Bases de l'échographie cardiaque dans les cardiopathies congéniales

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M3C

Necker
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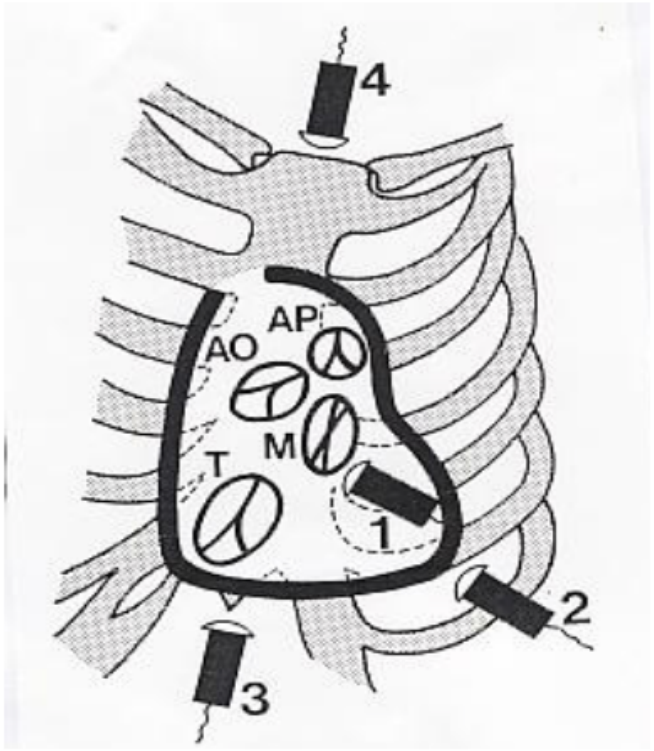
Analyse segmentaire : 2 règles d'or

- Chaque variable (segment) doit être définie par ses caractéristiques anatomiques propres et non par ses rapports avec les autres variables
- Lorsqu'on parle d'une structure cardiaque en termes de droite ou de gauche il s'agit de sa morphologie et non de sa situation dans le thorax

Les incidences d’étude du cœur en bi-dimentionnel

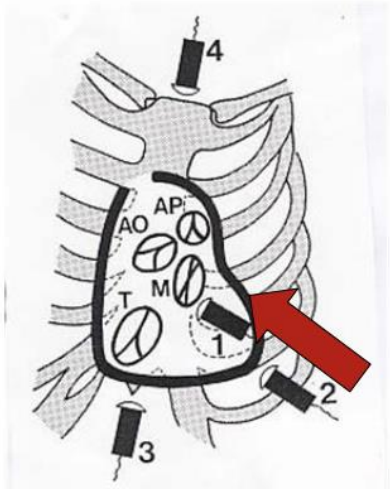
ECHOCARDIOGRAPHIE

- DIFFERENTES INCIDENCES D'ETUDE DU COEUR(MODE BIDIMENSIONNEL)
  - 1 : Voie parasternale (mode TM)
  - 2 : Voie apicale
  - 4: Voie suprasternale
  - 3 : Voie sous costale
  - Voie transoesophagienne
- ETUDE DOPPLER



INCIDENCE PARASTERNALE

- TRANSDUCTEUR EST PLACE AU NIVEAU DU 2EME 3EME EICG A PROXIMITE DU STERNUM
- GRAND AXE DU CŒUR
  - MODE TM (FONCTION VG)



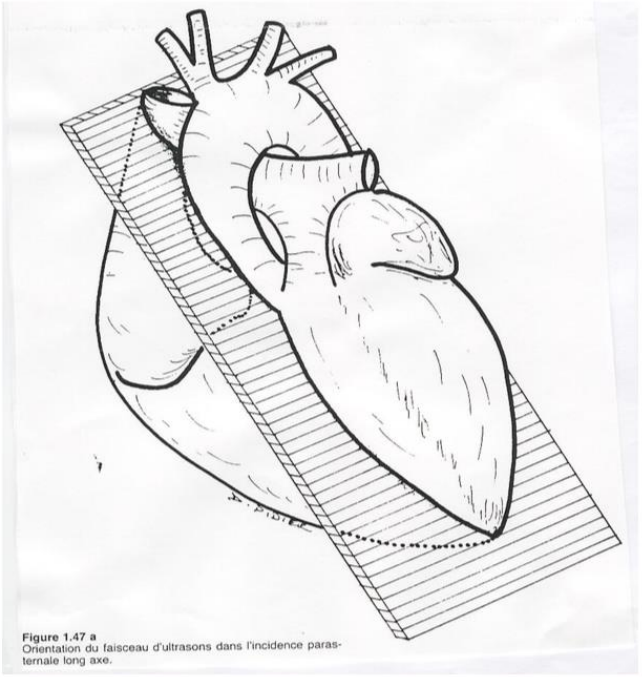
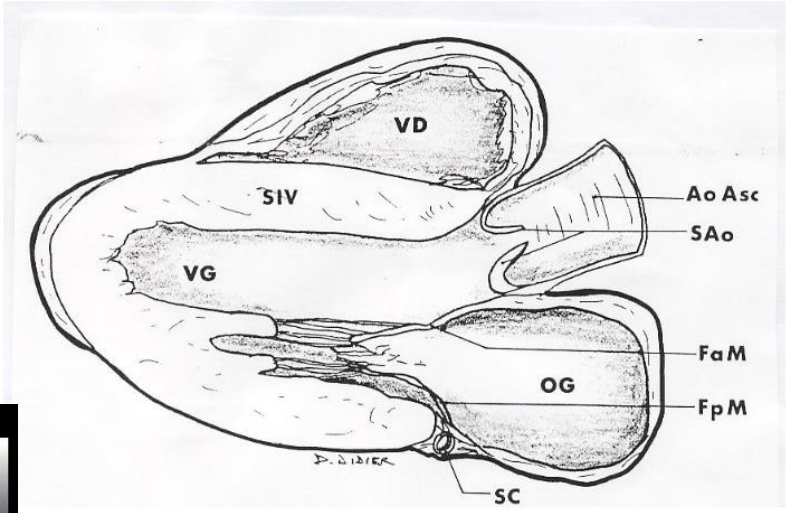


Figure 1.47 a
Orientation du faisceau d'ultrasons dans l'incidence parasternale long axe.

