>20
Windecker	1-5	6-20	>20
Saver	3-10	10-30	>30

Grading of right-to-left interatrial shunts using bubble contrast transthoracic echocardiography	
Grade 0	Subjective: No bubbles seen in the left atrium Objective: No bubbles seen in the left atrium
Grade 1	Subjective: A few scattered bubbles seen individually within the left atrium Objective: No more than 5 bubbles in one still frame in the left atrium
Grade 2	Subjective: Clusters of bubbles seen in left atrium Objective: 5-25 bubbles in one still frame in the left atrium
Grade 3	Subjective: Clouds of bubbles seen in left atrium, without complete opacification Objective: >25 bubbles in one still frame in left atrium but still countable
Grade 4	Subjective: Complete opacification of left heart chamber (LA or LV) Objective: Bubble contrast confluent throughout chamber
Grade 5	Subjective: Complete opacification of left heart chamber (LA or LV) at rest Objective: Bubble contrast confluent throughout chamber at rest

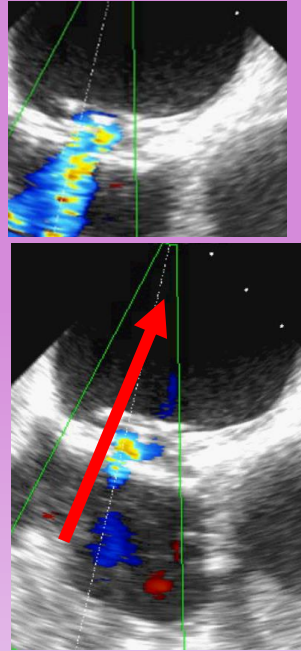
- Doppler trans-cranien
  - Grade 0: pas de hit; Grade I: 1–10 hits; Grade II: >10 hits; Grade III: pluie de hits.
  - Sensibilité: **95-98%**; Spécificité: **90-99%**, *Faux négatif: 0%*
  - Origine du shunt ambiguë
- ***Passage de bulles ≠ passage de thrombus***

