Embryologie des oreillettes

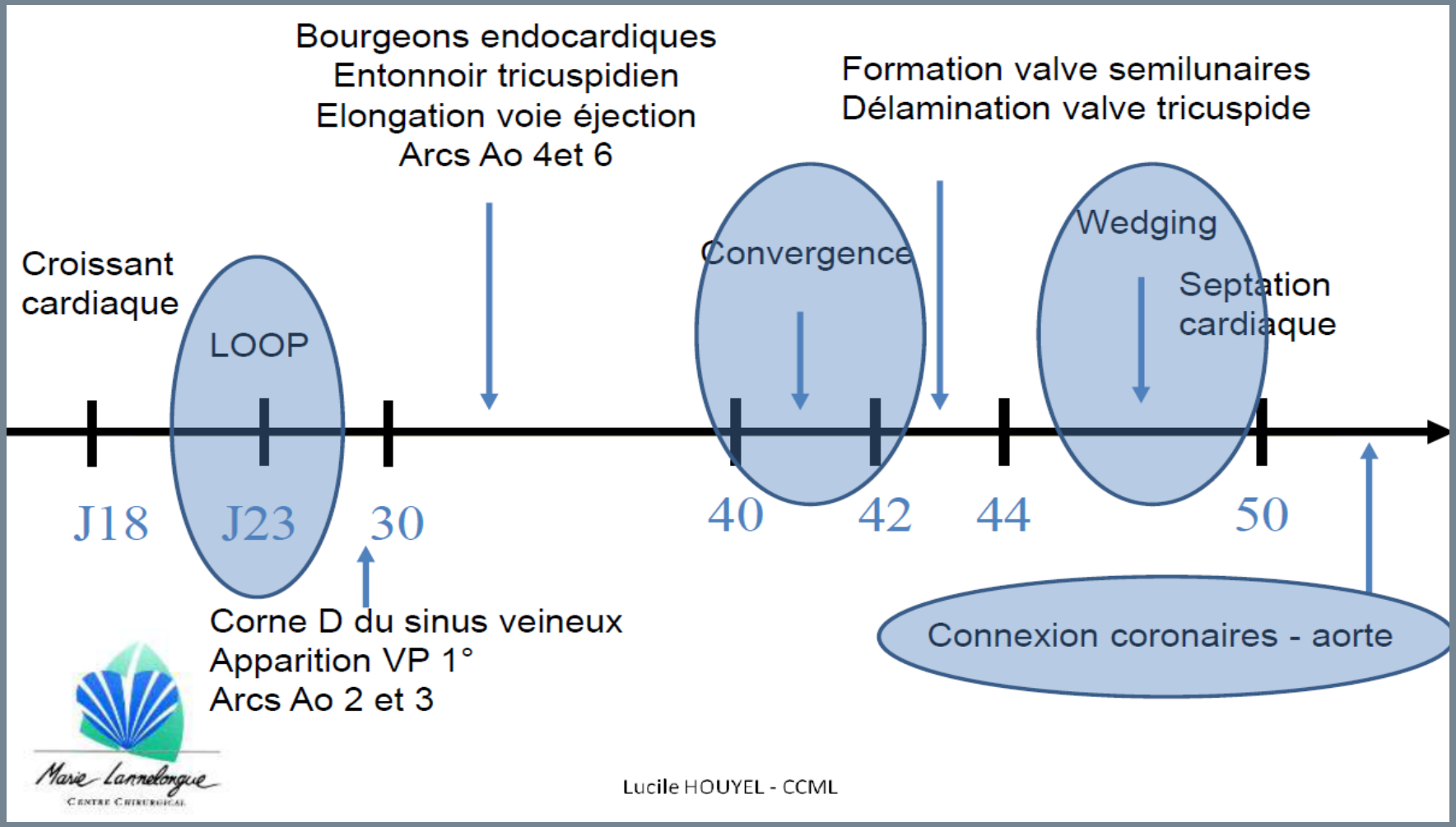
Fermetures des shunts inter-atriaux

Dr. F. BOURLON
Dr N. HUGUES

1. Embryologie
2. CIA
3. FOP

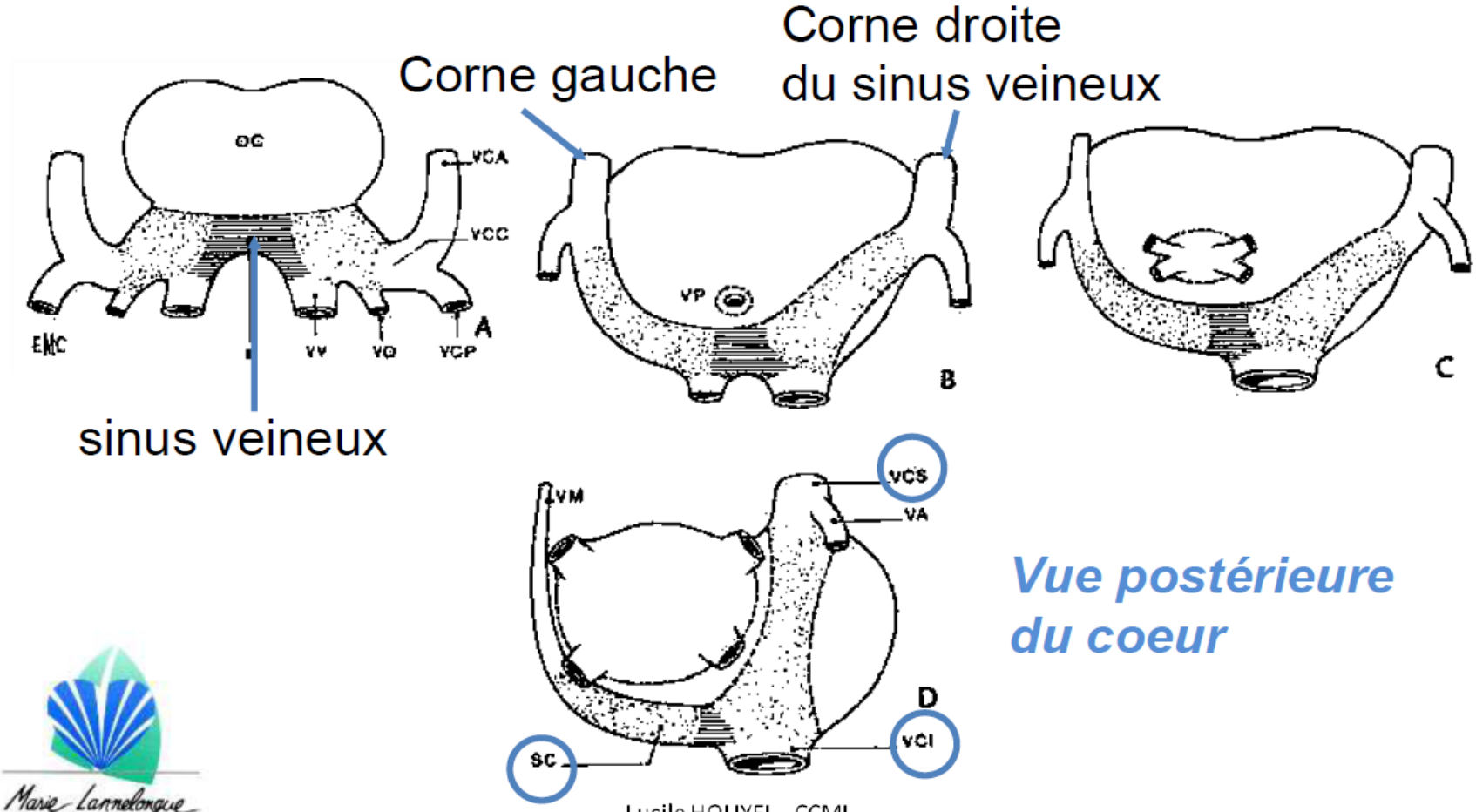
Embryologie:

Repères chronologiques



Embryologie:

Système veineux

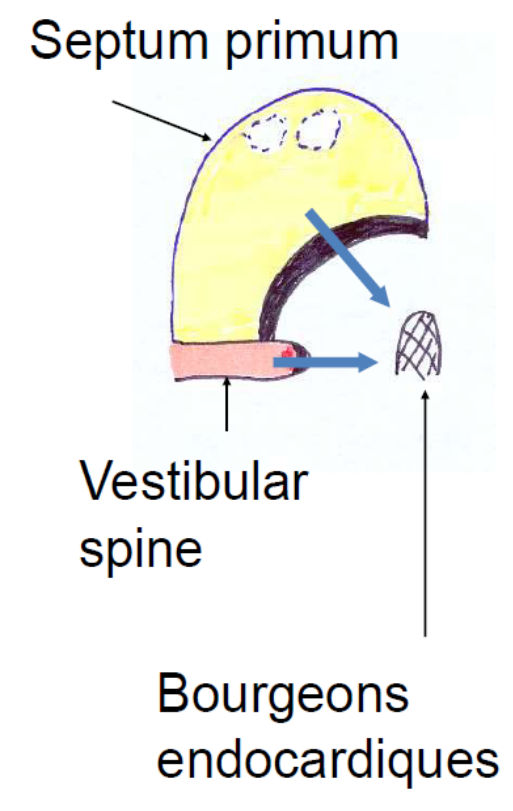


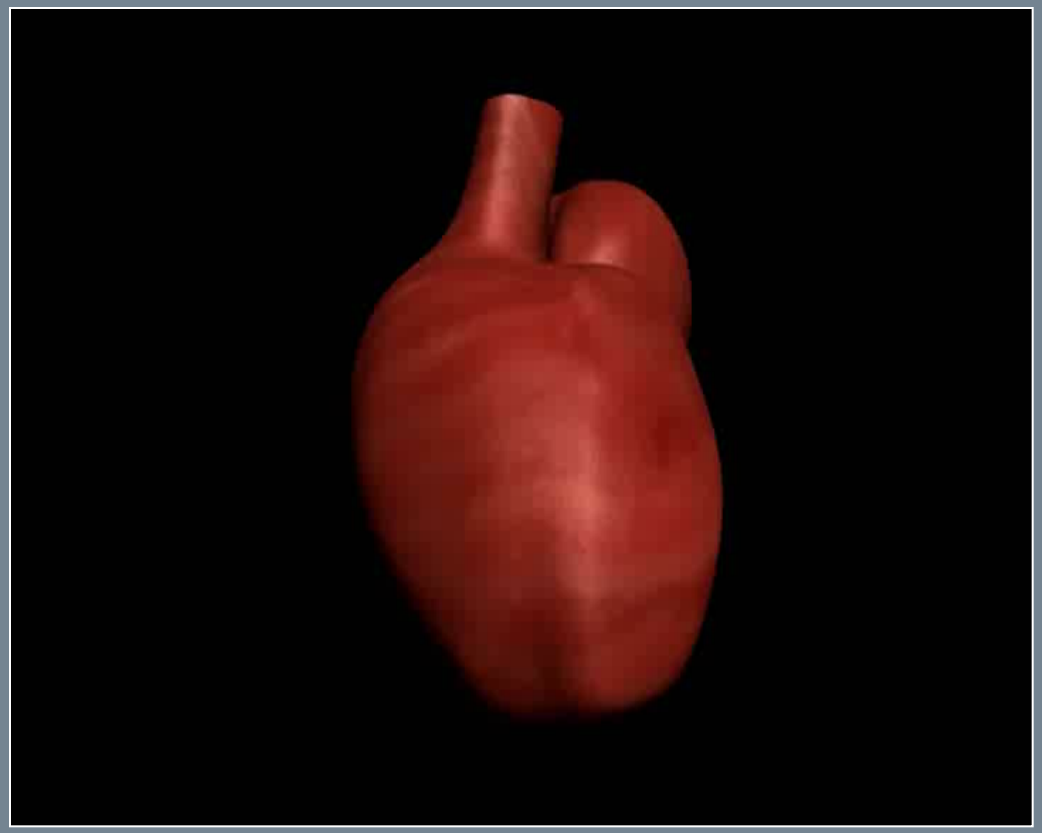
Vue postérieure du coeur

Lucile HOUYEL - CCML

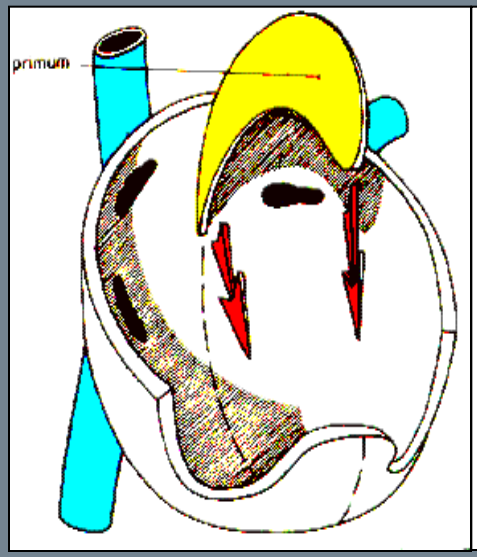
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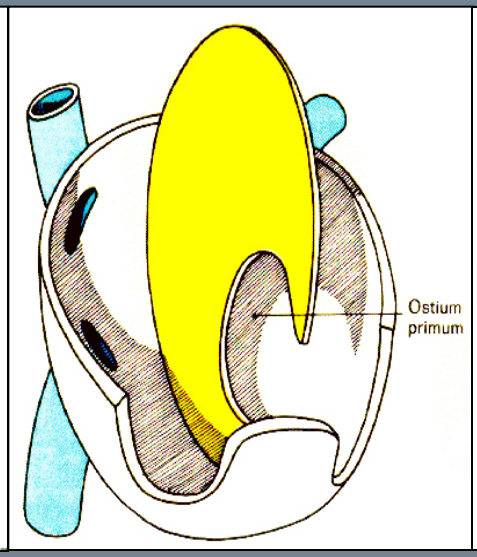
Septation auriculaire

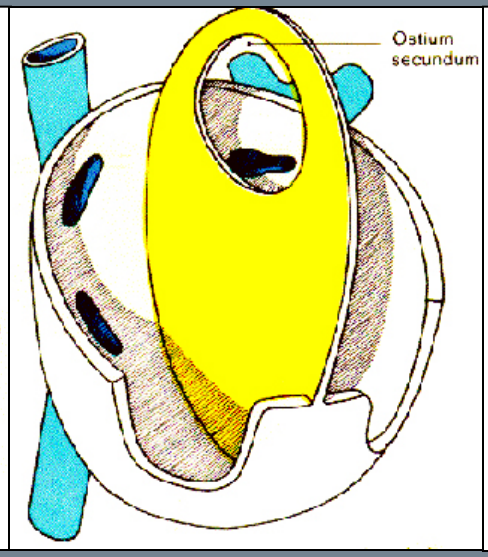


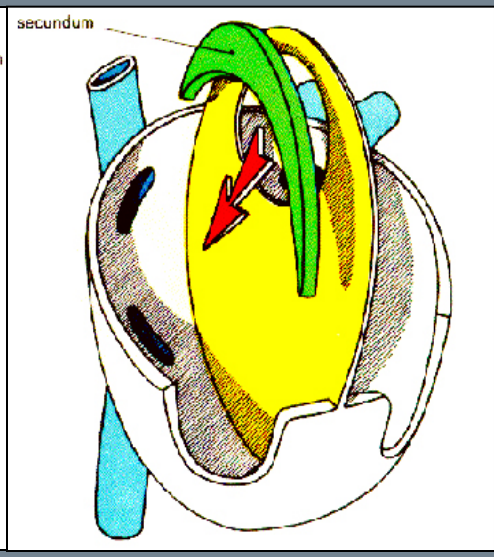


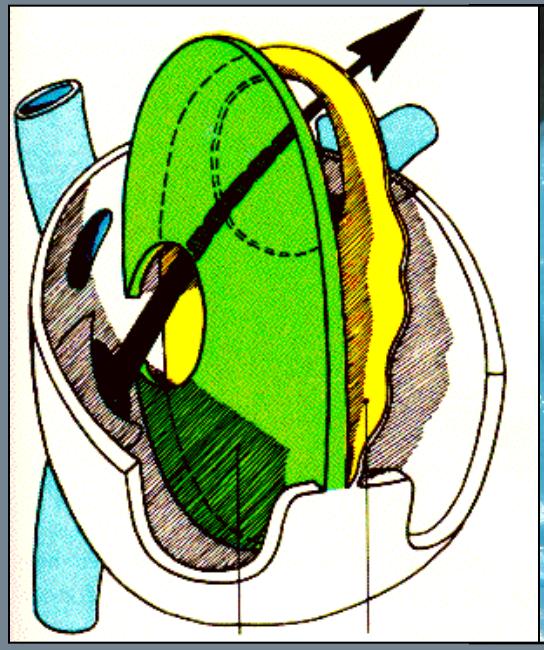
Schleich JM, Dillenseger JL, Houyel L, Almange C, Anderson RH.
A new dynamic 3D virtual methodology for teaching the mechanics of atrial septation as seen in the human heart. Anat Sci Educ. 2009;2:69-77.



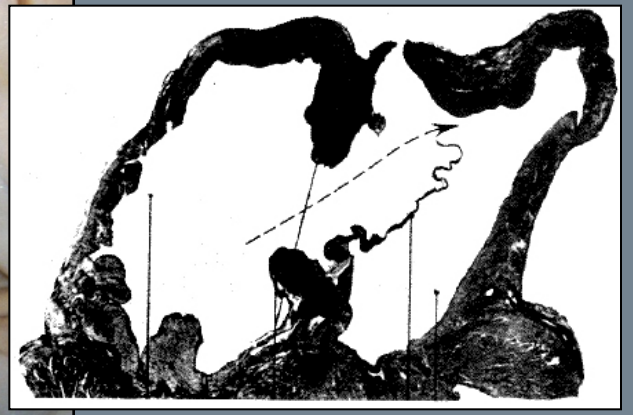








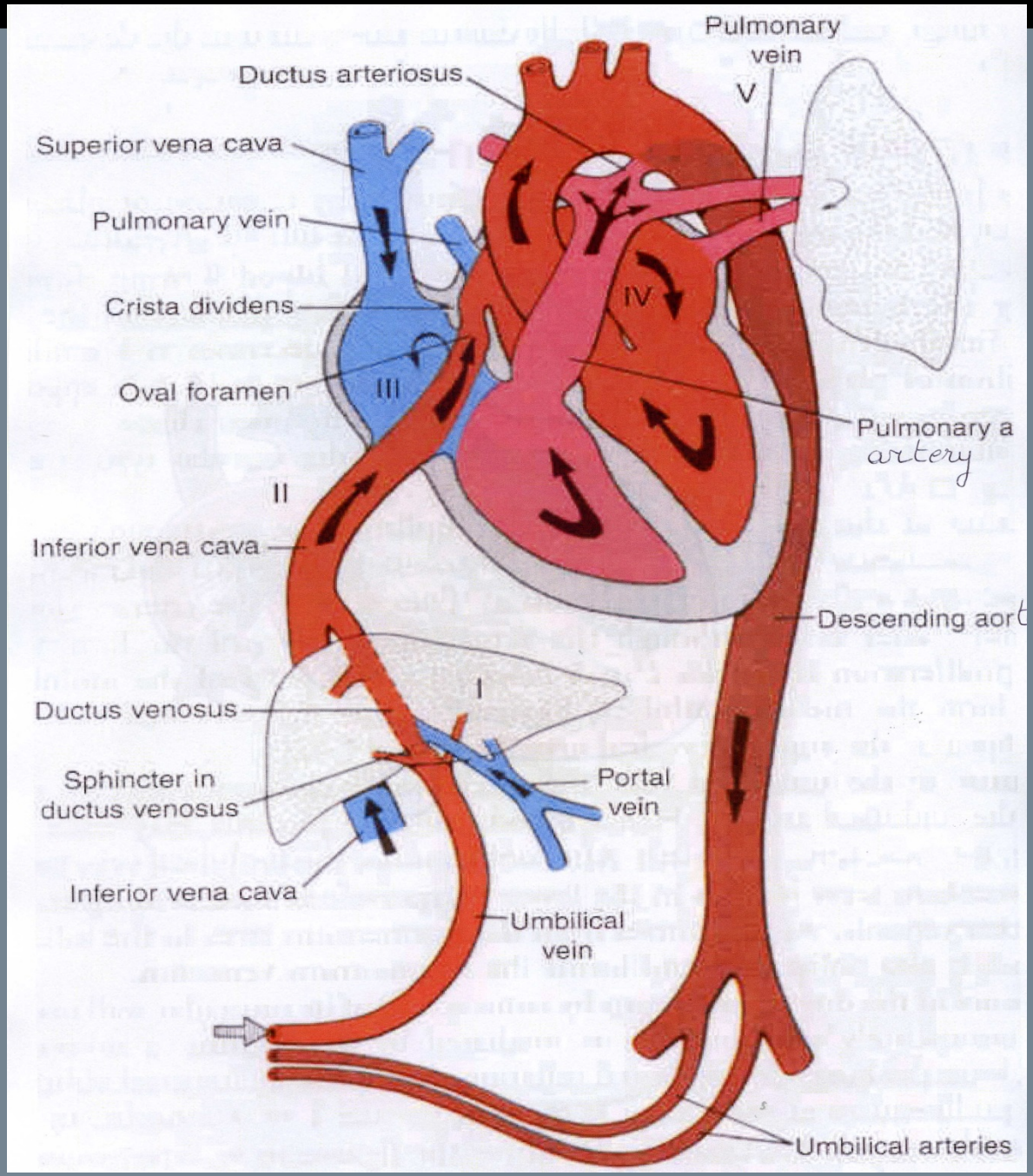




Courtesy: Kurt Amplatz, MD

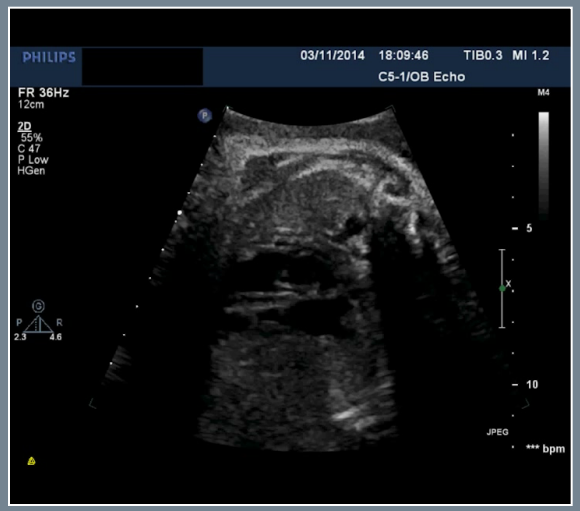
Embryologie:

Rôle de la valve d'Eustachi

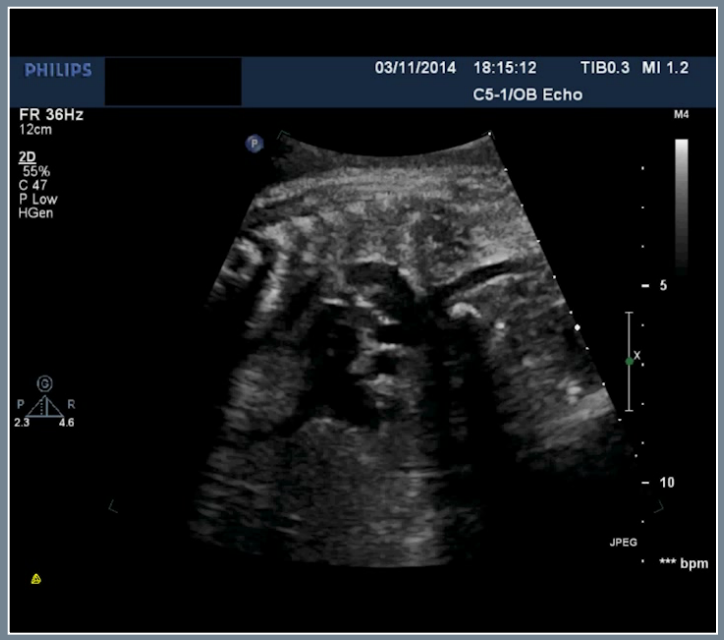


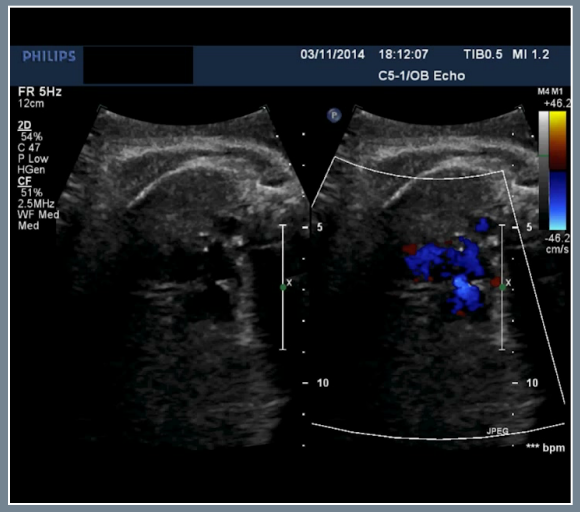
Embryologie:

Septation auriculaire





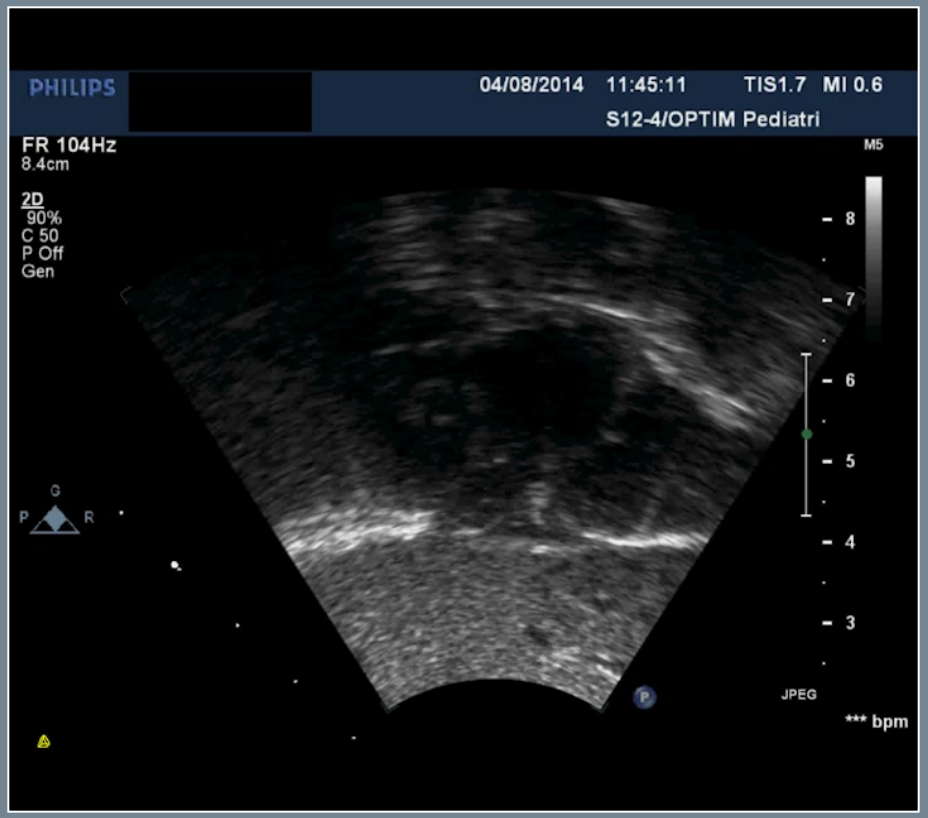


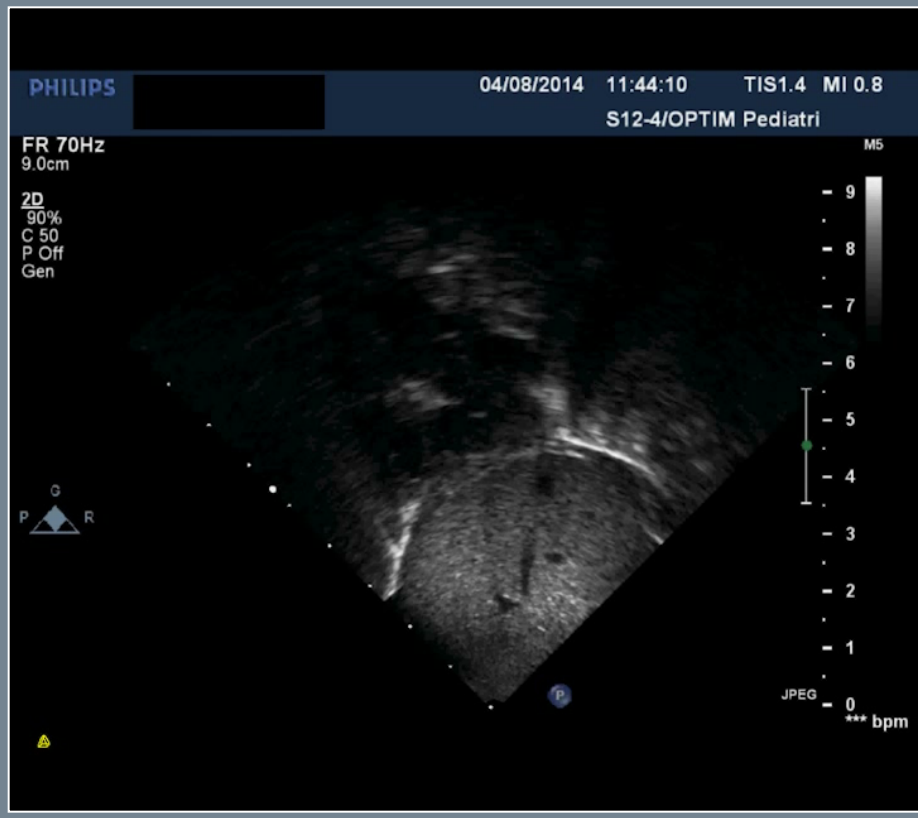


Echo fœtale (maman)

Embryologie:

Septation auriculaire

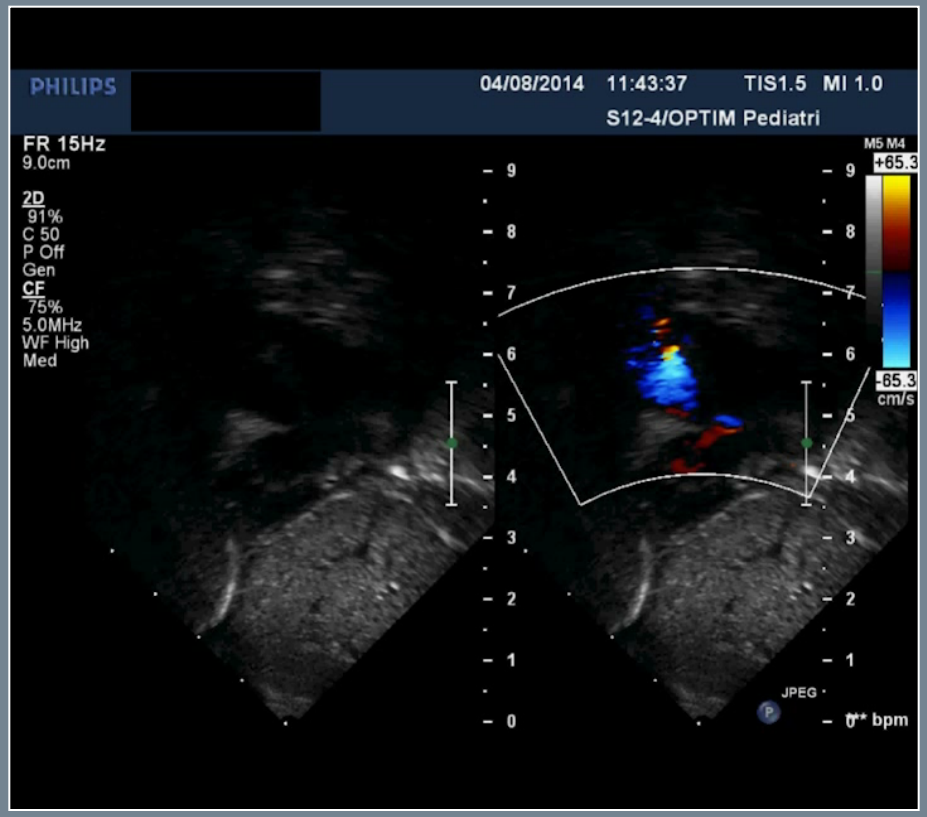




Echo post natale (enfant)

Embryologie:

Septation auriculaire



Echo post natale (enfant)

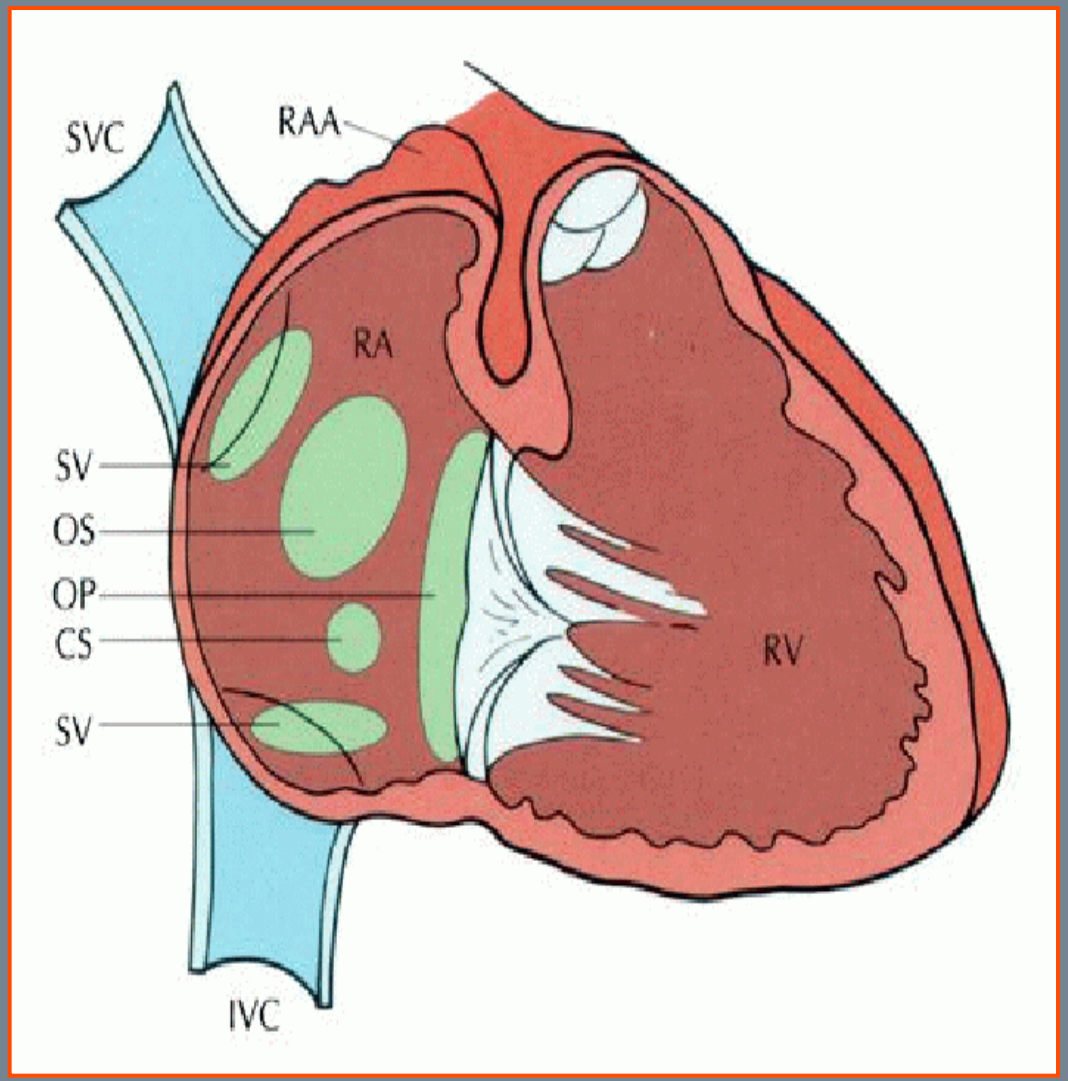
CIA

- La plus fréquente des malformations cardiaques, la moins grave
- Prévalence: 5/10000 soit 8% des cardiopathies congénitales
- Isolée, rarement dans le cadre d'un syndrome (Holt Oram, Poland) ou familiale (PR long)
- Grande tolérance
- Découverte fortuite
- Possibilité de fermeture spontanée jusque vers l'âge de 3 ans

CIA

Anatomie

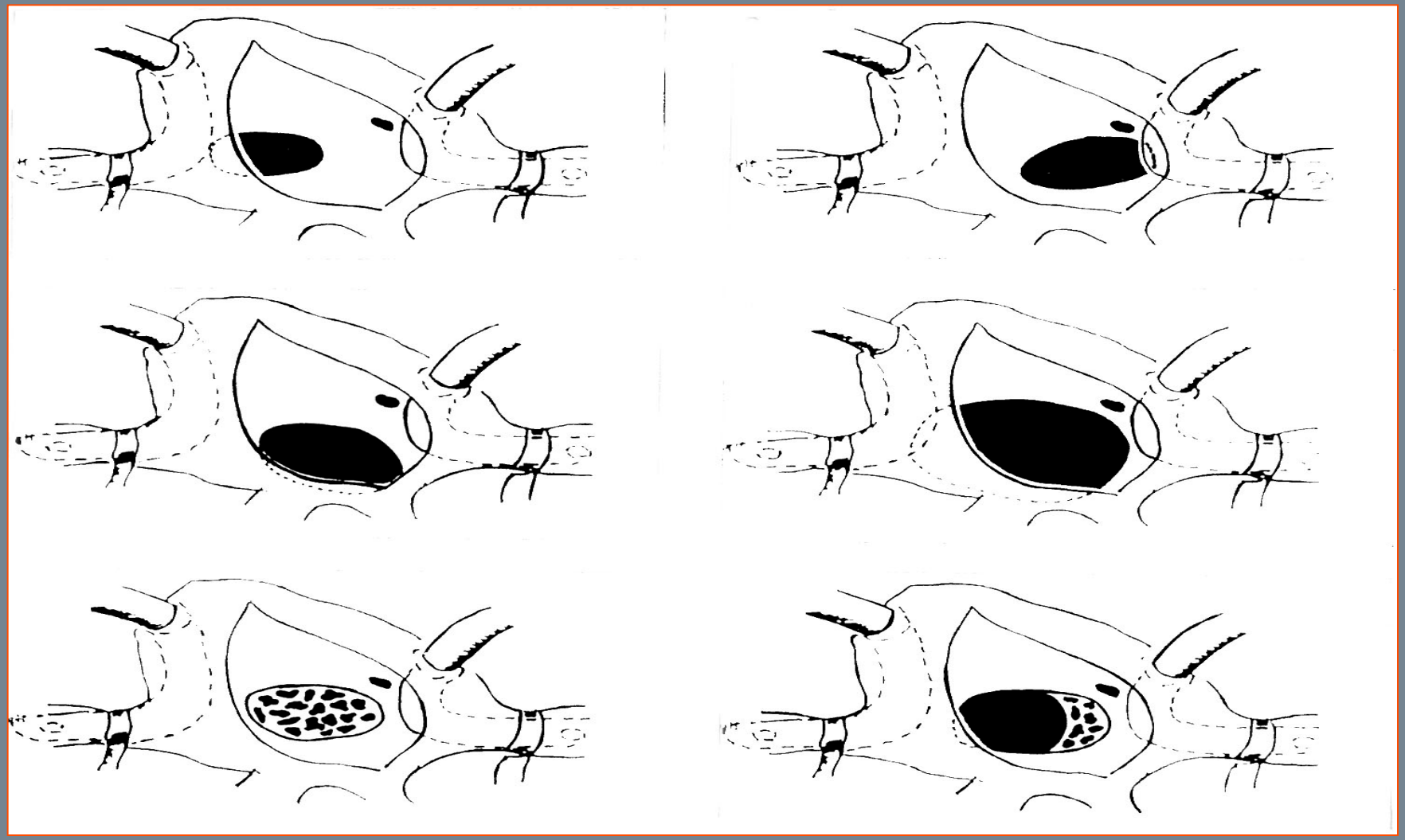
- Défect du septum interatrial:
  - CIA OP
  - CIA OS
- Défauts de la paroi auriculaire et des structures veineuses associées
  - CIA de type sinus veinosus
  - CIA de type low septal defect
  - CIA sans toit du sinus coronaire



CIA

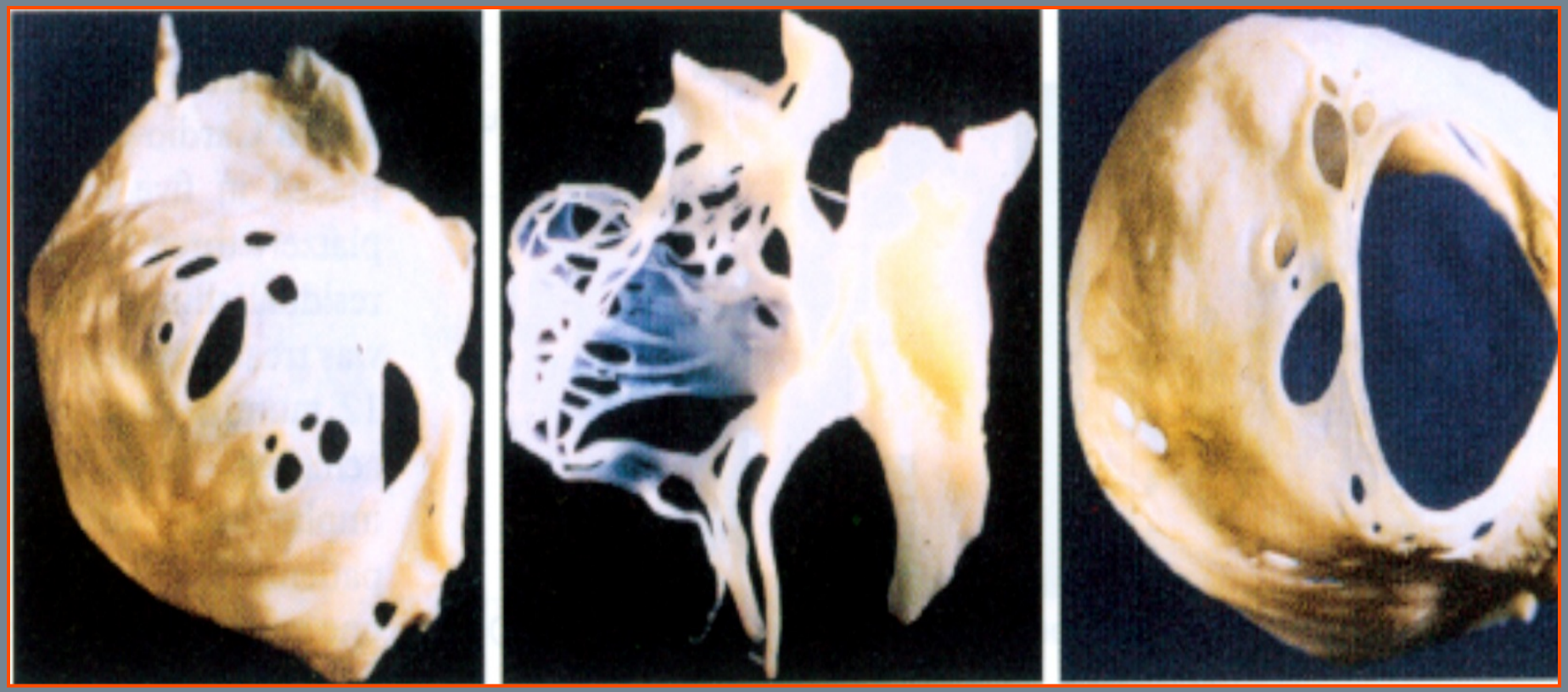
Anatomie des CIA OS

Anterior
Superior — Interior
Posterior



CIA

Anatomie des CIA OS

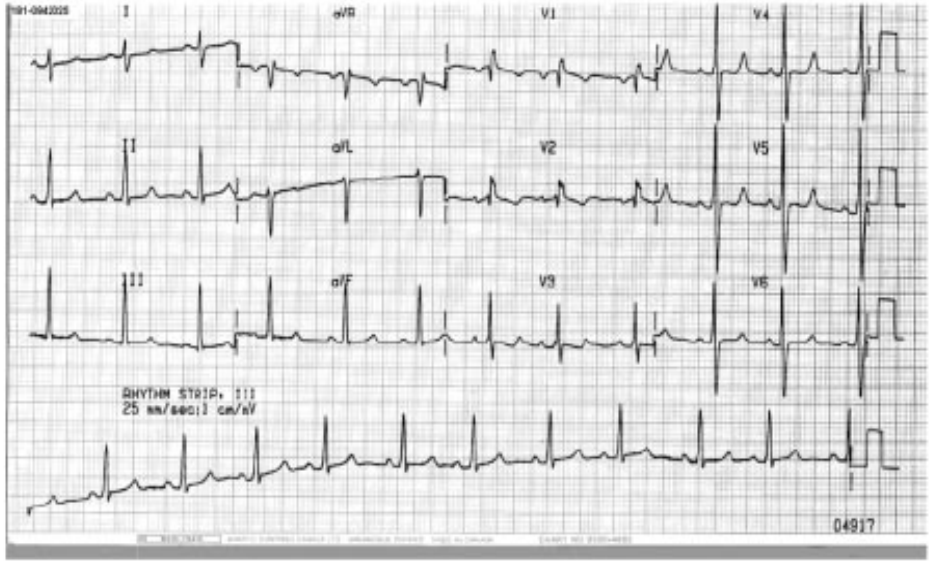


CIA

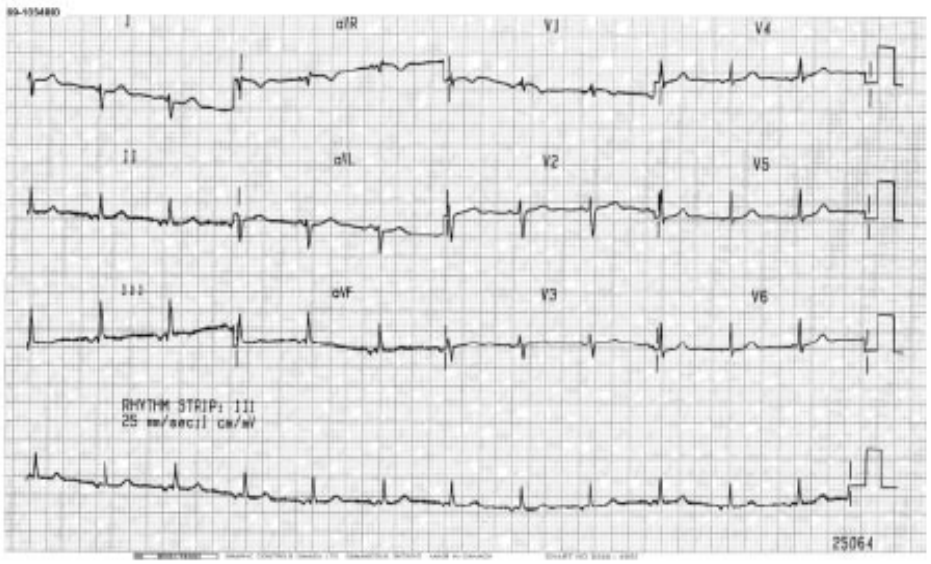
- Patients asymptomatiques, sémiologie frustre
- Clinique :
  - souffle systolique éjectionnel au foyer pulmonaire
  - Dédoublement du B2 fixe
  - Roulement diastolique tricuspidien d'hyperdébit
- ECG: BBd incomplet
- Radio: petite Ao, grosses AP
- Echo: diagnostic évoqué devant une dilatation des cavités droites; recherche des anomalies associées (retour veineux)