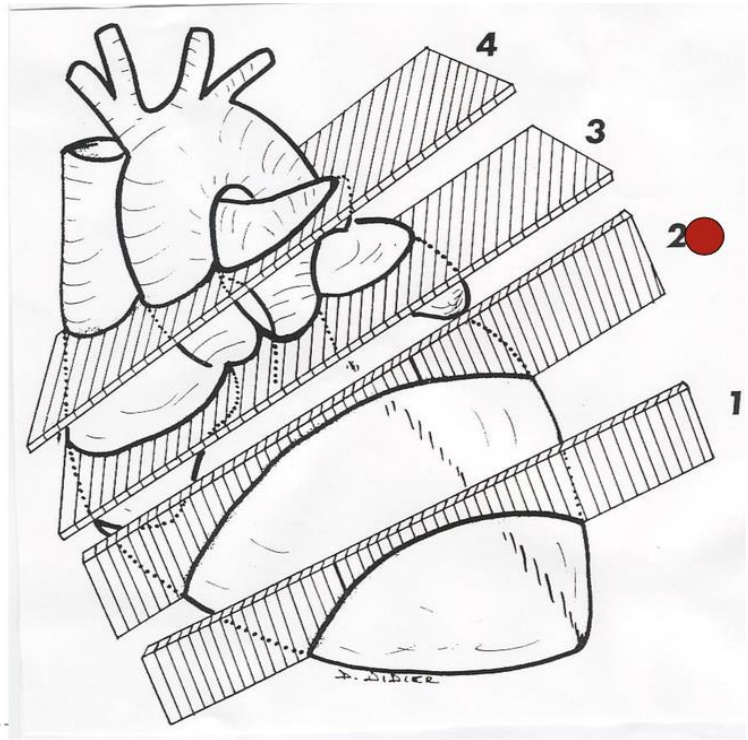
Parasternal grand axe

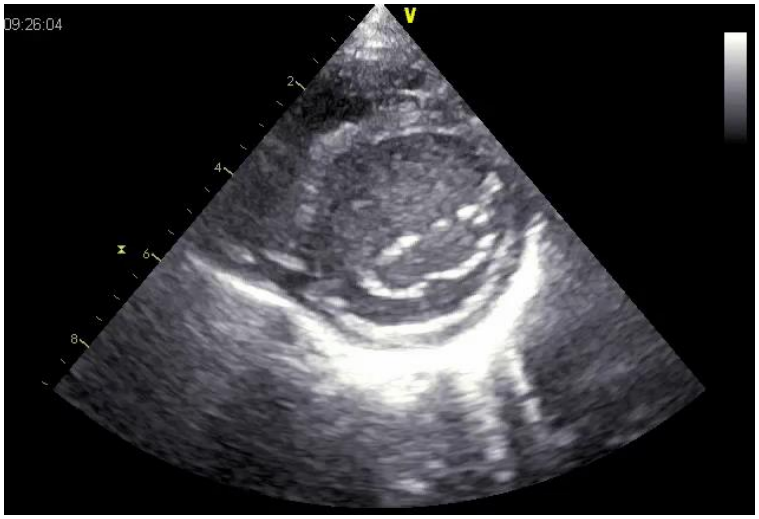


INCIDENCE PARASTERNALE

- TRANSDUCTEUR EST PLACE AU NIVEAU DU 2EME 3EME EICG A PROXIMITE DU STERNUM
- PETIT AXE DU CŒUR (rotation de 90° du capteur)

Figure 17
Les quatre incidences d'étude du cœur
1 - parasternale
2 - apexienne
3 - sous-xyphoïdienne (sous-costale)
4 - sus-sternale
Les quatre appareils valvulaires :
M mitrale, Ao : aorte, T : tricuspide ; AP pulmonaire.

