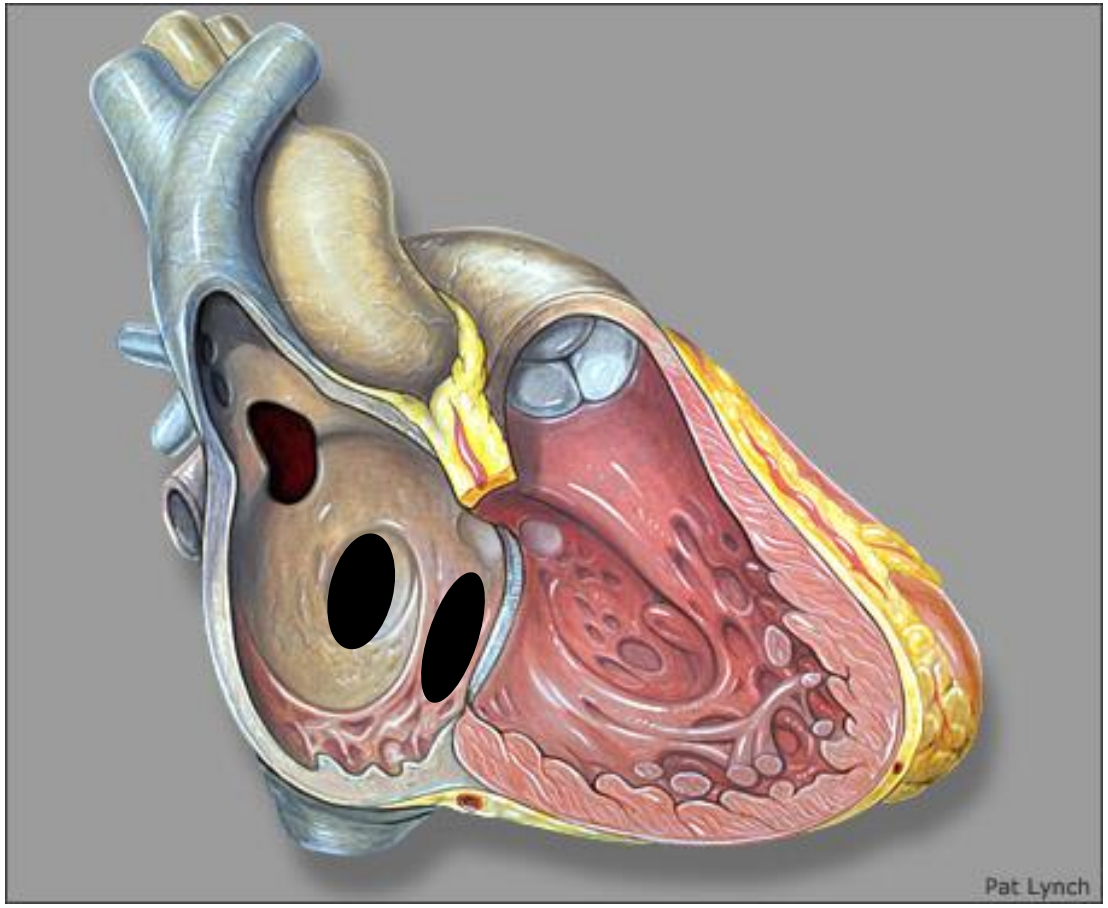
Communications inter atriales : Comment les analyser? Quand les adresser pour fermeture?

Dr Bruno Lefort

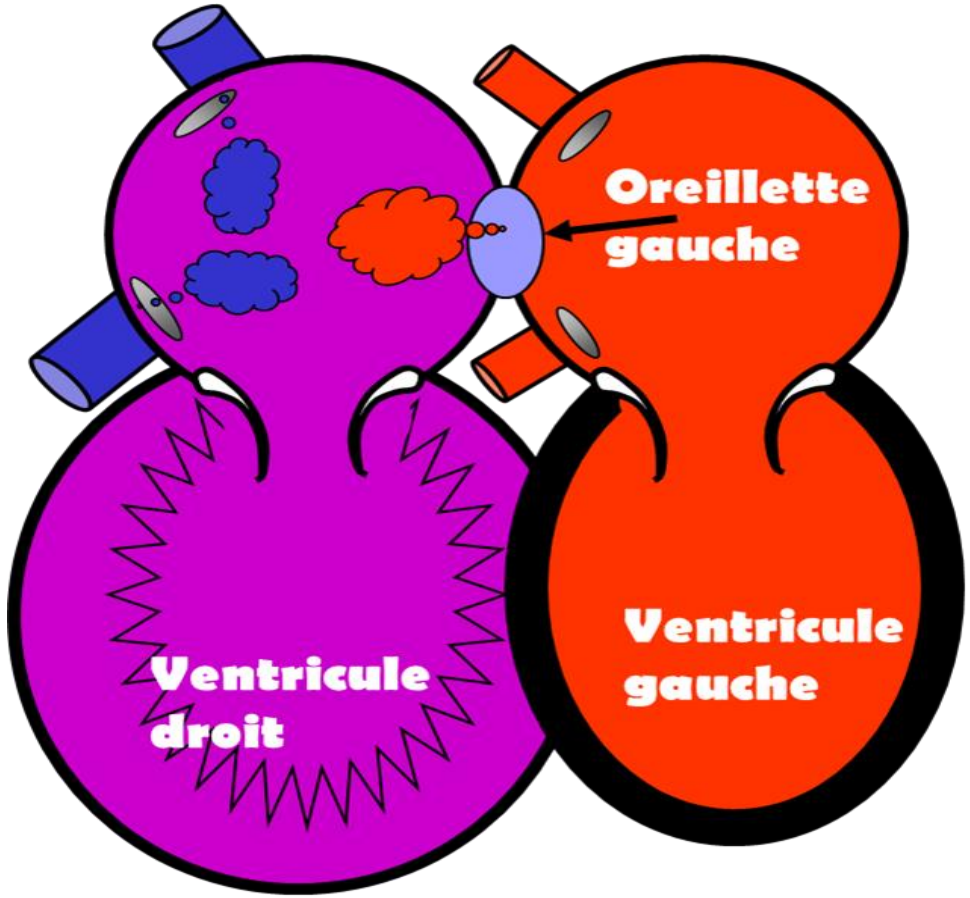
MCU-PH, Cardiologie congénitale, ICCT, CHU Tours

Anatomie



- CIA ostium secundum (la plus fréquente)
- CIA ostium primum (anomalie valve AV)
- CIA sinus veinosus (anomalie retour veineux pulmonaire)
- Sinus coronaire fenestré

Physiopathologie



- Shunt gauche droit auriculaire
- Surcharge volumétrique OD, VD, AP, VP
- Elévation du débit pulmonaire

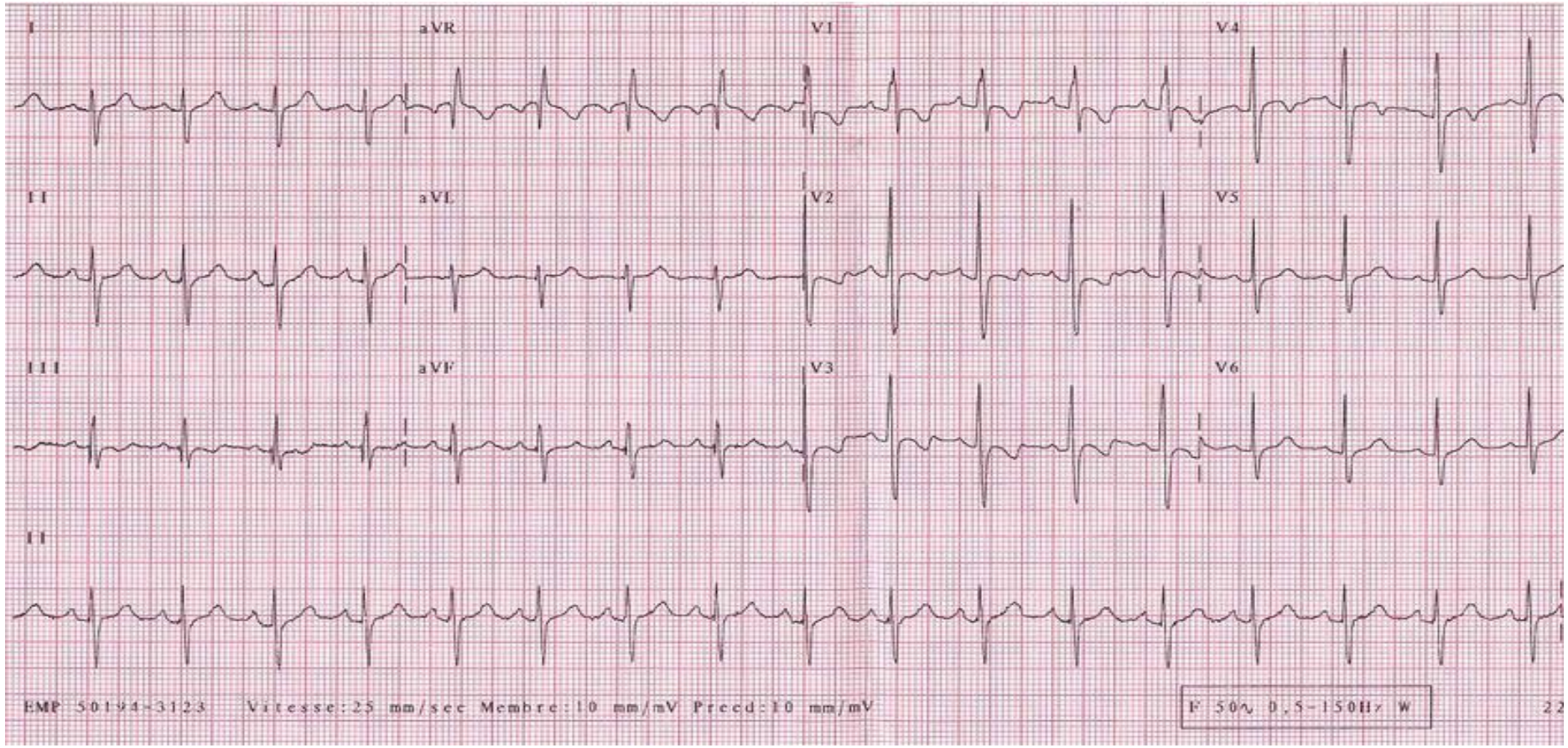
Evolution spontanée

- Fermeture spontanée possible des petites CIA OS pendant les 2 premières années
- TDR auriculaire
- Insuffisance cardiaque droite
- HTAP de débit, rarement élévation des résistances pulmonaires (susceptibilité génétique)
- Risque d’AVC

Clinique

- Très bonne tolérance clinique
- Eventuellement retard de croissance pondéral, ou symptomatologie pulmonaire (dyspnée d'effort, asthme mal contrôlé)
- Examen physique: SS foyer pulmonaire, dédoublement de B2
- Possible forme familiale (NKX2.5 (BAV1), GATA4, TBX6…)
- Possible syndrome : Noonan, Ellis van Creveled, Holt Oram…

ECG


I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
II
EMP 50194-3123 Vitesse:25 mm/sec Membre:10 mm/mV Precd:10 mm/mV
F 50∿ 0,5-150Hz W

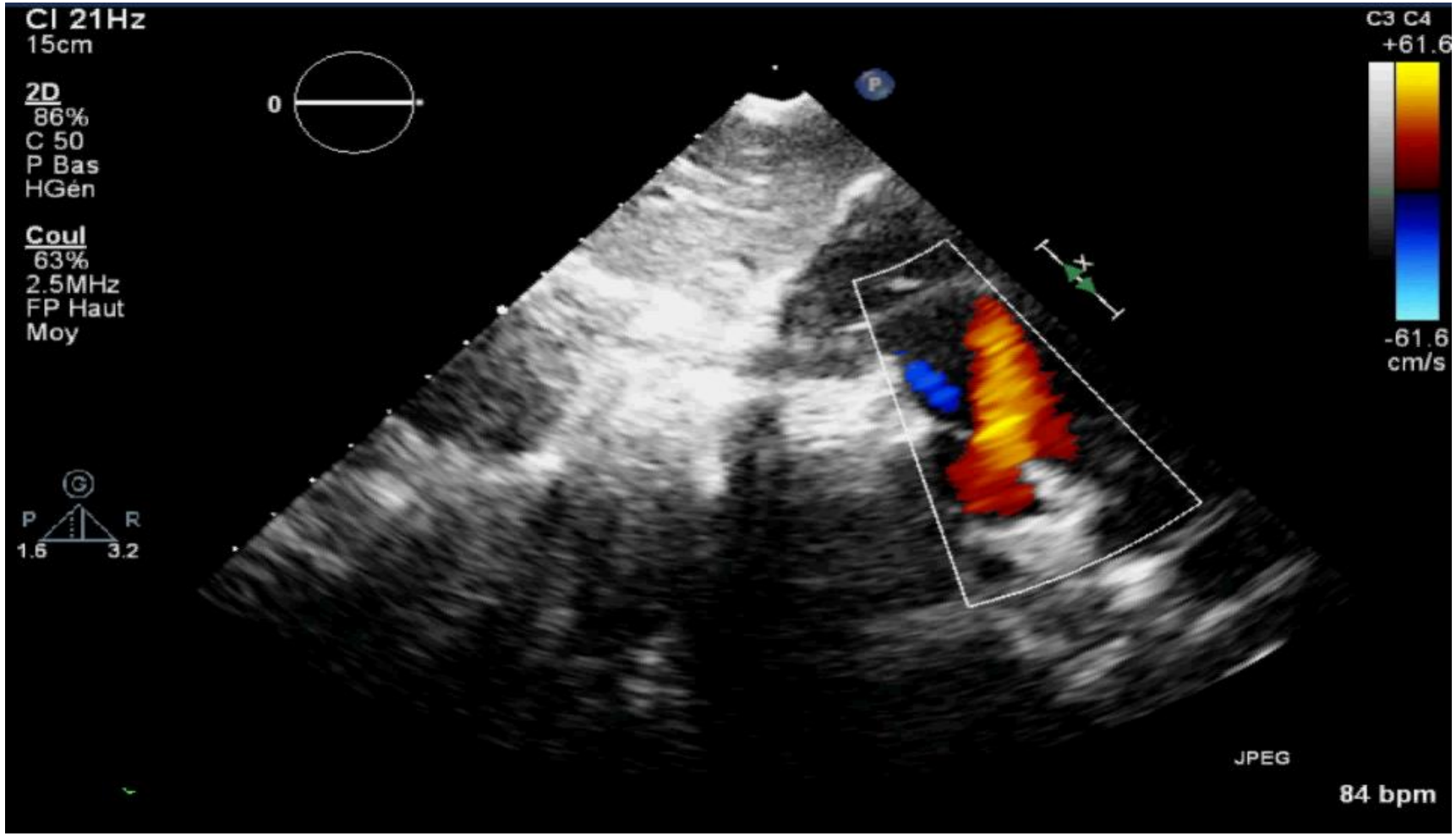
Echocardiographie

- ETT +/- ETO chez l'adulte peu échogène

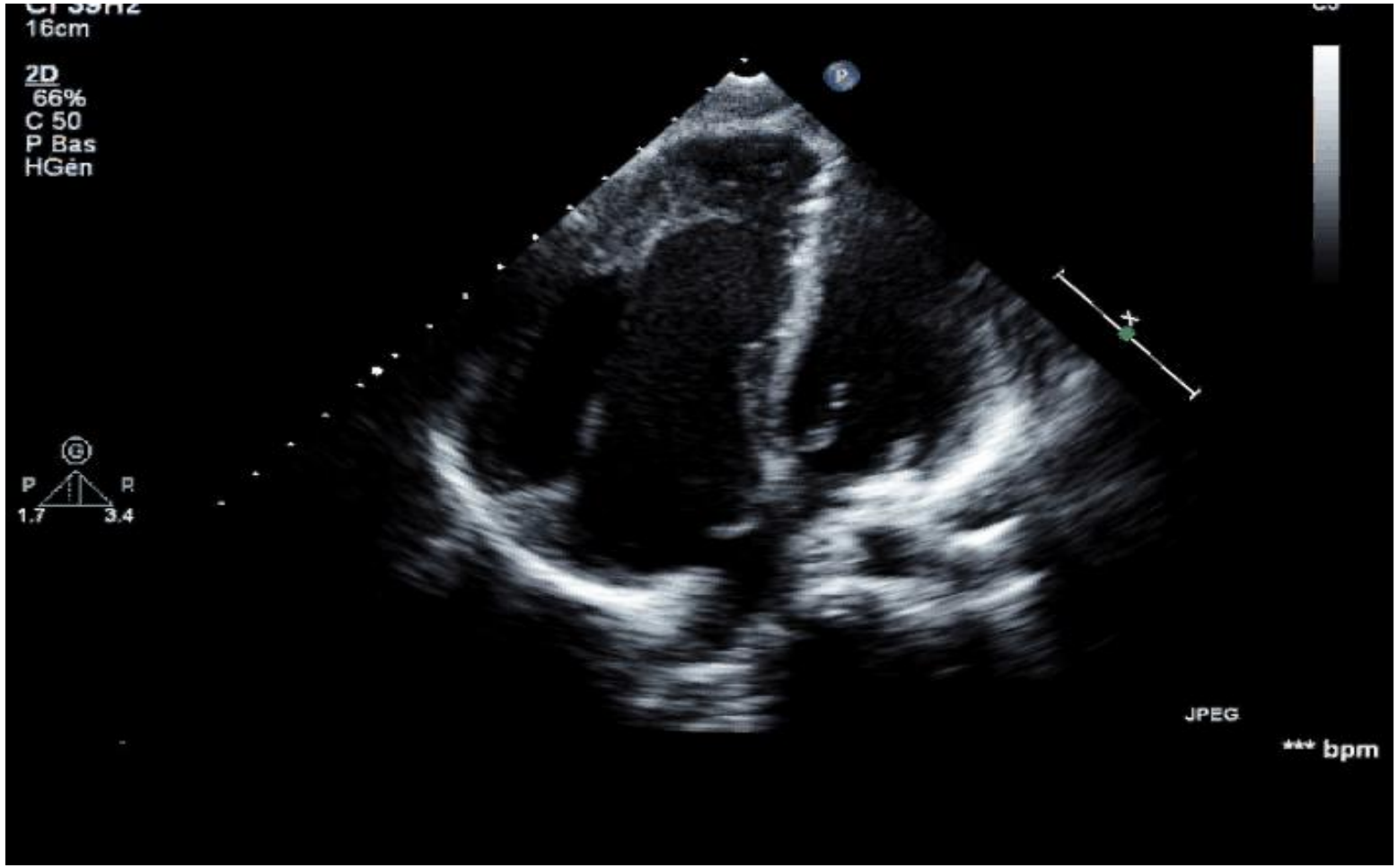
- Analyser en 4 étapes :

1. Diagnostic positif et anatomique
2. Retentissement sur les cavités droites
3. Quantification du shunt
4. Recherche de lésions associées
    1. HTAP
    2. RVPA
    3. Autre malformation cardiaque