CIA: ECG

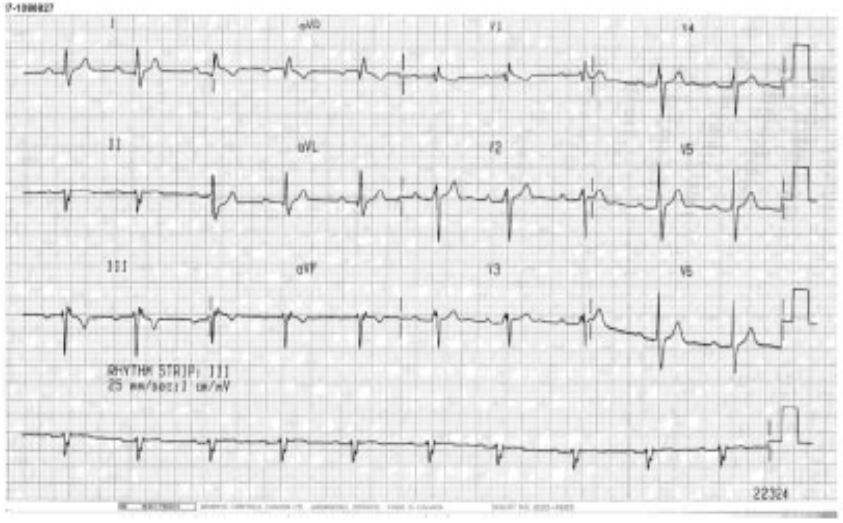
A OSTIUM SECUNDUM



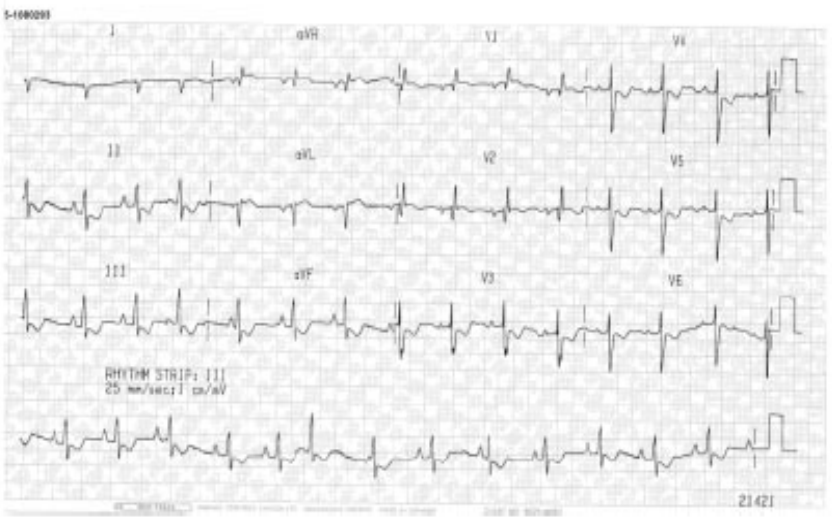
B SINUS VEINOSUS



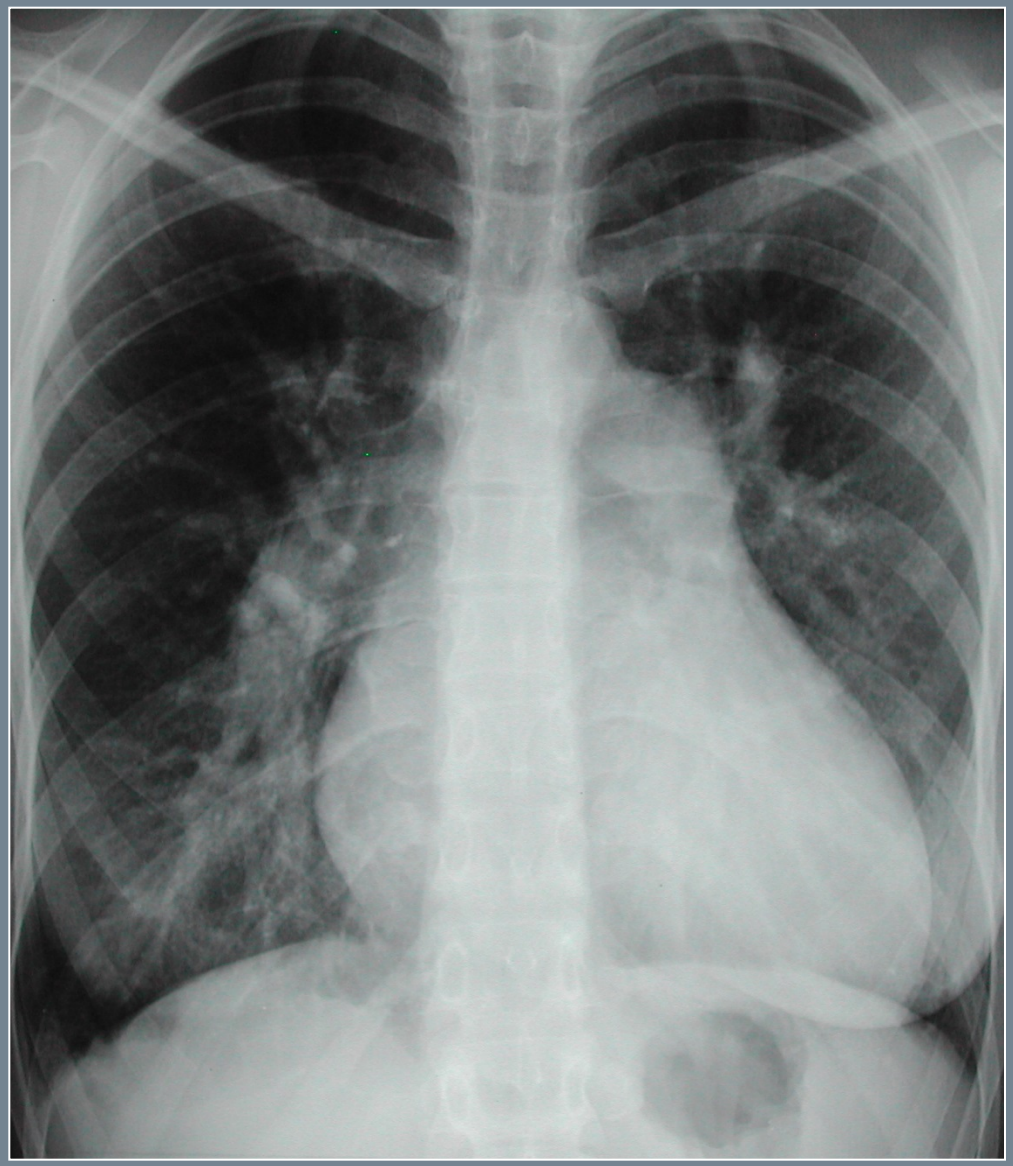
C OSTIUM PRIMUM



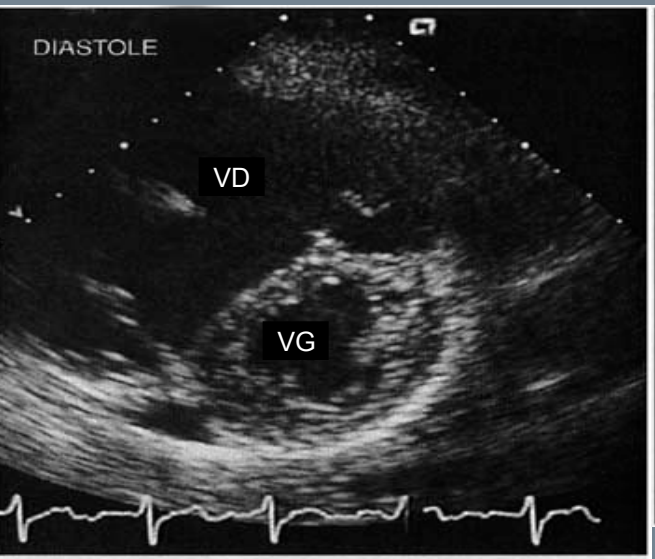
D EISENMENGER

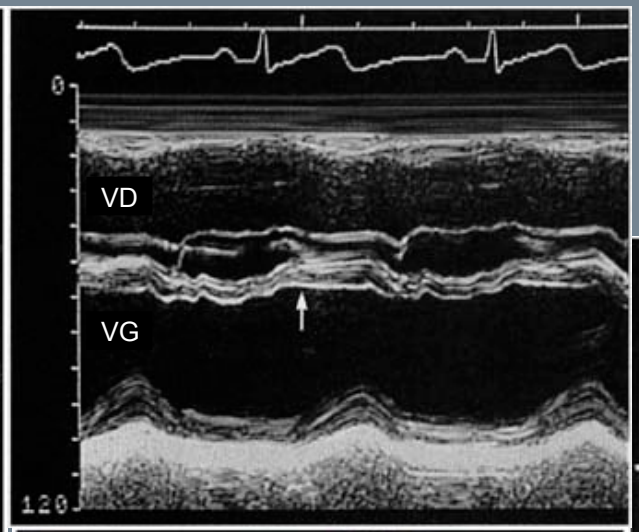


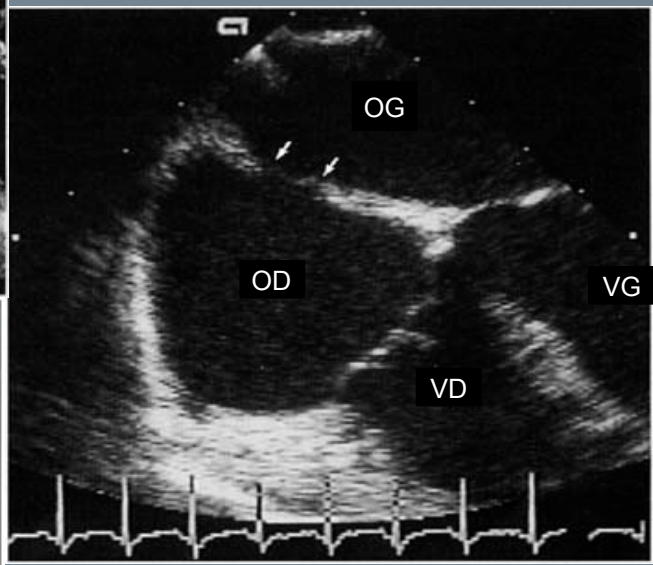
CIA : RP

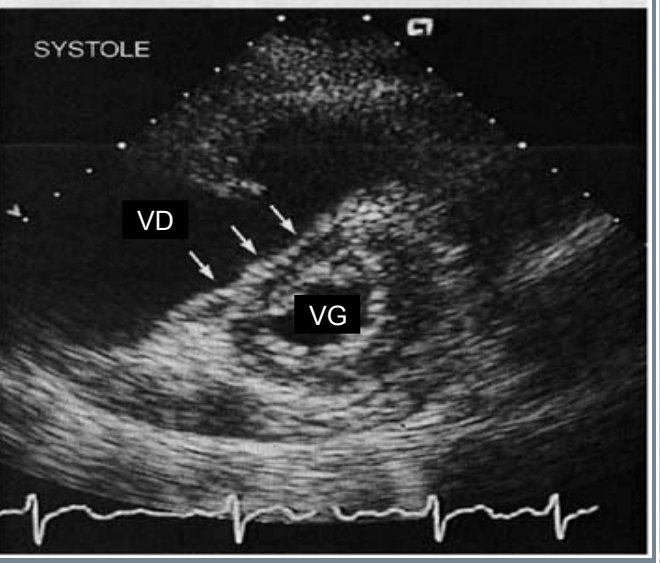


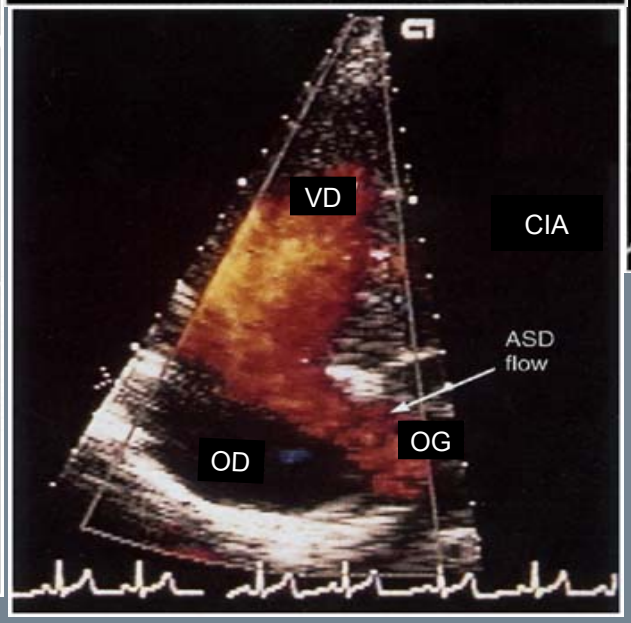
CIA: échographie





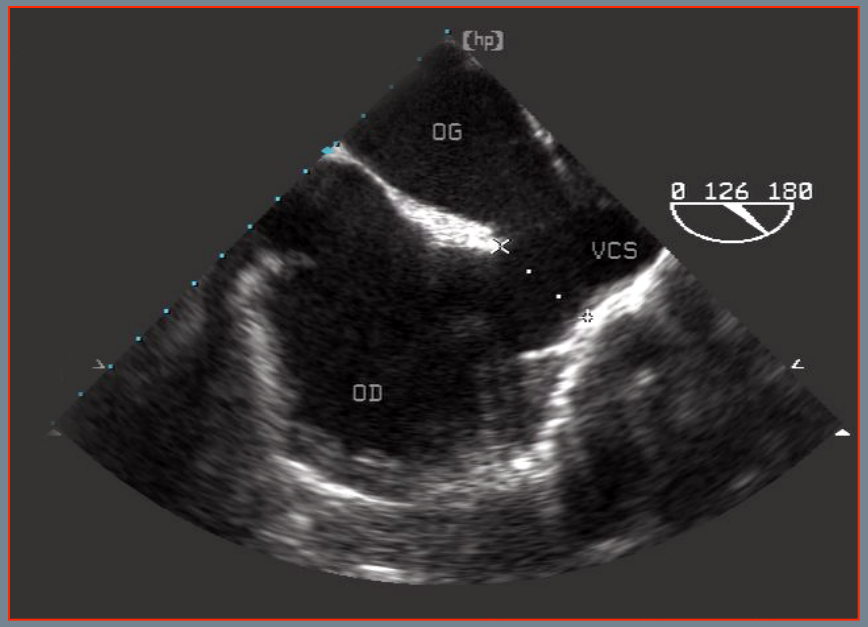


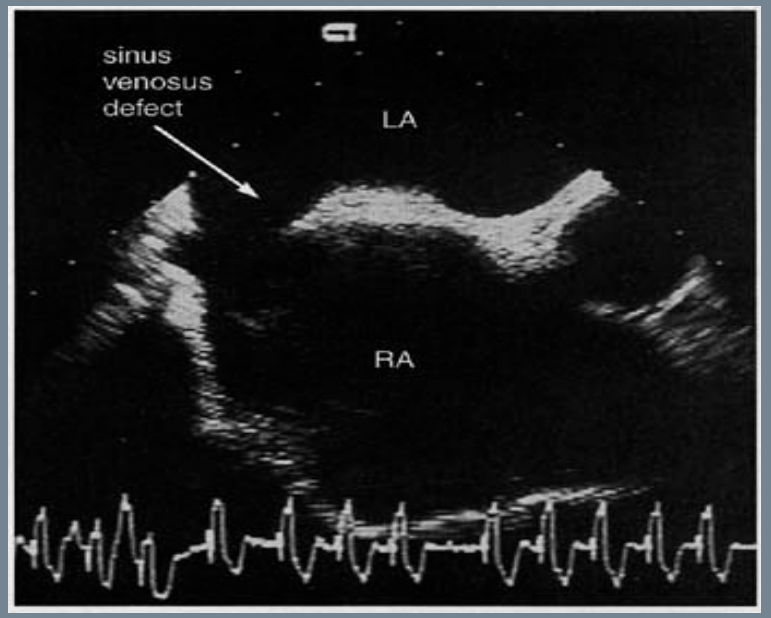




CIA:

Type sinus veinosus





CIA

- Histoire naturelle très longue
- Grande tolérance
- Importance du shunt fonction de la compliance ventriculaire
- Complications évolutives:
  - Troubles du rythmes auriculaires
  - Insuffisance cardiaque droite
  - Embolies paradoxales
  - HTAp tardive et modérée

CIA: Prise en charge

« Grosse » CIA

- Dyspnée
- FA
- Roulement tricuspide : QP/QS>2,5

→ Berges suffisantes : **Percutanée**

→ Berges insuffisantes : **Chirurgie**

Chirurgie dans tous les cas si :

- Sinus venosus
- Low septal defect
- Ostium primum / fente mitrale

CIA: Prise en charge

« Petite » CIA

- Asymptomatique
- Découverte fortuite

→ Si
- Sinus Venosus
- Low septal defect

Abstention

→ Si
- Ostium primum + fente mitrale

Discuter chirurgie

→ Si
- CIA centrale

Mêmes indications que FOP

CIA:

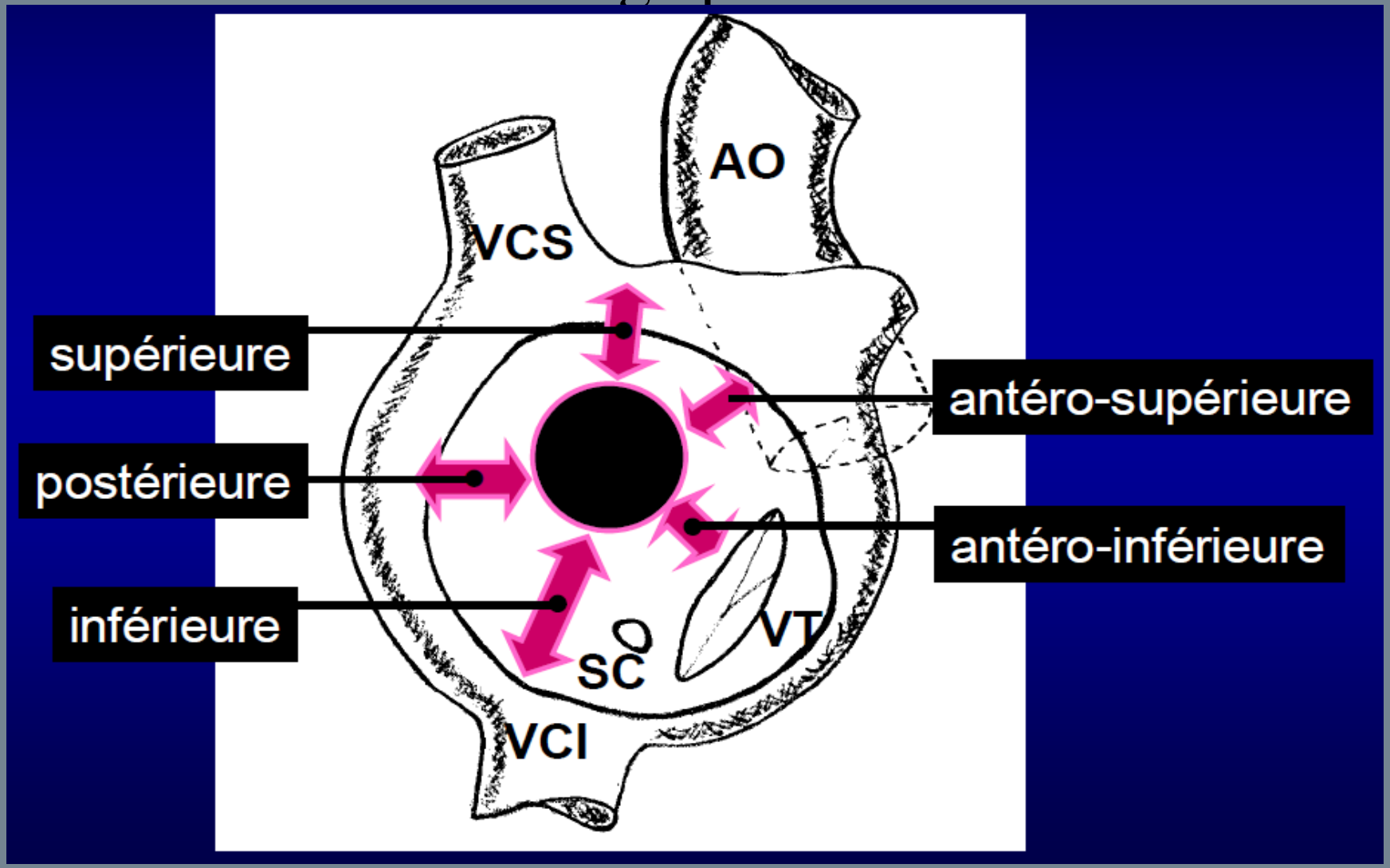
Prise en charge par cathétérisme

Uniquement les CIA de type ostium secundum

- De préférence > 20 Kg
- En réalité, seuls les rebords comptent :
  - rebord antéro-inférieur > 10 mm
  - rebord inférieur (VCI) > 5 mm
  - Rebord antéro-supérieur: peut être absent
  - En principe, sous AG et ETO
- De moins en moins d'AG et d'ETO
- Choix du diamètre de la prothèse par le diamètre « étiré » de la CIA

CIA:

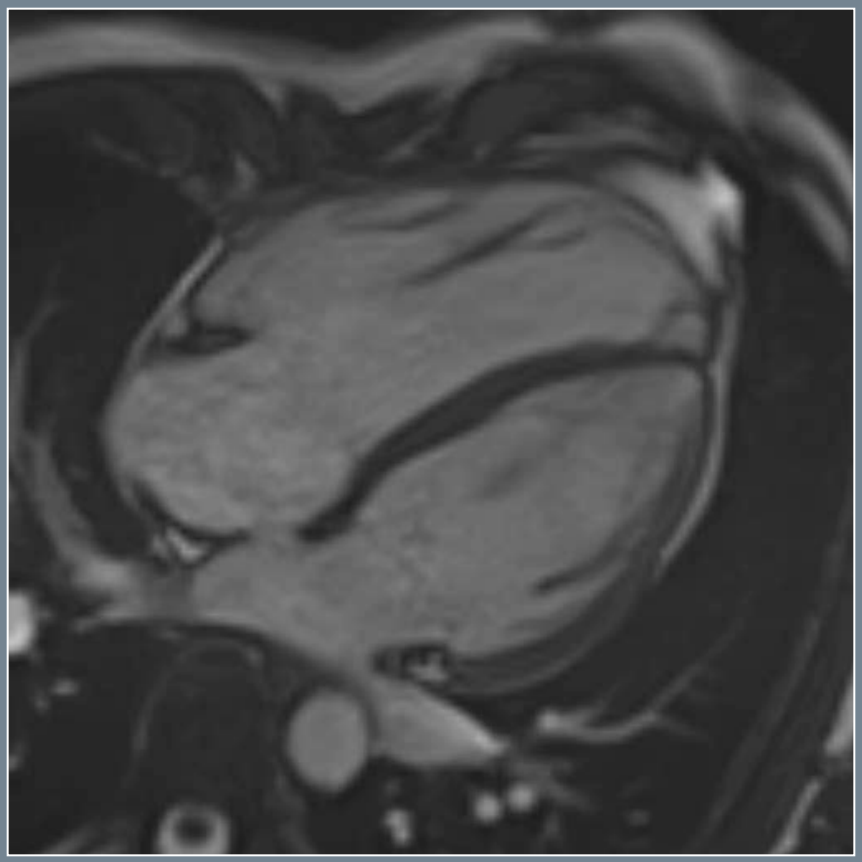
Prise en charge par cathétérisme

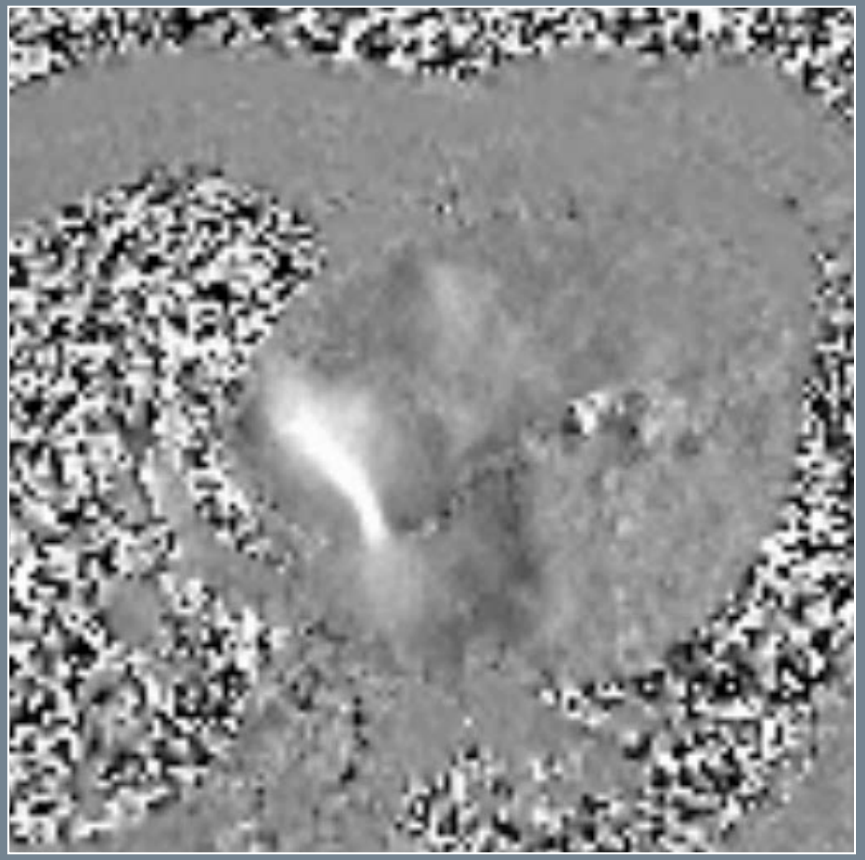


Homme, 40 ans

CIA:

Prise en charge par cathétérisme

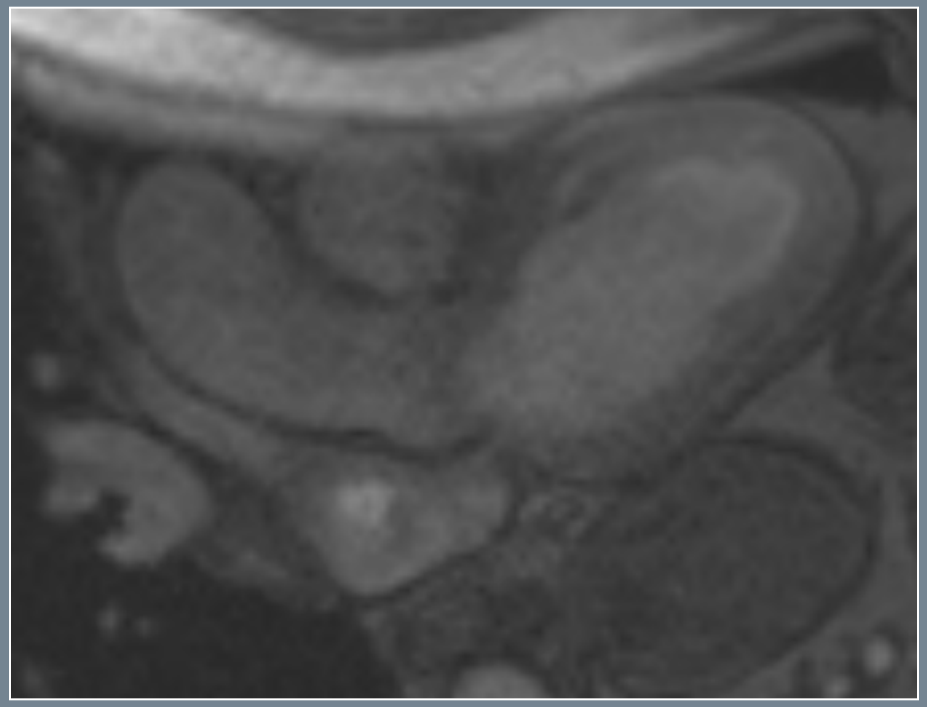


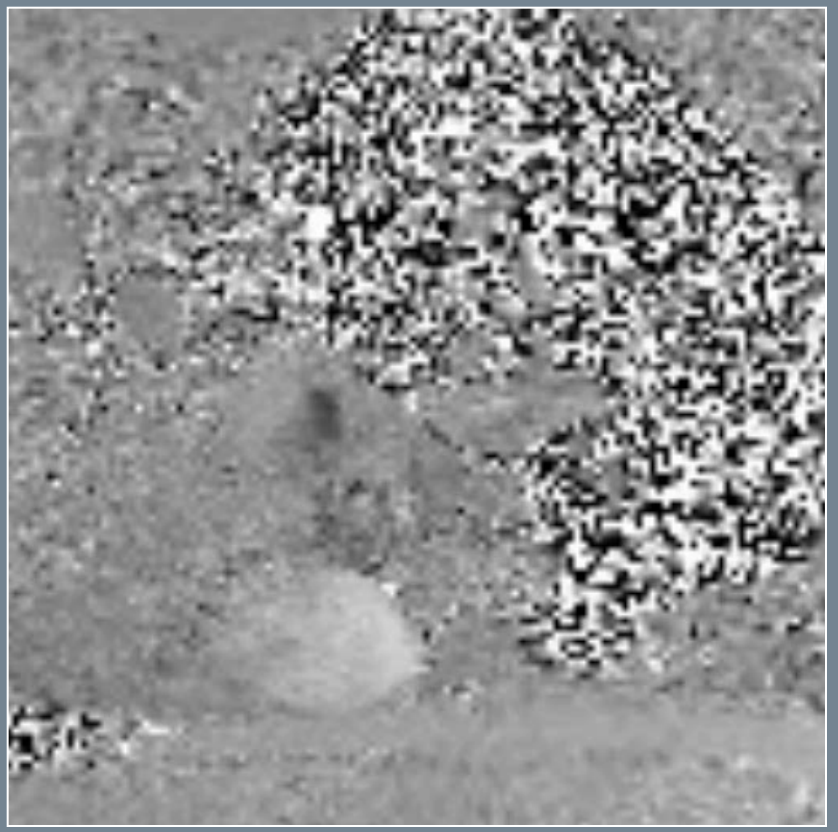


Homme, 40 ans

CIA:

Prise en charge par cathétérisme





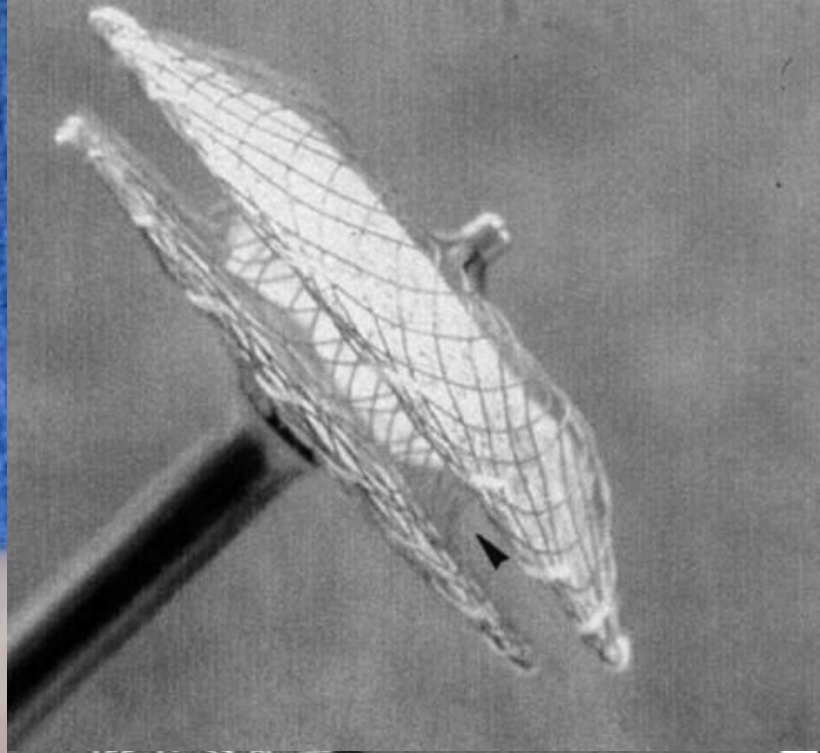
CIA:

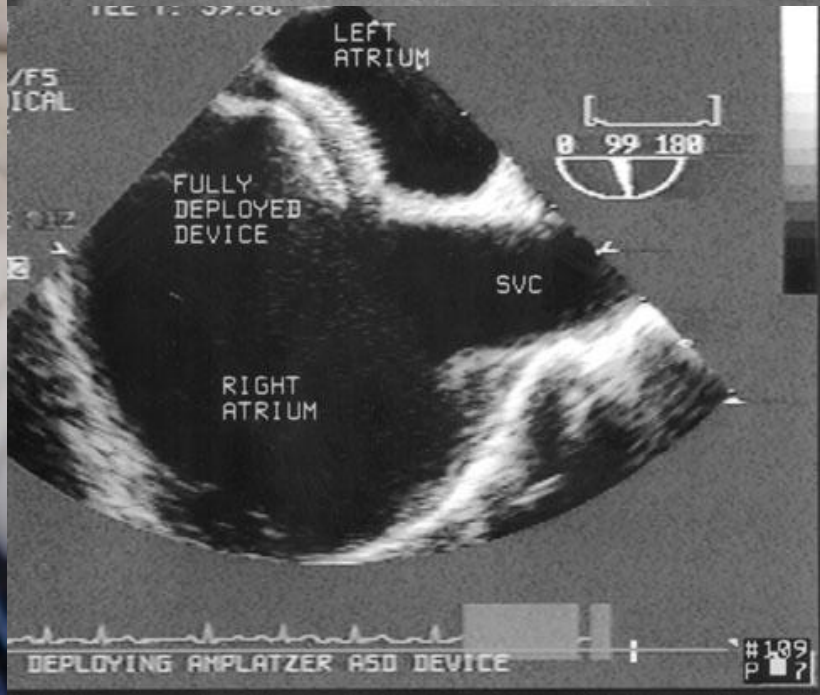
Prise en charge par cathétérisme



Ballon de calibration Amplatzer

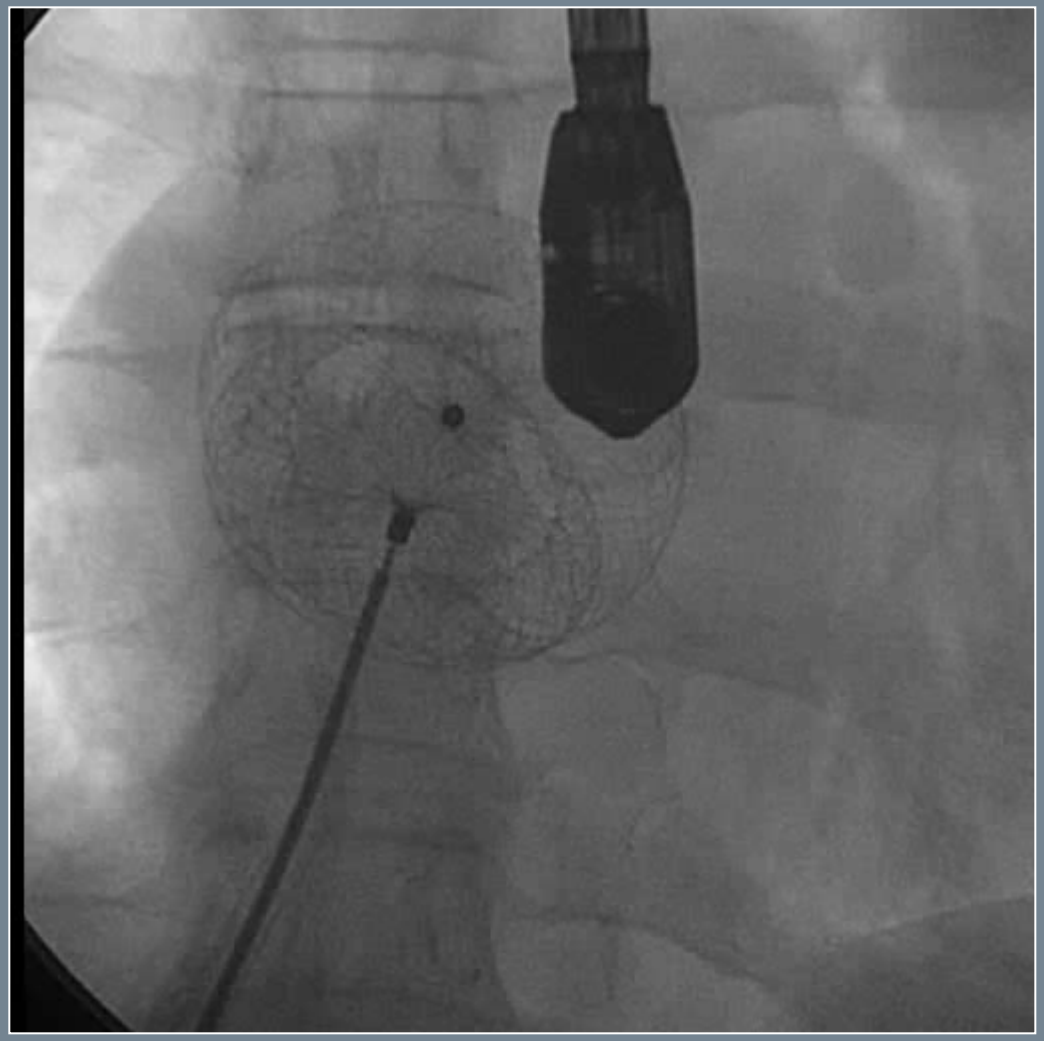




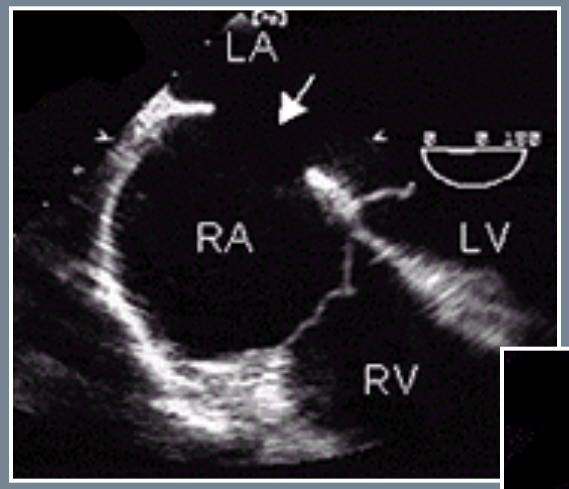

LEFT
ATRIUM
FULLY
DEPLOYED
DEVICE
SVC
RIGHT
ATRIUM
0 99 180
DEPLOYING AMPLATZER ASD DEVICE

CIA:

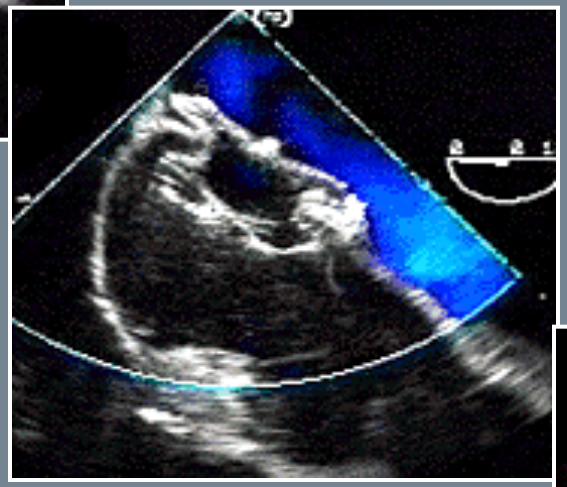
Prise en charge par cathétérisme



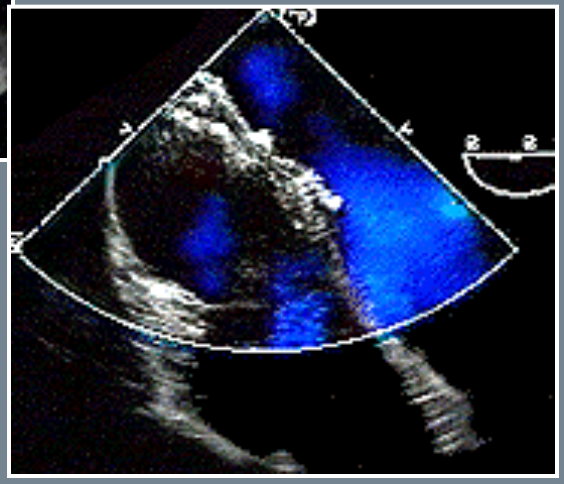
Prothèse Amplatzer 38 mm



1 mois



6 mois

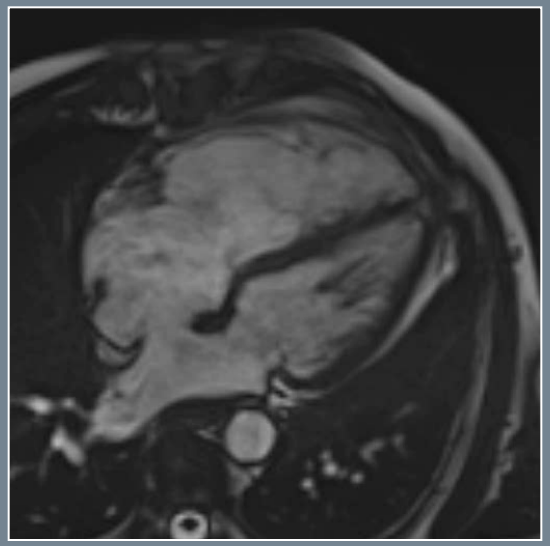


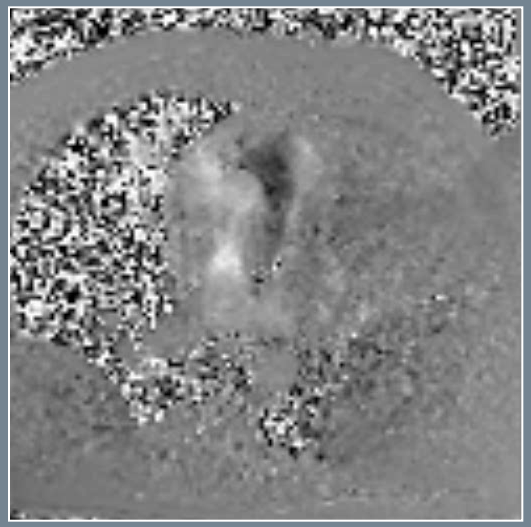
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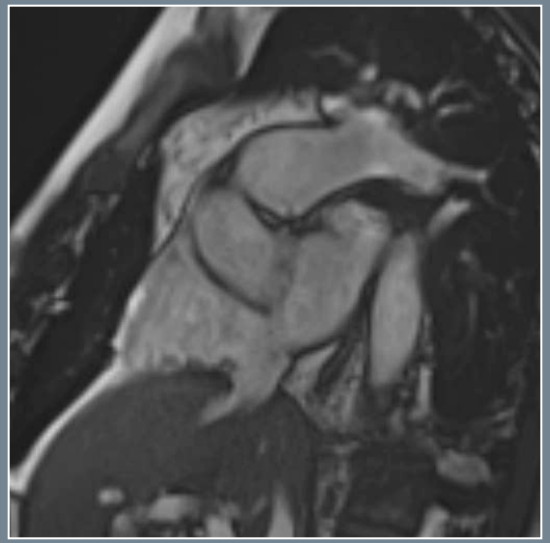
Homme, 59 ans

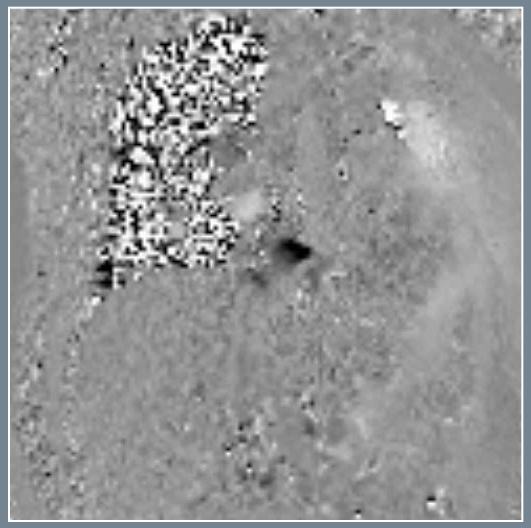
CIA:

Prise en charge par cathétérisme







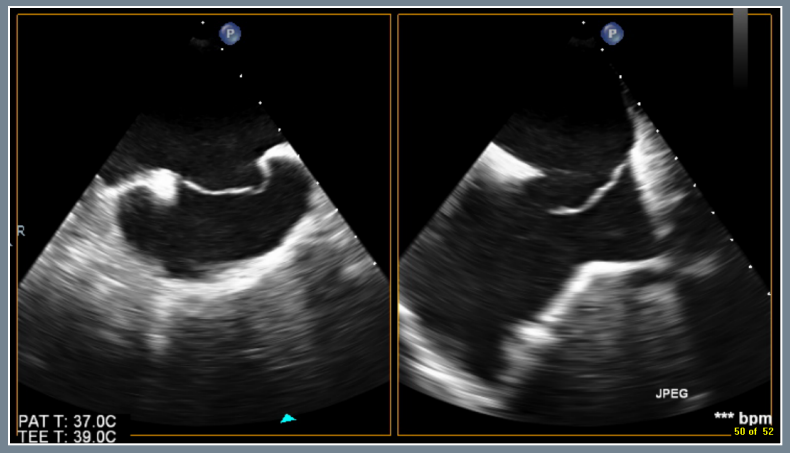


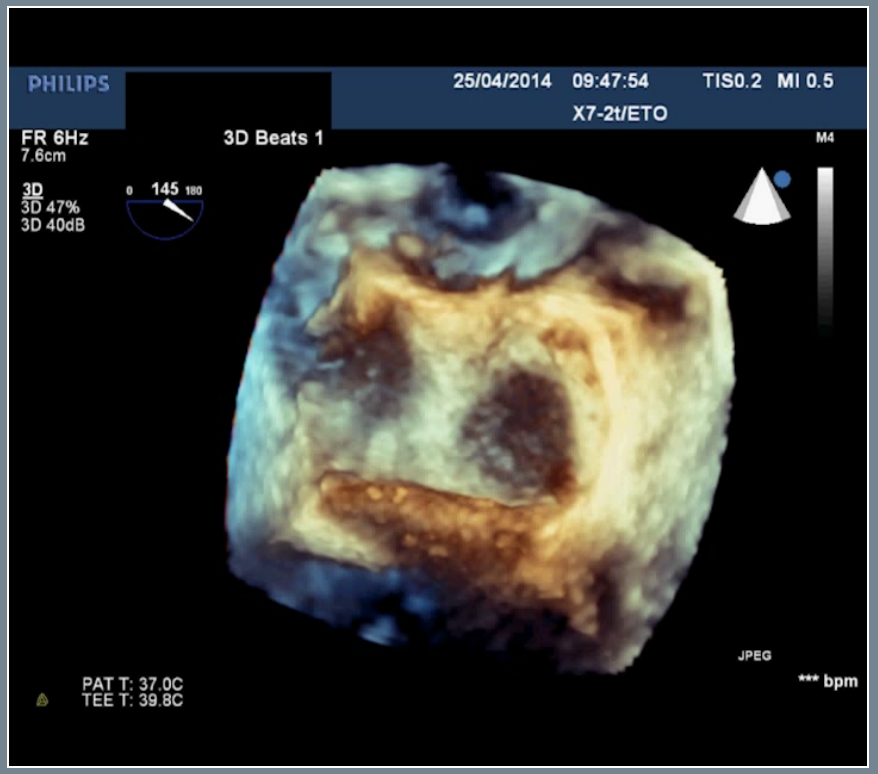
Pré procédure

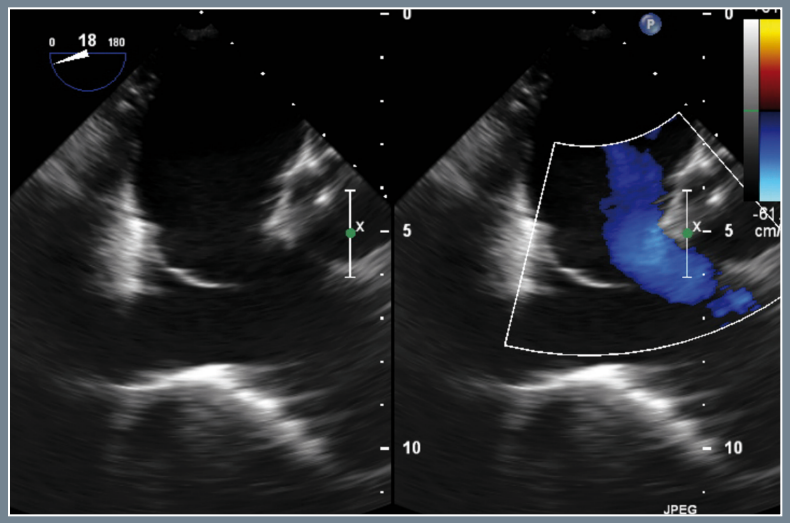
Homme, 59 ans

CIA:

Prise en charge par cathétérisme





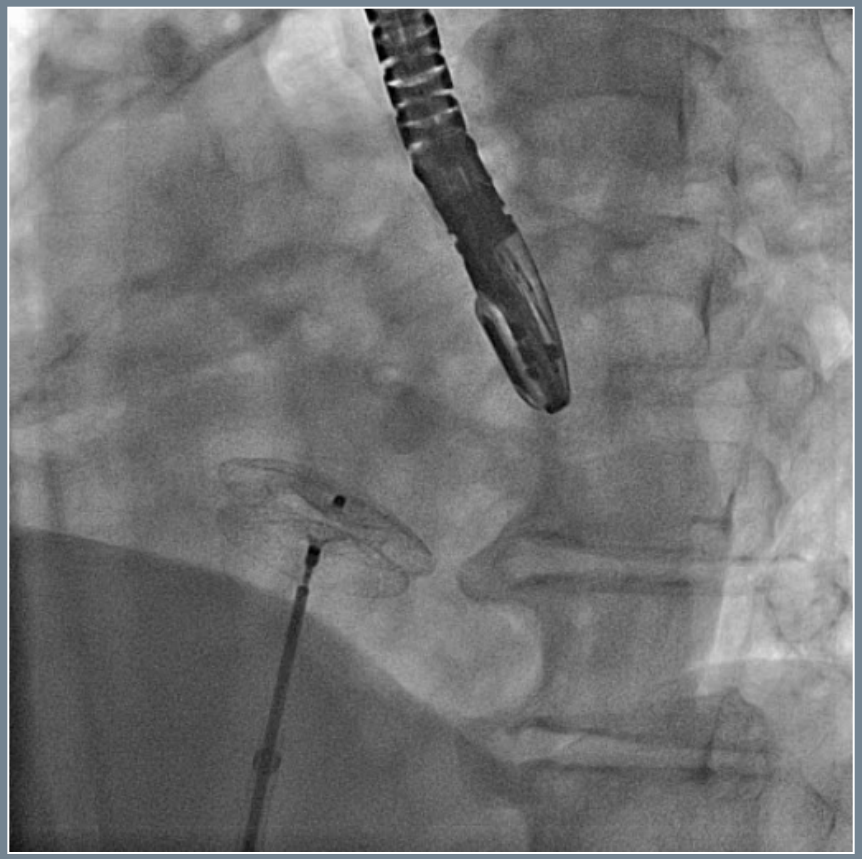


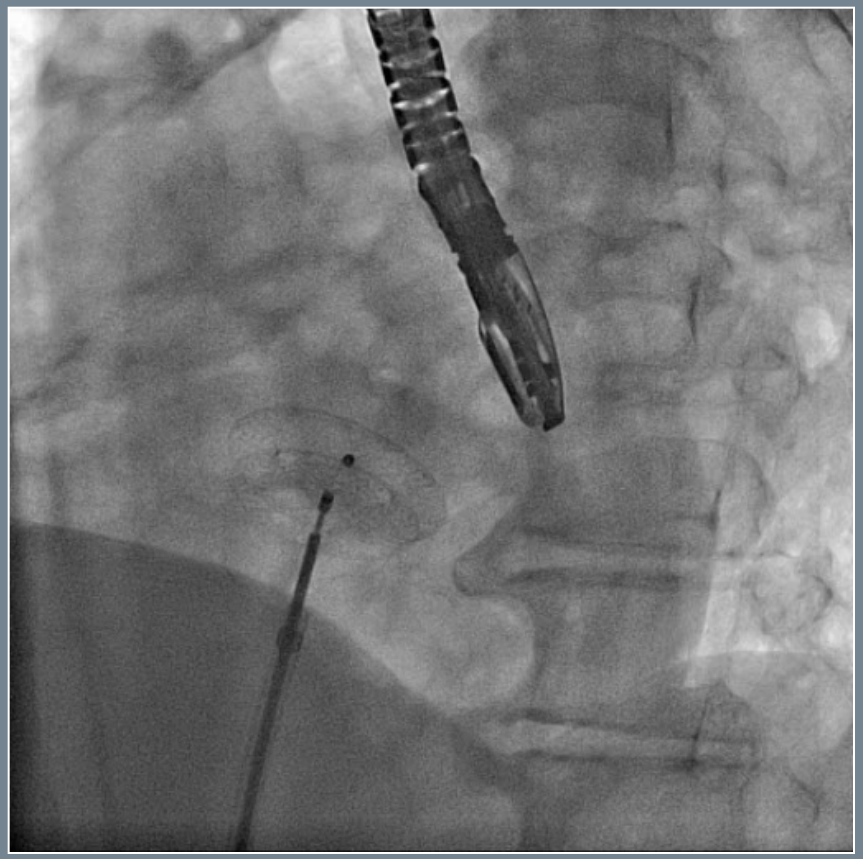
Pré procédure

Homme, 59 ans

CIA:

Prise en charge par cathétérisme



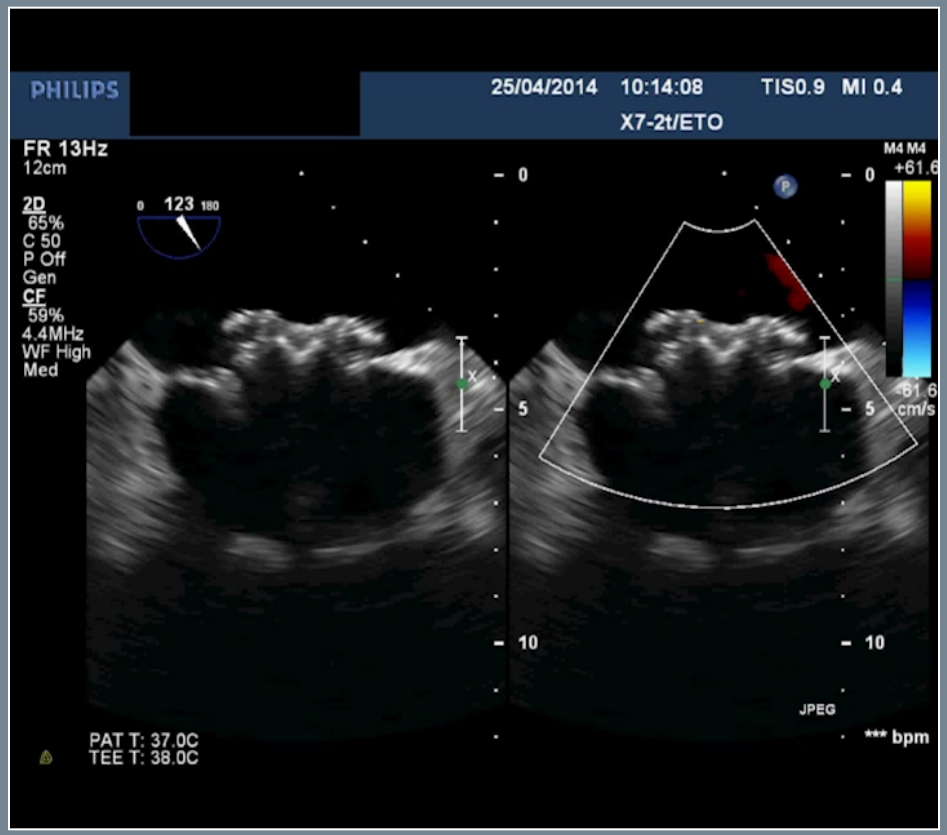


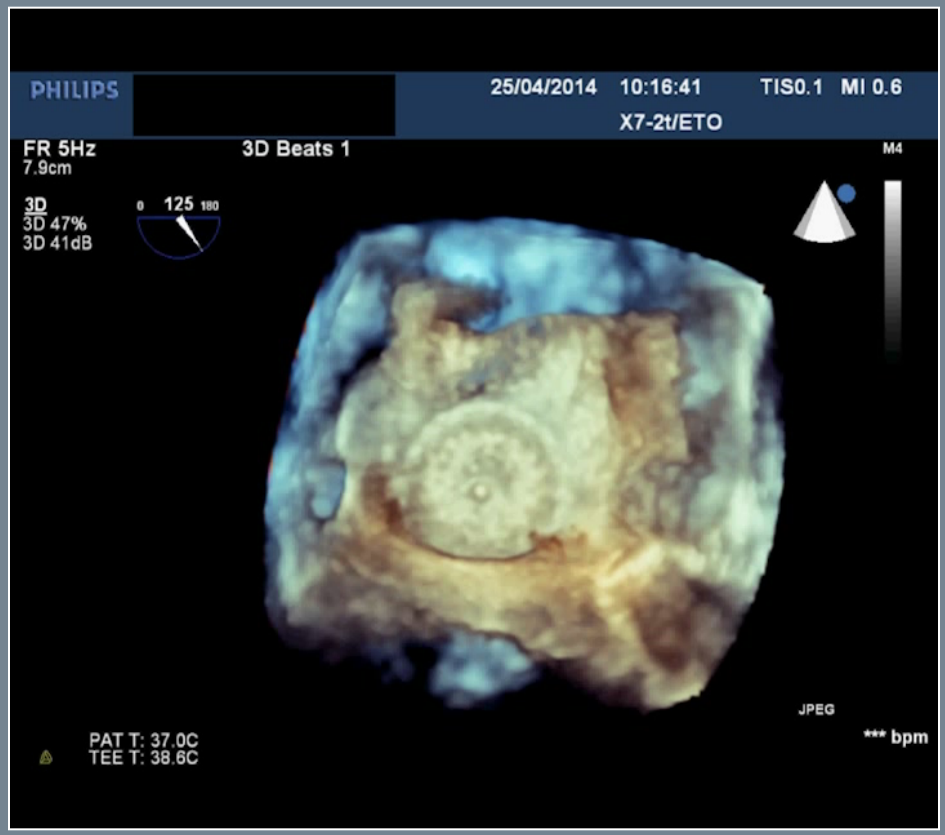
Procédure

Homme, 59 ans

CIA:

Prise en charge par cathétérisme





Post procédure

Traitement Per Procédure

- Héparine 100 ui/kg IV
- Aspirine 250 mg IV
- Antiobioprophylaxie

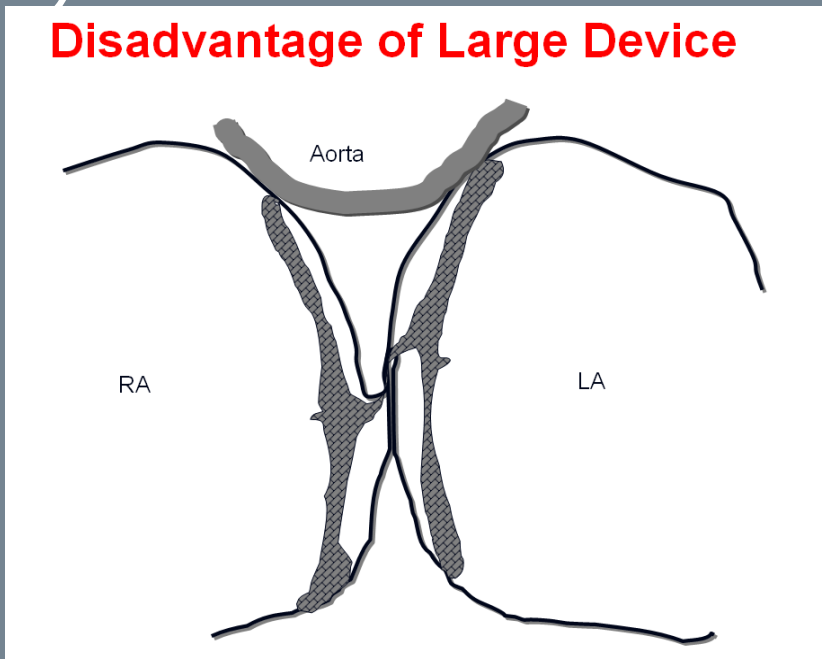
Traitement Post-Procédure

- Clopidogrel 3 mois
- Aspirine 6 mois

CIA:

Complications potentielles

- ≈1% (1)
- Risques infectieux: exceptionnels
- Malposition/migration de prothèse: rares
- Risques emboliques (cruoriques, gazeux): rares
- Risques traumatiques: (0.1%)
  - Pendant la procédure: très rares
  - A distance(érosion induite par les larges prothèses)



1: ZD.Du. J Am Coll Cardiol 2002; 39: 1836-44

CIA:

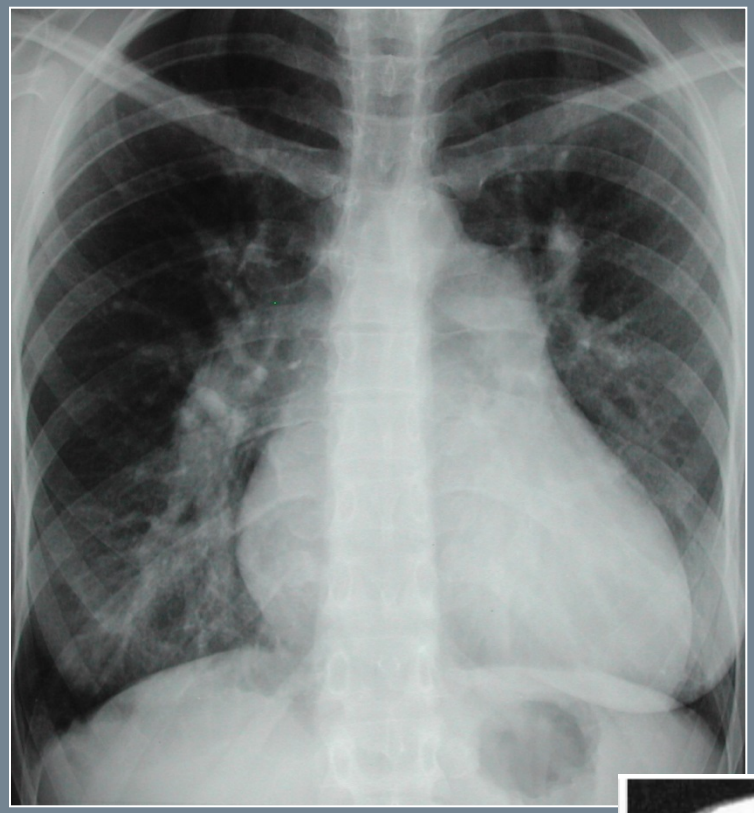
Résultats

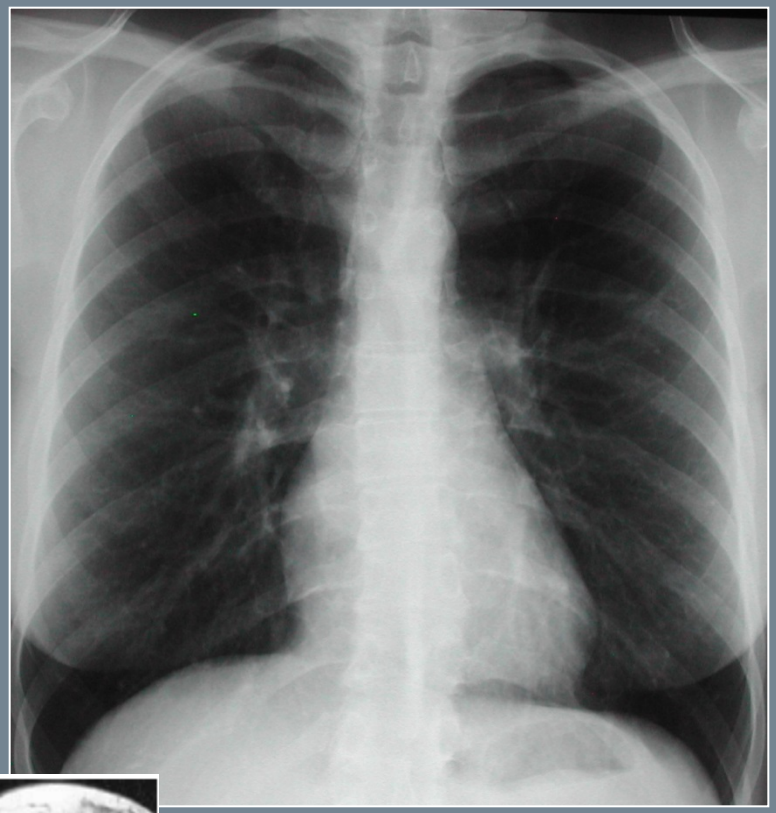
- Taux de succès d'implantation: 95%
- Taux d'efficacité ≥ 98%
- Diminution significative des volumes ventriculaires droits à moins de 6 mois
- Diminution de la classe fonctionnelle NYHA
- Diminution du risque rythmique ? (fonction de l'âge de la correction)
- Pas d'études comparatives randomisées versus chirurgie

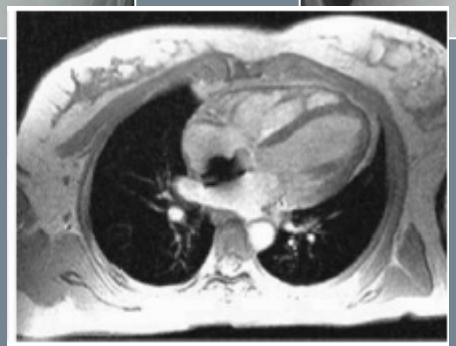
M.Humenberger. Eur Heart J 2011; 32: 553-60

CIA:

Évolution







IRM

CIA:

Recommandations

Table 3 Indications for intervention in atrial septal defect

Indications	Class[a]	Level[b]
Patients with significant shunt (signs of RV volume overload) and PVR <5 WU should undergo ASD closure regardless of symptoms	I	B[26]
Device closure is the method of choice for secundum ASD closure when applicable	I	C
All ASDs regardless of size in patients with suspicion of paradoxical embolism (exclusion of other causes) should be considered for intervention	IIa	C
Patients with PVR ≥5 WU but <2/3 SVR or PAP <2/3 systemic pressure (baseline or when challenged with vasodilators, preferably nitric oxide, or after targeted PAH therapy) and evidence of net L–R shunt (Qp:Qs >1.5) may be considered for intervention	IIb	C
ASD closure must be avoided in patients with Eisenmenger physiology	III	C

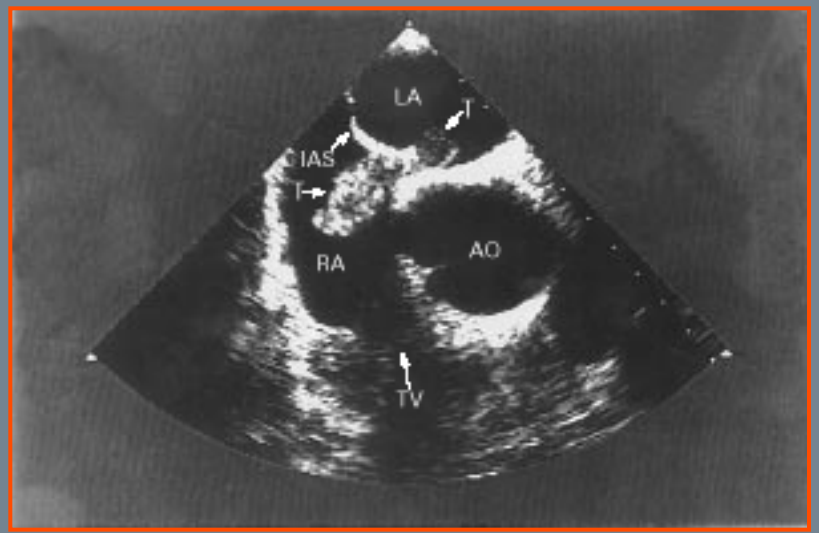
CIA:

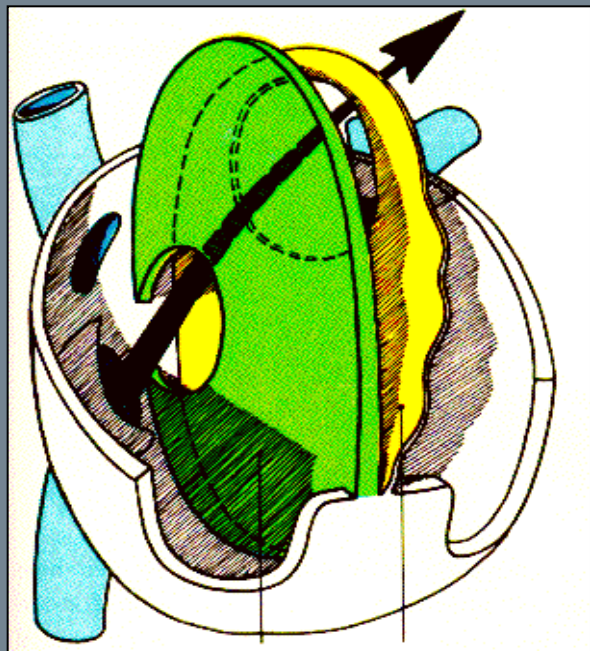
Expérience du Centre

- Tous les types de prothèses utilisés (Sidéris, Starflex, Cardia, Hellex-Gore, St Jude Premere, Amplatz)
- 223 procédures + procédures Marseille et Liban depuis mai 1992
- Complications:
  - Hémiplégie régressive: 2 (un enfant et un adulte, opérés un an après)
  - Perforation mitrale: 1 (enfant opéré 4 mois plus tard; Sidéris)
  - Perforation OD: 1 (adulte; Sidéris)
  - Embolisations dans l'AP (2), dans le VG (1)
  - Embolisations gazeuses: 11 sans séquelles
  - Pas de troubles conductifs
  - Pas de DC

FOP

- Défaut d'accolement du septum primum et du septum secundum
- Formen ovale demeure perméable à l'âge adulte dans 25% des cas
- Etiopathogénie impliquée dans les accidents vasculaires cérébraux ischémiques non expliqués (30%)





FOP:

Rôle de l'orientation du septum



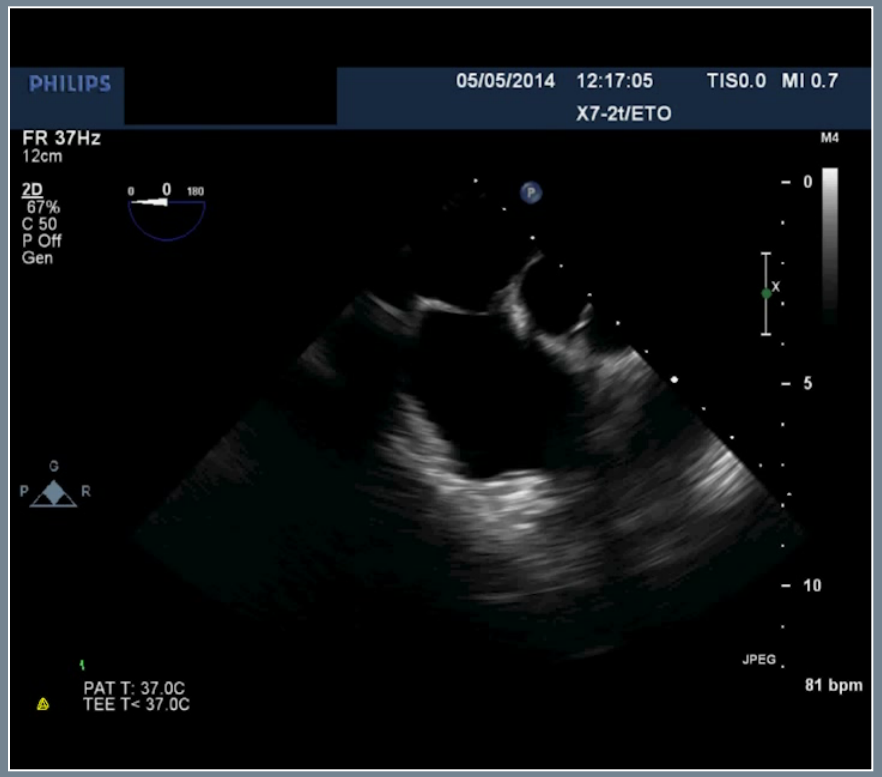


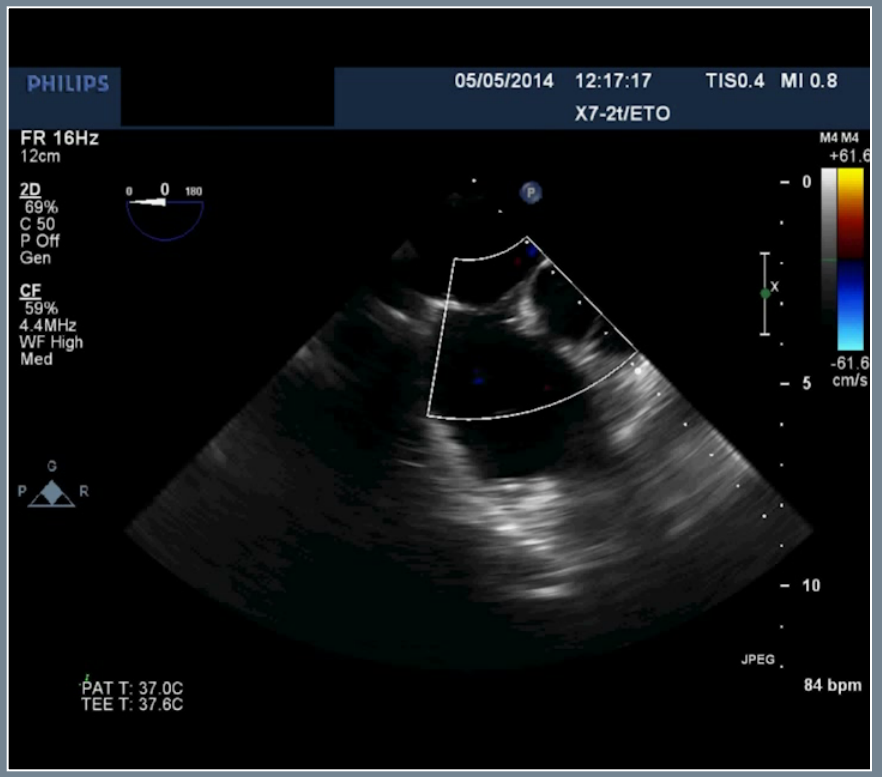
IRM

L Iacuzio

FOP:

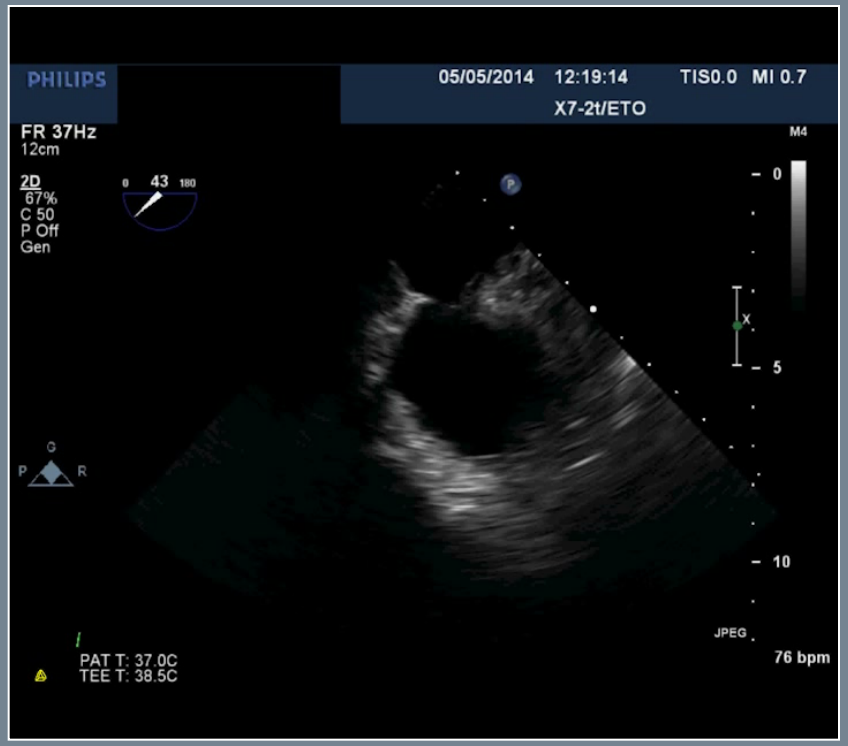
Rôle de la valve d'Eustache

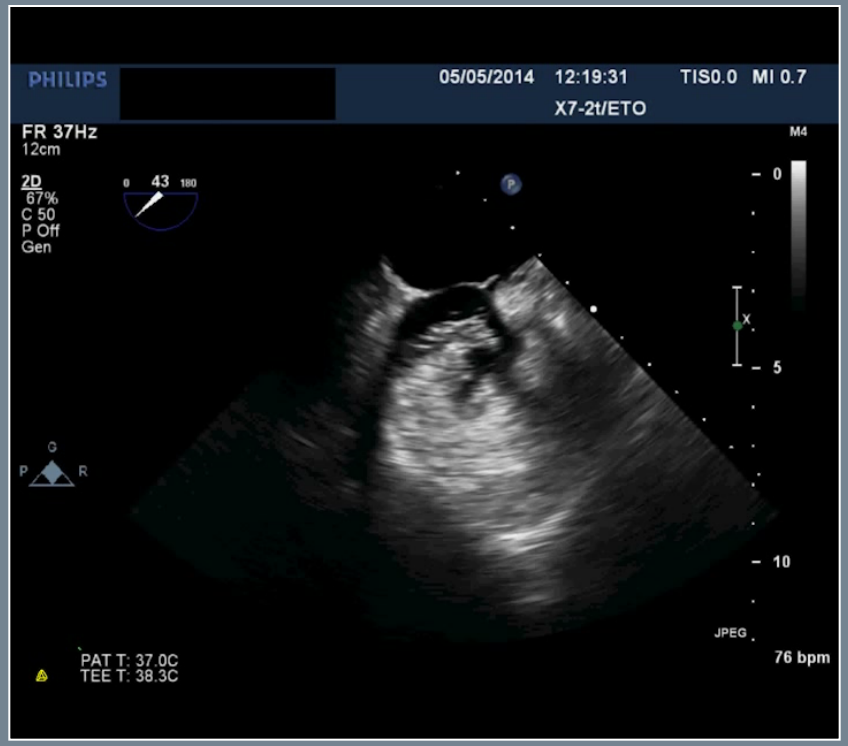




FOP:

Rôle de la valve d'Eustache

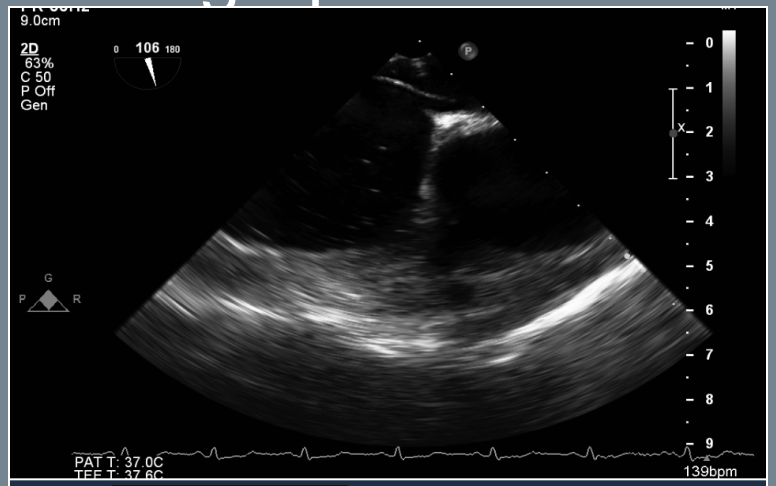


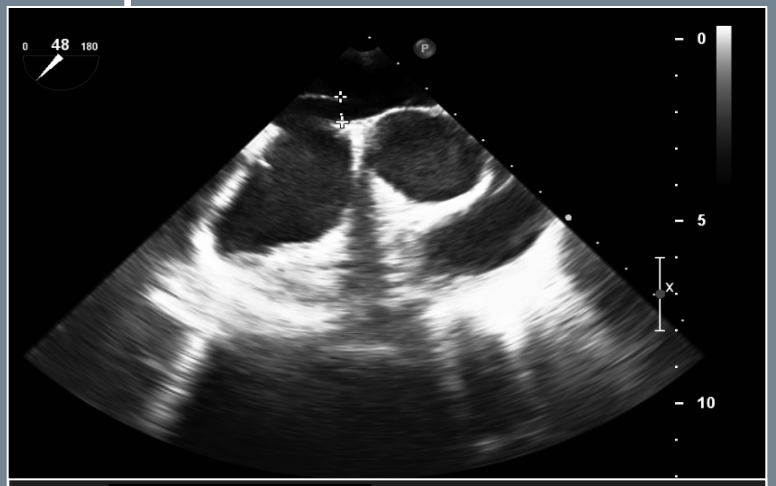


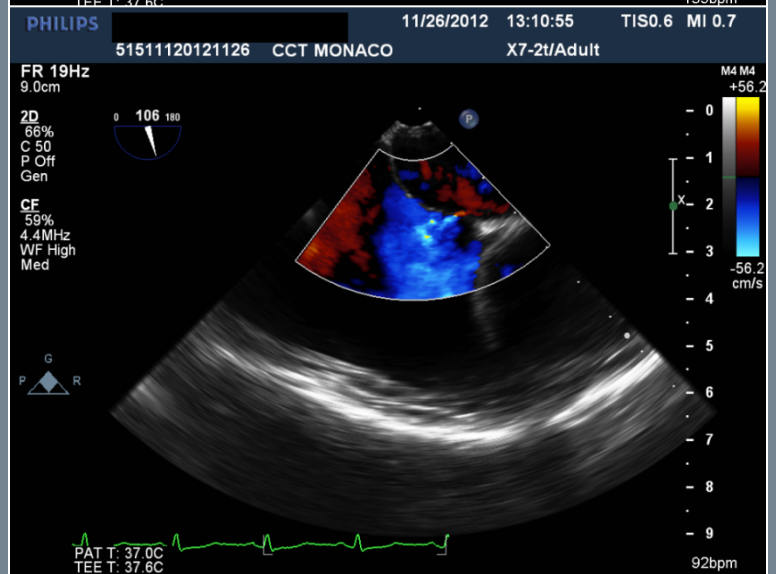
FOP:

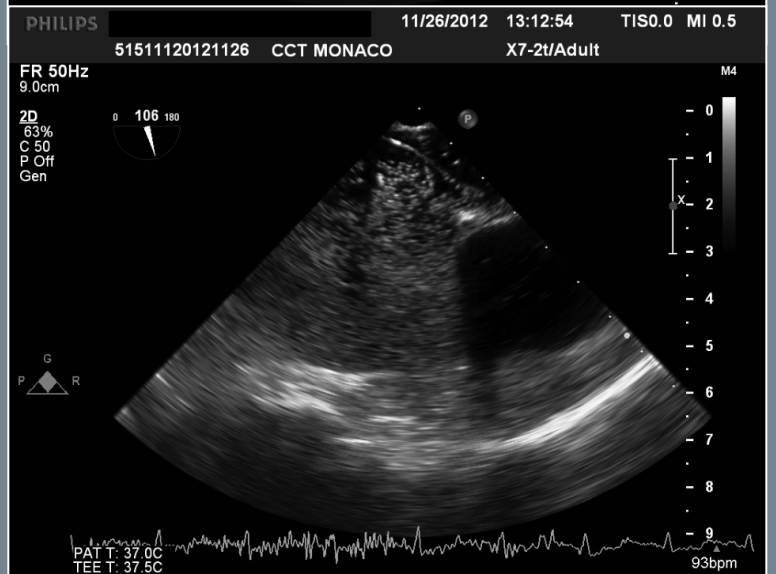
Détection

Echographie TT ou TO avec épreuve de contraste

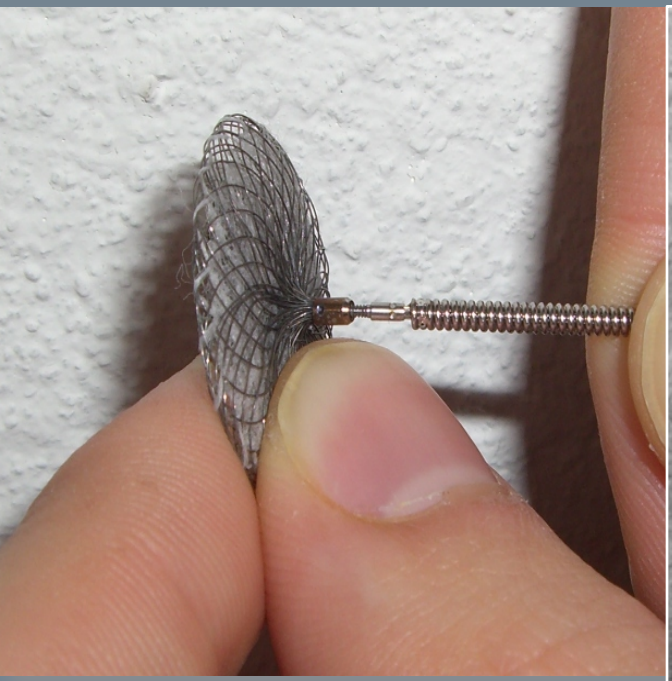


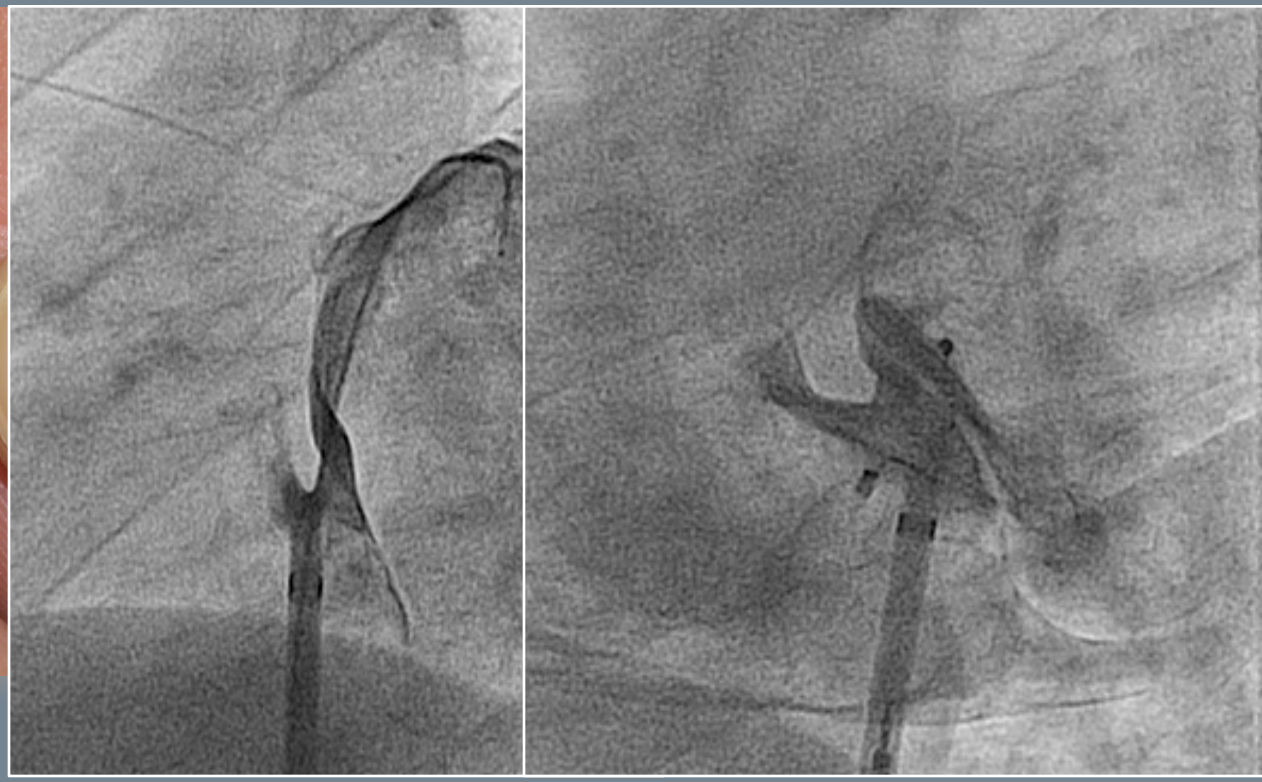






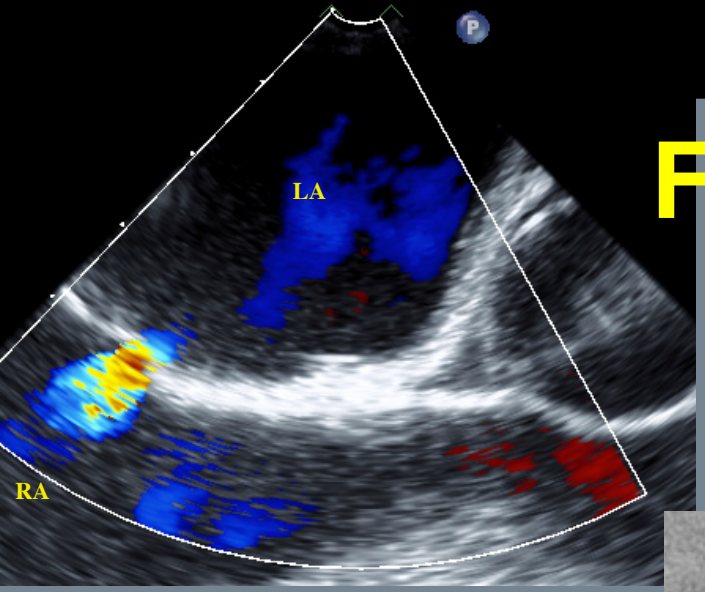
FOP: Fermeture



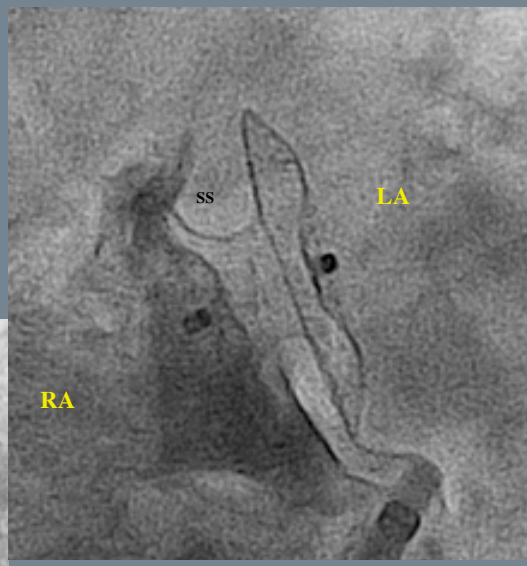


- Anésthésie locale
- Pas de guidance échographique trans-oesophagienne
- Procédure par voie fémorale sous héparine et aspirine en bolus
- Antiobioprophylaxie
- Traitement par aspirine (6 mois) et clopidogrel (3 mois)

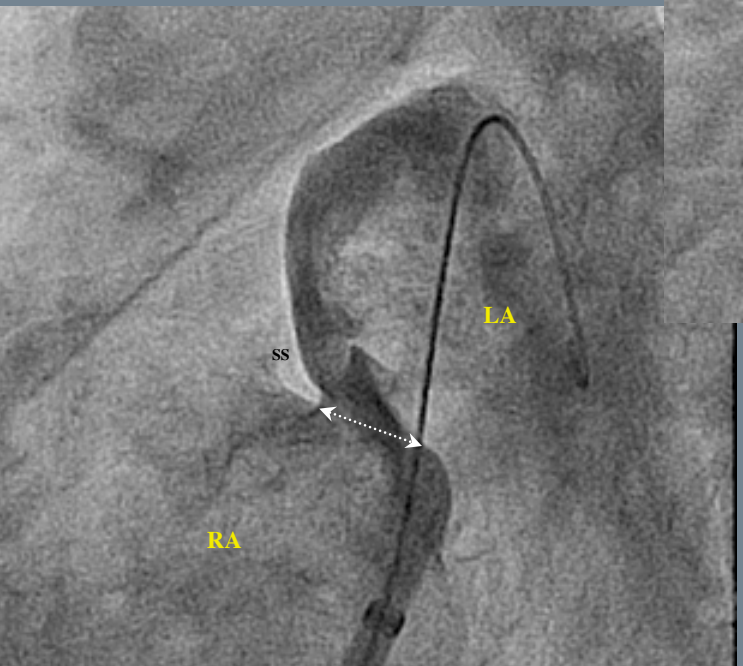
FOP: Fermeture



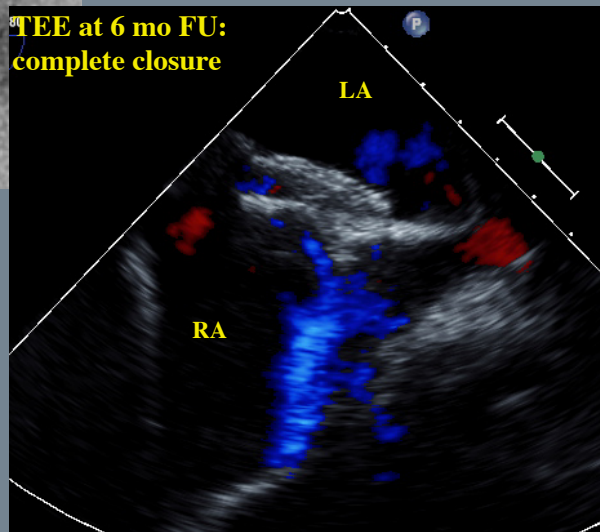
18 mm Amplatzer ASD Occluder







TEE at 6 mo FU: complete closure

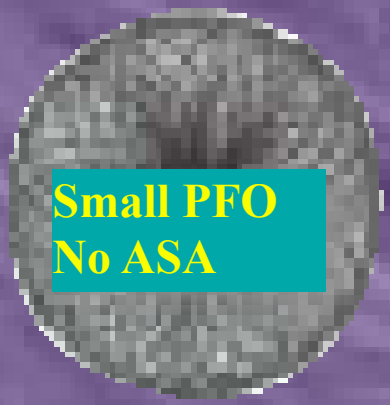


FOP: Fermeture

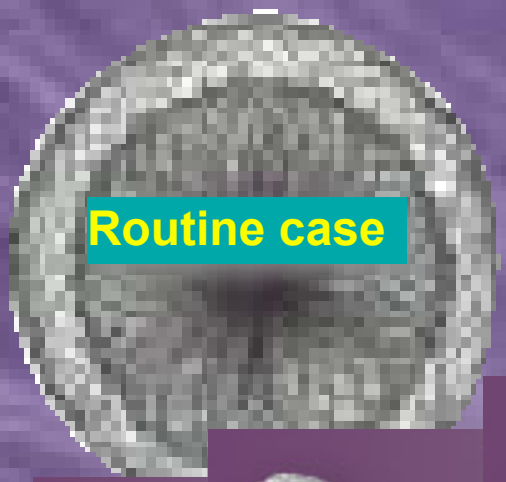
18 / 18 mm	18 / 25 mm	28 / 35 mm
8 French	8 French	9 French

as seen from left atrium

Amplazer PFO Occluders



Small PFO
No ASA



Routine case

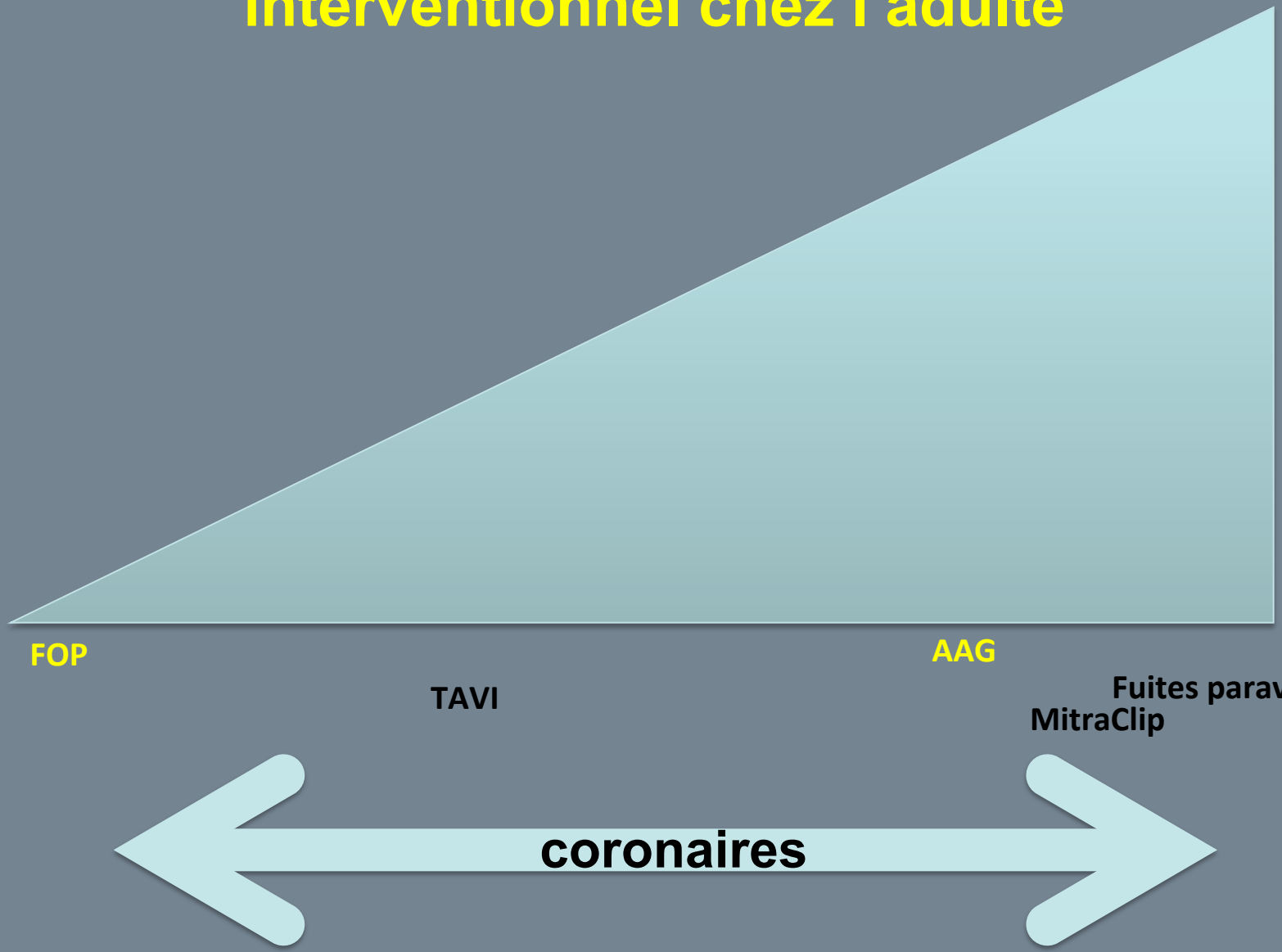


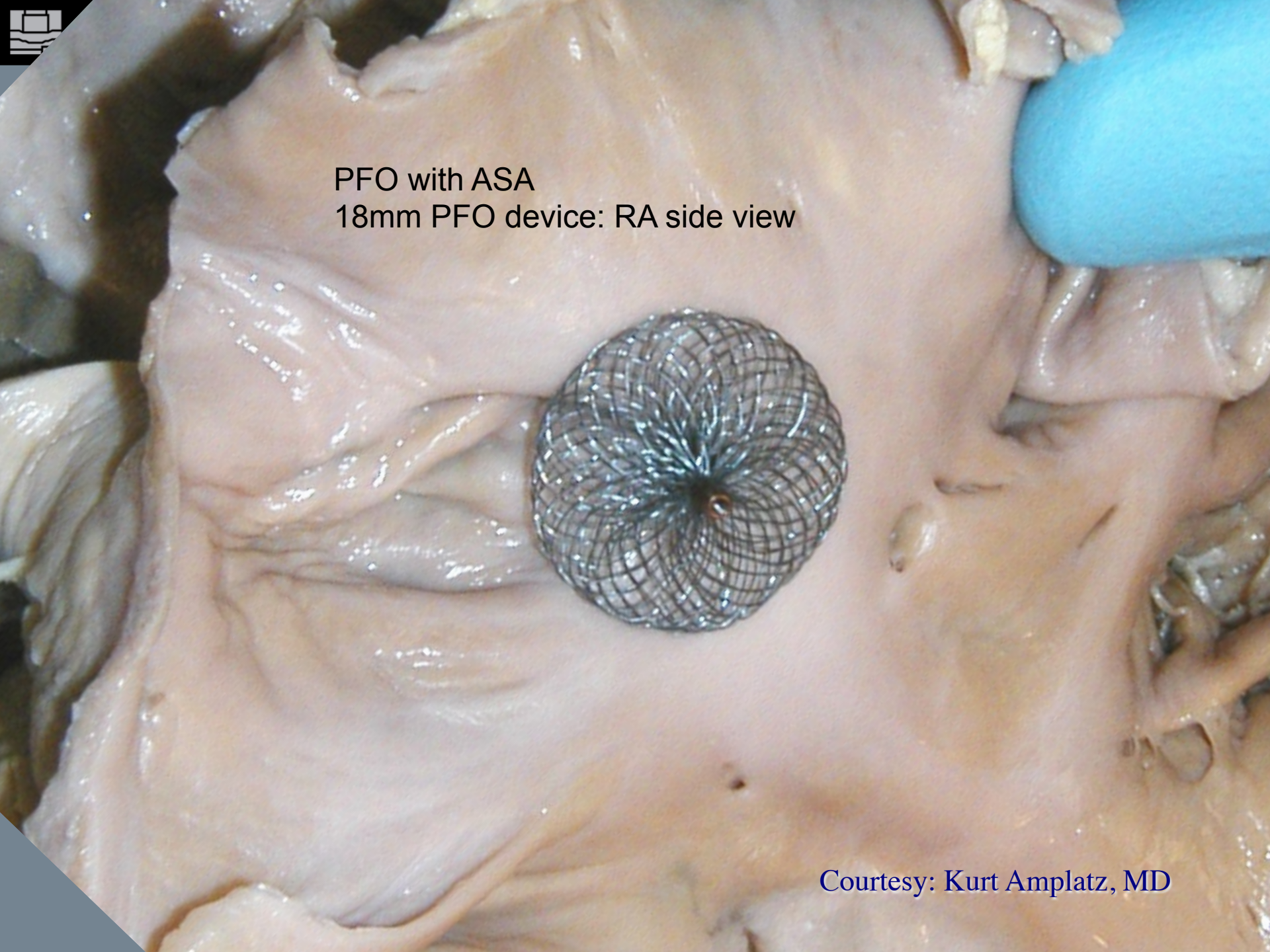
Enormous ASA
Very long tunnel
Very thick septum secundum