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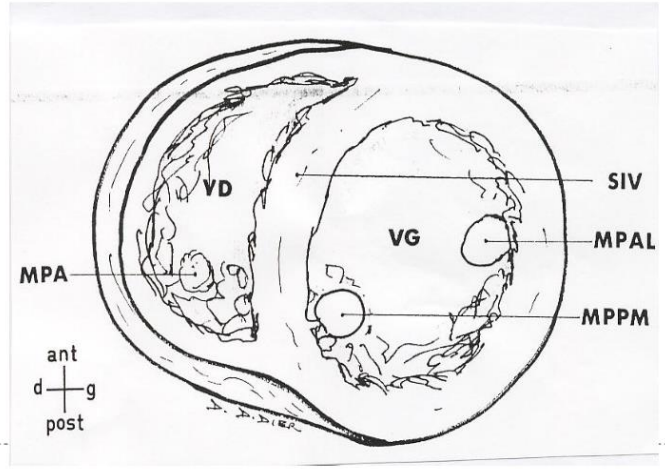
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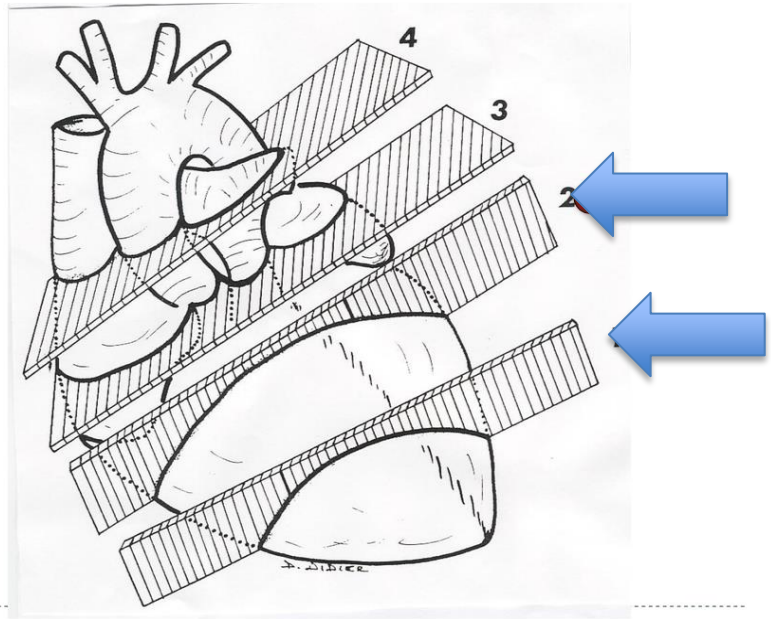
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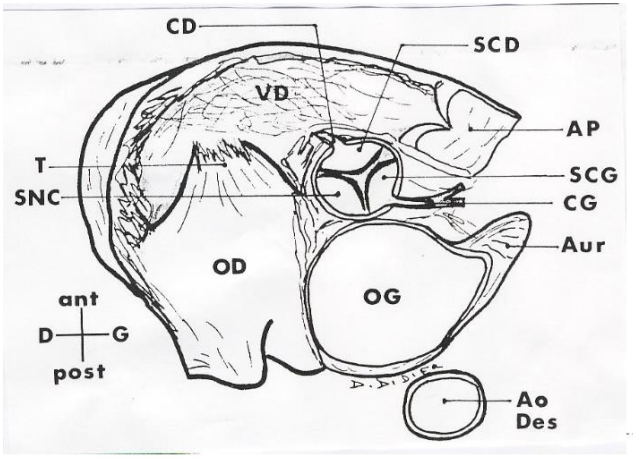
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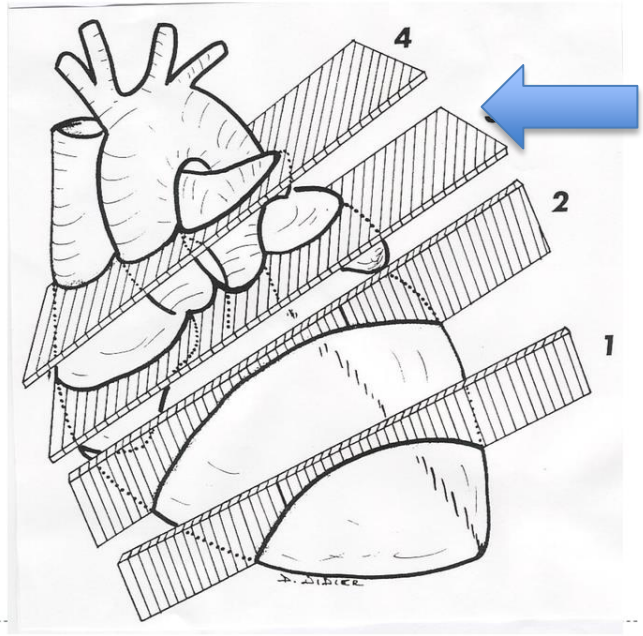
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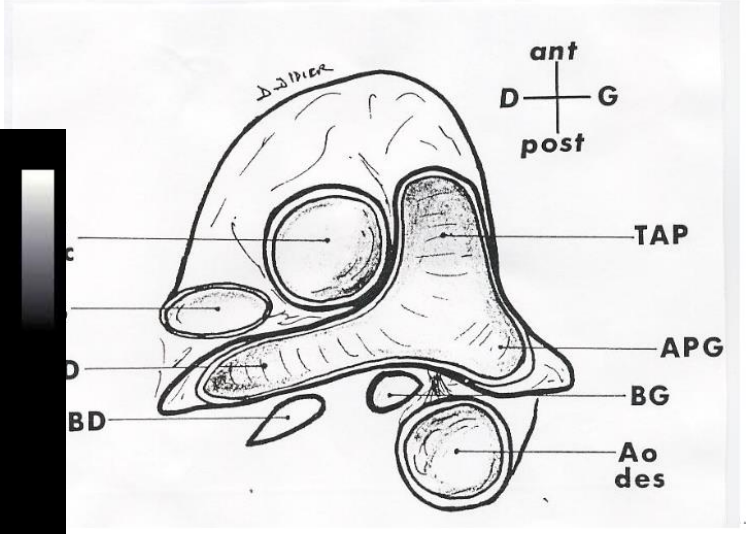
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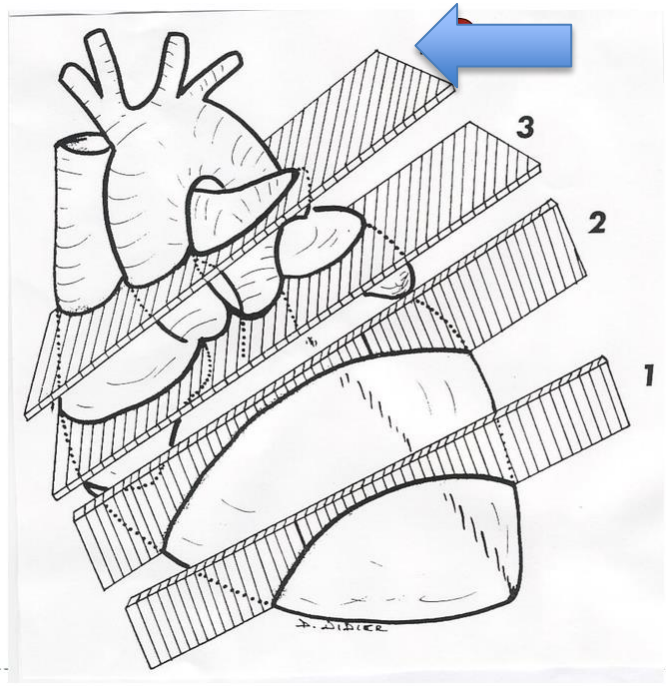
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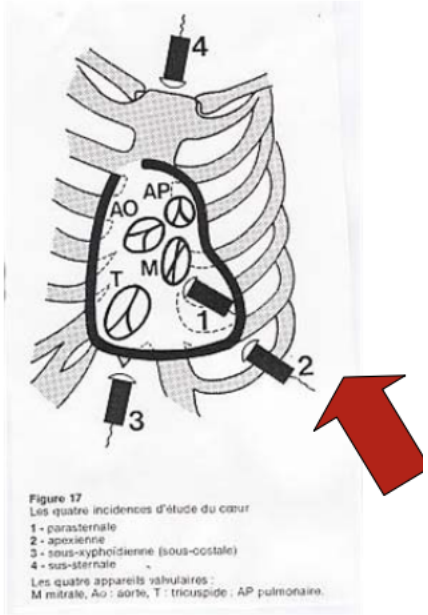
INCIDENCE APICALE