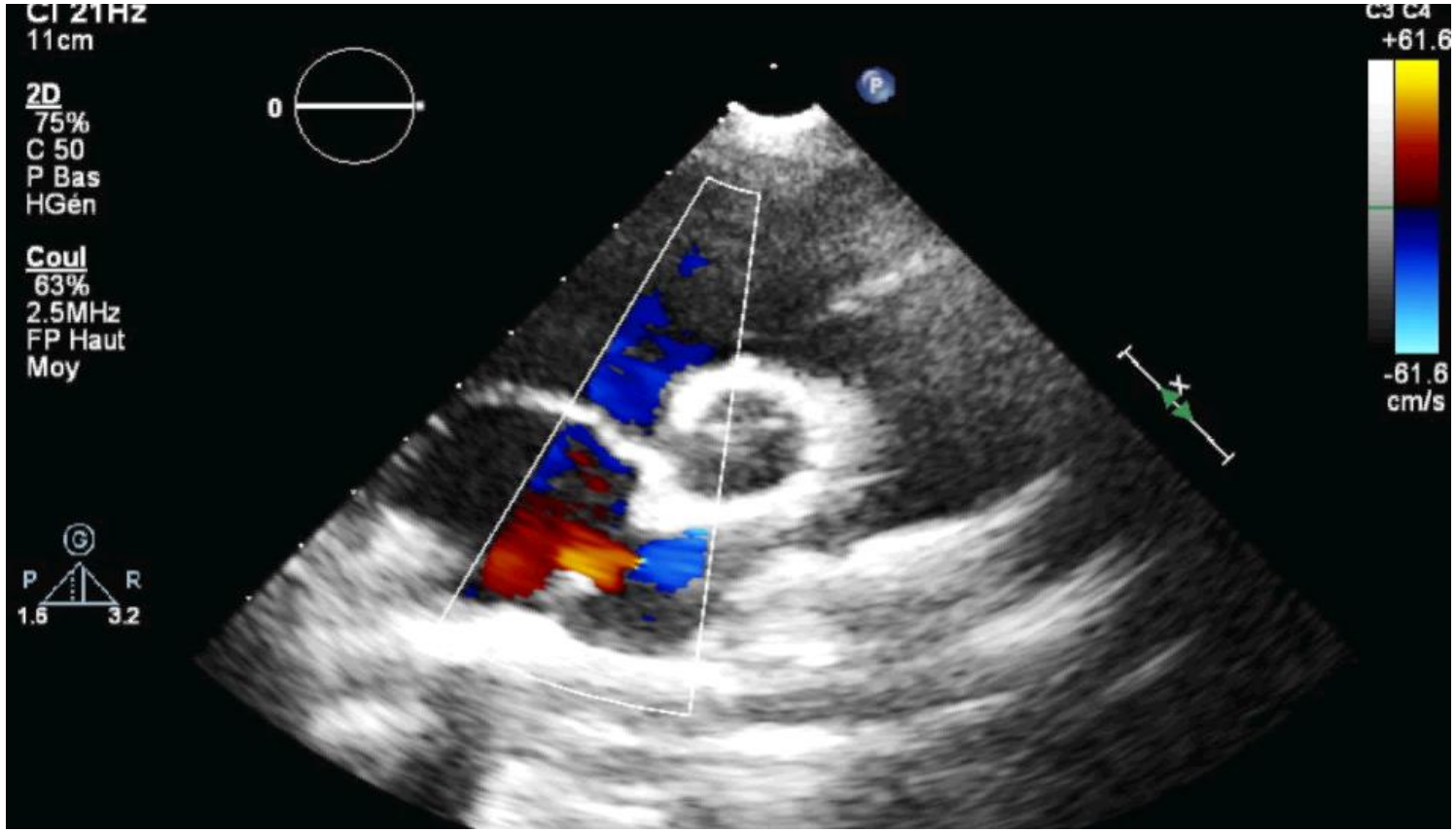
Echocardiographie : CIA OS



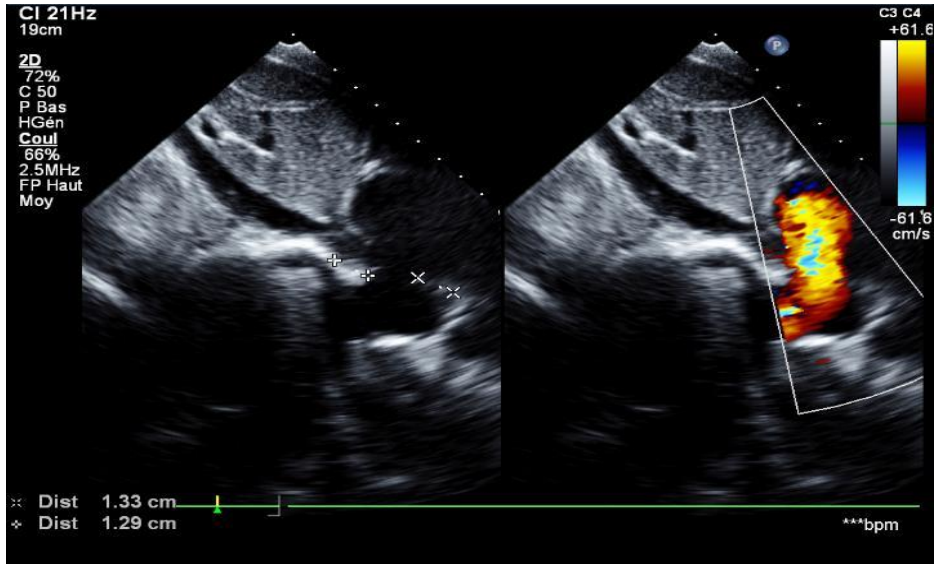
Echocardiographie : CIA OS

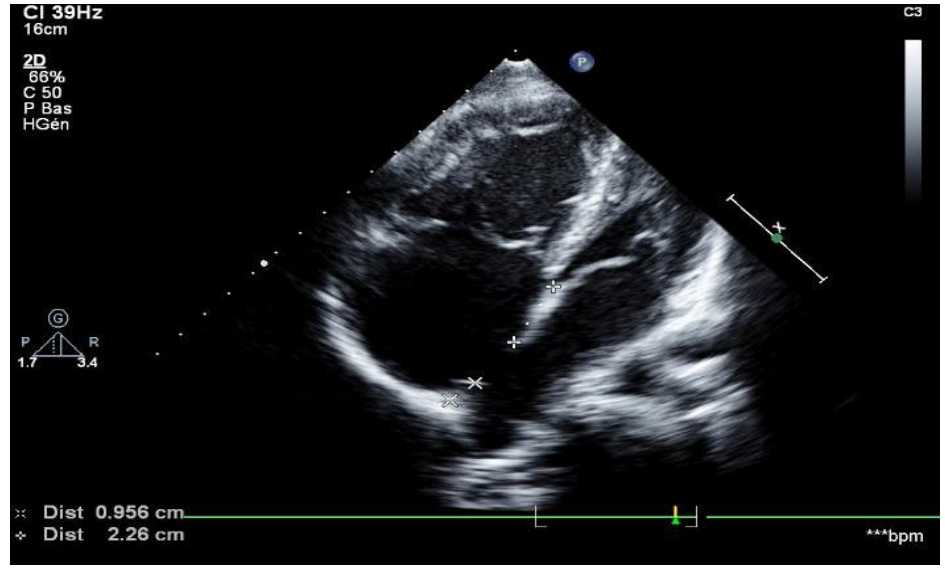


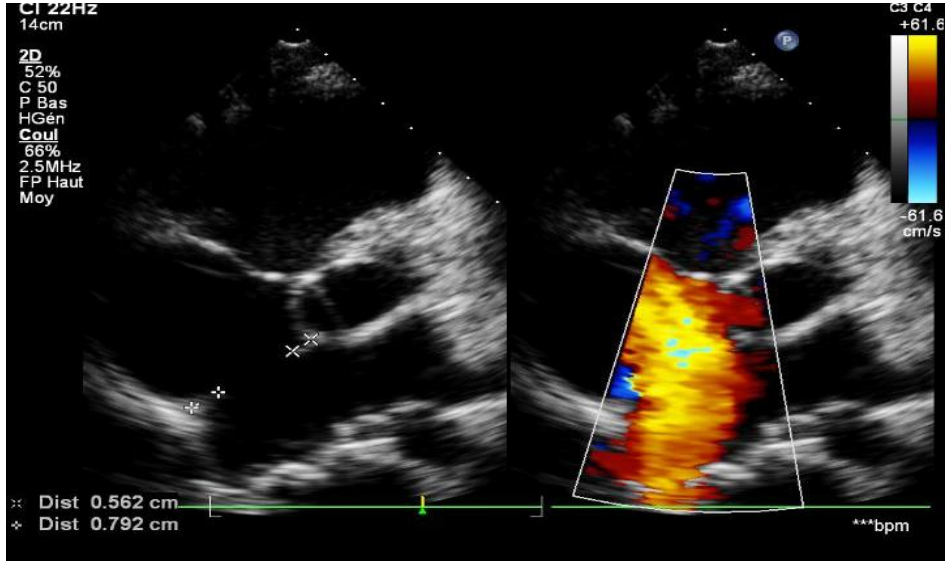
Echocardiographie : CIA OS

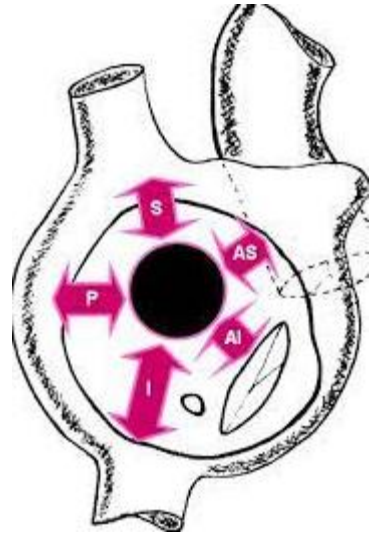


CIA OS : mesure des rebords

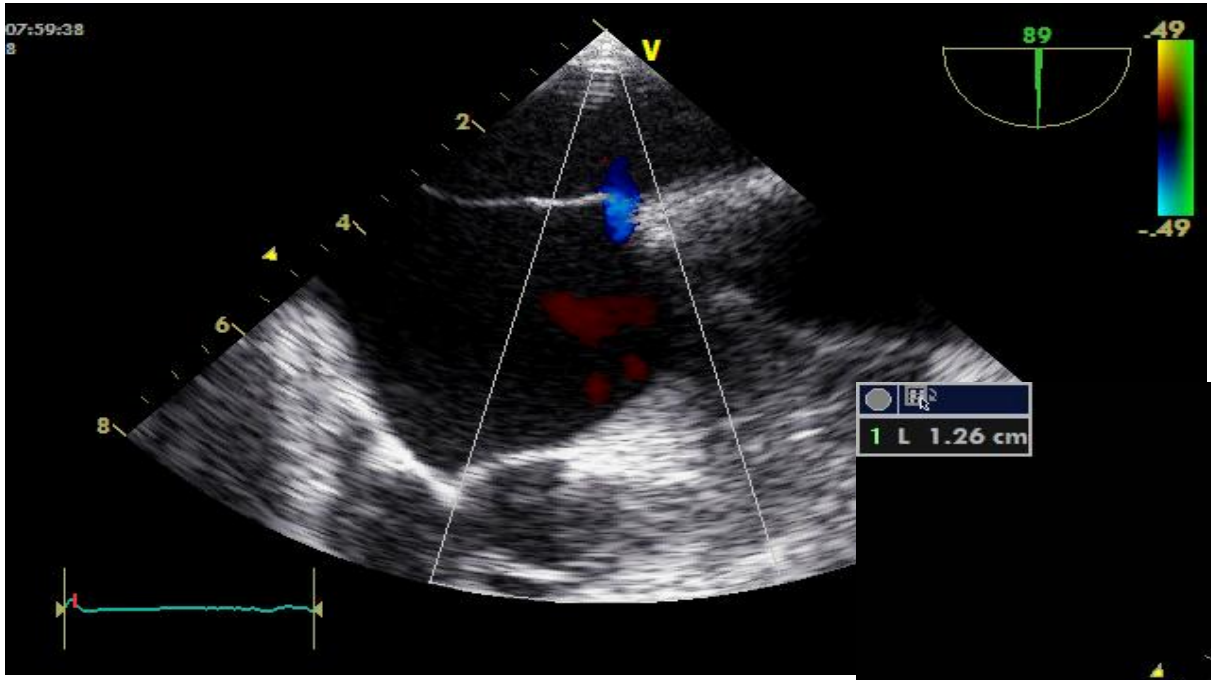


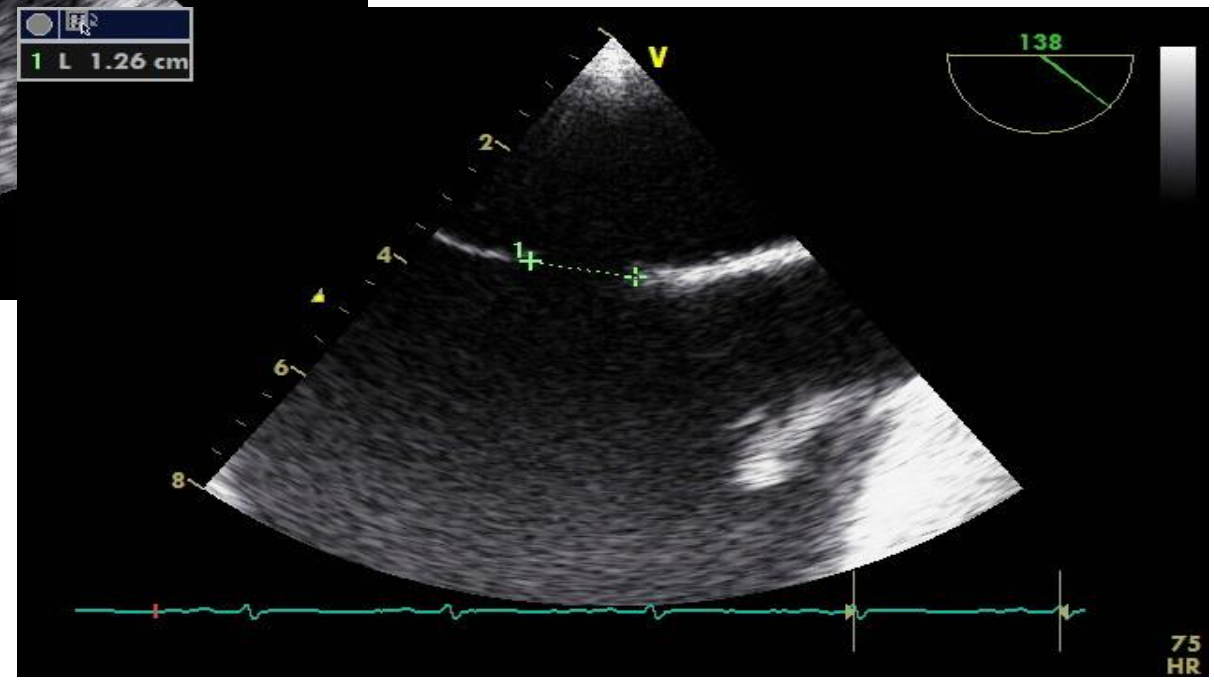




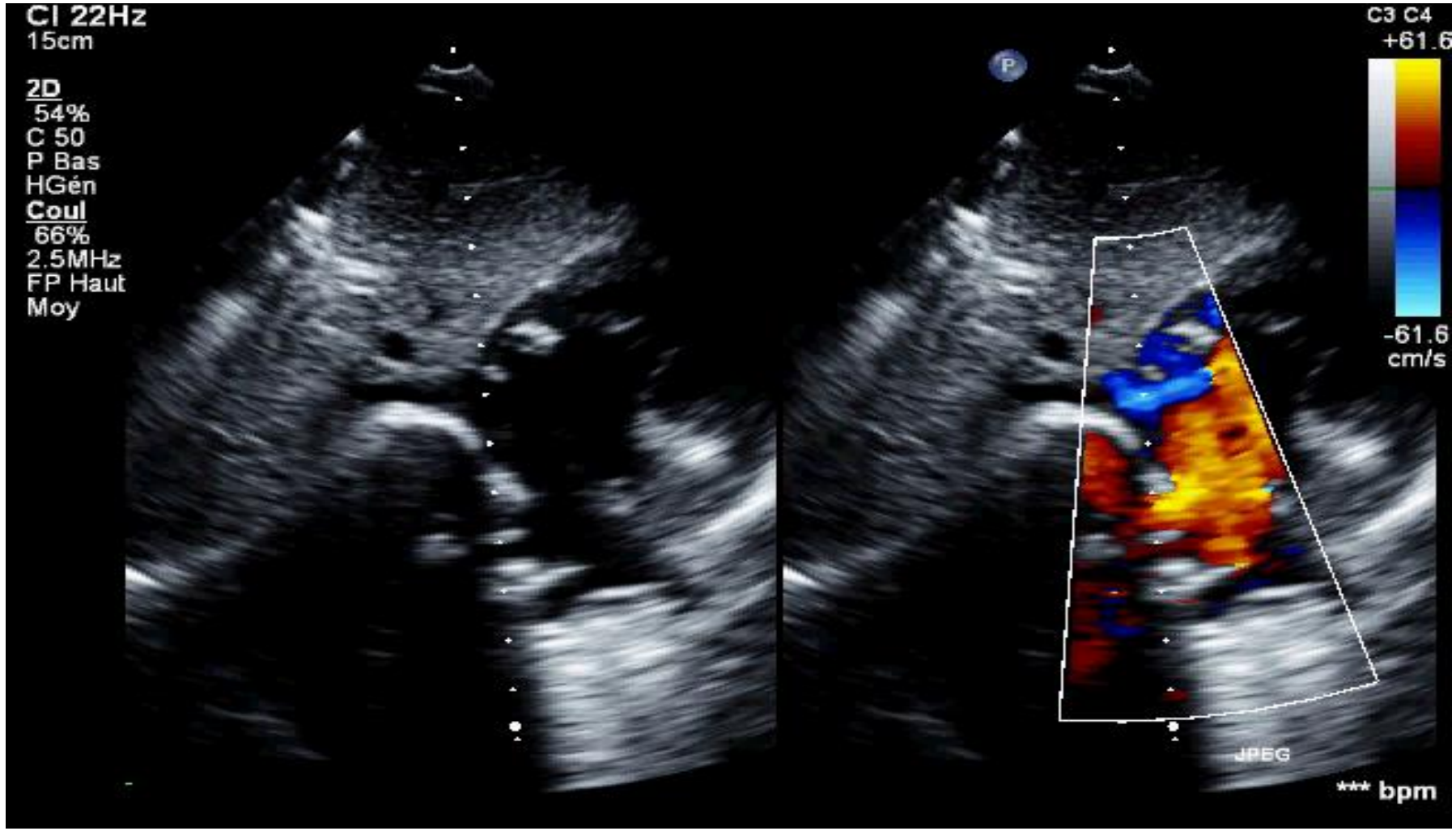


Si besoin : ETO

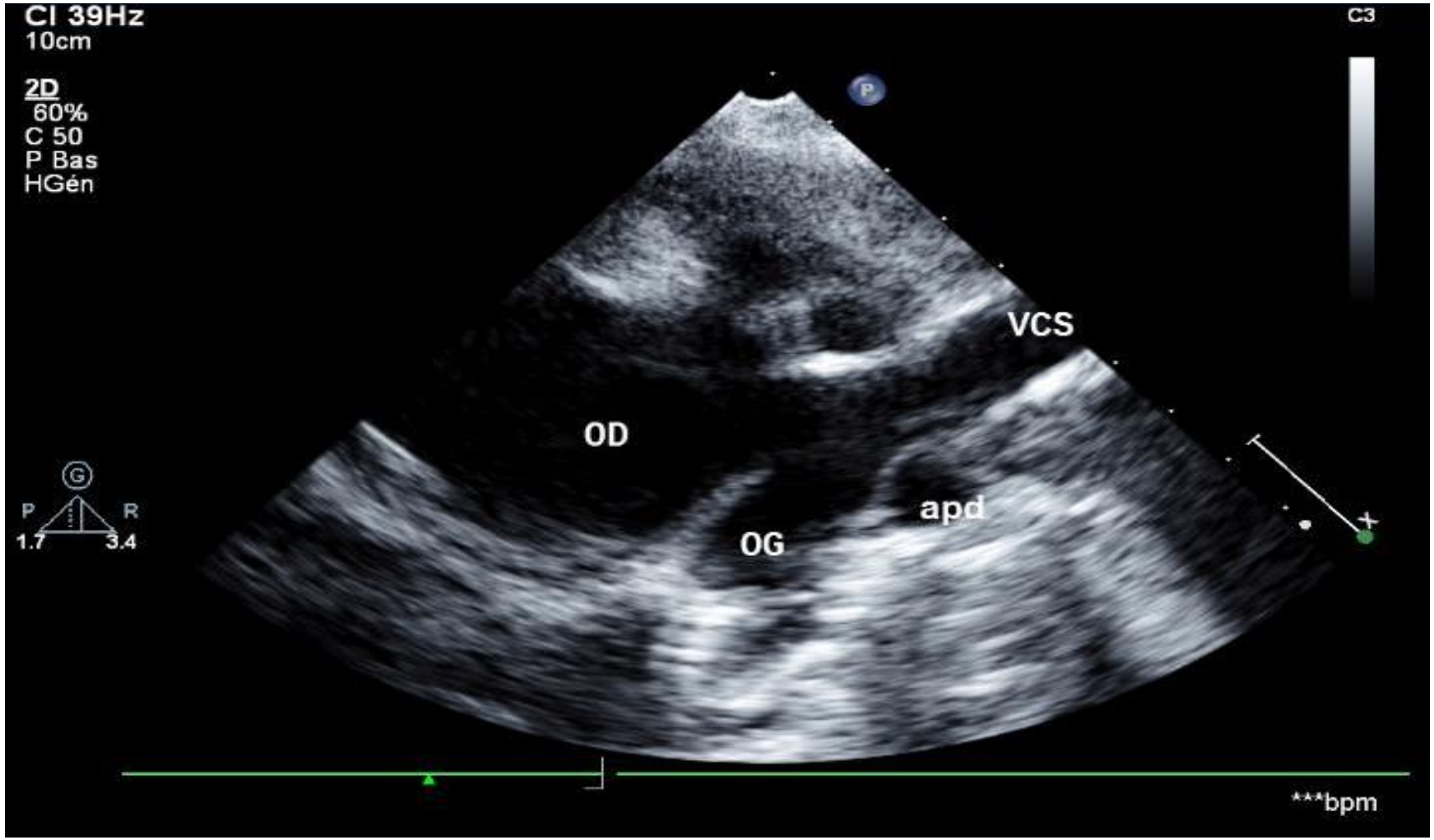