Twin (cribriform) 25 / 25 30 / 30 35 / 35 40 / 40 mm

Difficulté des procedures de cathétérisme interventionnel chez l'adulte




PFO with ASA
18mm PFO device: RA side view
Courtesy: Kurt Amplatz, MD

Indications potentielles de fermeture du FOP

- **Prevention secondaire**
  - AVC
  - AIT
  - IDM embolique
  - Embolie peripherique
  - **Accident de decompression**
  - Oedème pulmonaire d'altitude

- **Prevention primaire**
  - Facteurs agravant le PFO
    - Anevrysme septum inter atrial
    - Valve d'Eustachi
    - Reseau de Chiari
  - Facteurs prothrombotiques
  - Thrombose des veines profondes
  - Embolie pulmonaire
  - Electrodes Pacemaker/Defibrillat..
  - Chirurgie decubitus ventral
    - Orthopedique lourde
    - Cerebrale en position assise
  - Grossesse planifiée
  - Tumeurs carcinoïdes
  - Cardiopathies congenitales

- **Therapeutique**
  - Migraine (avec aura)
  - **Platypnea orthodeoxia**
  - **Desaturation**
  - Apnée du sommeil
  - Desaturation à l'exercice

- **Activités loisir / professionnelle**
  - Plongée avec scaphandre
  - Alpinisme
  - Musicien (cuivres)
  - Souffleurs de verre
  - Pilote de jet /Acrobatie aerienne
  - Astronaute
  - Pilote de ligne
  - Carreleur

Faut-il fermer les FOP après un AVC de cause indéterminée?

- Absence de preuves dans la littérature dans la prévention des récidives d'AVC: études CLOSURE I (1), RESPECT (2)
- Problème de robustesse et de biais de ces études
- Étude CLOSE en cours en France
- Dernières méta-analyses (3, 4): supériorité de la fermeture des FOP par Amplatzer par rapport au traitement médical dans la prévention des récidives d'AVC

1:J.Furlan. N Engl J Med. 2012; 366: 991-9
2:JD.Caroll. N Engl J Med. 2013; 368: 1092-100
3:D.Capodanno. Eurointervention. 2014; 9: 1342-1349
4:AR.Khan. JACC Cardiovasc Interv. 2013; 6: 1316-23

FOP:

Expérience du Centre

- **439 patients ont eu une fermeture de FOP :**
  - **410 dans les suites d'un AVC**
  - **29 pour d'autres raisons:**
- **Syndrome de platypné orthodéoxie** **16**
  - **tumeur hépatique** **1**
  - **avant pneumonectomie** **3**
  - **hernie diaphragmatique** **1**
  - **après pneumonectomie** **8**
  - **dilatation aortique** **2**
  - **sclérodermie** **1**
- **Traumatisme thoracique** **1**
- **Syndrome d'apnée du sommeil** **2**
- **Infactus du ventricule droit** **1**
- **Cardiopathies congénitales** **9**

- **Un échec de pose**
- **Complications: une migration de prothèse, récupérée et repositionnée dans le même temps**

Conclusion

- Seules indications retenues de fermeture de FOP: hypoxémies secondaires
- Étude des dossiers au cas par cas (cf cardiopathies congénitales)
- Technique simple et sure
- La menée à terme des études randomisées en cours permettra d'établir scientifiquement le bénéfice de la fermeture des FOP dans la prévention des récidives d'AVC mais… on sera tous à la retraite!
- Et en attendant, on s'occupe des patients.

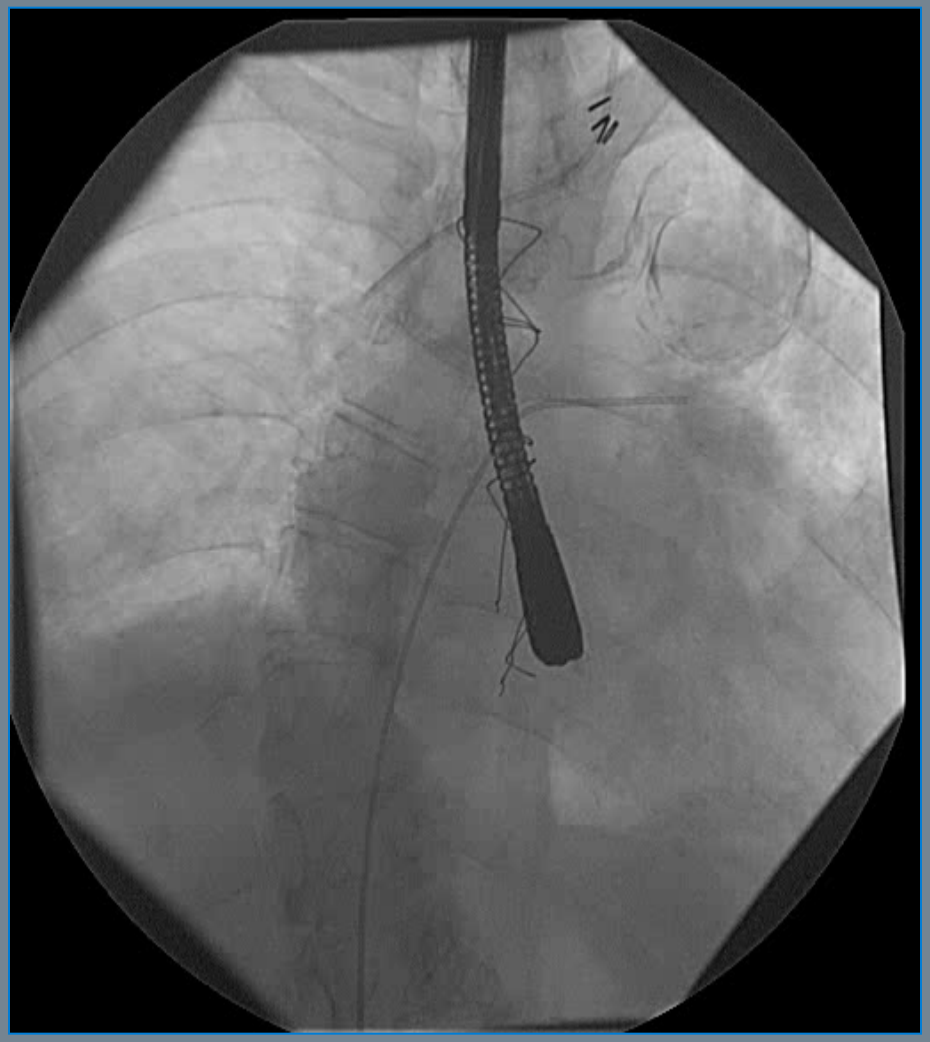
Merci de votre attention

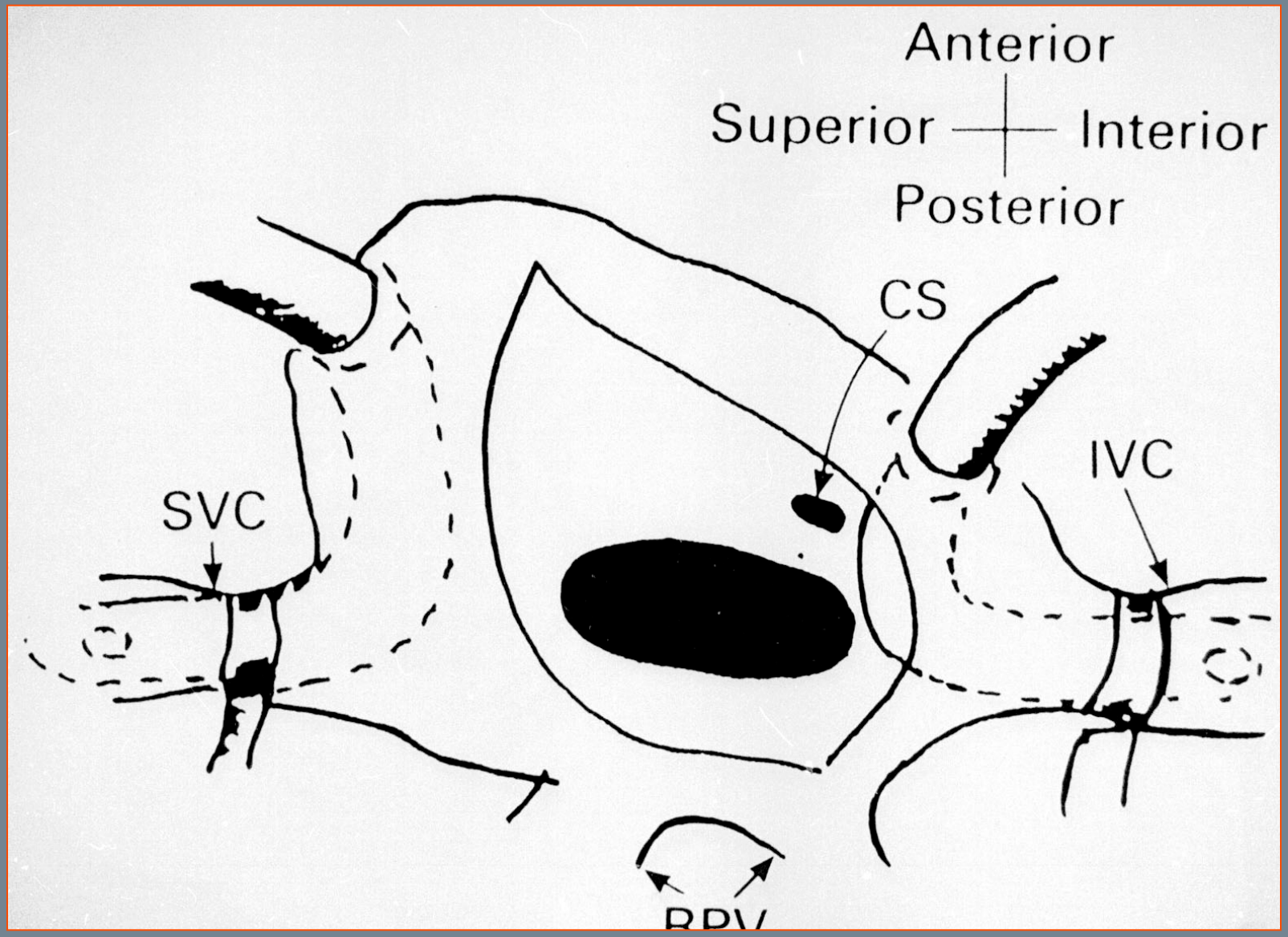


Merci de votre attention



EMBOLISATION




Anterior
Superior
Interior
Posterior
CS
SVC
IVC
RPV

CARDIOPATHIES PASSEES AU TRAVERS DES FILTRES SANITAIRES

CIA

- Sémiologie frustre
- ECG → BBDT – surcharge droite
- ECHO ++
  - ✓ CIA isolée
  - ✓ Retour veineux anormal associé
  - ✓ Anatomie ?
  - ✓ Fuites valvulaires ++
- Recherche de pathologie générale pouvant contre-indiquer la chirurgie ou la fermeture percutanée
- Rechercher :
  - ✓ Ischémie myocardique ++
  - ✓ Troubles du rythme ++

CIA:
prise en charge par cathétérisme

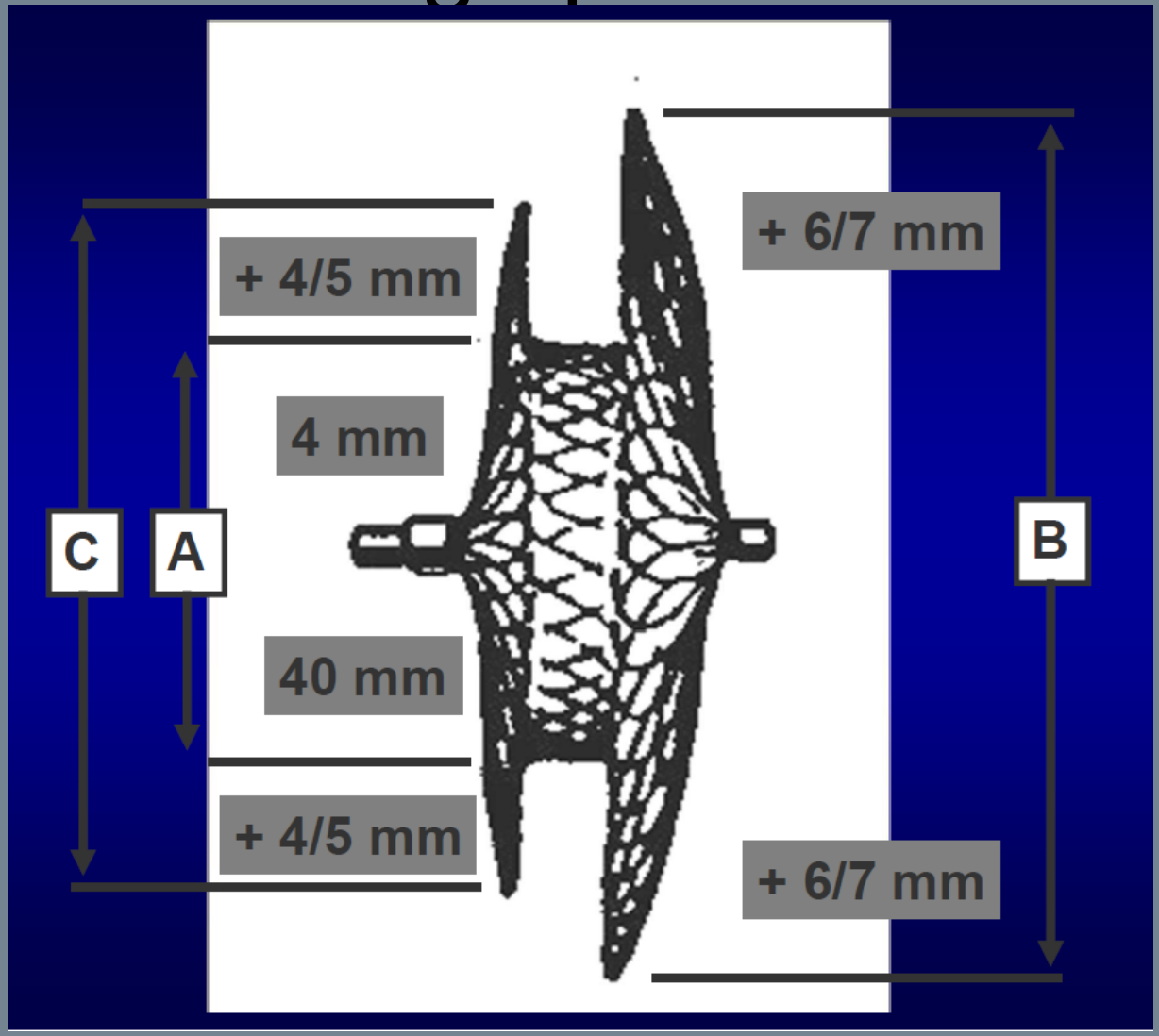
Les méthodes « d'occlusion »

Fermeture CIA et PFO

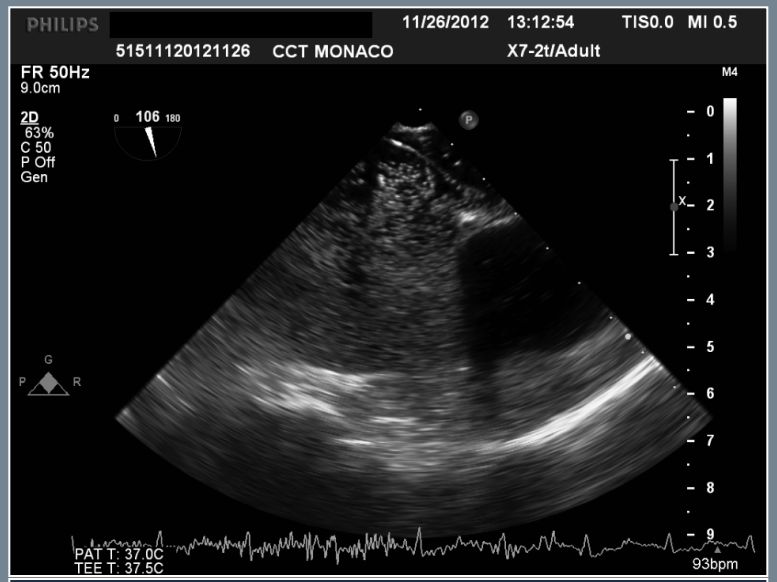
- **De moins en moins d'AG et d'ETO**
  - **ETT seule pour CIA**
  - **Scopie seule pour les PFO**

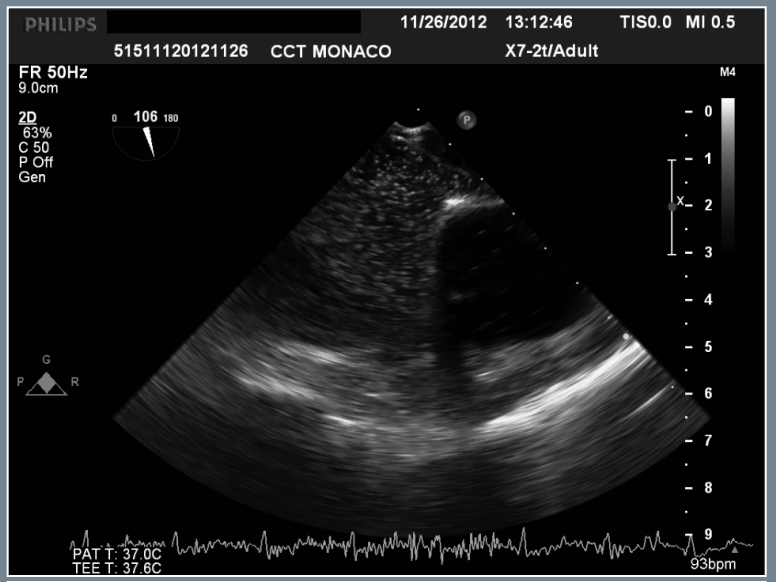
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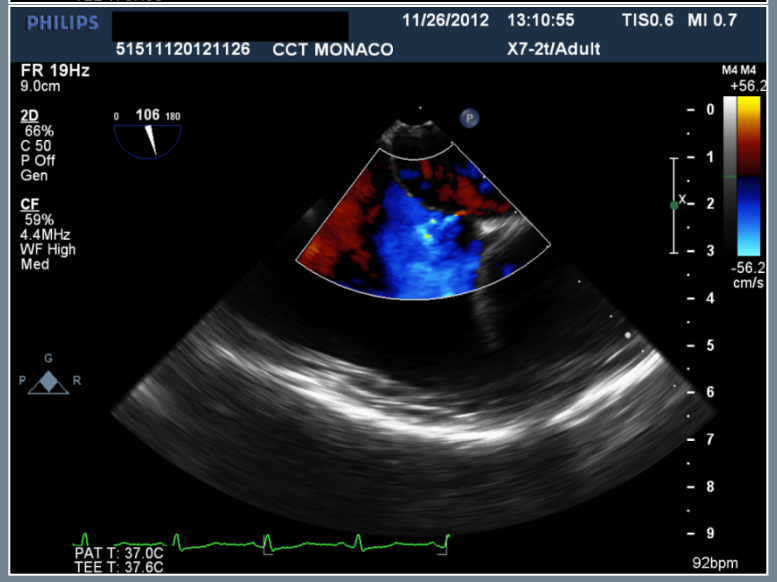
prise en charge par cathétérisme

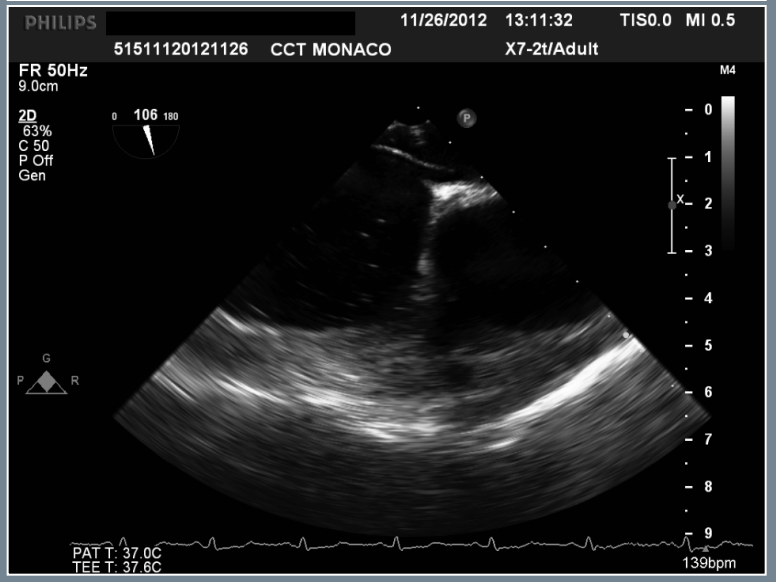


TOE

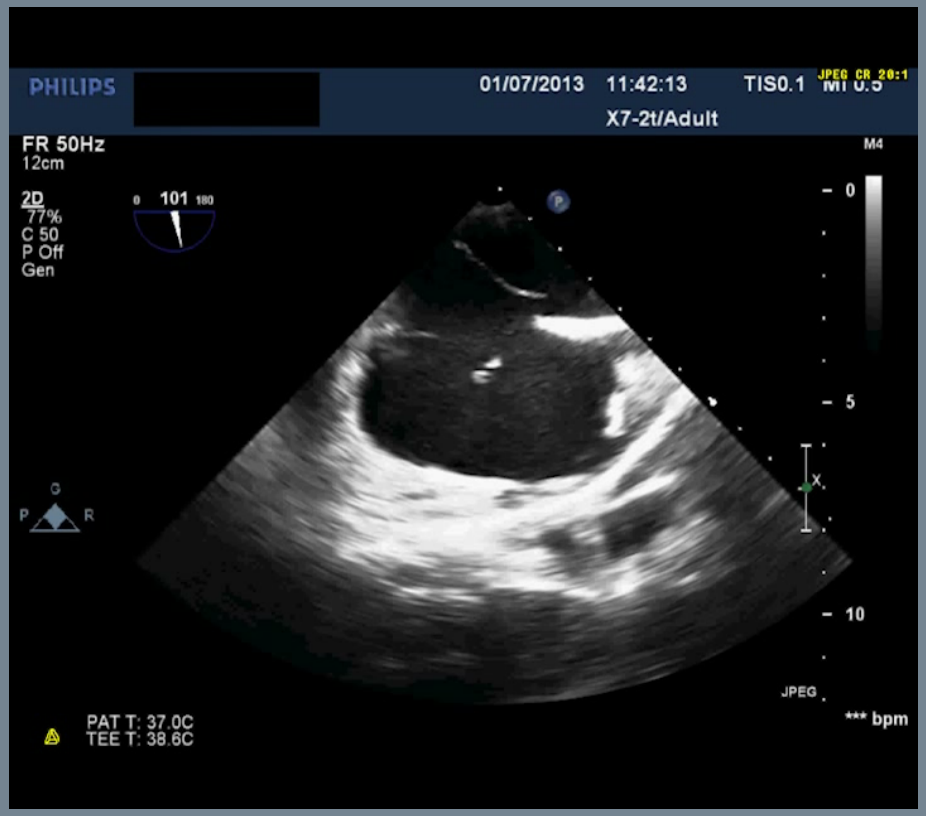

PHILIPS
11/26/2012 13:12:54 TIS0.0 MI 0.5
51511120121126 CCT MONACO X7-2t/Adult
FR 50Hz
9.0cm
2D
63%
C 50
P Off
Gen
106
M4
PAT T: 37.0C
TEE T: 37.5C
93bpm