- TRANSDUCTEUR PLACE AU NIVEAU DE L'APEX CARDIAQUE EN REGARD DU CHOC DE POINTE
- DIRIGE VERS LA BASE DU COEUR



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Les quatre incidences d'étude du cœur
1 - parasternale
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Les quatre appareils valvulaires :
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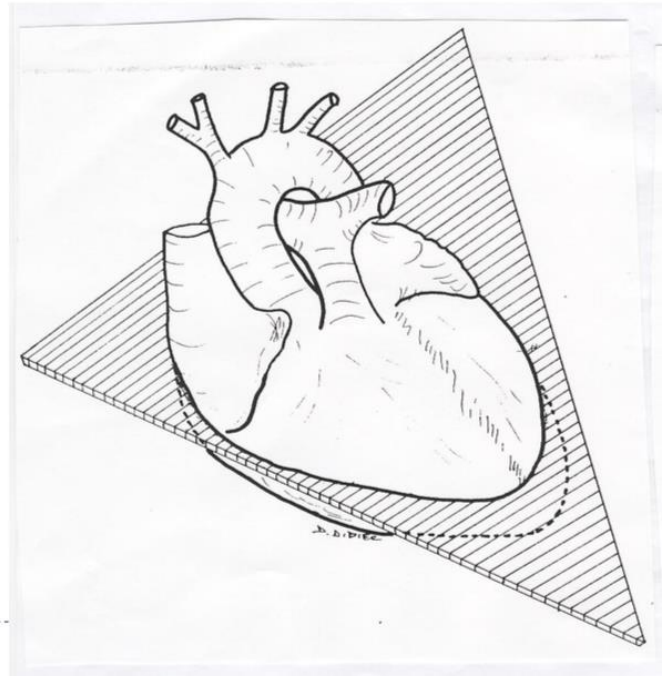

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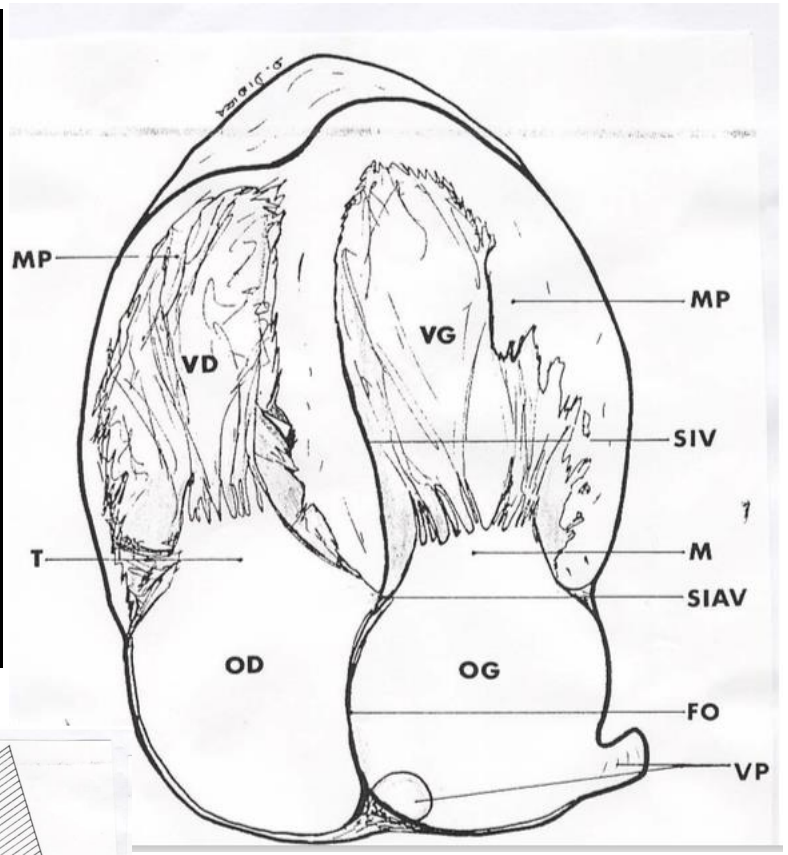
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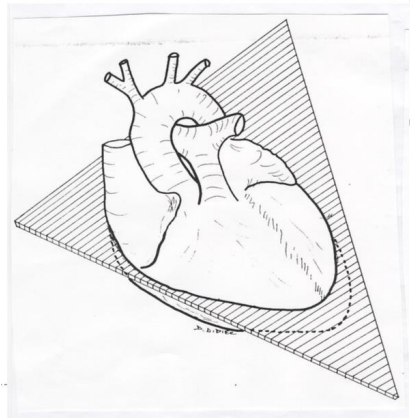
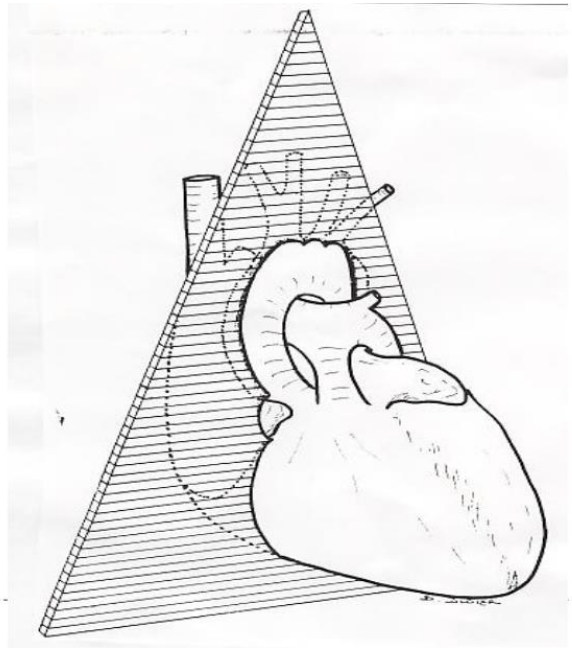
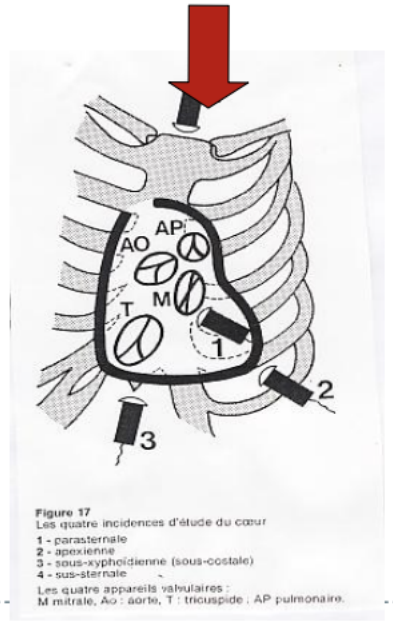