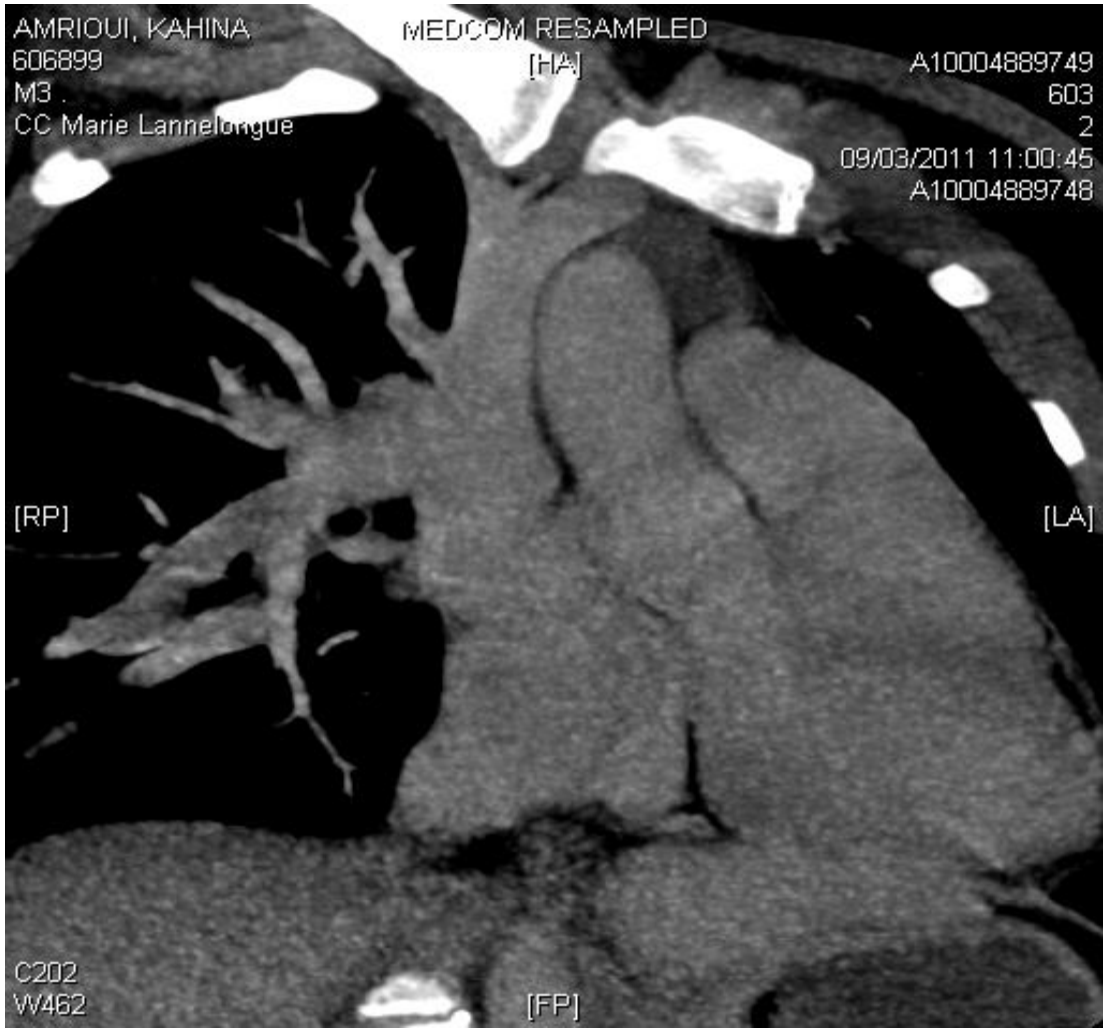


Echocardiographie : CIA SV



Echocardiographie : CIA SV

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CC Marie Lannelongue
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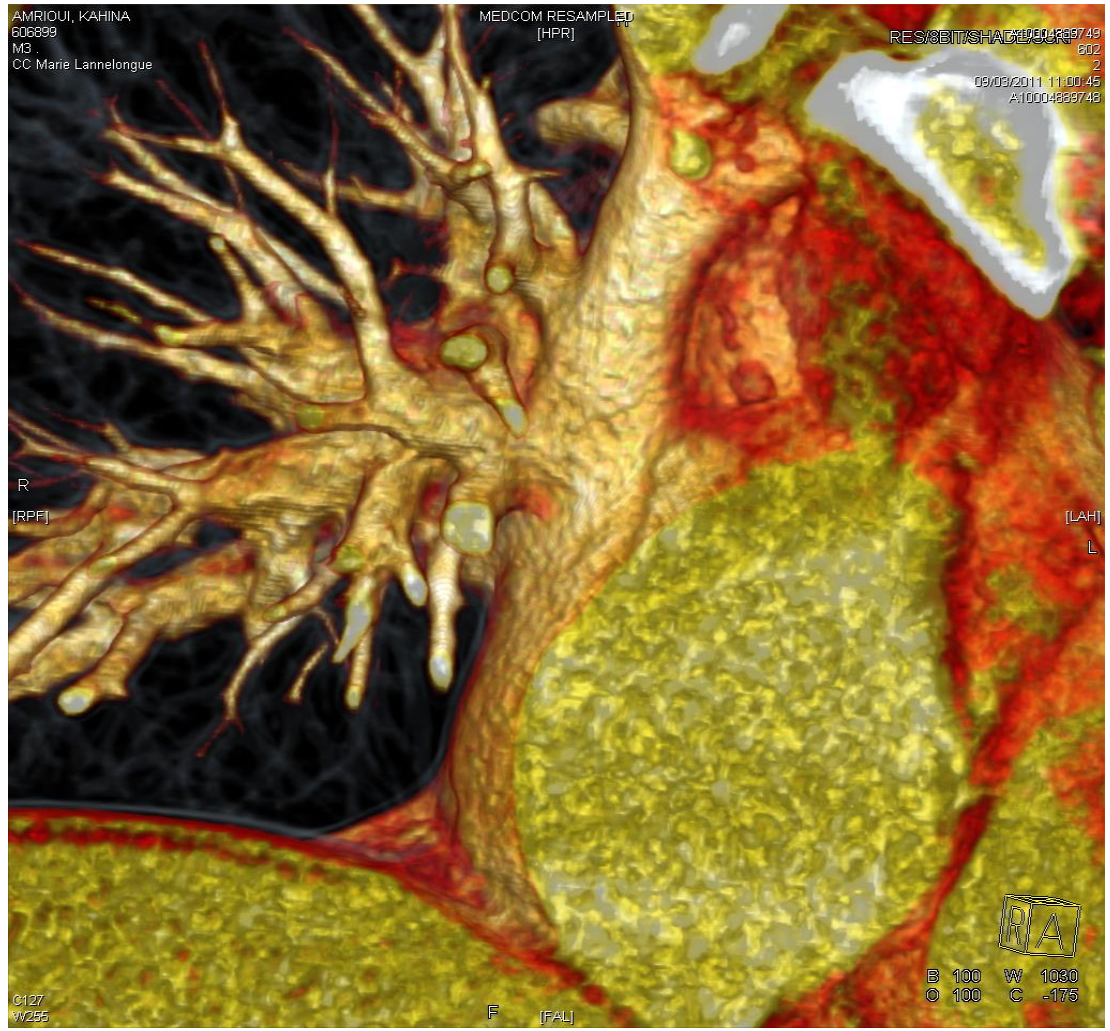
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W255
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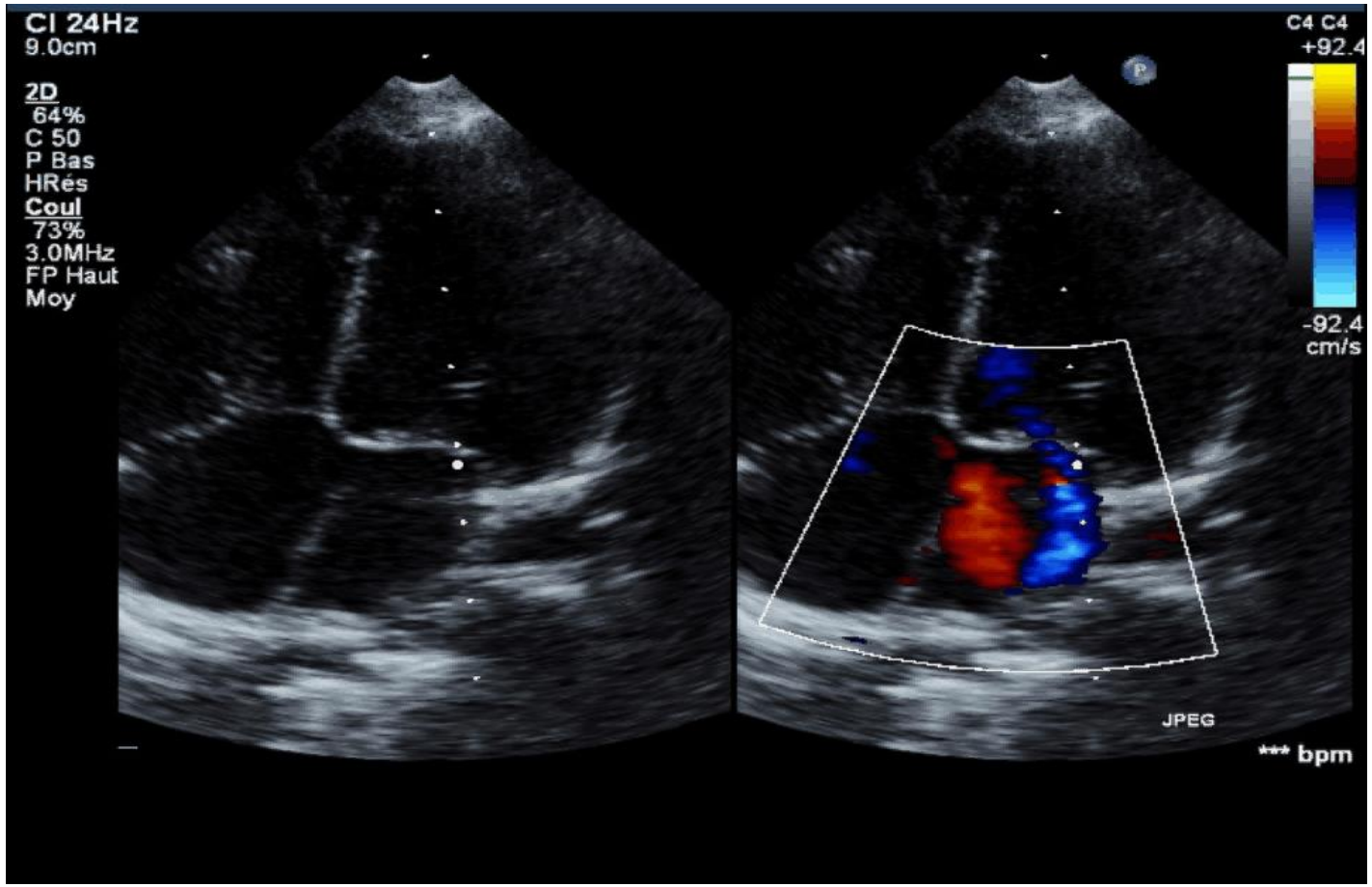
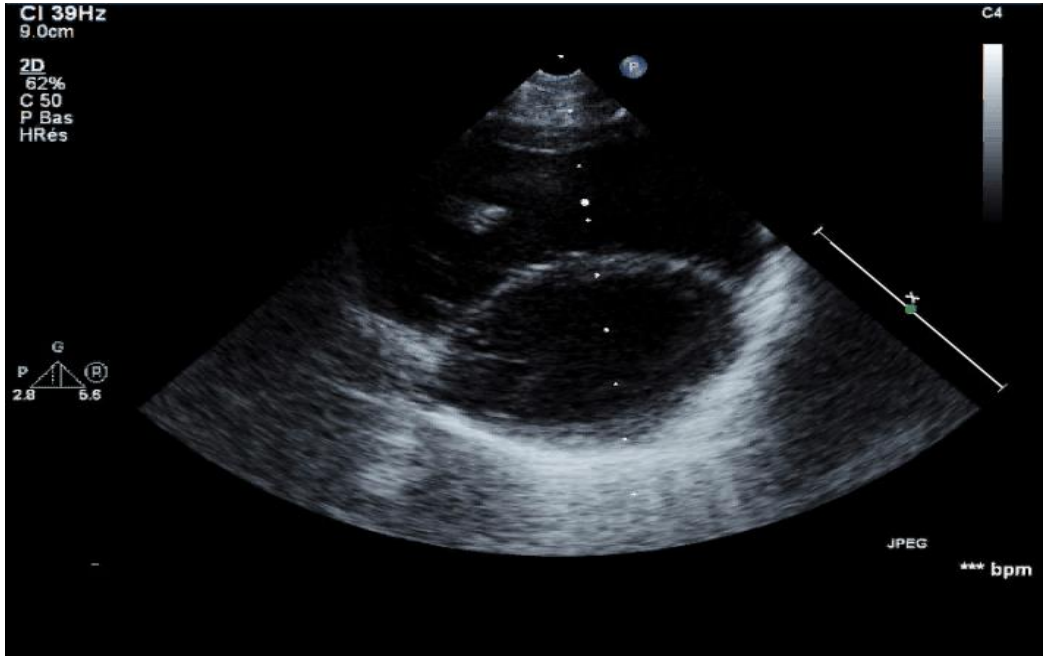
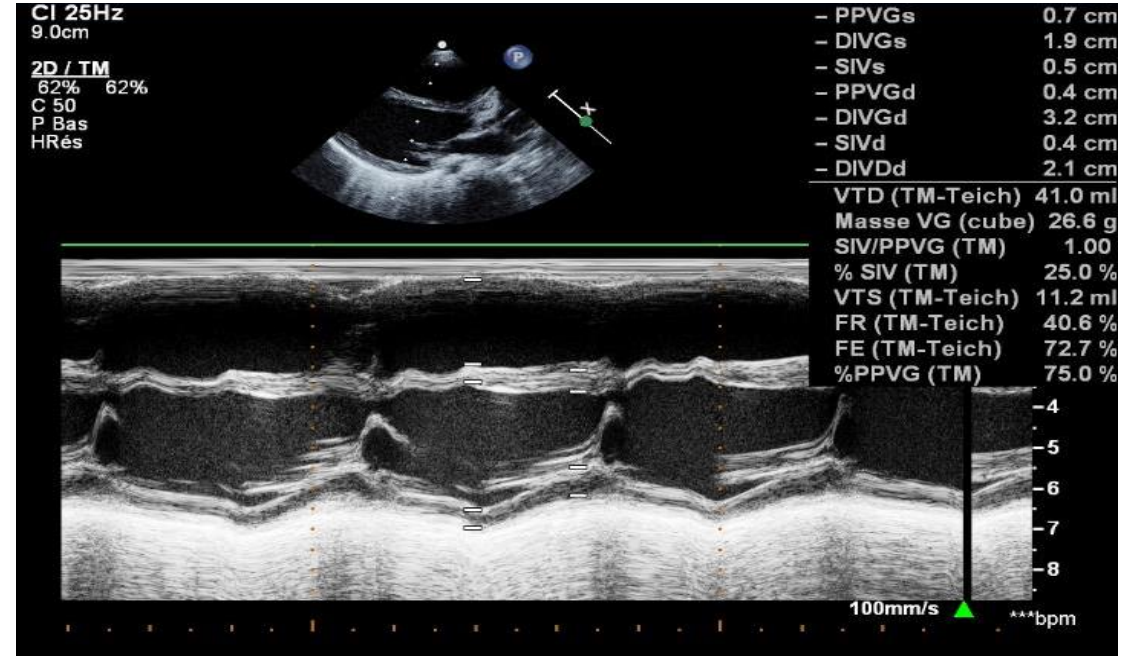
Echocardiographie : CIA OP