# Caractérisation du shunt

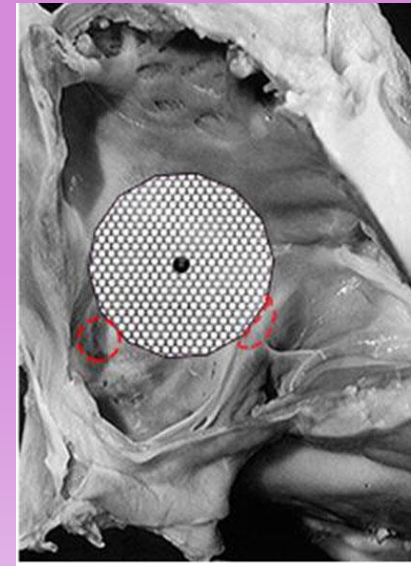
## En rapport avec le FOP



Passage per-prothétique  
Tunnel



Passage per-prothétique  
Perforation



Passage péri-prothétique

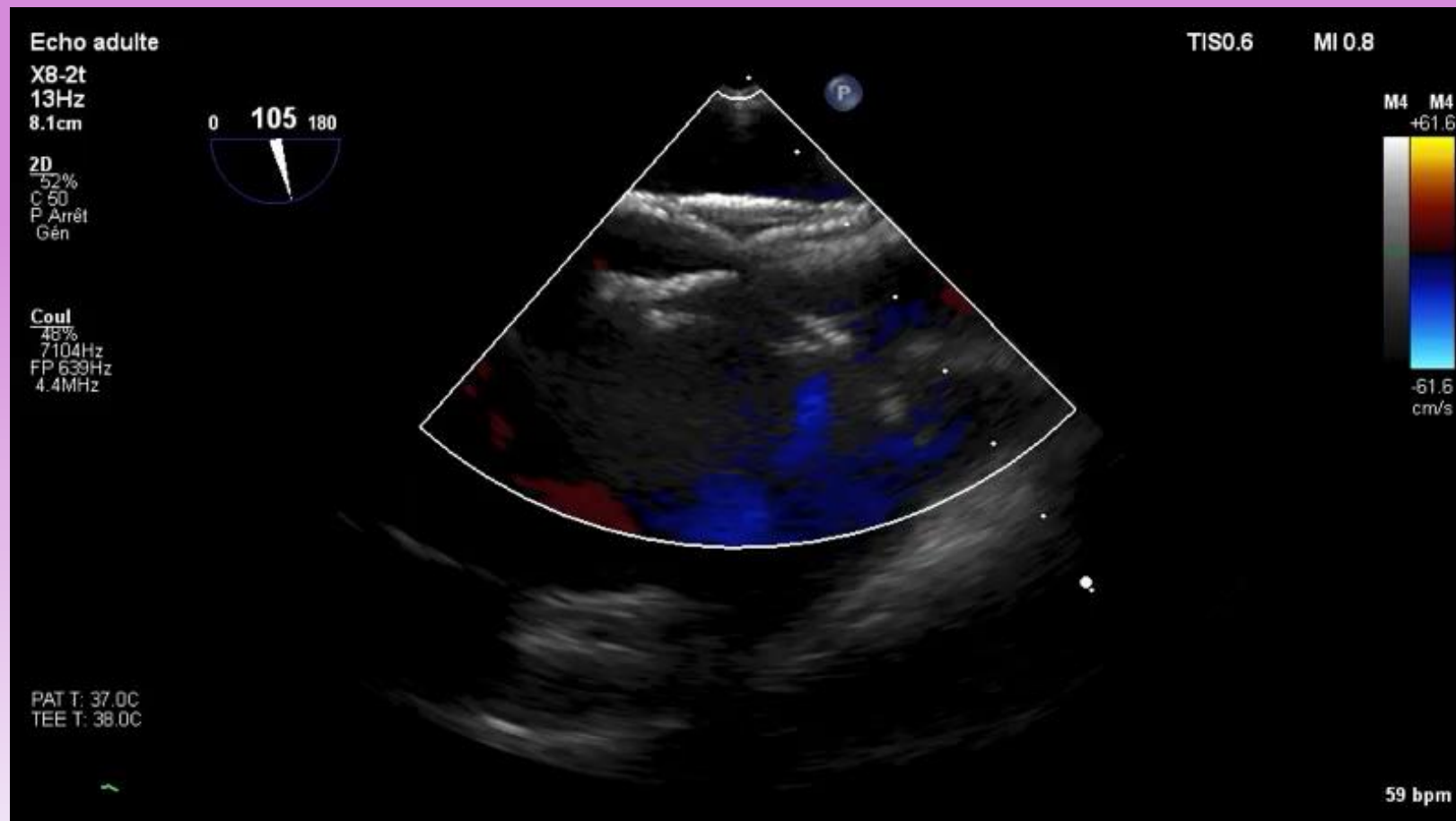
## Sans rapport avec le FOP

CIA, fenestration

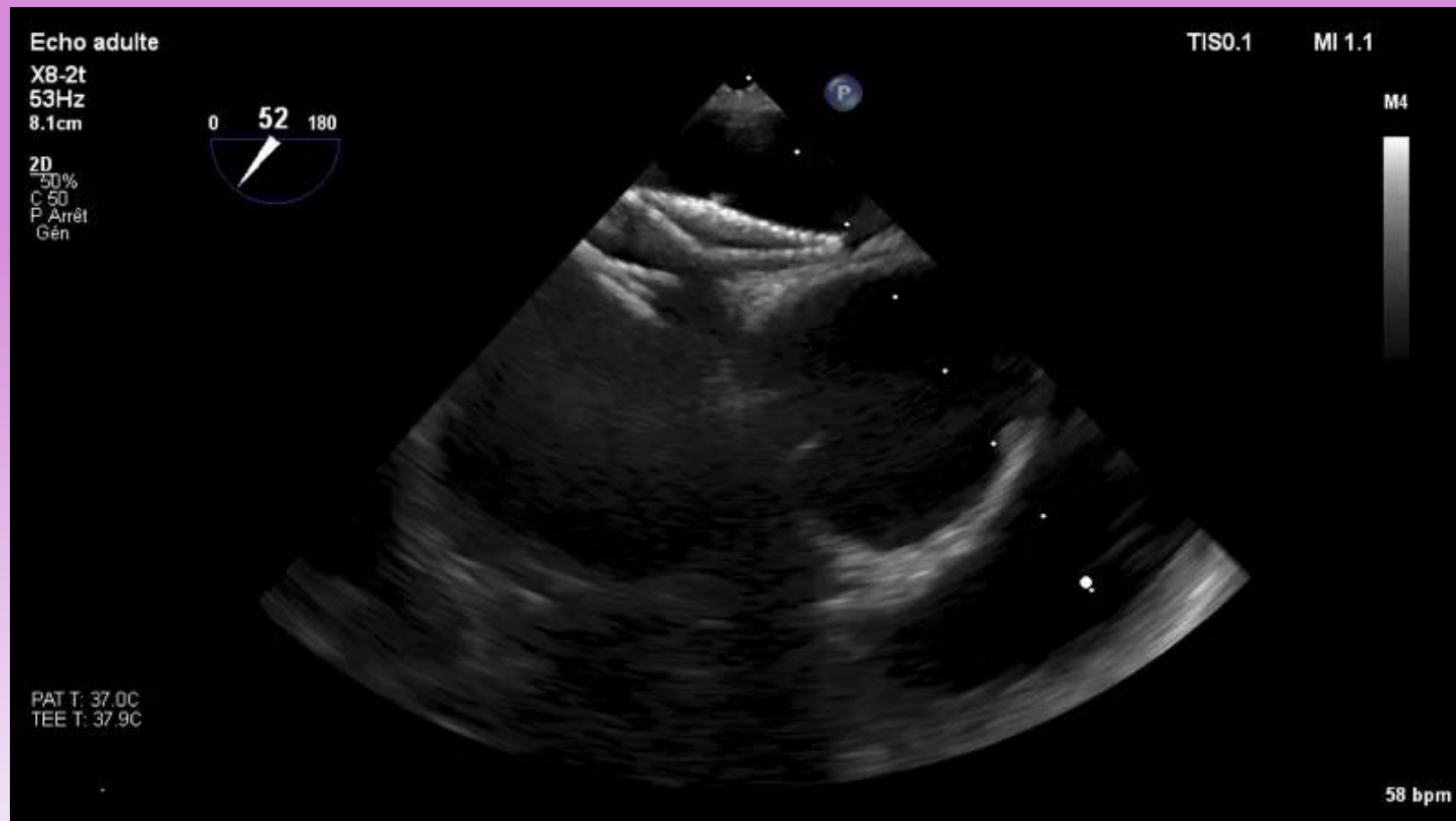
MAVP

VCSG persistante....