Suprasternal

- TRANSDUCTEUR PLACE DANS LE CREUX SUS STERNAL
- DIRIGE VERS LE BAS





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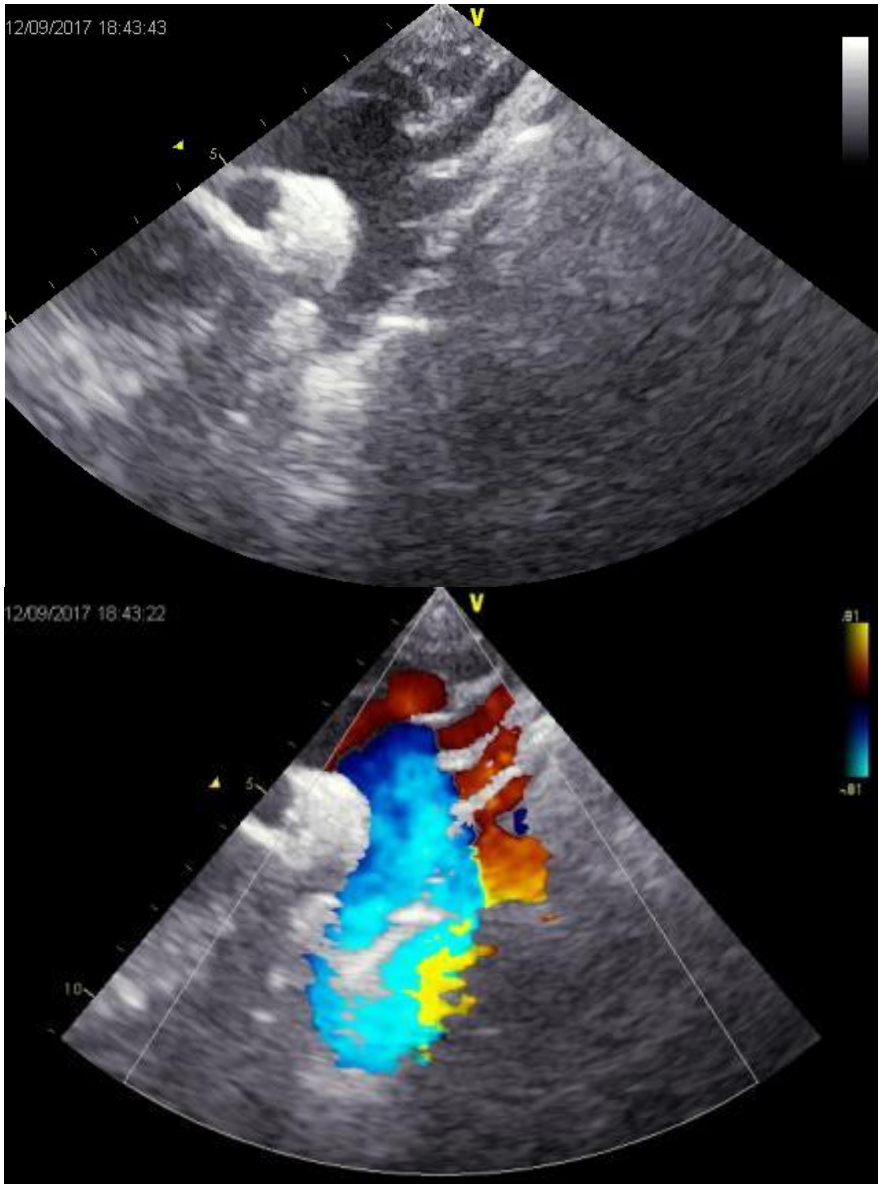
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