CAVc : valve AV unique

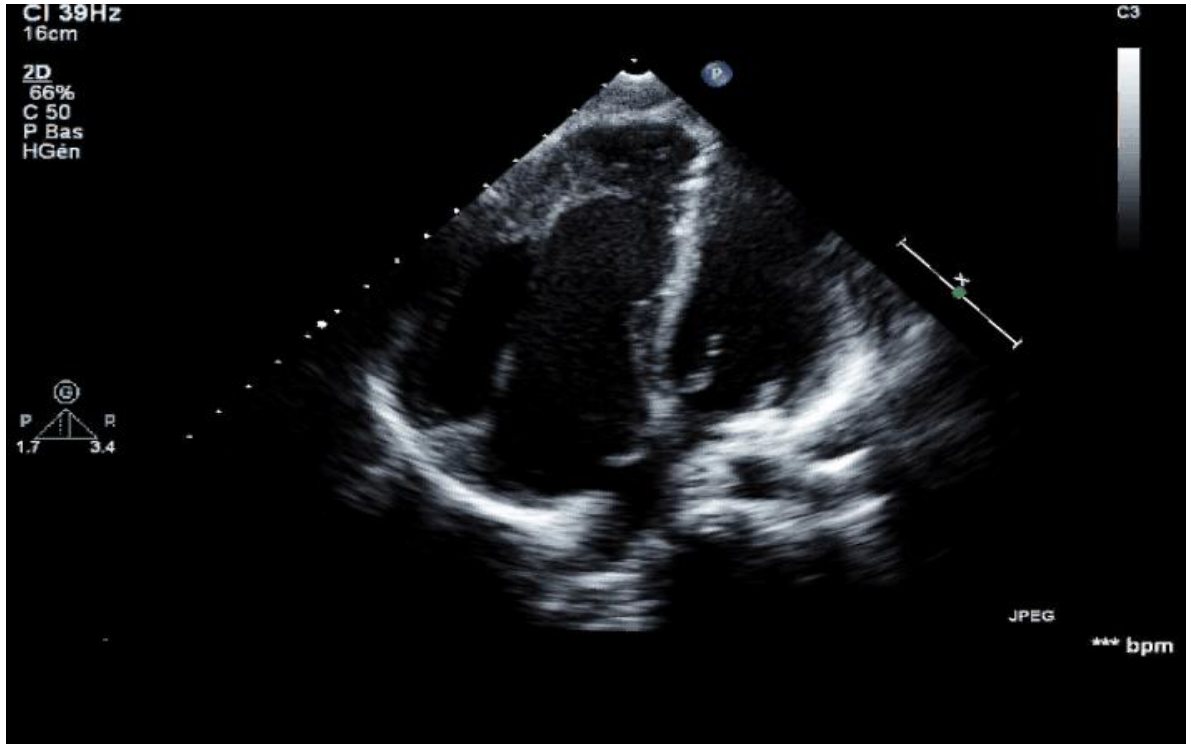
Retentissement VD





Indication de fermeture si VD/VG > 0,6 en petit axe ou grand axe

Retentissement VD

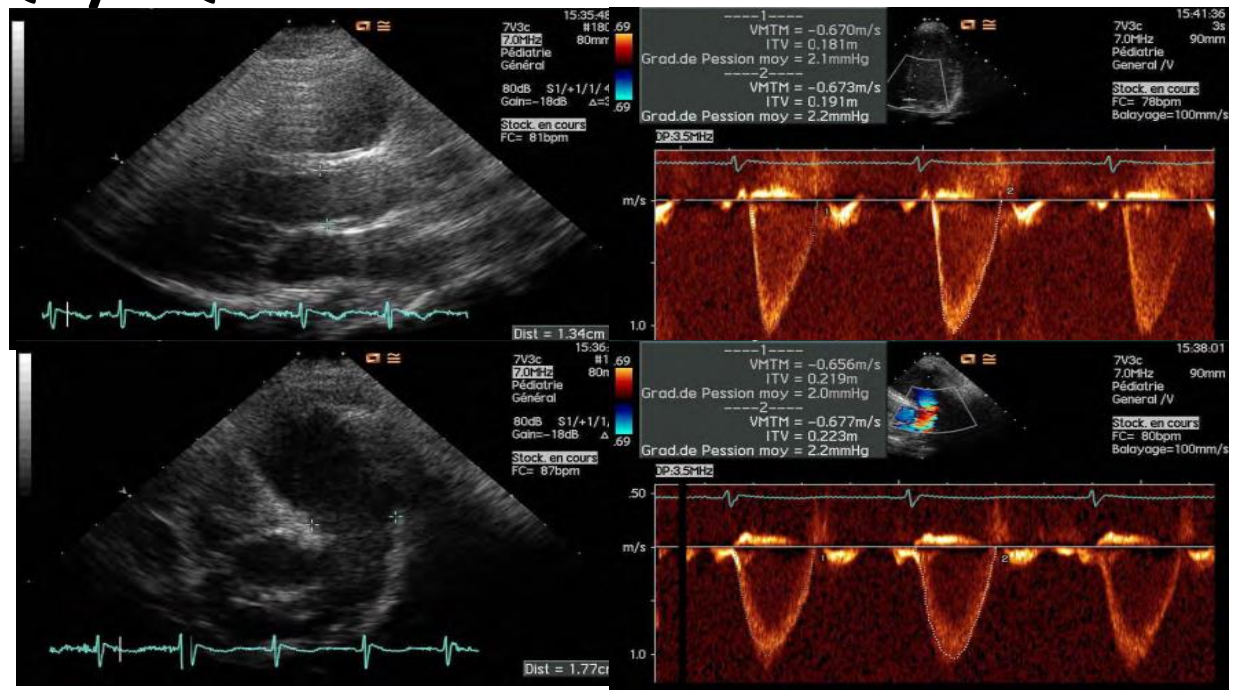


Indication de fermeture si VD/VG > 0,9 en apical 4C

Calcul QP/QS écho

- Estimation du Qp/Qs

  $Q = ITV \times FC \times (\pi \times d^2/4)$



Ao : 1.35 x 1.35 x 3.14/4 = 1.43 cm^2

1.43 x 18.5 = 26.4 cm3

AP : 1.7 x 1.7 x 3.14/4 = 2.26 cm^2

2.46 x 22 = 49 cm3

⇨ QP/QS = 1.8

Fermeture CIA : indications

Recommendations for intervention in atrial septal defect (native and residual)

Recommendations	Class[a]	Level[b]
In patients with evidence of RV volume overload[c] and no PAH (no non-invasive signs of PAP elevation or invasive confirmation of PVR <3 WU in case of such signs) or LV disease, ASD closure is recommended regardless of symptoms.[146,147]	I	B
Device closure is recommended as the method of choice for secundum ASD closure when technically suitable.	I	C
In elderly patients not suitable for device closure, it is recommended to carefully weigh the surgical risk against the potential benefit of ASD closure.	I	C
In patients with non-invasive signs of PAP elevation, invasive measurement of PVR is mandatory.	I	C
In patients with LV disease, it is recommended to perform balloon testing and carefully weigh the benefit of eliminating L–R shunt against the potential negative impact of ASD closure on outcome due to an increase in filling pressure (taking closure, fenestrated closure, and no closure into consideration).	I	C
In patients with suspicion of paradoxical embolism (exclusion of other causes), ASD closure should be considered regardless of size providing there is absence of PAH and LV disease.	IIa	C
In patients with PVR 3–5 WU, ASD closure should be considered when significant L–R shunt is present (Qp:Qs >1.5).	IIa	C
In patients with PVR ≥5 WU, fenestrated ASD closure may be considered when PVR falls below 5 WU after targeted PAH treatment and significant L–R shunt is present (Qp:Qs >1.5).	IIb	C
ASD closure is not recommended in patients with Eisenmenger physiology, patients with PAH and PVR ≥5 WU despite targeted PAH treatment, or desaturation on exercise.[d]	III	C

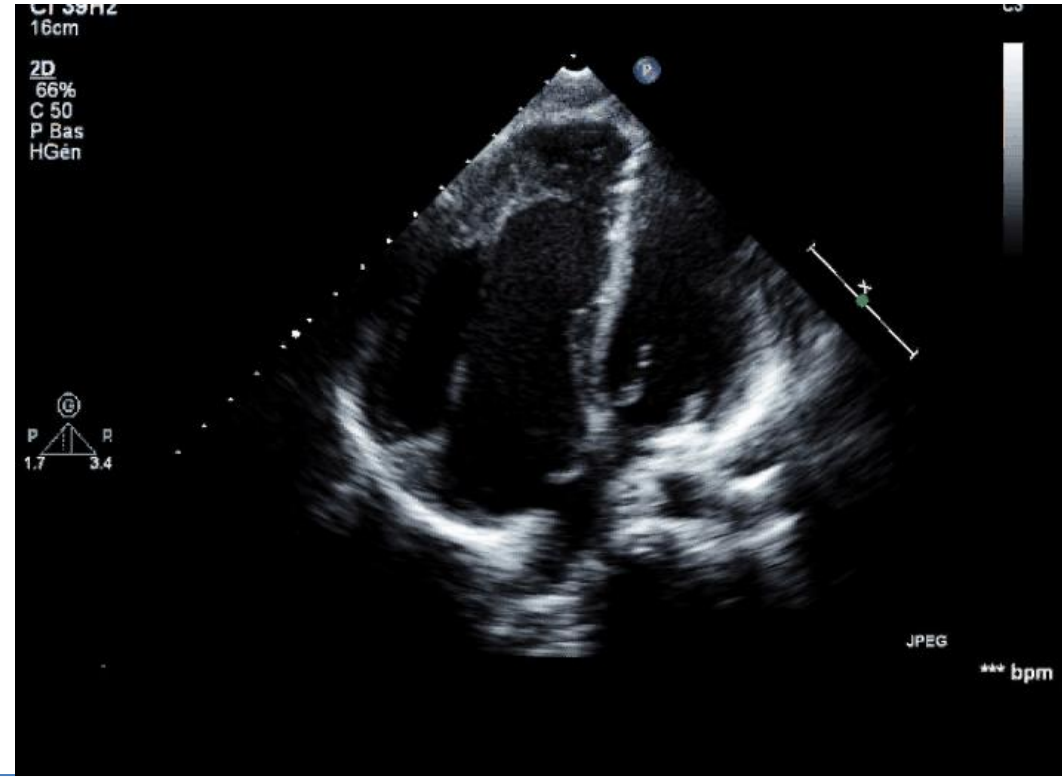
- Cathétérisme ou chirurgie?
- Timing?

KT vs chir?

- Type CIA : OS, OP, SV, SC
- Pour CIA OS : rebords, diamètre max de la CIA (rapport diamètre/poids), nombre/SIA multi-perforé
- Poids
- Tolérance :
  - Croissance
  - Dyspnée
  - Infections respiratoires récidivantes

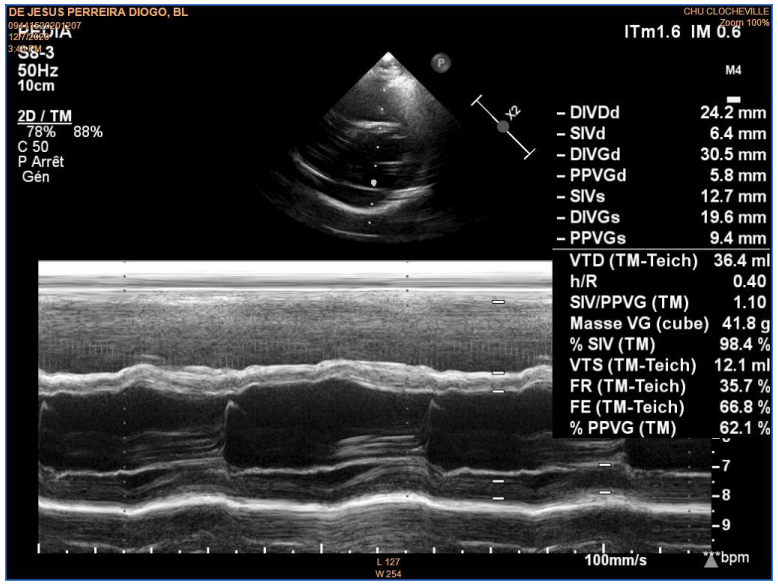
Diogo, 7 ans, 18kg

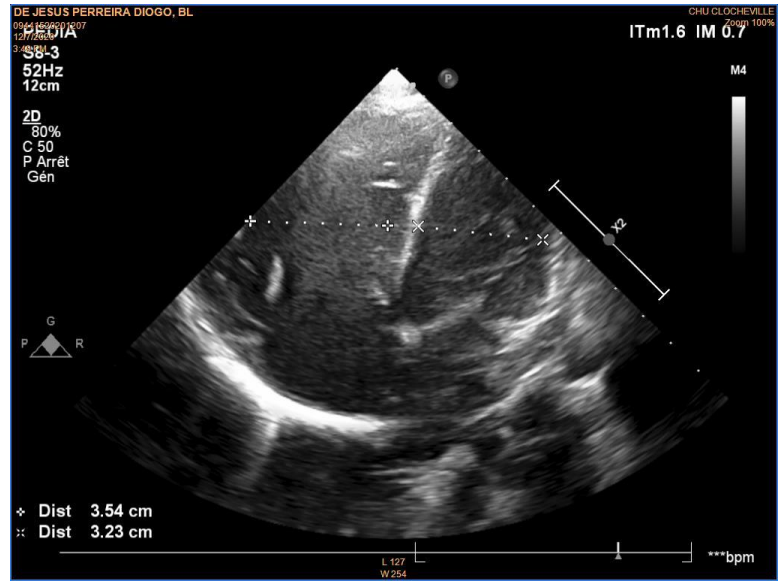
- CIA découverte sur souffle à 5 ans
- Dyspnée NYHA 2, retard pondéral



Diogo, 7 ans, 18kg

- Dilatation des cavités droites





- VD/VG > 0.6 petit axe ou long axe
- VD/VG > 0.9 apicale 4C

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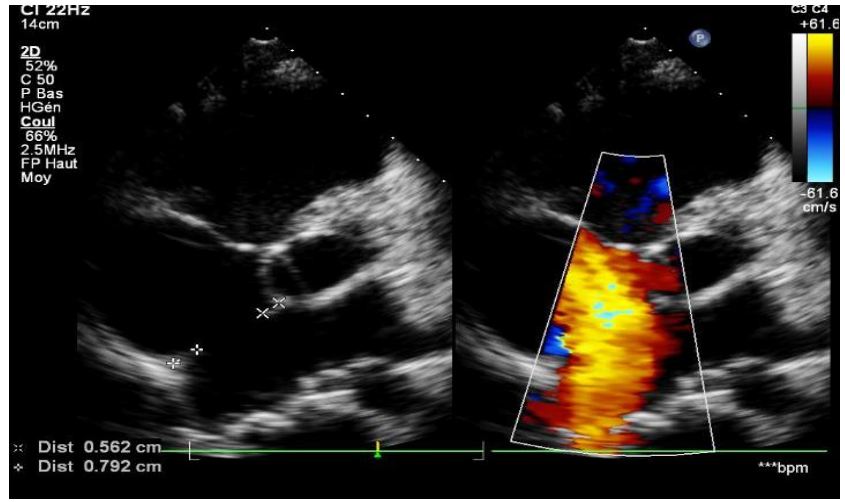
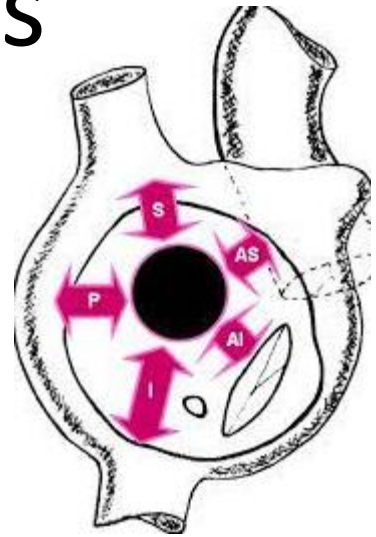
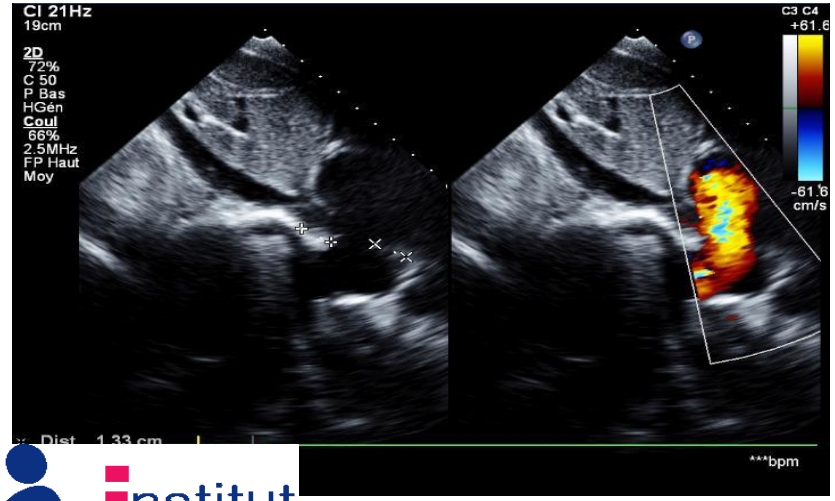
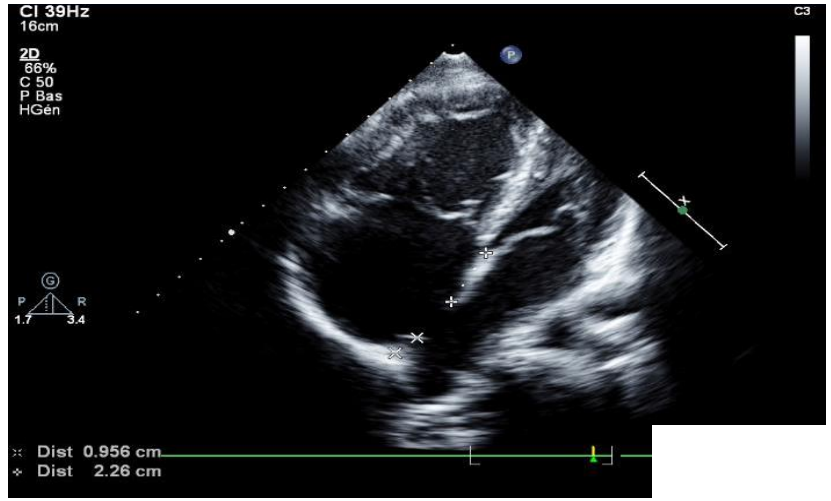
CIA OS : mesure des rebords