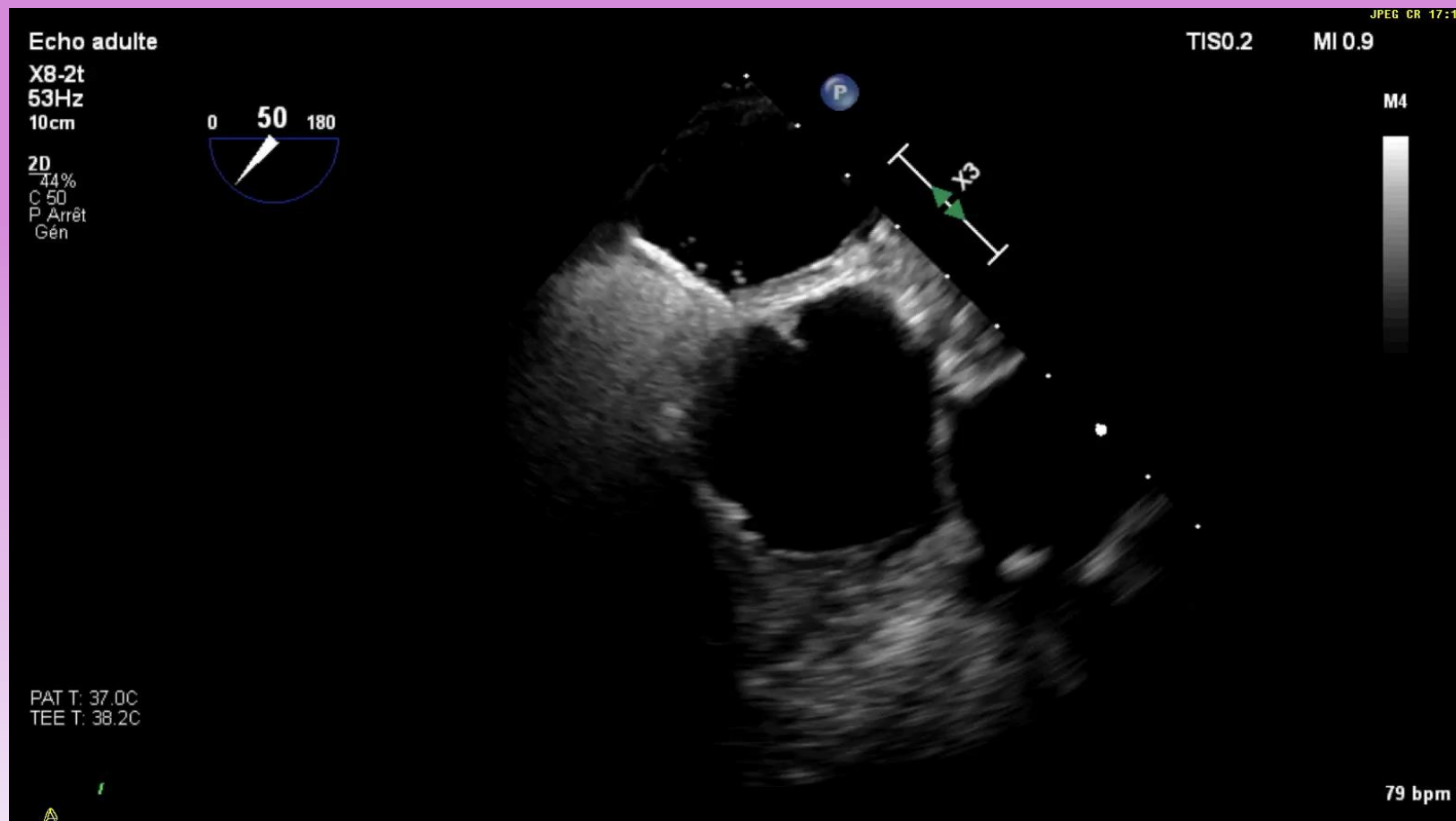
# Shunt résiduel



# Shunt résiduel



# Shunt résiduel

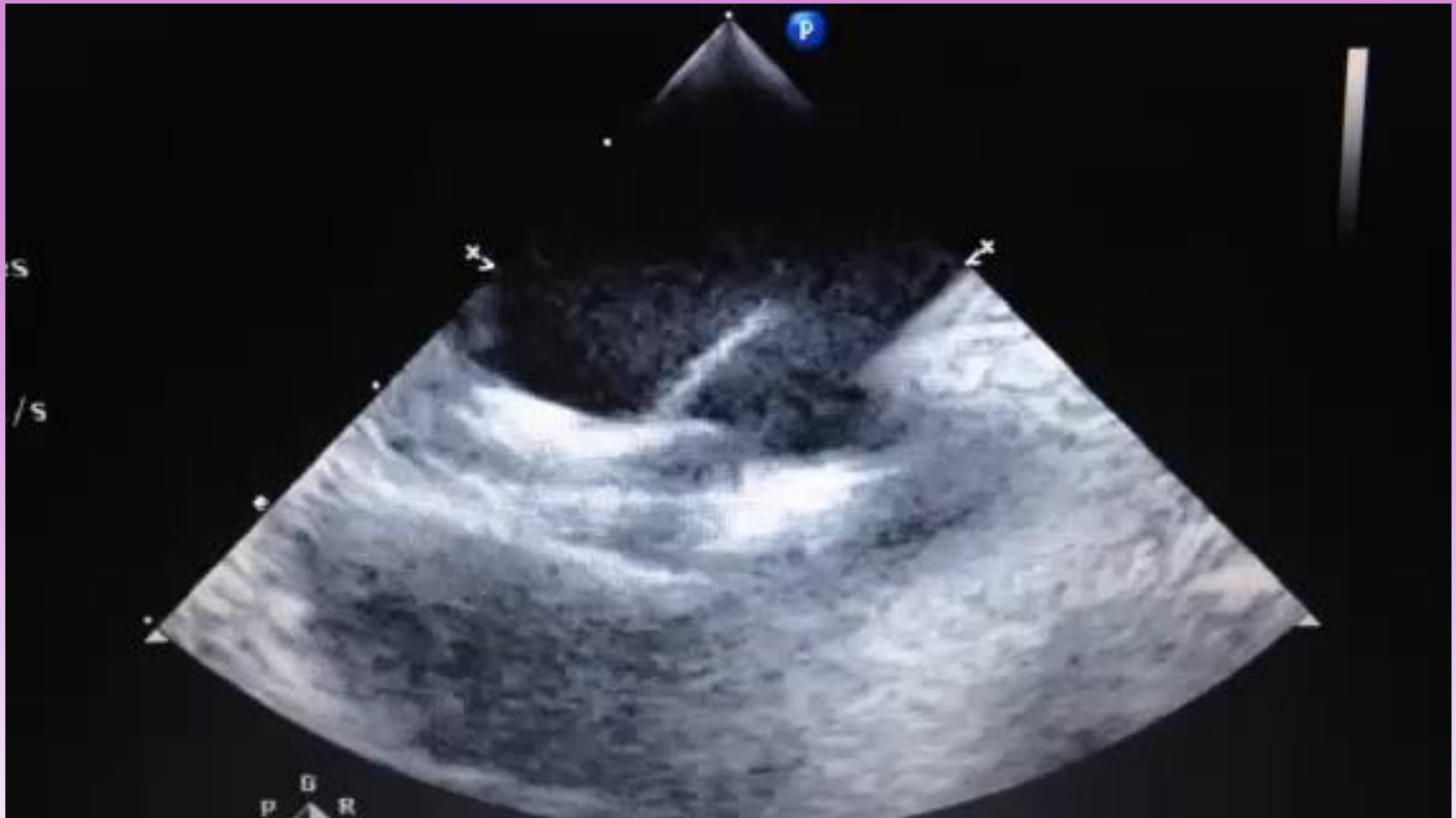


# Shunt résiduel

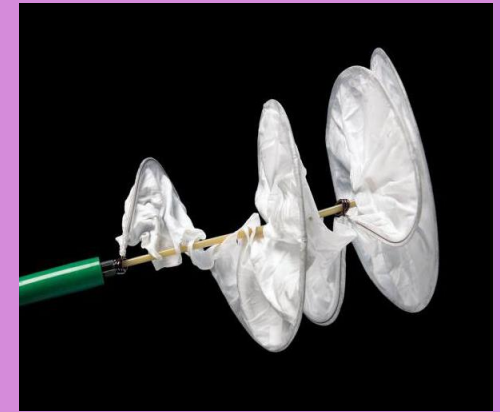




# Shunt résiduel



# Gore septal occluder

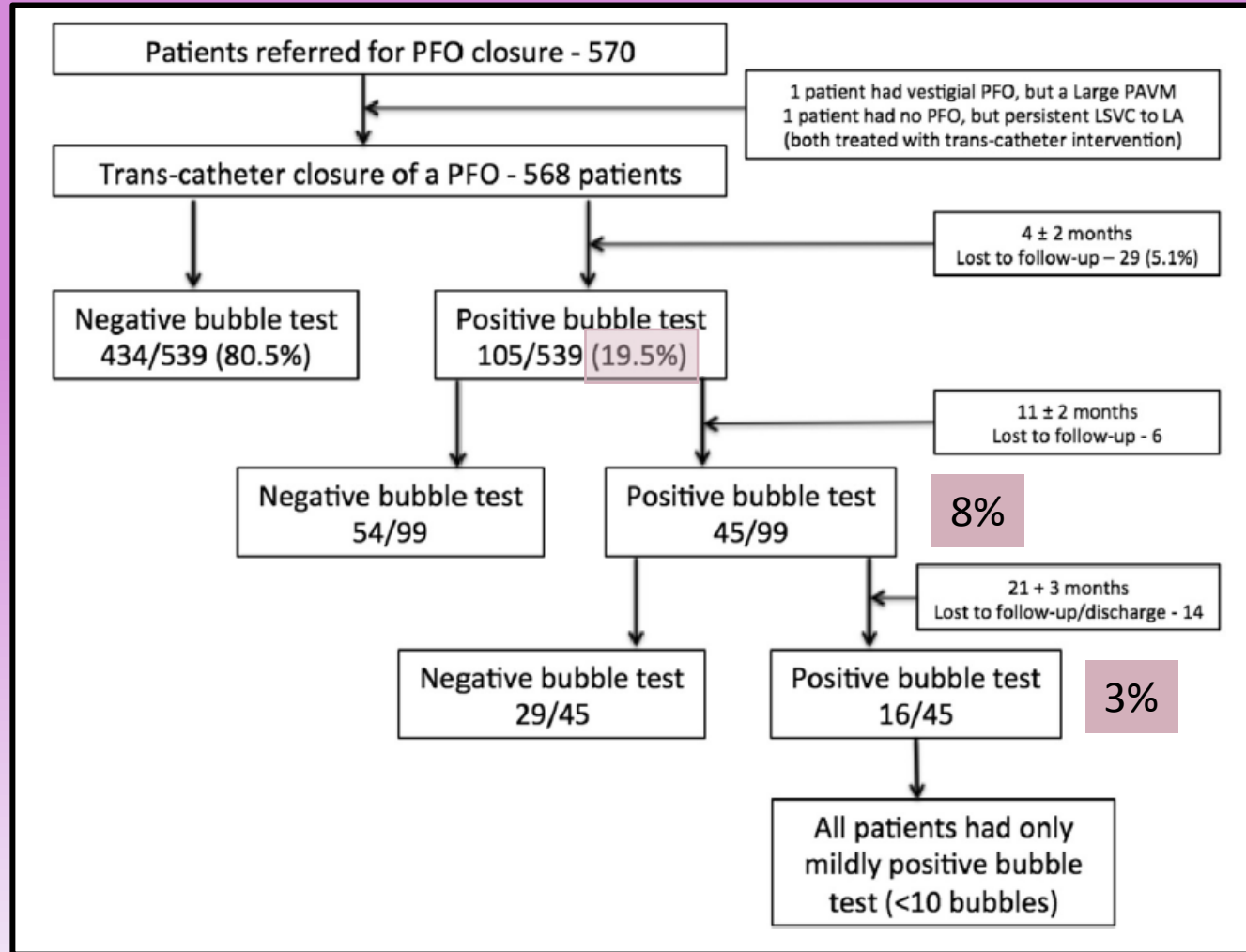


Performance Outcome	GSO n/ N (%)	HELEX n/ N (%)	Total n/ N (%)	P-Value
Technical success <sup>1</sup>	250/253 (98.8%)	158/160 (98.8%)	408/413 (98.8%)	1.0
Complete closure <sup>2</sup>	154/198 (77.8%)	78/109 (71.6%)	232/307 (75.6%)	0.27

<sup>1</sup>proportion of closure group subjects with successful implantation and retention of a study device where study device implant was attempted

<sup>2</sup>12 mo. shunt status of occluded in subjects with retained study device, adjudicated by echo core lab