PHILIPS
11/26/2012 13:12:46 TIS0.0 MI 0.5
51511120121126 CCT MONACO X7-2t/Adult
FR 50Hz
9.0cm
2D
63%
C 50
P Off
Gen
106
M4
PAT T: 37.0C
TEE T: 37.6C
93bpm


PHILIPS
11/26/2012 13:10:55 TIS0.6 MI 0.7
51511120121126 CCT MONACO X7-2t/Adult
FR 19Hz
9.0cm
2D
66%
C 50
P Off
Gen
CF
59%
4.4MHz
WF High
Med
106
M4 M4
+56.2
-56.2
cm/s
PAT T: 37.0C
TEE T: 37.6C
92bpm

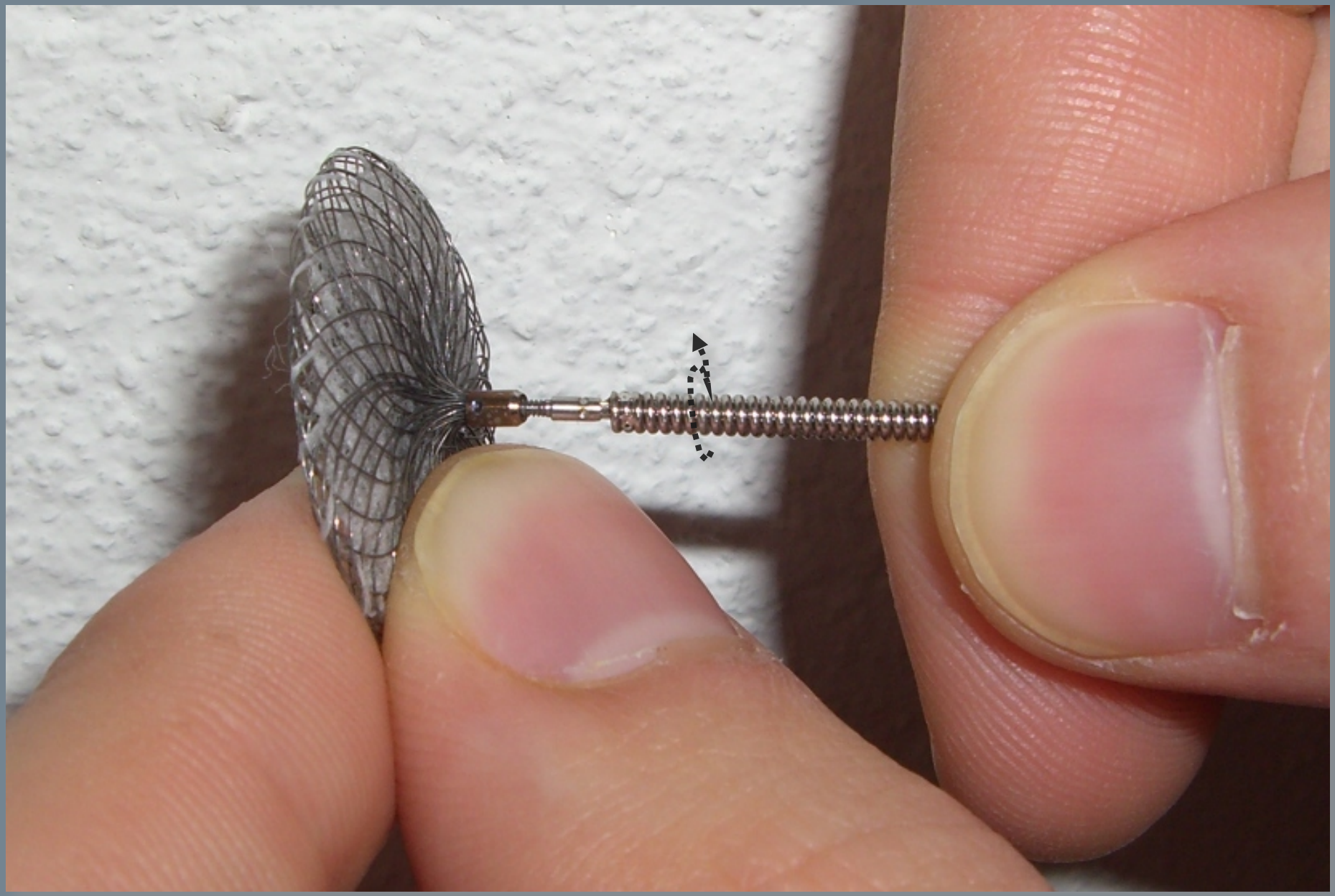

PHILIPS
11/26/2012 13:11:32 TIS0.0 MI 0.5
51511120121126 CCT MONACO X7-2t/Adult
FR 50Hz
9.0cm
2D
63%
C 50
P Off
Gen
106
M4
PAT T: 37.0C
TEE T: 37.6C
139bpm

TOE


PHILIPS
01/07/2013 11:42:13 TIS0.1
X7-2t/Adult
FR 50Hz
12cm
2D
77%
C 50
P Off
Gen
M4
JPEG
PAT T: 37.0C
TEE T: 38.6C
*** bpm

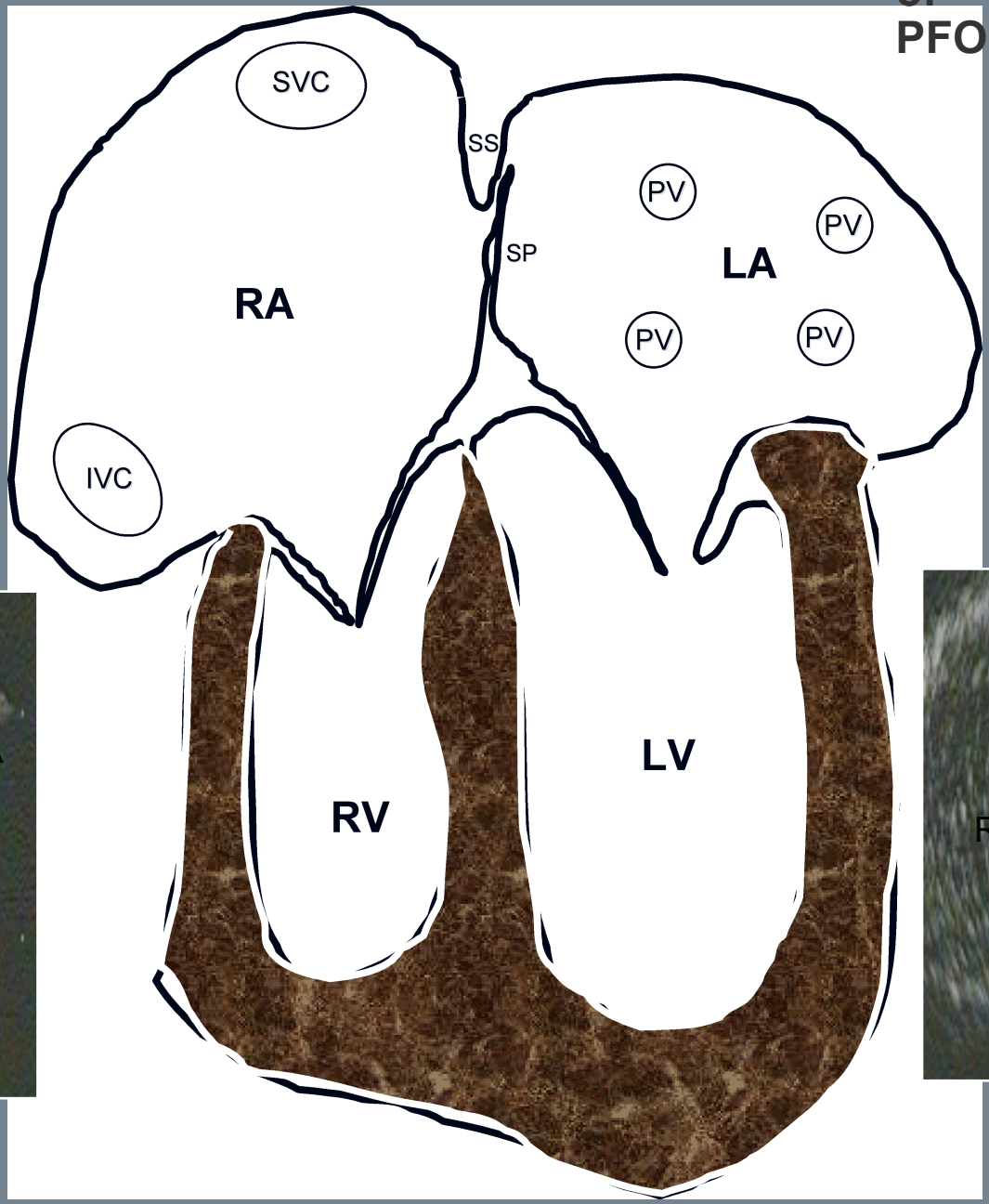

01/07/2013 11:39:27 TIS0.1 MI 0.5
CCT MONACO
X7-2t/Adult
M4
91 cm

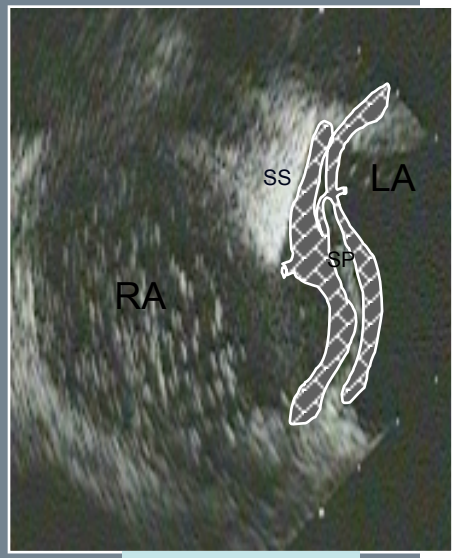
Technique of Amplatzer PFO Occlusion



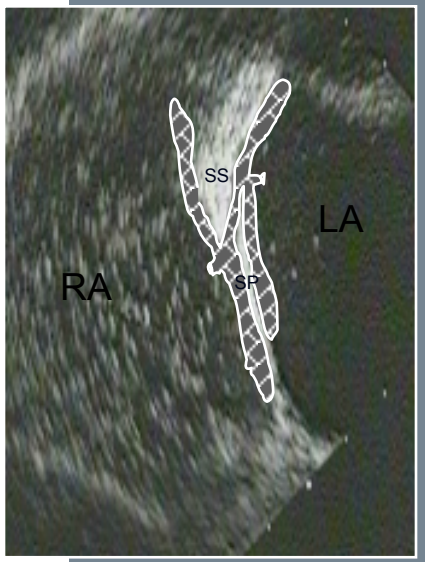
Pacman Sign of PFO Closure





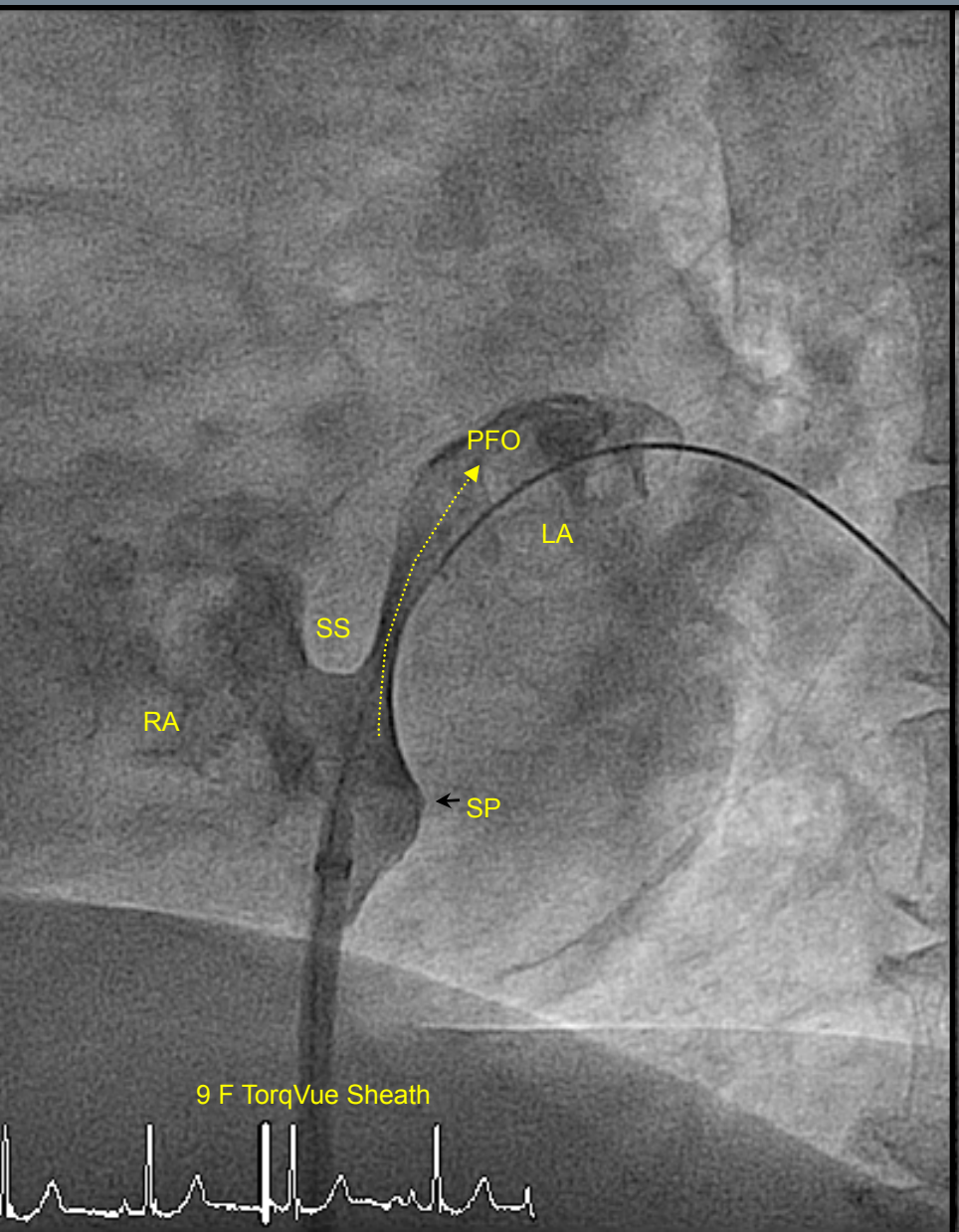


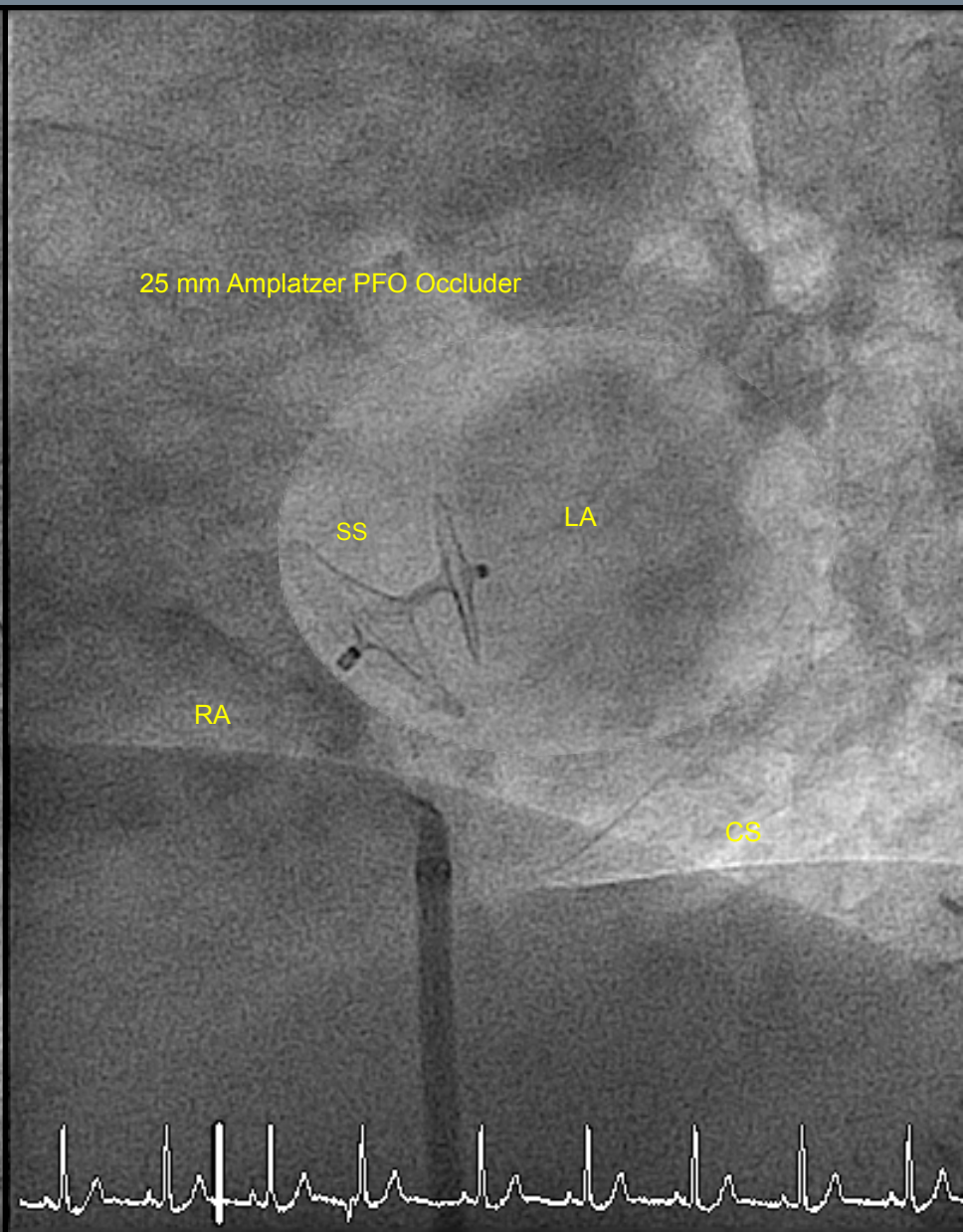
incorrect



correct

High suspicion by TTE

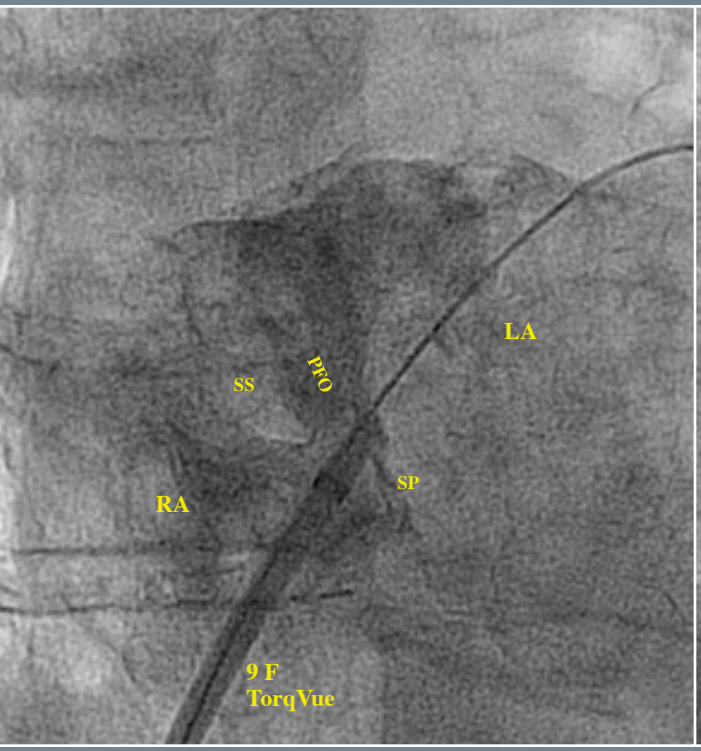




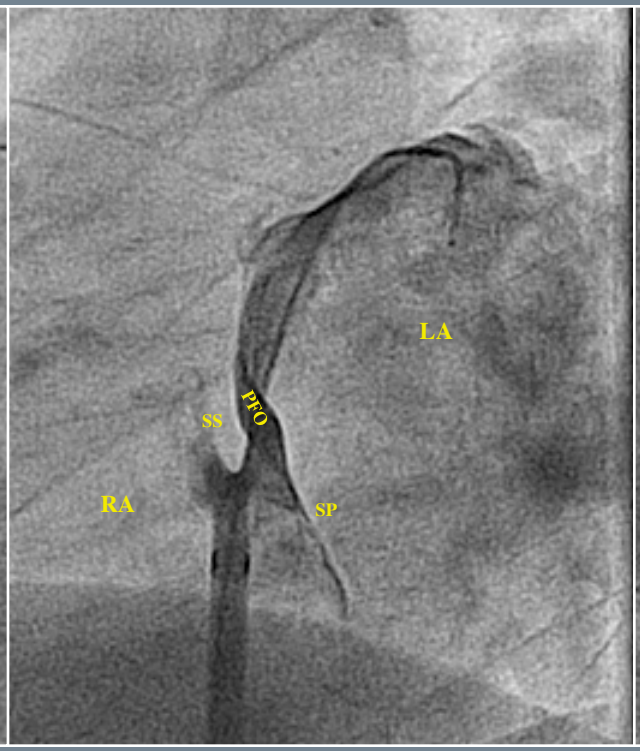
PFO Closure Without Prior Echo

Check anatomy with injection through sheath

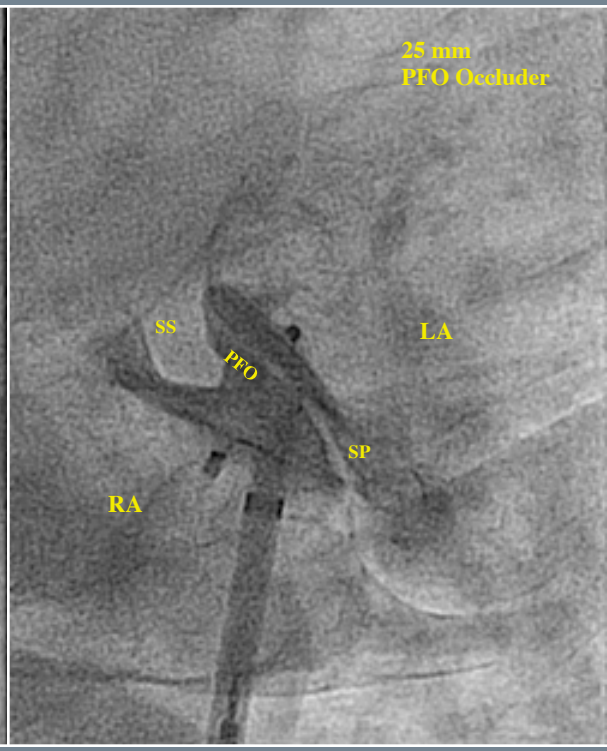
AP pre



LAO pre



LAO post



Embryologie

- J23: oreillette commune sans septation
- Pôle veineux où convergent toutes les veines de façon symétrique
- Latéralisation
- Involution de la corne G (VCSG) avec persistance du sinus coronaire
- Anomalie du développement:
  - Persistance VCSG – SC
  - Anomalie VCS dte: CIA sinus veinosus
- VCI gardée par valve d'Eustachi