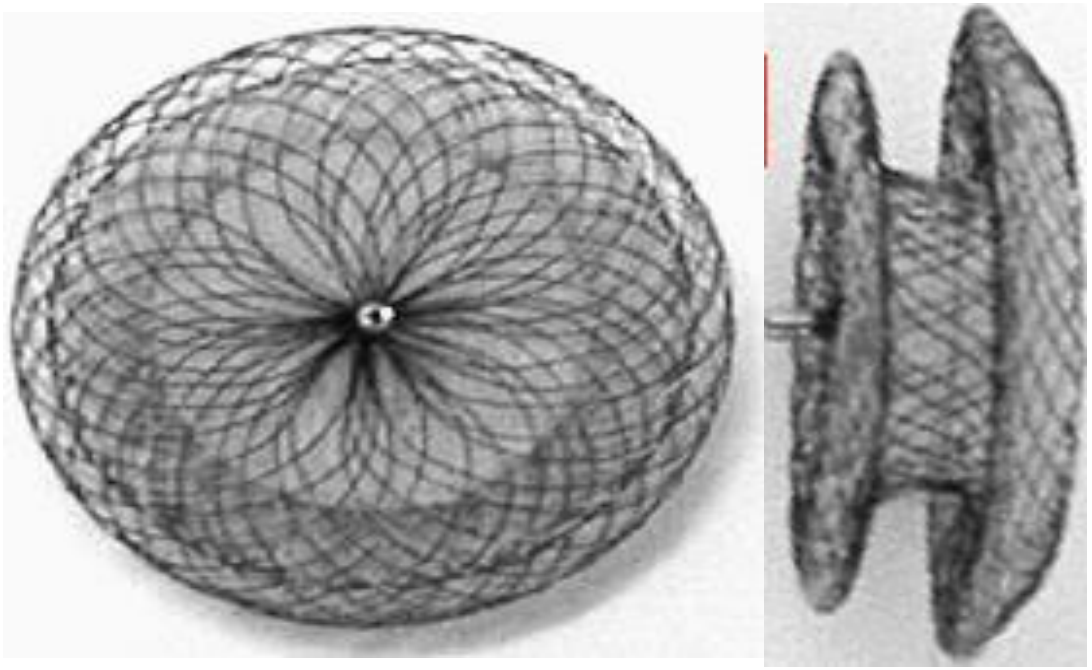


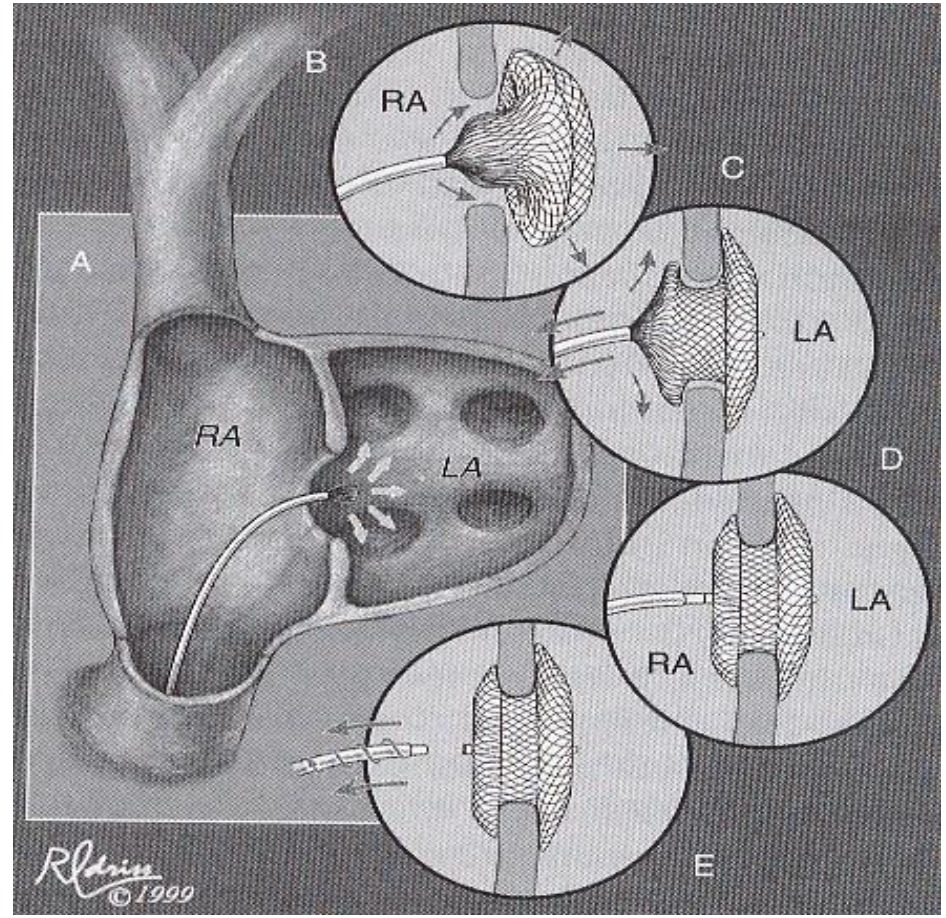






Fermeture percutanée





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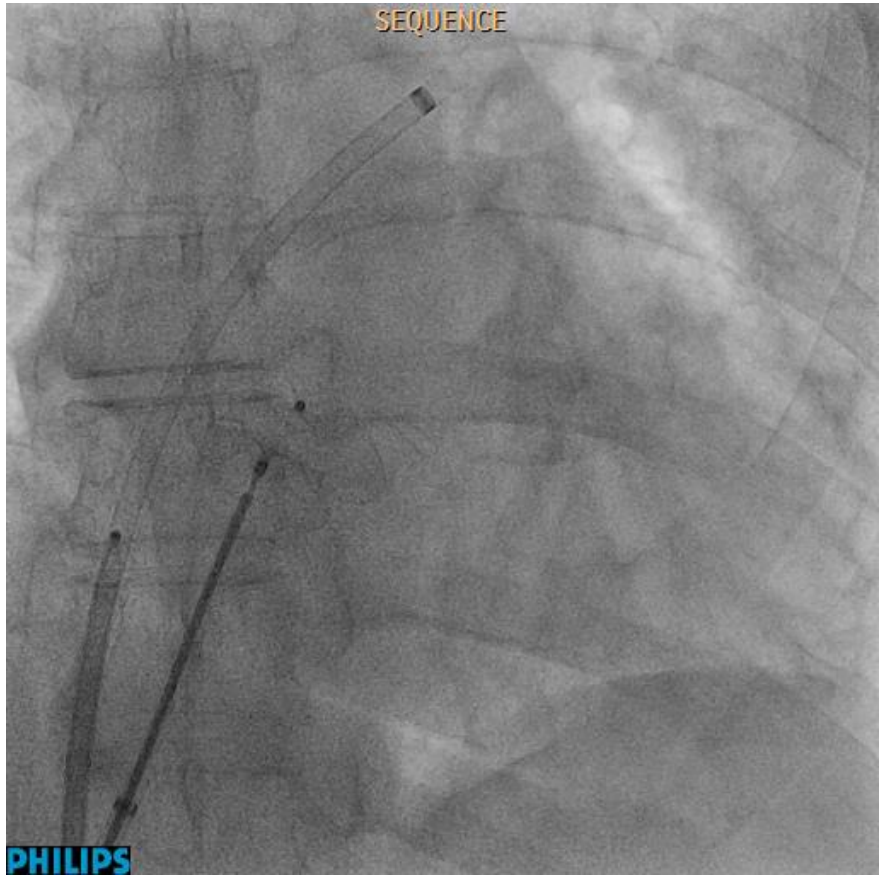
Diogo 7 ans

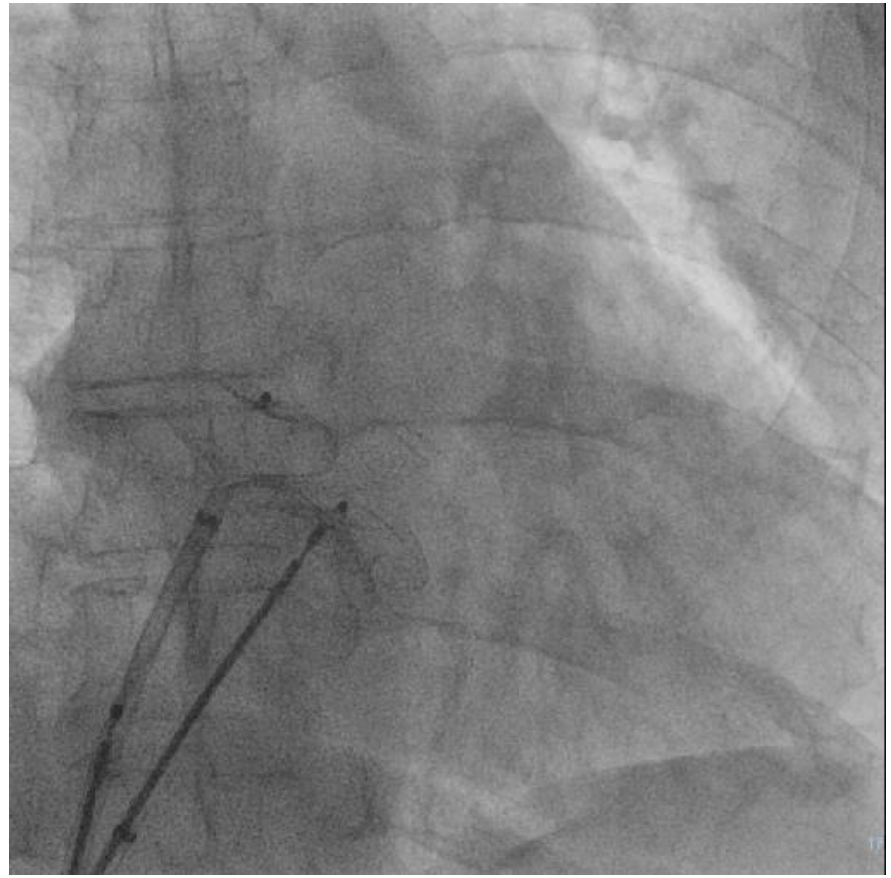
- Retour domicile J1
- Activités tranquilles 7 jours puis vie normale
- Aspegic 100mg/jour pendant 1 an
- ETT 1 mois, 6 mois, 1 an, puis /2 ans

Francis, 25 ans

- Myopathie de Becker, AG difficile
- CIA OS * 2

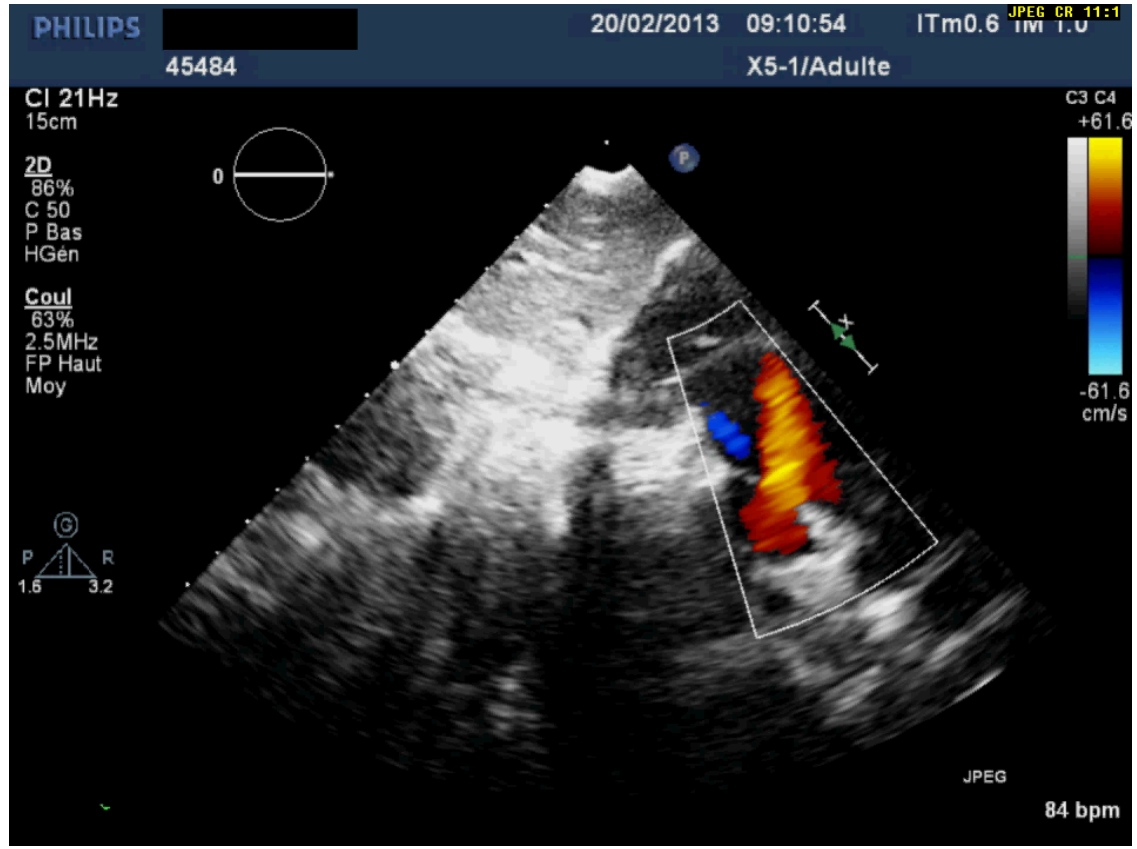
Francis, 25 ans



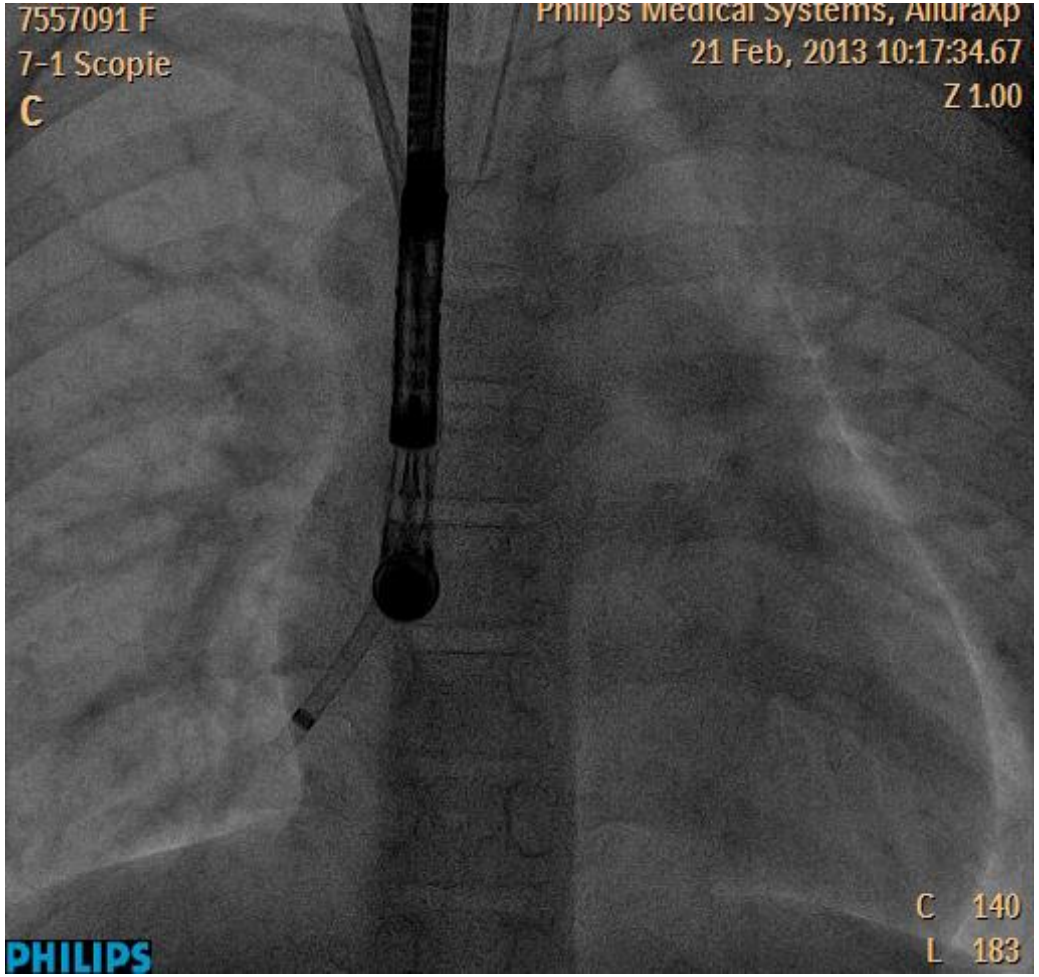


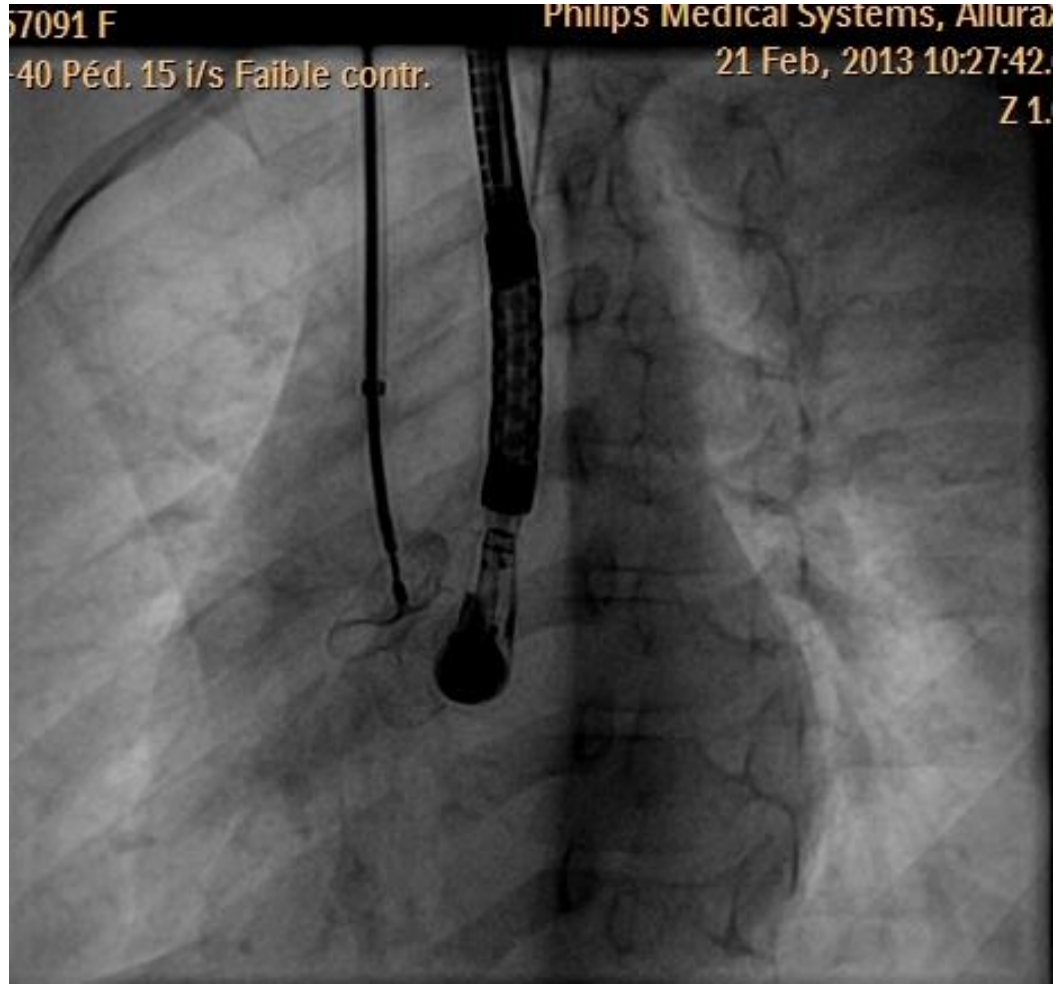
Maëlie, 12 ans

- CIA OS découverte sur souffle
- Asymptomatique
- Interruption VCI



CIA voie jugulaire





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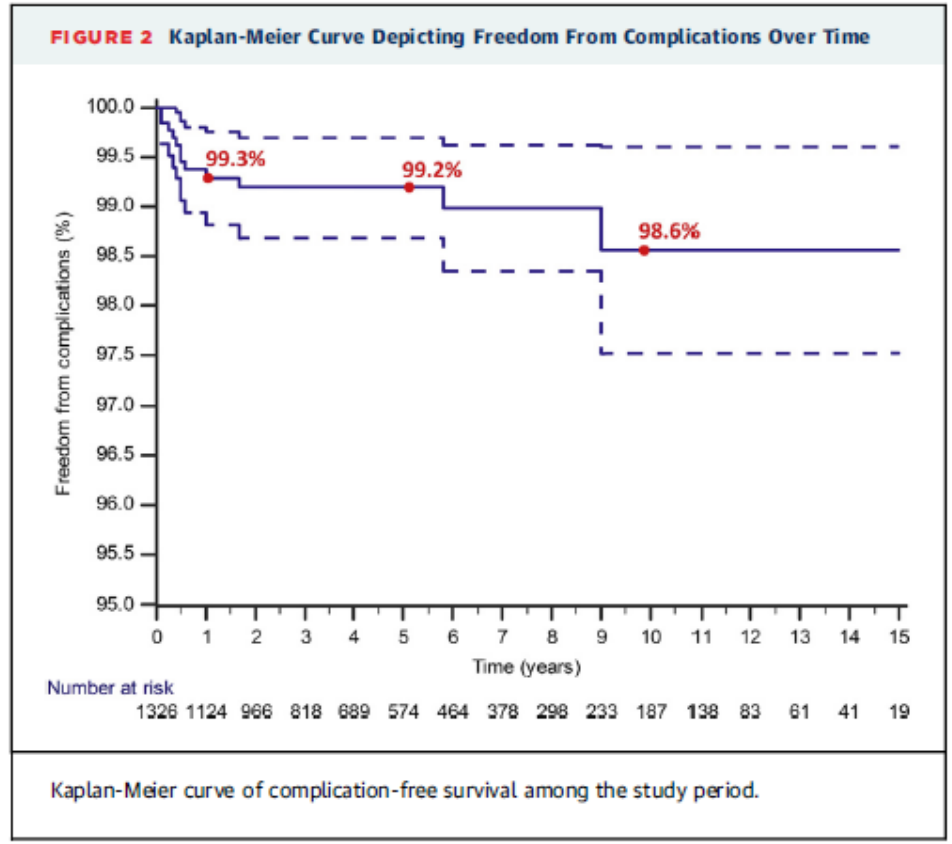
Complications KT