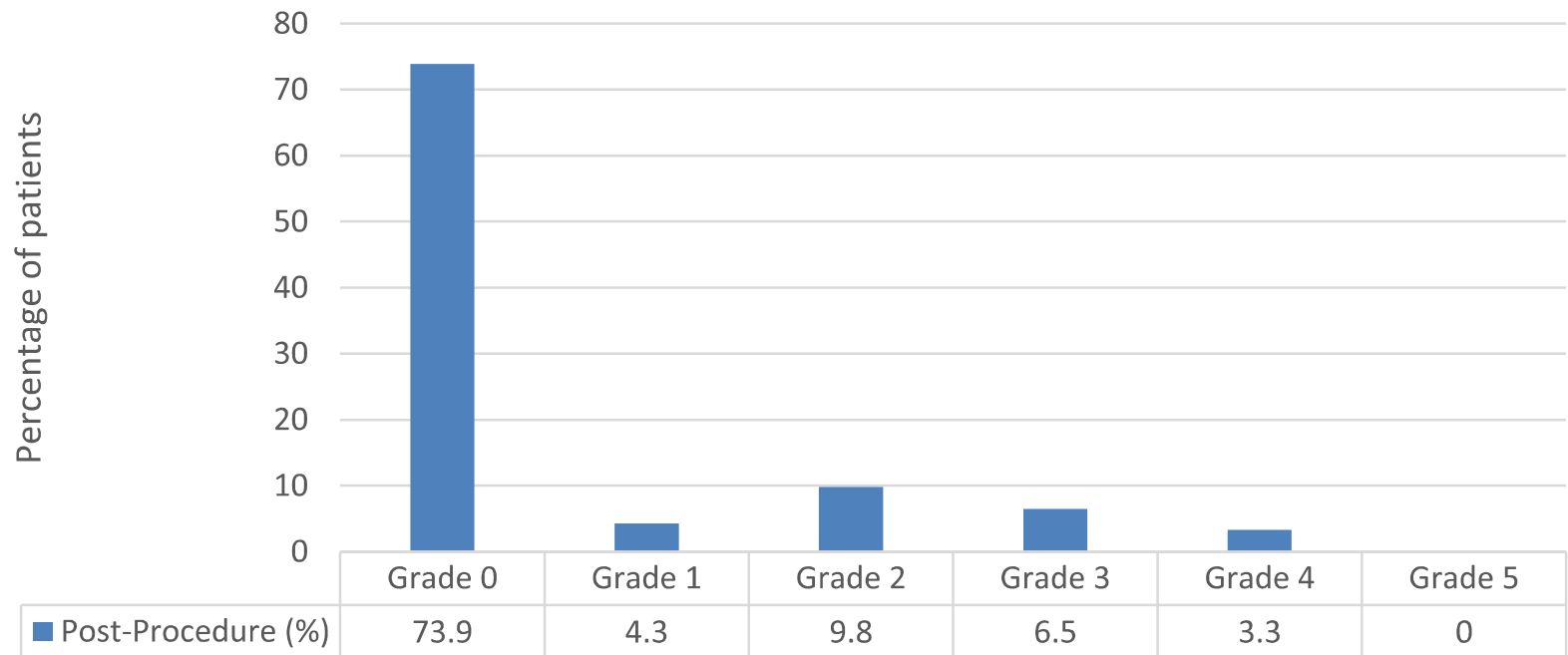
# Amplatzer PFO occluder



# Occlutech Figulla Flex II



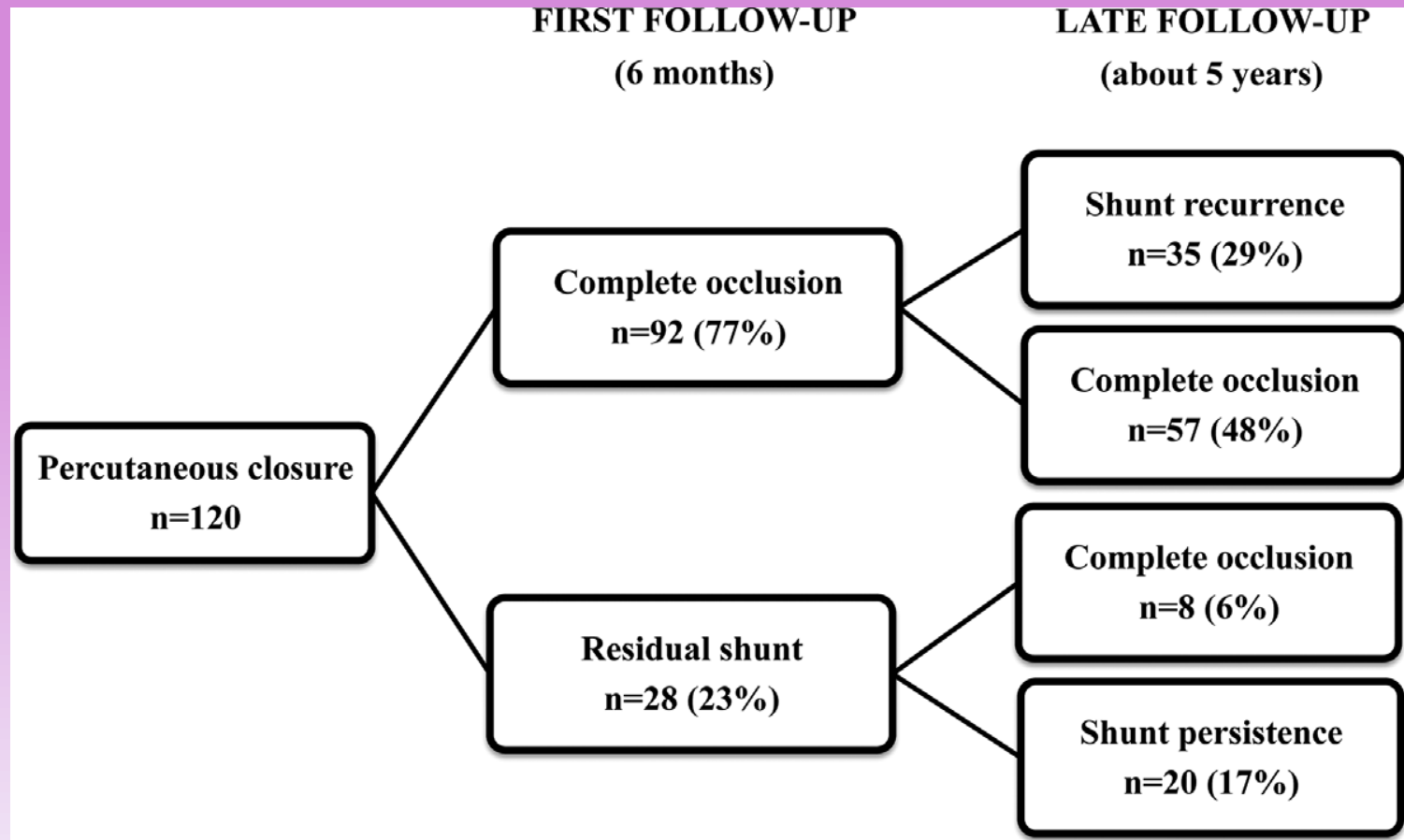
Right to left shunt 6 months post-procedure



Shunt grade by BCTTE

■ Post-Procedure (%)

# Amplatzer PFO



# Shunt résiduel nécessitant une ré-intervention n = 980, suivi moyen 5.9 ans

**Table 3. Serious Adverse Events Related to the Procedure or Device among the 499 Patients in the PFO Closure Group.\***

Serious Adverse Event	Patients with Event	Total No. of Events	Procedure-Related Events	Device-Related Events
	no. (%)		no. (%)	
Allergic drug reaction	1 (0.2)	1	1 (0.2)	0
Atrial fibrillation	2 (0.4)	2	1 (0.2)	1 (0.2)
Atrial flutter	1 (0.2)	1	0	1 (0.2)
Cardiac perforation	1 (0.2)	1	1 (0.2)	0
Cardiac thrombus	2 (0.4)	2	1 (0.2)	1 (0.2)
Chest tightness	1 (0.2)	1	0	1 (0.2)
Deep-vein thrombosis	1 (0.2)	1	1 (0.2)	0
Infective endocarditis	1 (0.2)	1	0	1 (0.2)
Ischemic stroke	2 (0.4)	2	0	2 (0.4)
Pericardial effusion	1 (0.2)	1	1 (0.2)	0
Pericardial tamponade	2 (0.4)	2	2 (0.4)	0
Pulmonary embolism	2 (0.4)	2	0	2 (0.4)
Residual shunt requiring closure	2 (0.4)	2	0	2 (0.4)
Sepsis	1 (0.2)	1	0	1 (0.2)
Nonsustained ventricular tachycardia	1 (0.2)	1	0	1 (0.2)
Major vascular complications				
Bleeding	2 (0.4)	2	2 (0.4)	0
Hematoma	1 (0.2)	1	1 (0.2)	0
Vasovagal reaction	1 (0.2)	1	1 (0.2)	0
Total	21 (4.2)	25	12 (2.4)	13 (2.6)