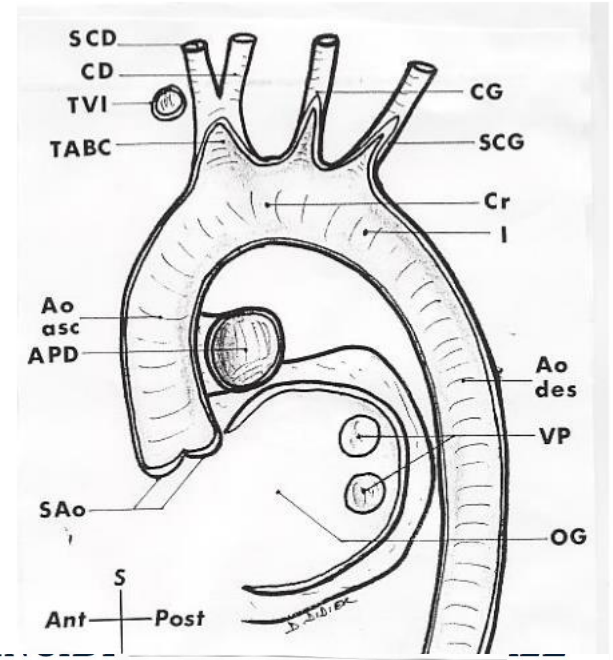
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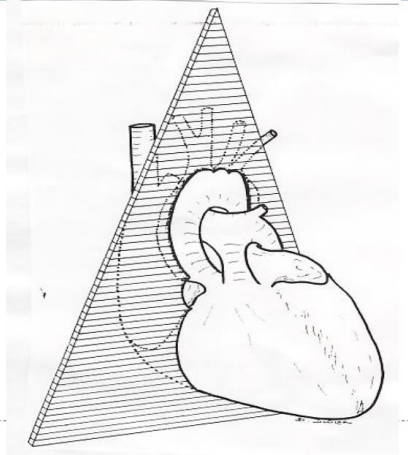
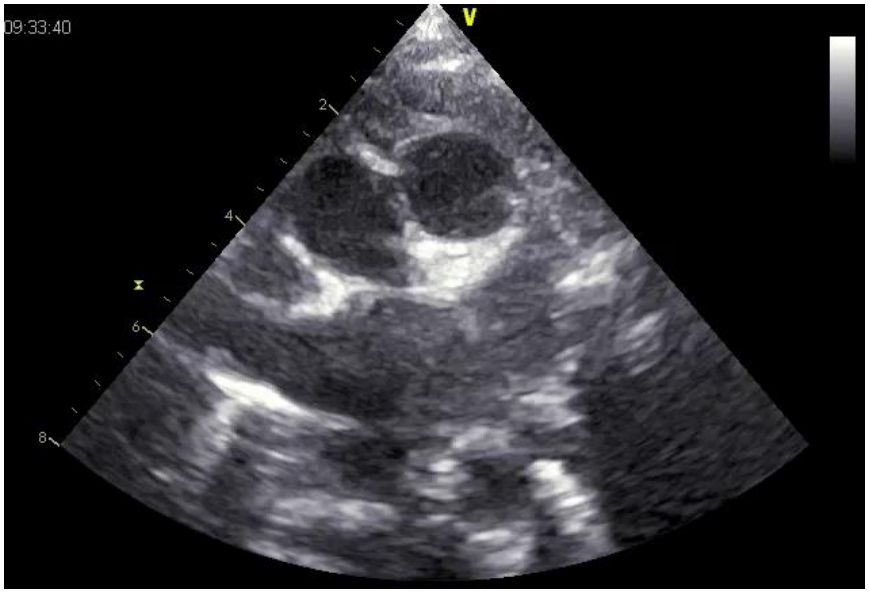
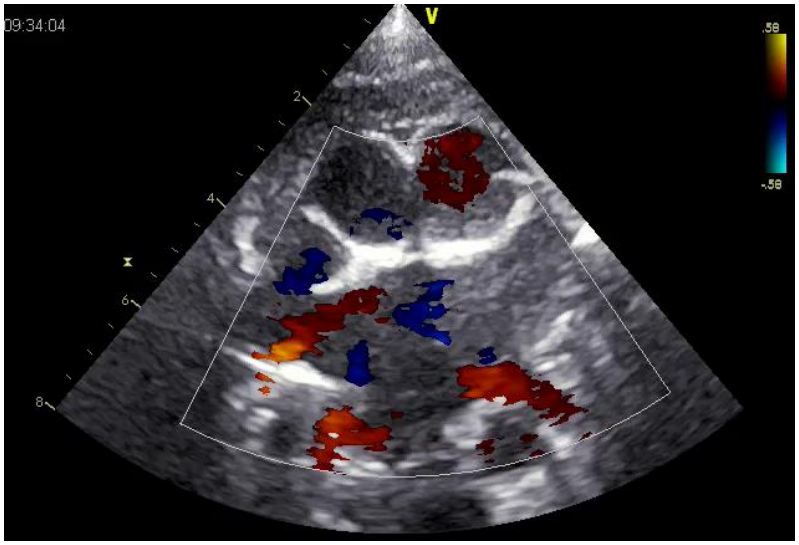