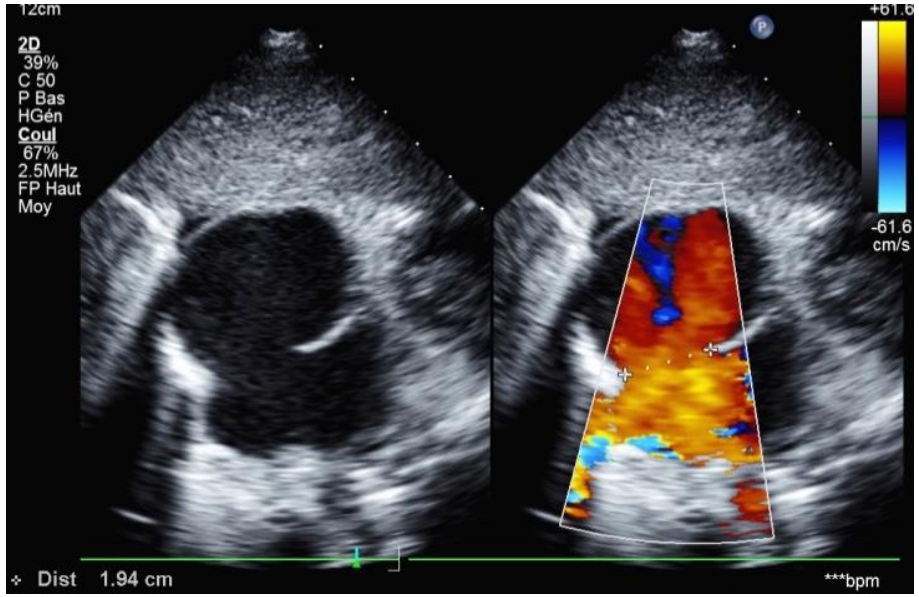
- Embolisation de la prothèse (les premiers jours)
- Obstruction valves AV, veines pulmonaires ou veines caves
- BAV
- Erosion aortique
- Shunt résiduel para prothétique
- Formation de thrombus : antiagrégant plaquettaire 1 an

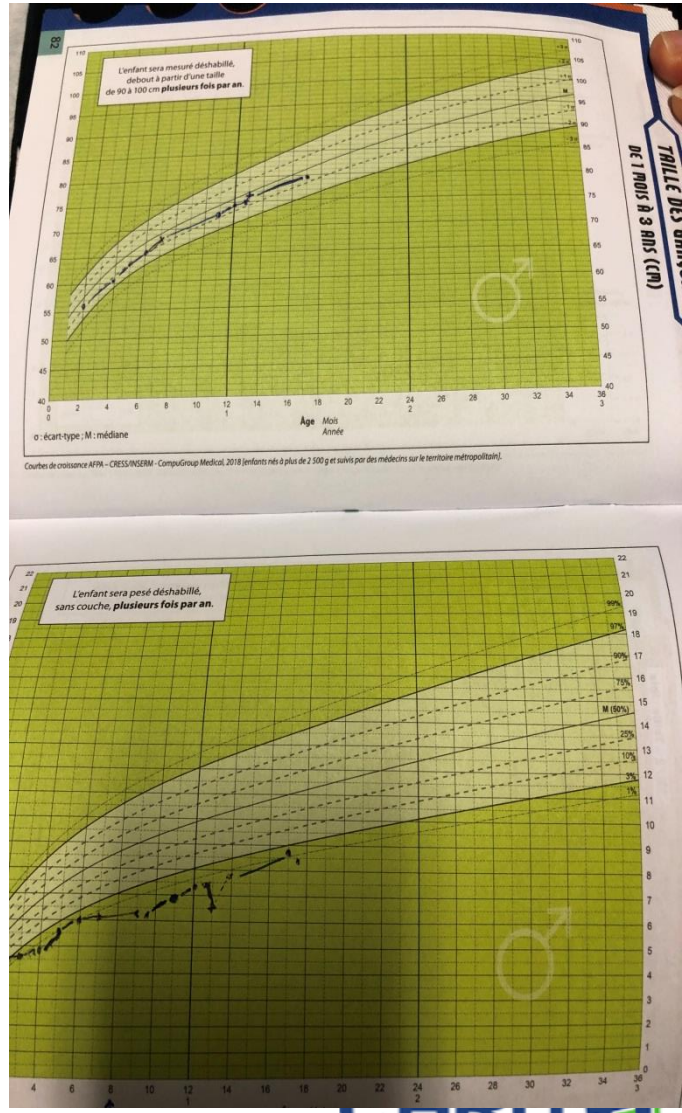


Jalal Z, JACC 2018

Eliott, 1 an 1/2

- CIA OS connue depuis la naissance
- Retard pondéral : 8,5kg/79cm





➔Chirurgie

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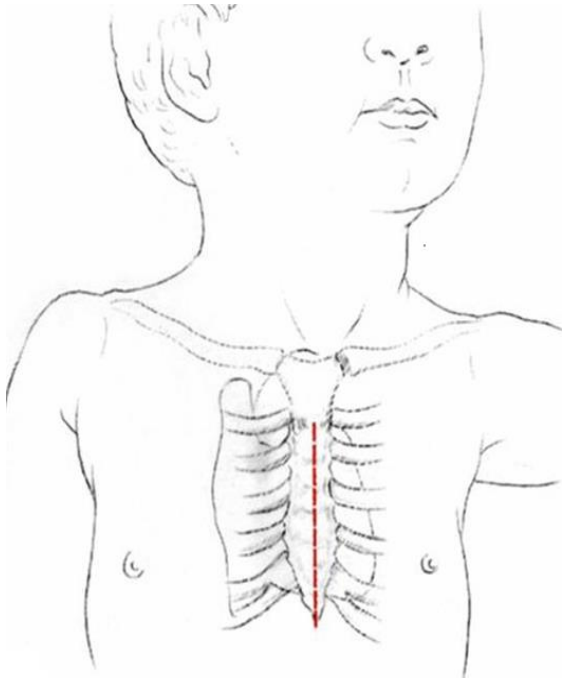
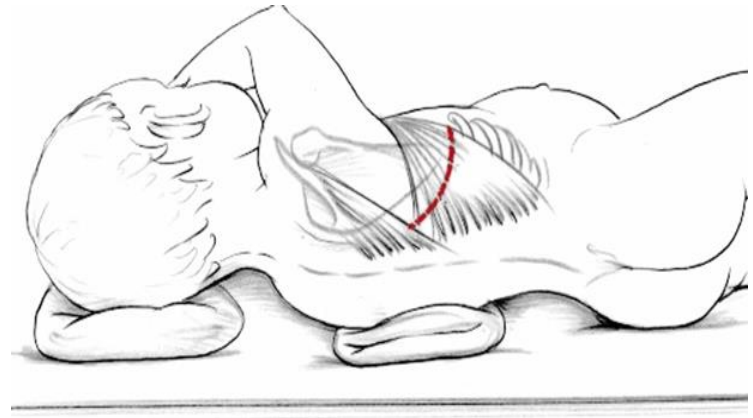
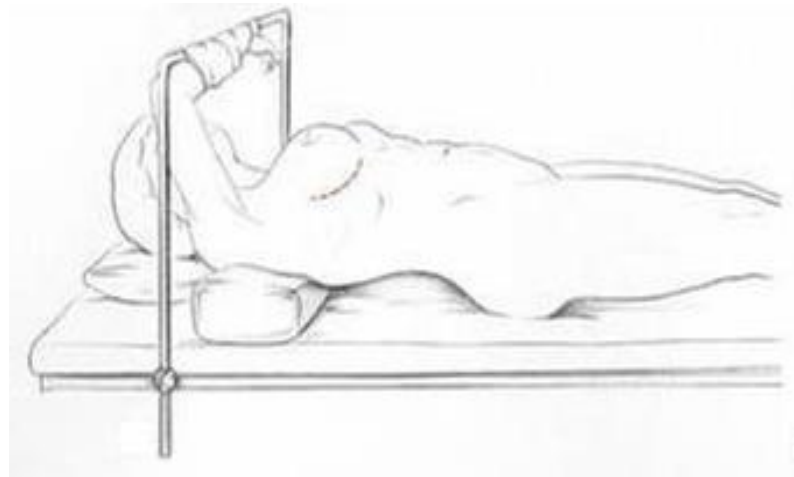
CHRU HÔPITAUX DE TOURS

Voies d’abord

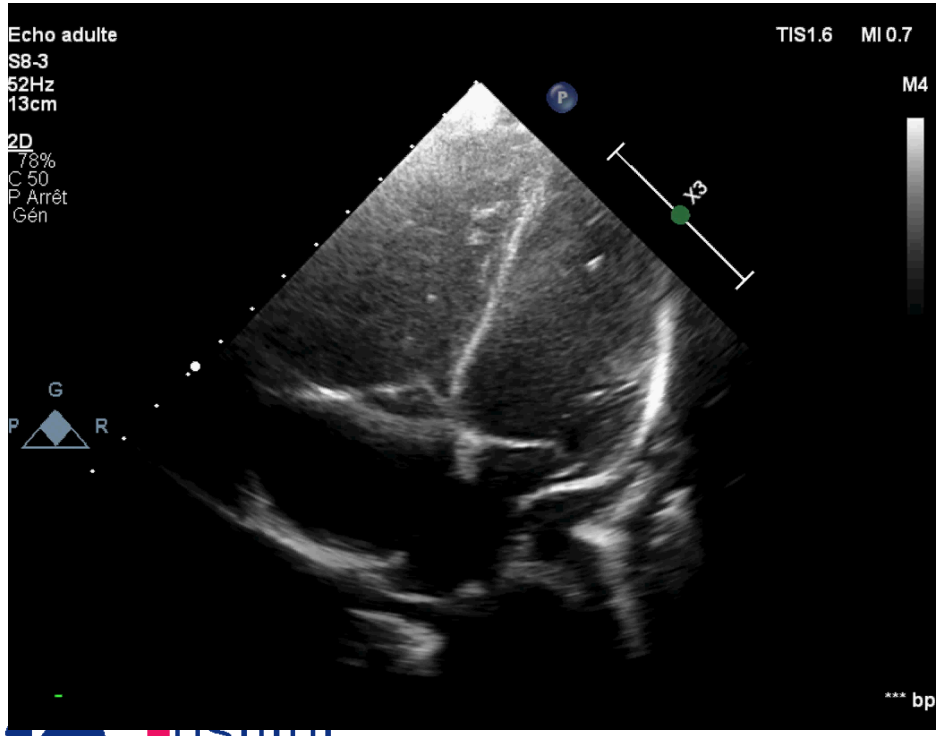


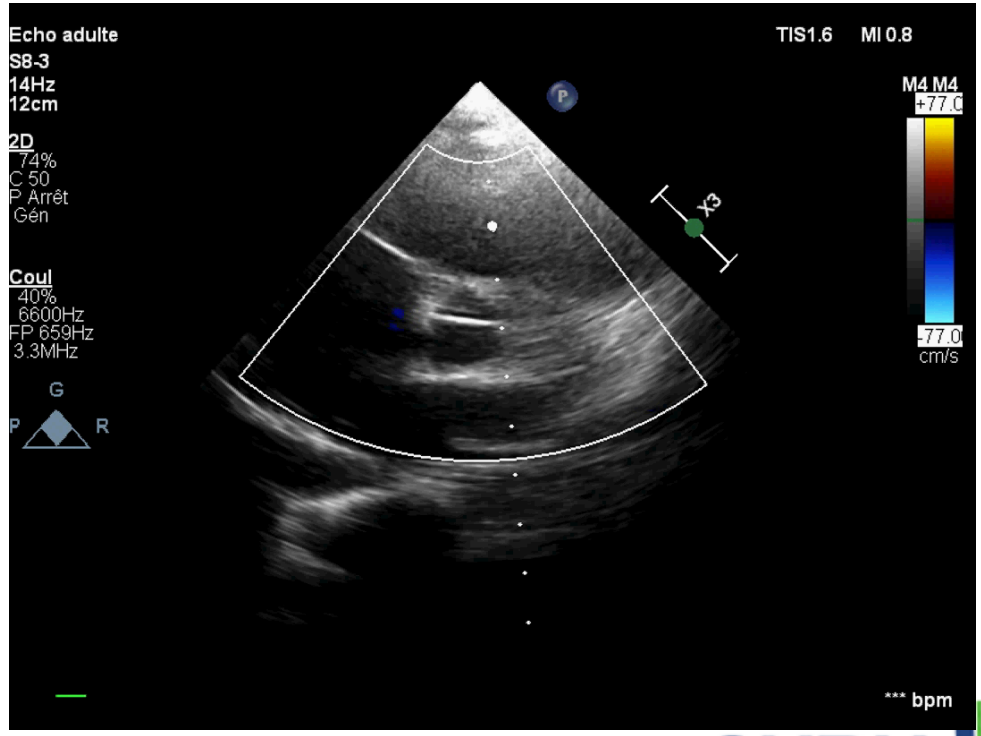




Flavio, 4 ans

- Asymptomatique, 18 kg
- CIA OS peu de rebord





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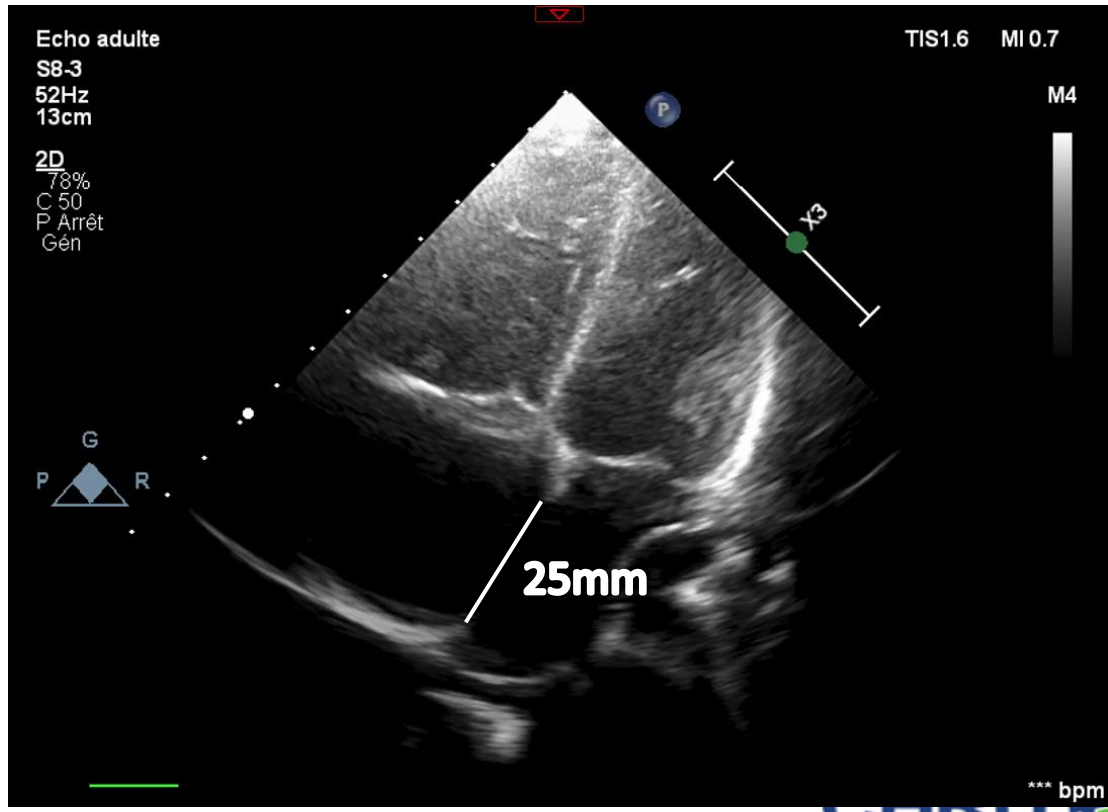
CHRU HÔPITAUX DE TOURS

Flavio, 4 ans

- Asymptomatique, 18 kg
- CIA OS peu de rebord
- Diamètre 27mm/m²
- Diam/poids = 1,4

➔Chirurgie



1326 enfants référés pour KT

TABLE 4 Procedural Characteristics and Patient Outcomes According to Defects Size and Patients Body Weight