# Facteurs associés au shunt résiduel

- Anatomie du FOP:
    - Long tunnel
    - FOP excentré
    - FOP large
    - Septum « lipomateux »
    - ASIA
  - Taille des prothèse
  - Shunt résiduel post procédure immédiat
  - Anomalies associées (Fenestrations, VCSGP, MAVP)
  - Prothèse: oui pour la perforation
    - Cardia Ultrasept+++
    - Cardioseal
- [Catheter Cardiovasc Interv.](#) 2017 Mar 1;89(4):E141-E144  
[Am J Cardiol.](#) 2004 Feb 15;93(4):426-31  
[J Interv Cardiol.](#) 2015 Dec;28(6):600-8  
[EuroIntervention](#) 2013;9:382-388

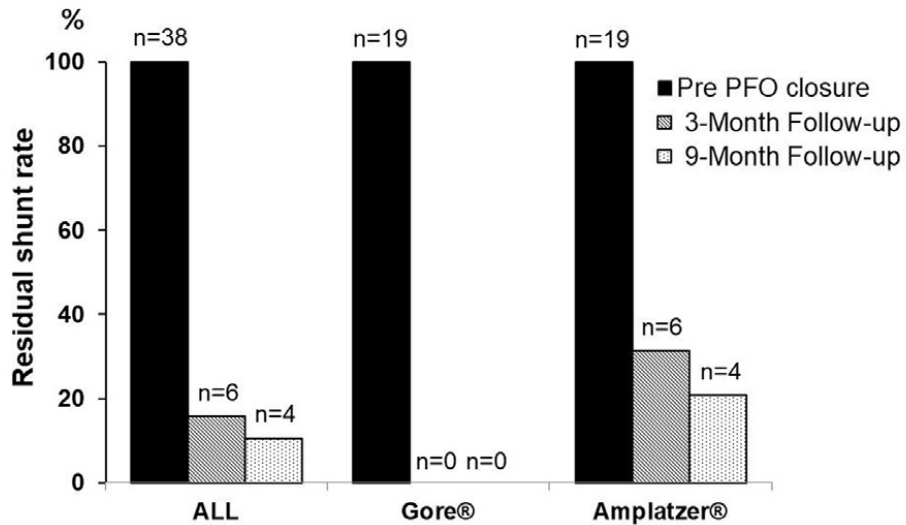
# Facteurs prédictifs: prothèse?

## Suivi median 6 ans

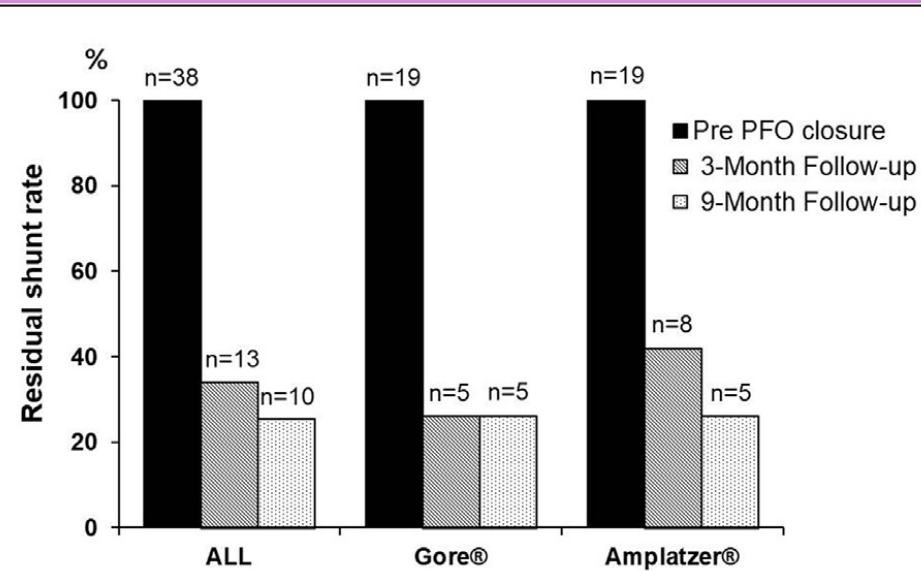
Device type	No shunt ( <i>n</i> = 700)		Residual shunt ( <i>n</i> = 25)		P value vs. amplatzer septal occluder
	Amplatzer septal occluder, <i>n</i> (%)	580	(97%)	15	(3%)
Gore HELEX, <i>n</i> (%)	59	(92%)	5	(8%)	<b>0.02</b>
Amplatzer Cribiform, <i>n</i> (%)	57	(92%)	5	(8%)	<b>0.02</b>
CardioSEAL, <i>n</i> (%)	4	(100%)	0	(0%)	0.75



# Facteurs prédictifs: prothèse?



$\geq$  grade 2 Shunt

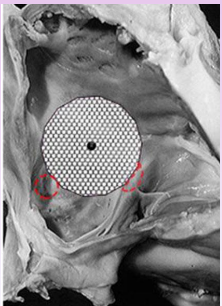
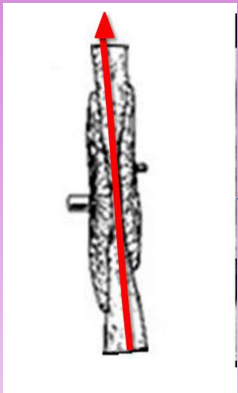
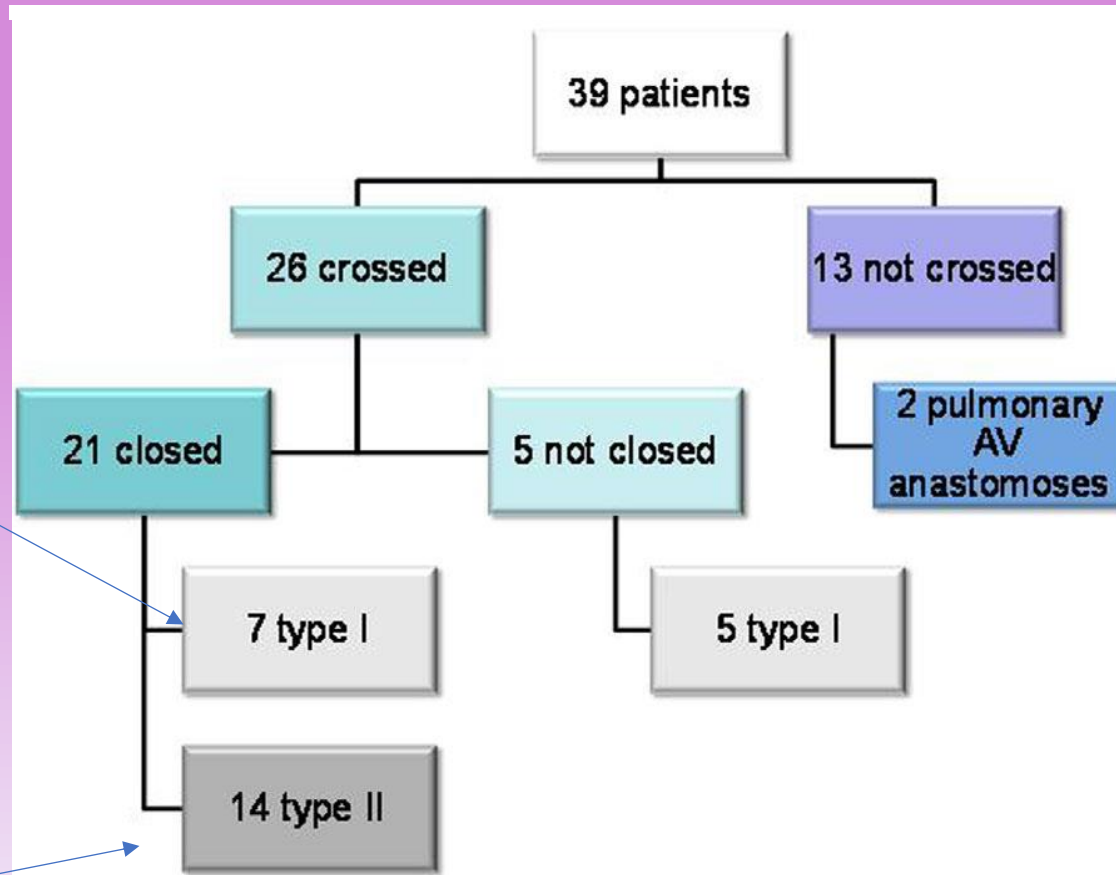