Suprasternale





INCIDENCE SOUS COSTALE

- ENFANT +++
- TRANSDUCTEUR PLACE SOUS L'APPENDICE XYPHOIDE
- DIRIGE VERS EPAULE GAUCHE

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Les quatre appareils valvulaires :
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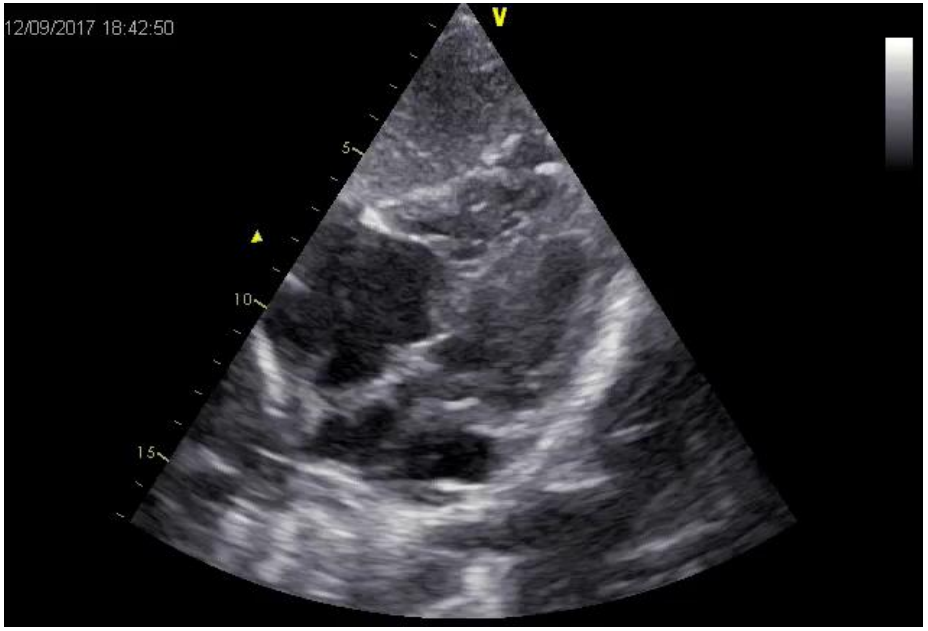
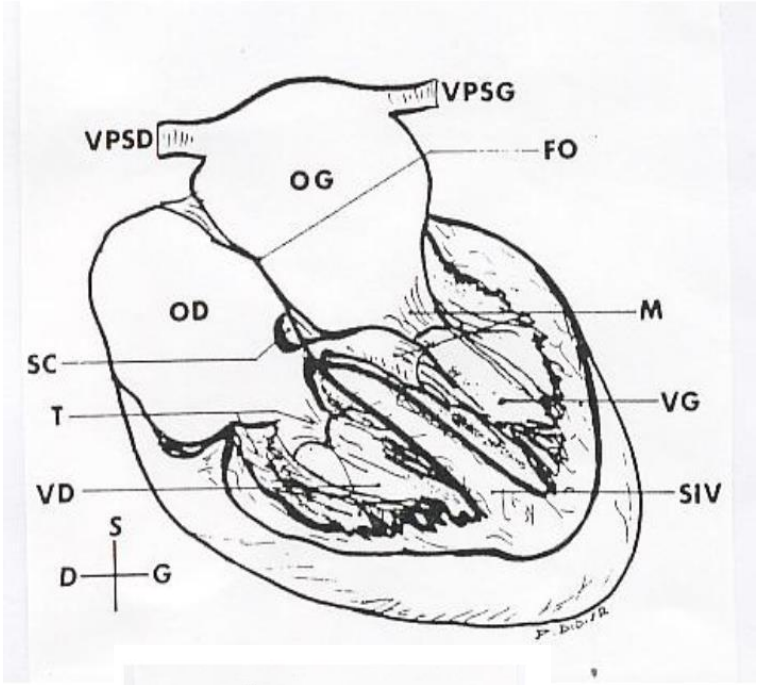
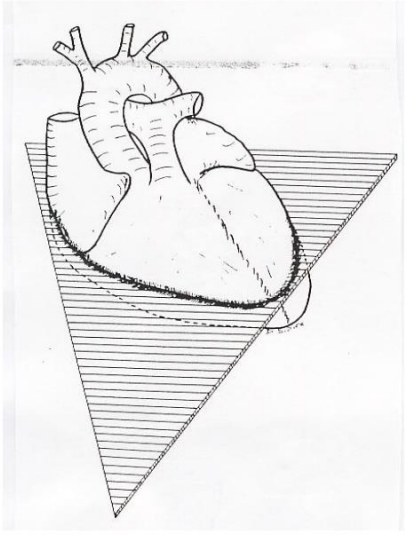
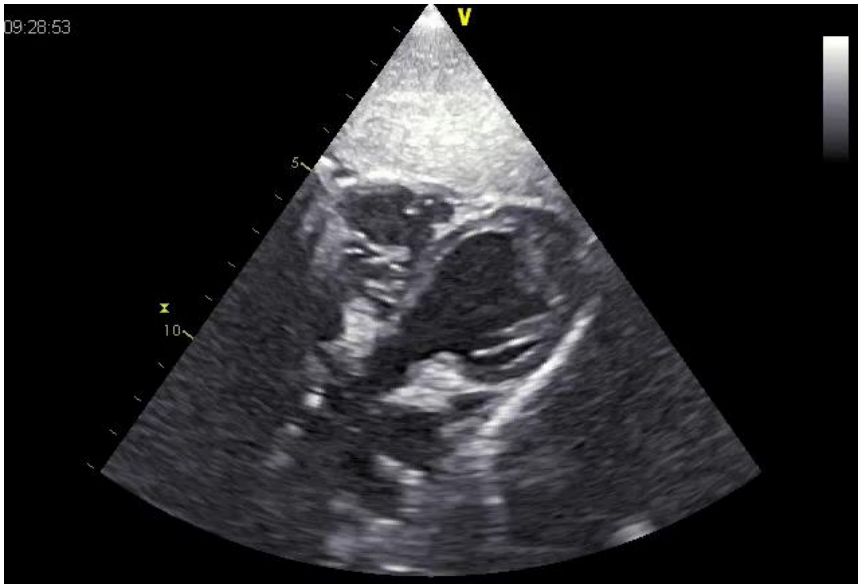
Apicale