	Large Defects			Low Body Weight		
	ASD <20 mm/m² (n = 1,072)	ASD ≥20 mm/m² (n = 254)	p Value	≤15 kg (n = 96)	>15 kg (n = 1,230)	p Value
Age, yrs	10.1 (0.7-18)	6 (1-18)	<0.001	3.8 (0.7-6)	9.3 (6-18)	<0.001
Weight, kg	31 (3.6-92)	20 (3.7-78)	<0.001	13 (3.6-15)	30 (15-92)	<0.001
ASD indexed diameter, mm/m²	12 (3.5-20)	23 (20-48.6)	<0.001	25 (9.4-48.6)	14 (3.5-39)	<0.001
Deficient rims (n = 1,133)						
Aortic	246 (23.0)	75 (33.0)	0.52	19 (25.0)	378 (30.7)	0.32
Posterior	120 (11.4)	41 (18.5)	0.26	11 (14.0)	196 (15.9)	0.89
Anteroinferior	75 (7.1)	37 (16.5)	0.003	9 (12.5)	132 (10.7)	0.69
Posterosuperior	16 (1.5)	9 (4.0)	0.09	2 (2.6)	29 (2.3)	0.86
Inferior	112 (10.6)	43 (19.3)	0.06	12 (16.0)	180 (14.6)	0.72
Superior	29 (2.7)	20 (9.0)	0.001	8 (10.6)	52 (4.2)	0.01
ASO size, mm	18 (4-38)	20 (4-40)	0.007	16 (5-26)	18 (4-40)	0.001
Procedural success	1,042 (97.2)	222 (87.4)	<0.001	91 (94.7)	1,173 (95.4)	0.126
Fluoroscopy time, min (n = 1,214)	4.6 (0.5-54)	4.9 (0.5-120)	0.49	6 (2-38)	5.3 (0.5-120)	0.24
Periprocedural complications	16 (1.4)	9 (3.5)	0.008	5 (5.2)	19 (1.5)	0.007
Device migration	6 (0.5)	4 (1.5)	0.008	0 (0.0)	10 (0.8)	0.38
Pericardial effusion	3 (0.2)	3 (1.1)	<0.001	2 (2.0)	4 (0.3)	0.002
Conduction abnormality	3 (0.2)	2 (0.7)	0.008	2 (2.0)	3 (0.2)	0.001
Mitral regurgitation	1 (0.1)	0 (0.0)	0.59	1 (1.0)	0 (0.0)	0.02
Transient hemolysis	1 (0.1)	0 (0.0)	0.59	0 (0.0)	1 (0.1)	0.76
Air embolus	1 (0.1)	0 (0.0)	0.59	0 (0.0)	1 (0.1)	0.76
Follow-up, yrs (n = 1,158)	3 (0.5-18)	3 (0.5-17)	0.22	3 (0.5-17)	3 (0.5-18)	0.83
Delayed complications	8 (0.7)	4 (1.7)	0.052	3 (3.1)	9 (0.7)	0.007
Arrhythmias	6 (0.5)	2 (0.7)	0.27	1 (1.0)	7 (0.5)	0.44
Stroke	0 (0.0)	2 (0.7)	0.007	0 (0.0)	2 (0.1)	0.76
PAH	2 (0.1)	0 (0.0)	0.59	2 (2.0)	0 (0.0)	<0.001

Values are median (range) or n (%).

PAH = pulmonary arterial hypertension; other abbreviations as in Table 2.

[1] *Jalal Z, JACC 2018*

61 enfants de moins de 4 ans référés pour KT

Table 2 Group 1 and group 2 characteristics

Characteristics	ASD closed successfully (group 1) $N = 48$	ASD referred to surgery (group 2) $N = 13$	*P*
Age	3.0 ± 0.9	2.8 ± 1.2	0.91
Weight	11.8 ± 3.1	11.5 ± 4.1	0.80
BSA	0.58 ± 0.11	0.56 ± 0.14	0.61
Qp:Qs ratio	2.1 ± 0.7	2.4 ± 0.7	0.21
Mean PA pressure (mm Hg)	18.0 ± 5.1	17.4 ± 6.8	0.83
ASD size (mm)	12.1 ± 4.2	17.5 ± 6.1	<0.01
ASD balloon-stretched size (mm)	14.1 ± 4.0	20.6 ± 6.3	0.03
Deficient rim (%)	26 (54)	10 (77)	0.09
TSL (mm)	34.5 ± 4.6	34.6 ± 5.8	0.96
ASD-to-TSL ratio	0.34 ± 0.11	0.53 ± 0.14	<0.01
ASD-to-weight ratio	0.90 ± 0.34	1.43 ± 0.74	<0.01
ASD-to-BSA ratio	20.5 ± 6.6	32.1 ± 10.4	<0.01
ASD-to-weight ratio <1.2 (%)	36 (88)	2 (17)	<0.01

Petit CJ, Pediatr Cardiol 2013

280 enfants de moins de 6 ans référés pour KT

Table 3. Logistic Regression Model for Failure of Percutaneous ASD Closure in Patients With a Single ASO Device (n=280)

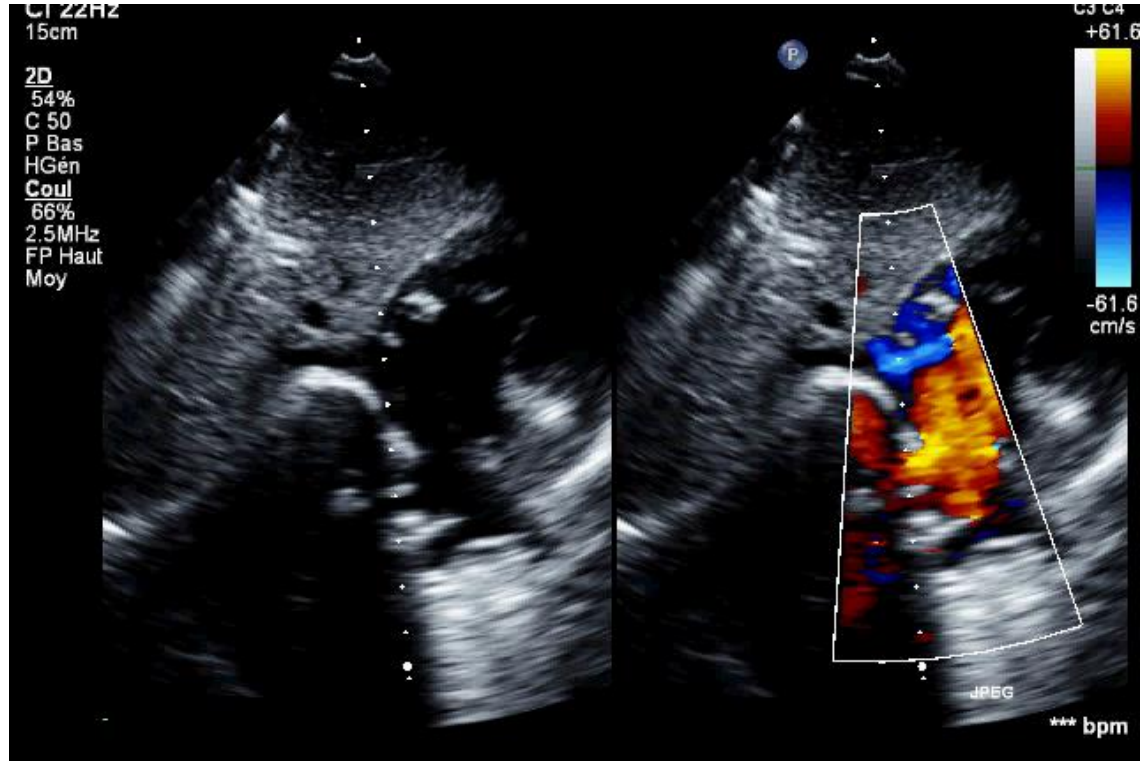
	Univariate		Multivariate	
	OR (95% CI)	P value	OR (95% CI)	P value
Sex (female)	0.844 (0.139–5.135)	0.854	–	–
Age at closure (years)	1.685 (0.729–3.894)	0.223	–	–
BSA (m^2)	1,189,140 (0.100–14108610)	0.139	–	–
ASD size (mm)	1.622 (1.212–2.172)	0.001	1.828 (1.139–2.934)	0.012
Multiple ASDs	0.000 (0.000–)	0.998	–	–
Used sizing balloon	1.559 (0.170–14.326)	0.695	–	–
SVC rim (mm)	1.045 (0.830–1.315)	0.711	–	–
IVC rim (mm)	0.833 (0.645–1.075)	0.159	–	–
retroAo rim (mm)	1.113 (0.783–1.582)	0.549	–	–
PI rim (mm)	0.644 (0.413–1.004)	0.052	1.218 (0.579–2.564)	0.604
MV rim (mm)	1.047 (0.740–1.480)	0.796	–	–
PS rim (mm)	0.603 (0.396–0.917)	0.018	0.816 (0.439–1.514)	0.519
retroAo-PI rims deficiency	1.911 (0.207–17.652)	0.568	–	–
SVC-PS rims deficiency	0.000 (0.000–)	0.999	–	–
PS-PI rims deficiency	0.000 (0.000–)	0.999	–	–
SVC-PI rims deficiency	13.350 (1.257–141.836)	0.032	8.676 (0.252–298.360)	0.231
IVC-retroAo rims deficiency	13.200 (1.242–140.247)	0.032	12.074 (0.227–641.334)	0.219
Atrial septal malalignment	0.000 (0.000–)	0.999	–	–

ASO, Amplatzer Septal Occluder; CI, confidence interval; OR, odds ratio. Other abbreviations as in Table 1.

Cha SG, Circ J 2021

Shanna, 2 ans

- Bronchiolite à répétition, asthme mal équilibré
- Echo à 2 ans pour SS



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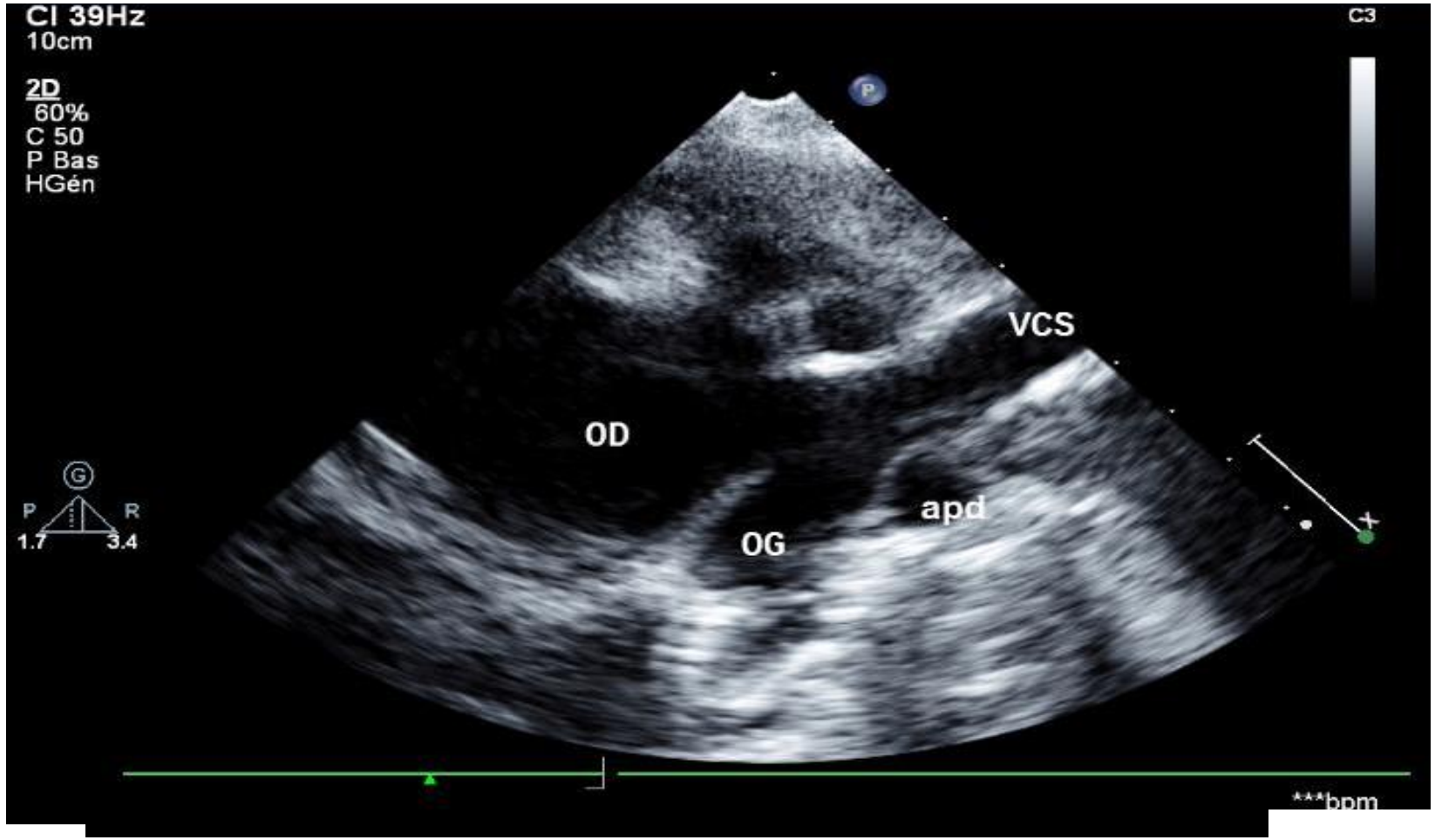
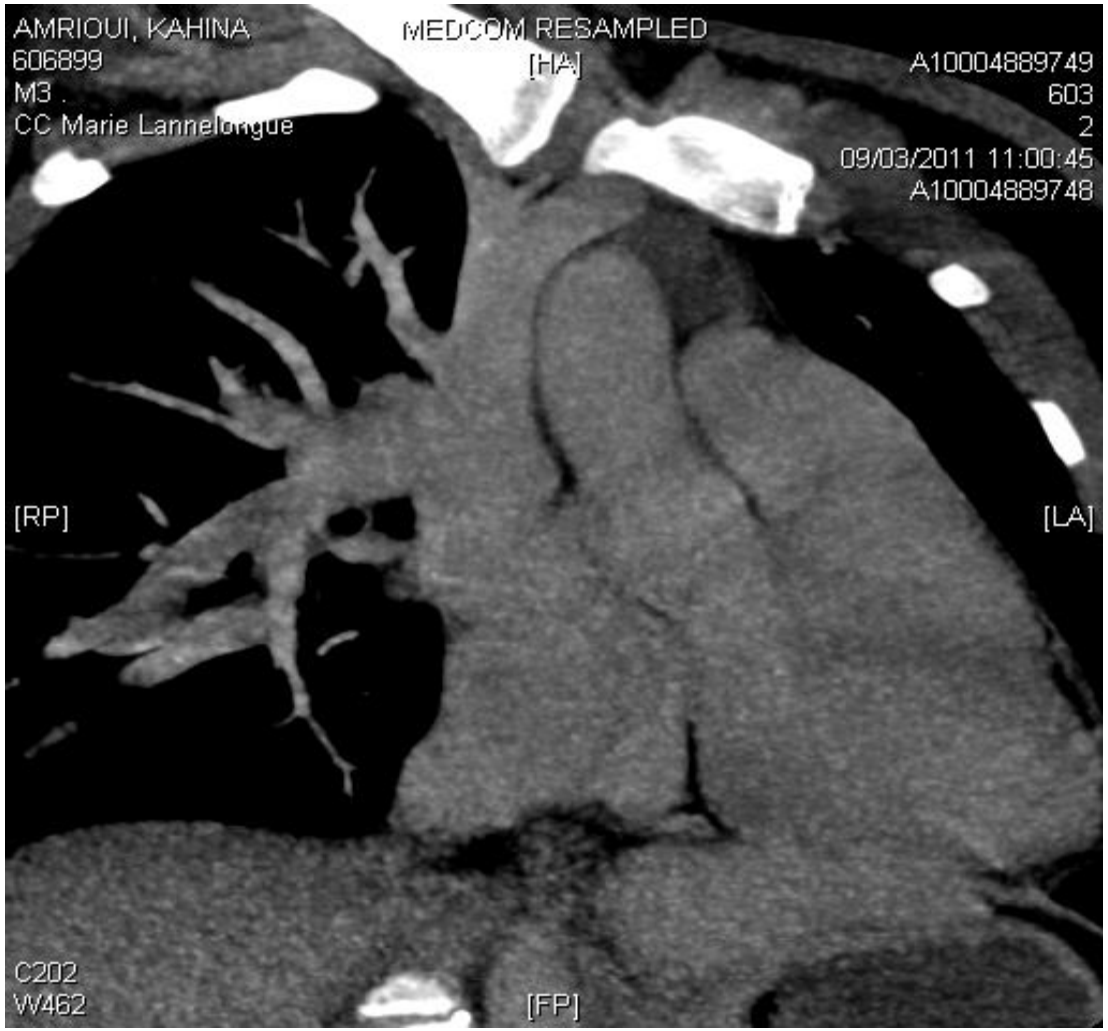
Echocardiographie : CIA SV