Any Shunt

# Conséquences: AVC?

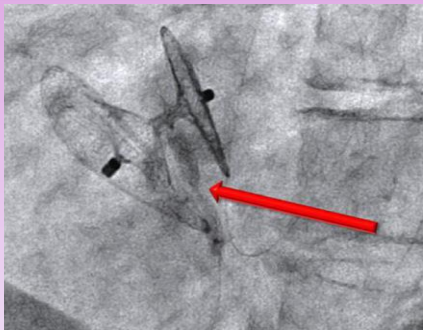
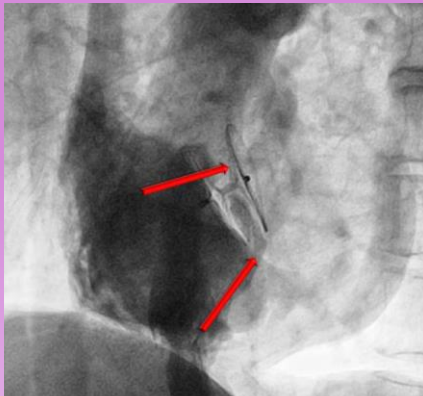
Variable	No event (n = 674)		Event (n = 45)		HR (95% CI)		P value
Mean age, yrs (SD)	53.1	(13.5)	60.0	(16.8)	1.04	(1.02–1.07)	<b>&lt;0.001</b>
Male, n (%)	397	(59%)	30	(67%)	1.43	(0.77–2.65)	0.26
Aspirin, n (%)	534	(79%)	38	(84%)	1.68	(0.75–3.76)	0.21
Clopidogrel, n (%)	257	(38%)	16	(36%)	1.45	(0.78–2.71)	0.24
Warfarin, n (%)	220	(33%)	13	(29%)	0.66	(0.34–1.26)	0.21
Hypertension, n (%)	245	(37%)	24	(53%)	2.07	(1.15–3.72)	<b>0.015</b>
Hyperlipidemia, n (%)	286	(43%)	24	(53%)	1.64	(0.91–2.95)	0.10
Diabetes mellitus, n (%)	43	(6%)	9	(20%)	3.82	(1.84–7.94)	<b>&lt;0.001</b>
Oral contraceptives, n (%)	21	(3%)	2	(4%)	1.26	(0.31–5.21)	0.75
Smoking status							
Former, n (%)	148	(22%)	13	(29%)	0.95	(0.60–1.52)	0.84
Current, n (%)	59	(9%)	2	(4%)			
Atrial septal aneurysm, n (%)	164	(28%)	13	(33%)	1.31	(0.67–2.56)	0.42
Normal coagulation screen, n (%)	535	(88%)	34	(85%)	0.71	(0.30–1.70)	0.44
Protein C deficiency, n (%)	20	(3%)	2	(5%)	1.32	(0.32–5.46)	0.70
Protein S deficiency, n (%)	16	(2%)	2	(5%)	1.98	(0.48–8.18)	0.35
Factor V leiden, n (%)	33	(5%)	3	(7%)	1.52	(0.47–4.94)	0.48
Lupus anticoagulant, n (%)	8	(1%)	0	(0%)			
Anticardiolipin antibodies, n (%)	15	(2%)	1	(2%)	0.87	(0.12–6.29)	0.89
Mean RA pressure, mm Hg (SD)	6.0	(3.2)	6.5	(3.7)	1.03	(0.94–1.14)	0.50
Mean LA pressure, mm Hg (SD)	8.4	(3.3)	8.9	(4.3)	1.04	(0.92–1.17)	0.57
RV systolic pressure, mm Hg (SD)	28.9	(6.7)	31.3	(6.7)	1.04	(1.01–1.07)	<b>0.013</b>
PA systolic pressure, mm Hg (SD)	26.7	(6.9)	30.1	(6.7)	1.05	(1.02–1.08)	<b>&lt;0.001</b>
Mean PCW pressure, mm Hg (SD)	9.2	(3.8)	10.5	(4.9)	1.06	(0.99–1.15)	0.09
Stretched PFO diameter, mm (SD)	11.1	(4.1)	11.7	(4.9)	1.03	(0.96–1.11)	0.44
Residual right-to-left shunt (at any point during follow-up), n (%)	46	(7%)	4	(9%)	1.38	(0.49–3.84)	0.54

# Prise en charge interventionnelle



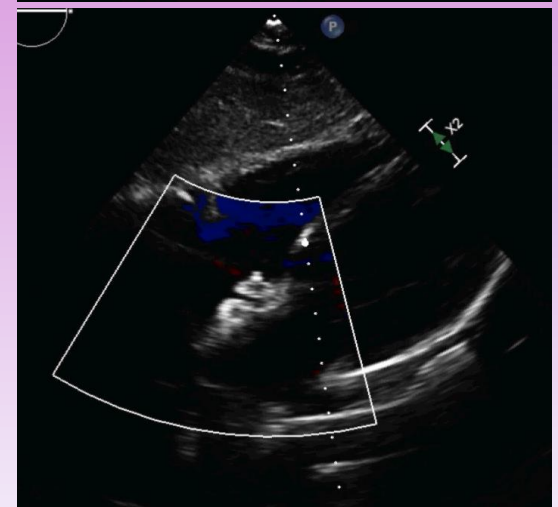
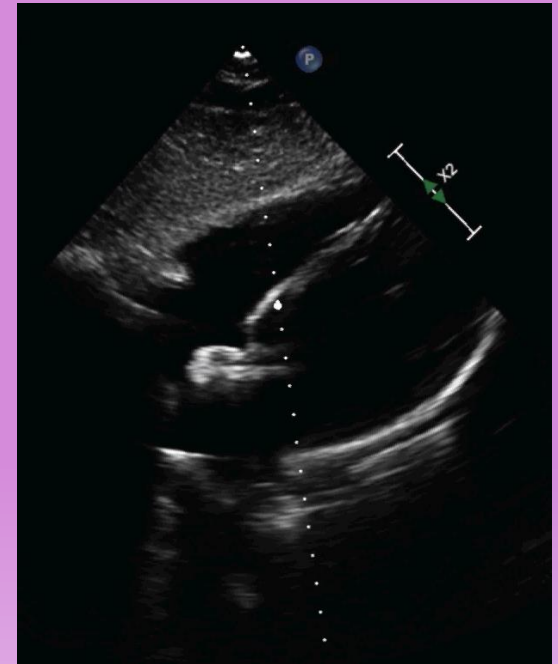
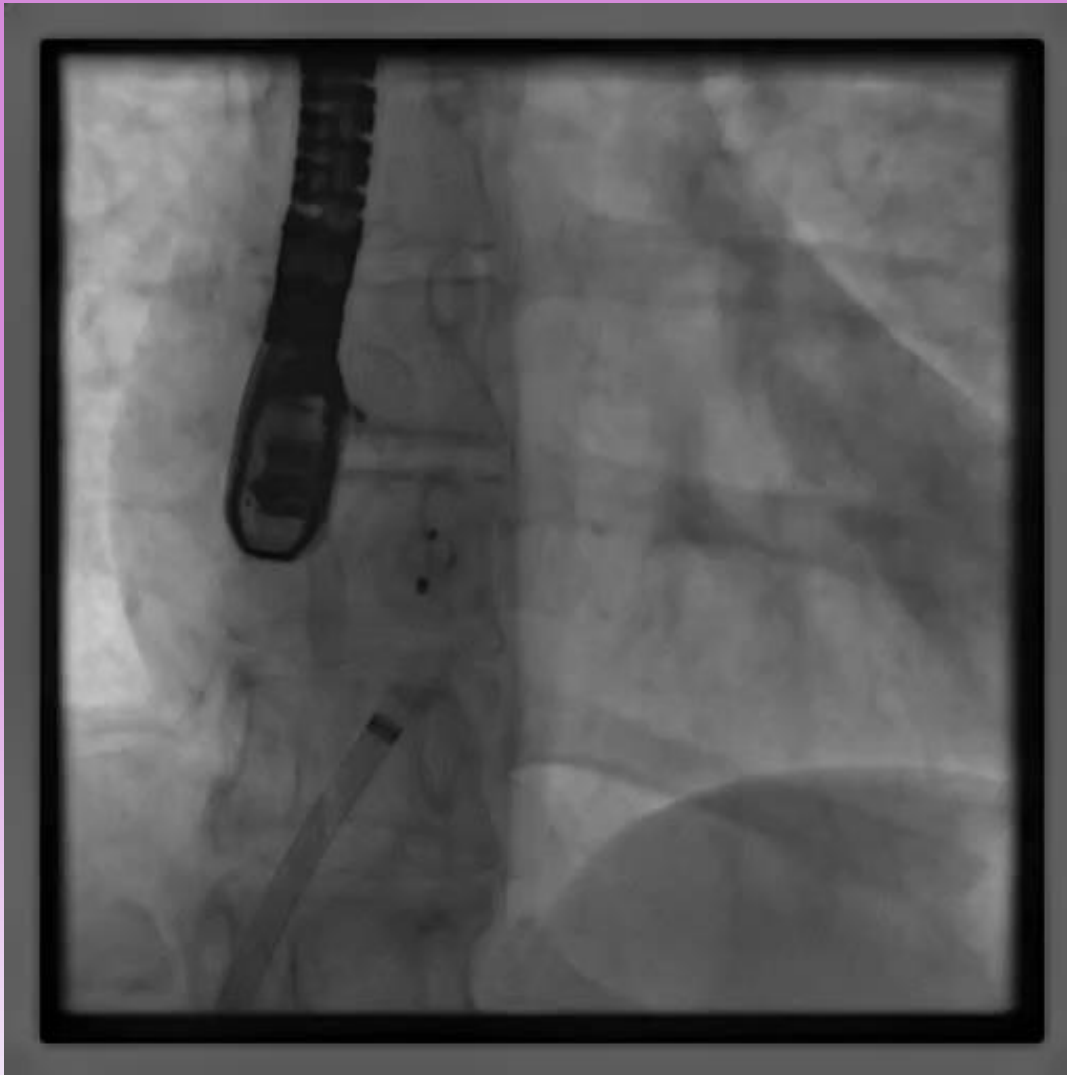
Patients with  $\geq$  moderate shunt on TCD at 1 year  
J Interven Cardiol 2014;27:548–554

# Prise en charge en pratique



- En dehors des perforations: ttt interventionnel
  - Catheter standards ou steerable (agilis)
  - Sous ETO et angio
  - Franchissement:
    - Guides 0.014
    - Hydrophiles et rigides 0.035
  - Sizing au ballon
  - Fermeture par:
    - Plugs vasculaires
    - Plugs canal artériel
    - ASD ou PFO occluder
    - VSD occluder
- En cas de perforation
  - Risque d'embolization+++
  - Interventionnel ou traitement chirurgical (explantation)

# FOP+ CIA



# Conclusions

## Shunts résiduels post fermeture de FOP

- Fréquents en post procédure immédiat et précoce (20-25%)
- De plus en plus rare avec le temps (<5% à 2 ans)
- Relation avec événements emboliques non démontrée
- Indication de ré-intervention à discuter au cas par cas
  - 2<sup>ème</sup> fermeture percutanée reste possible si shunt important
  - Récidive d'AVC et shunt important?
  - Perforations et embolisation de matériel prothétique (Explantation?)
- Importance de suivi ETT des prothèses++++