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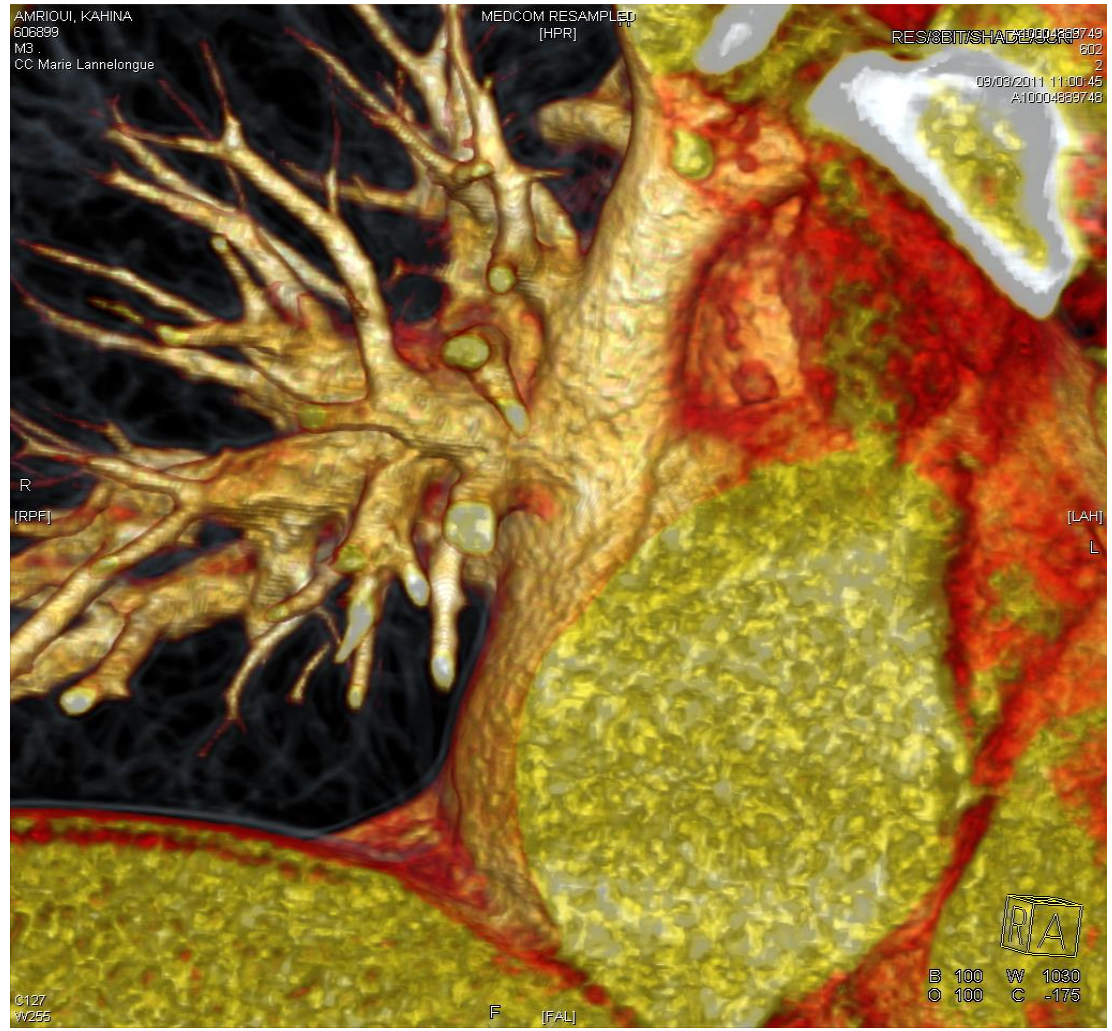
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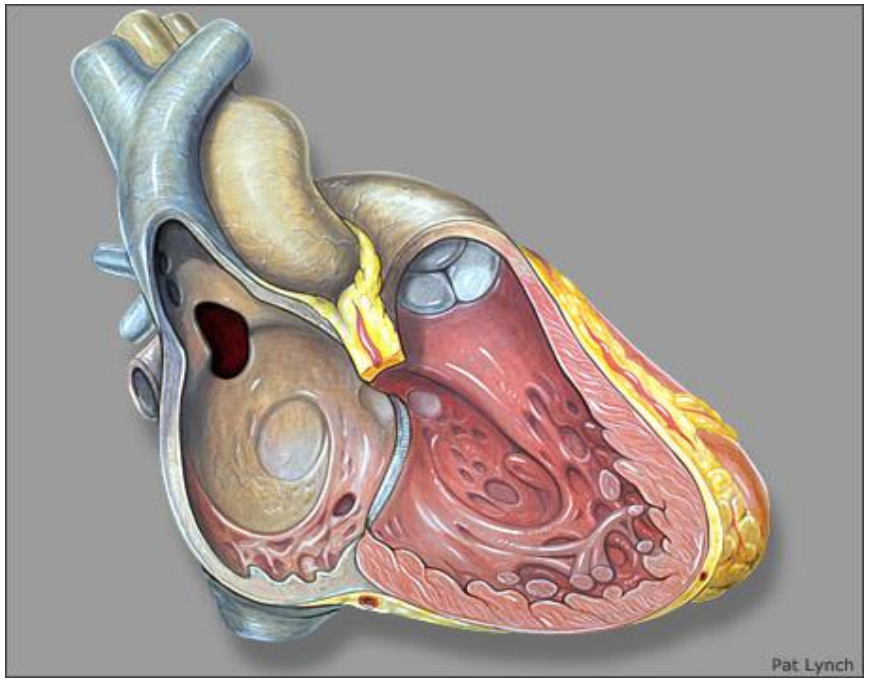
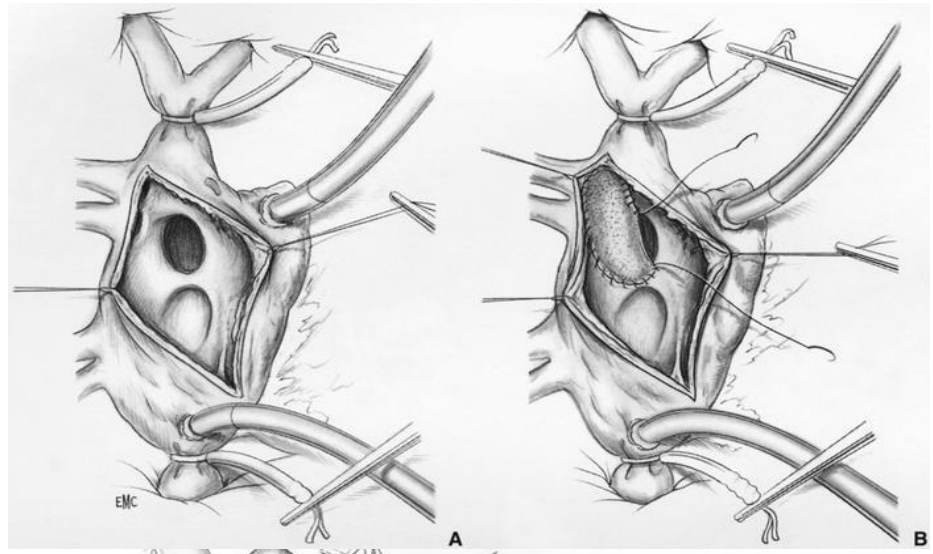
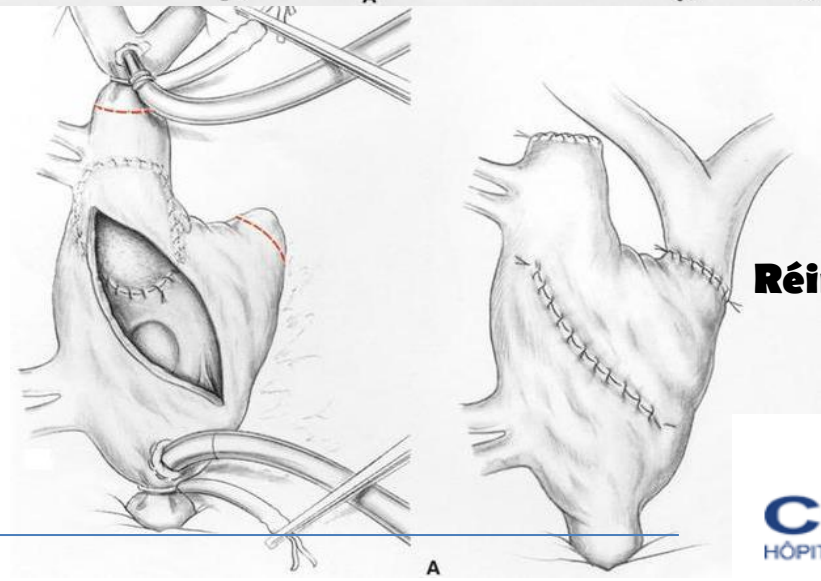
Traitement CIA Sinus Venosus = CHIRURGICAL





Tunnelisation



Réimplantation

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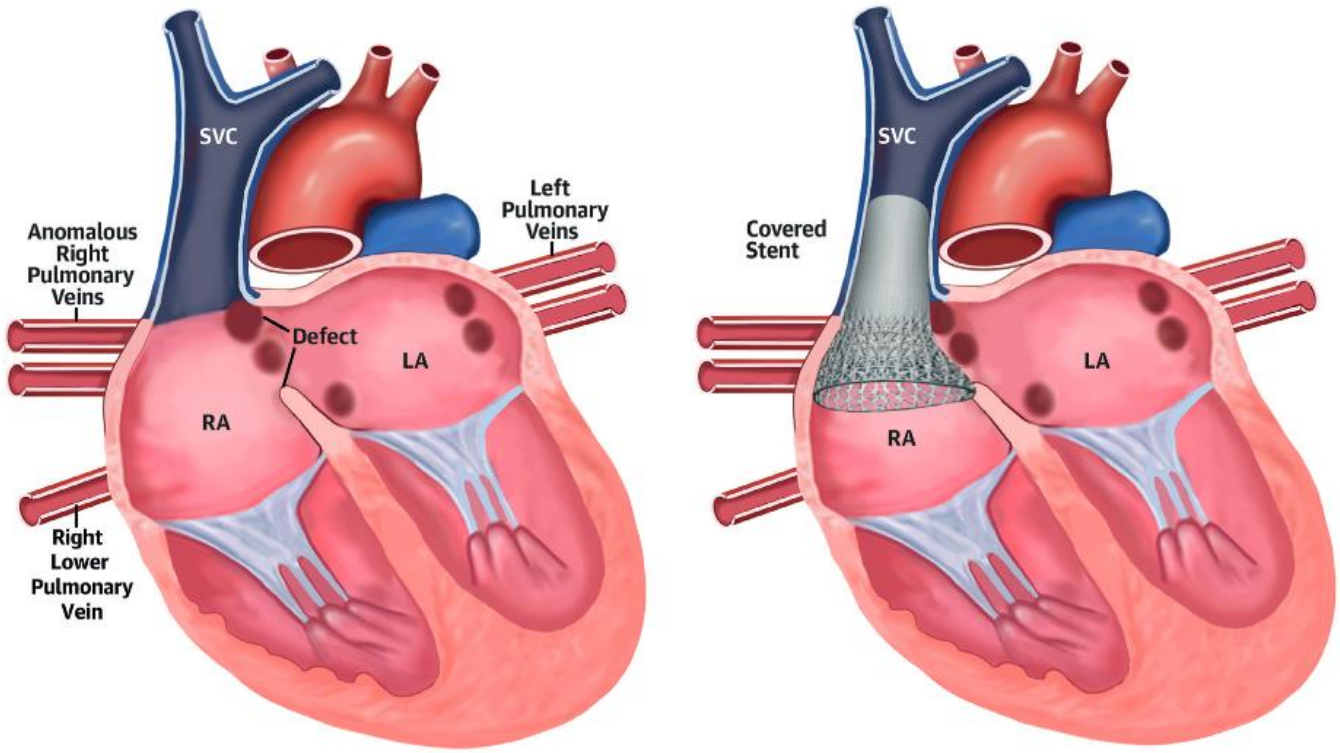
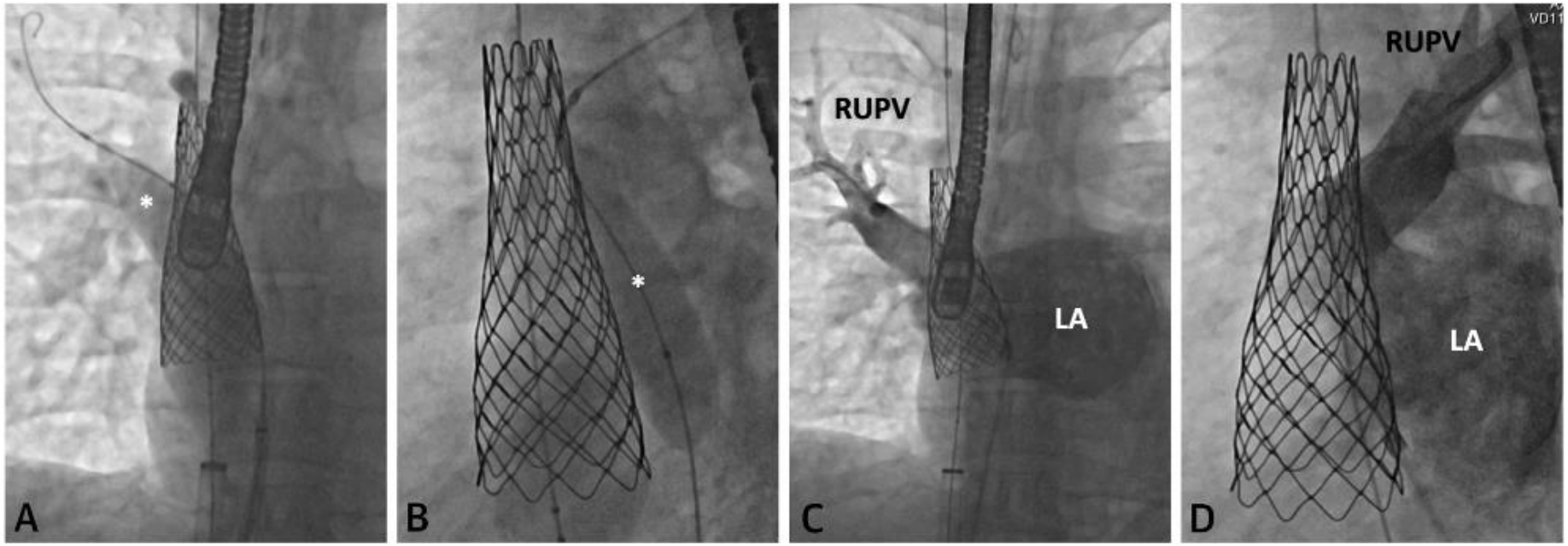
CENTRAL ILLUSTRATION **Transcatheter Correction of Superior Sinus Venosus Atrial Septal Defects**



Hansen, J.H. et al. J Am Coll Cardiol. 2020;75(11):1266–78.

The diagram demonstrates how the covered stent is able to simultaneously close the atrial septal defect and redirect the pulmonary venous drainage to the left atrium (LA) behind the covered stent. The flared stent portion in the right atrium (RA) ensures occlusion of the interatrial communication. SVC = superior vena cava.

FIGURE 5 Protection of the Pulmonary Venous Pathway to Prevent Obstruction



Same patient as in Figure 4. **(A, B)** Protection of the RUPV with Atlas Gold balloon **(*)** during stent deployment and flaring, preventing protrusion of the stent into the pulmonary venous pathway. **(C, D)** Pulmonary vein angiography confirms unobstructed flow to the LA. Abbreviations as in Figure 1.

CIA HTAP

Recommendations for intervention in atrial septal defect (native and residual)

Recommendations	Class[a]	Level[b]
In patients with evidence of RV volume overload[c] and no PAH (no non-invasive signs of PAP elevation or invasive confirmation of PVR <3 WU in case of such signs) or LV disease, ASD closure is recommended regardless of symptoms.[146,147]	I	B
Device closure is recommended as the method of choice for secundum ASD closure when technically suitable.	I	C
In elderly patients not suitable for device closure, it is recommended to carefully weigh the surgical risk against the potential benefit of ASD closure.	I	C
In patients with non-invasive signs of PAP elevation, invasive measurement of PVR is mandatory.	I	C
In patients with LV disease, it is recommended to perform balloon testing and carefully weigh the benefit of eliminating L–R shunt against the potential negative impact of ASD closure on outcome due to an increase in filling pressure (taking closure, fenestrated closure, and no closure into consideration).	I	C
In patients with suspicion of paradoxical embolism (exclusion of other causes), ASD closure should be considered regardless of size providing there is absence of PAH and LV disease.	IIa	C
In patients with PVR 3–5 WU, ASD closure should be considered when significant L–R shunt is present (Qp:Qs >1.5).	IIa	C
In patients with PVR ≥5 WU, fenestrated ASD closure may be considered when PVR falls below 5 WU after targeted PAH treatment and significant L–R shunt is present (Qp:Qs >1.5).	IIb	C
ASD closure is not recommended in patients with Eisenmenger physiology, patients with PAH and PVR ≥5 WU despite targeted PAH treatment, or desaturation on exercise.[d]	III	C

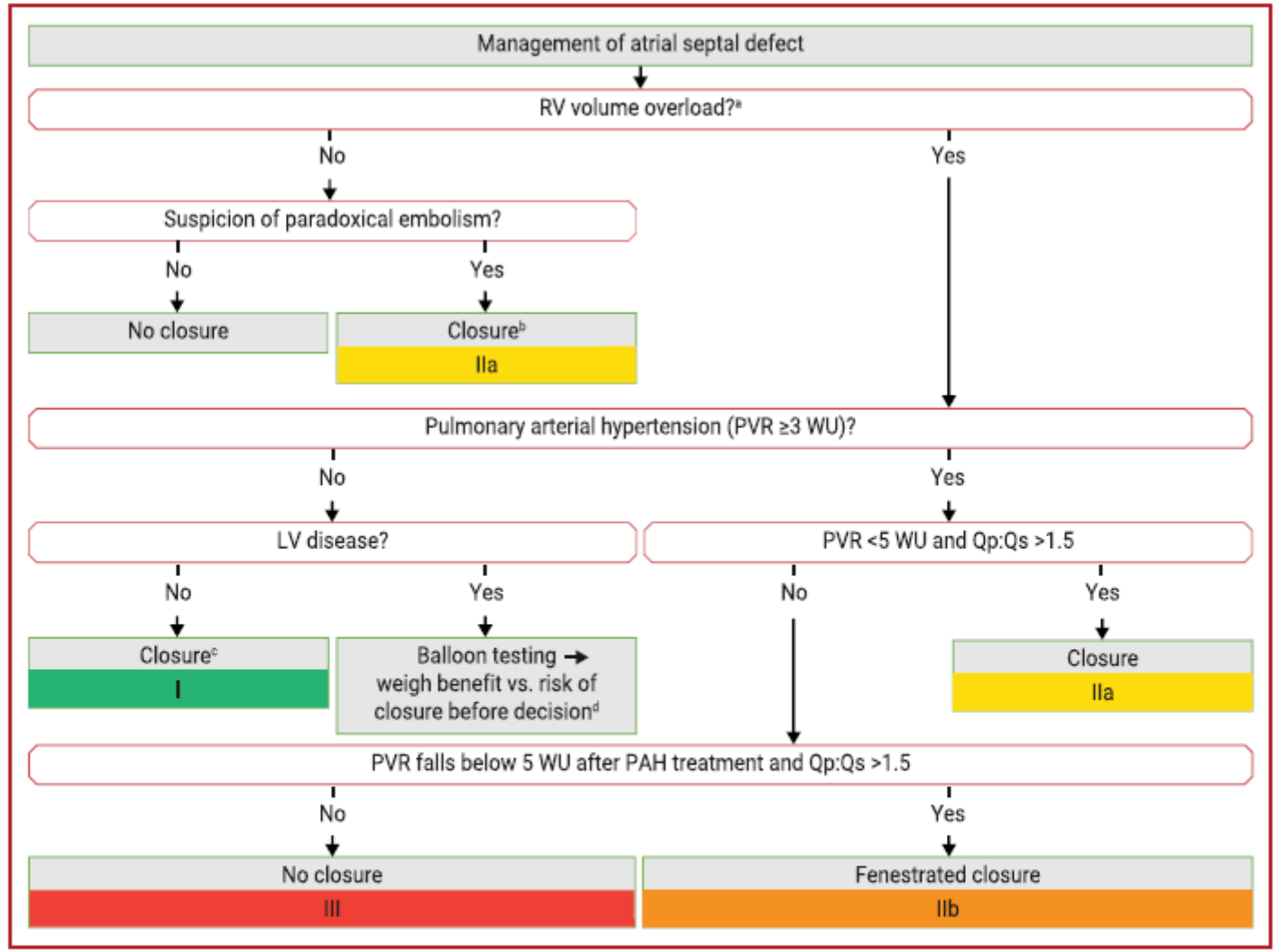


Figure 2 Management of atrial septal defect.

ASD = atrial septal defect; L – R = left-to-right; LV = left ventricle/ventricular; PAH = pulmonary arterial hypertension; PVR = pulmonary vascular resistance; Qp:Qs = pulmonary to systemic flow ratio; RV = right ventricle/ventricular; WU = Wood units.

[a]RV enlargement with increased stroke volume.

[b]Providing there is no PAH or LV disease.

[c]In elderly patients not suitable for device closure, carefully weigh surgical risk vs. potential benefit of ASD closure.

[d]Carefully weigh the benefit of eliminating L – R shunt against the potential negative impact of ASD closure on outcome due to an increase in filling pressure (taking closure, fenestrated closure, and no closure into consideration).

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