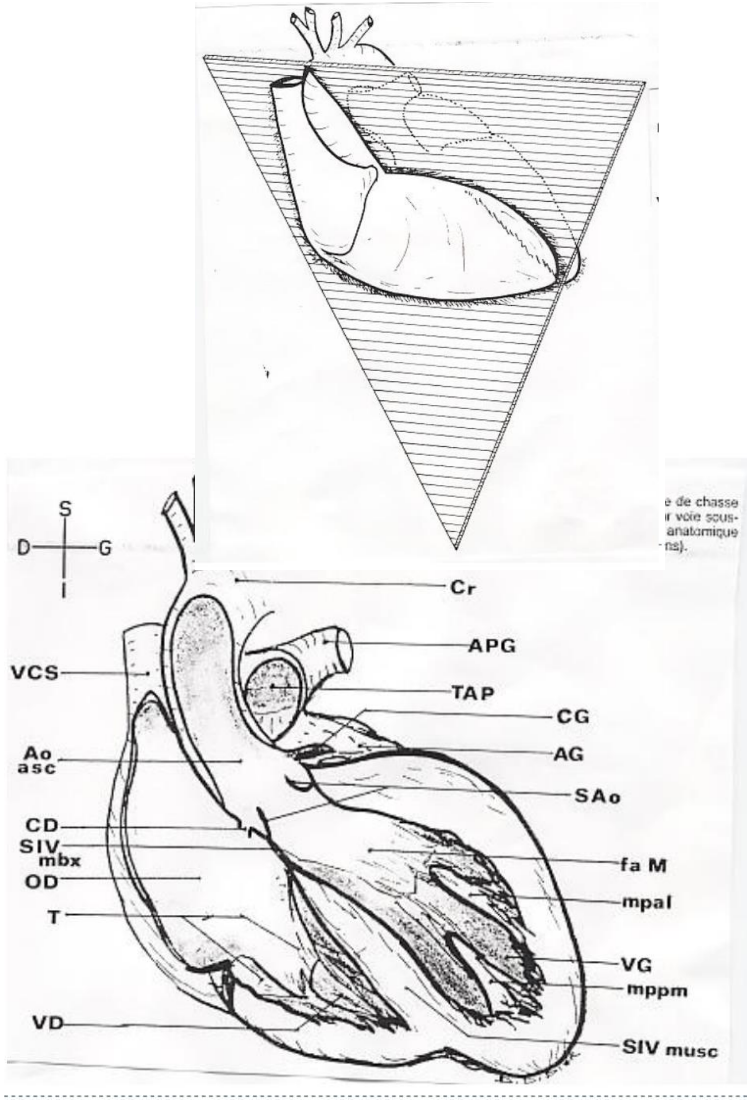




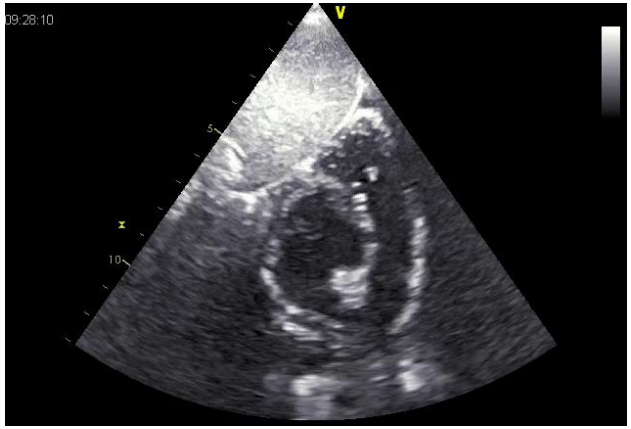


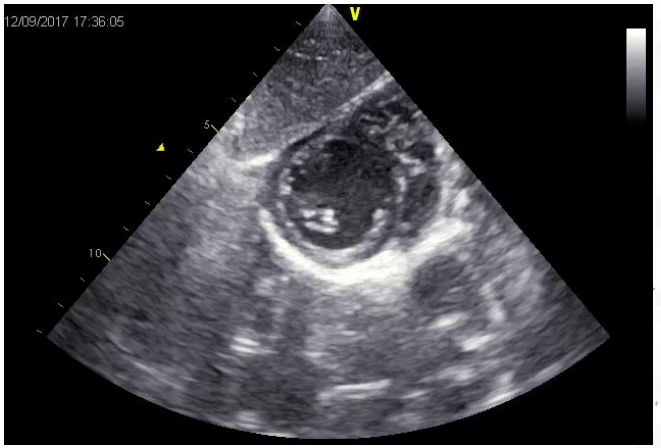
Voie d'éjéction du VG





Sous costal, petit axe





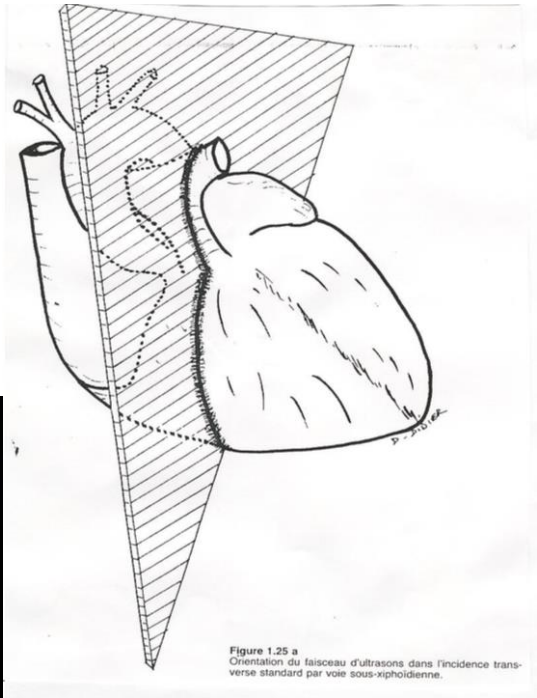
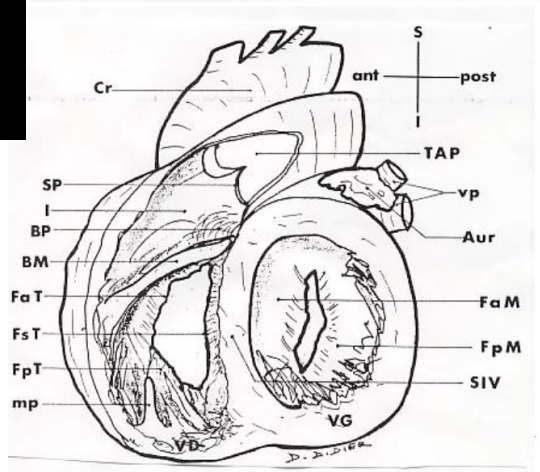
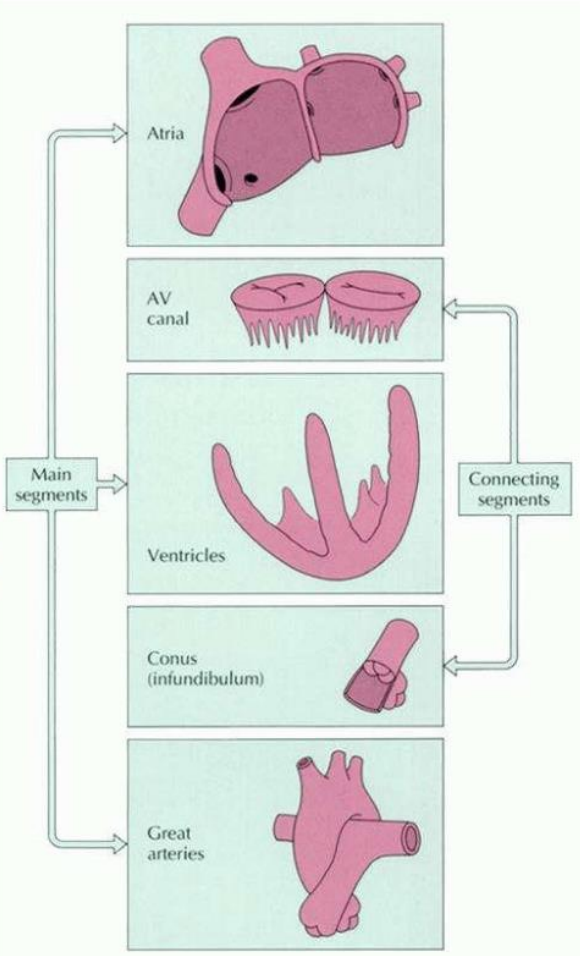


Figure 1.25 a
Orientation du faisceau d'ultrasons dans l'incidence transverse standard par voie sous-xipholdienne.

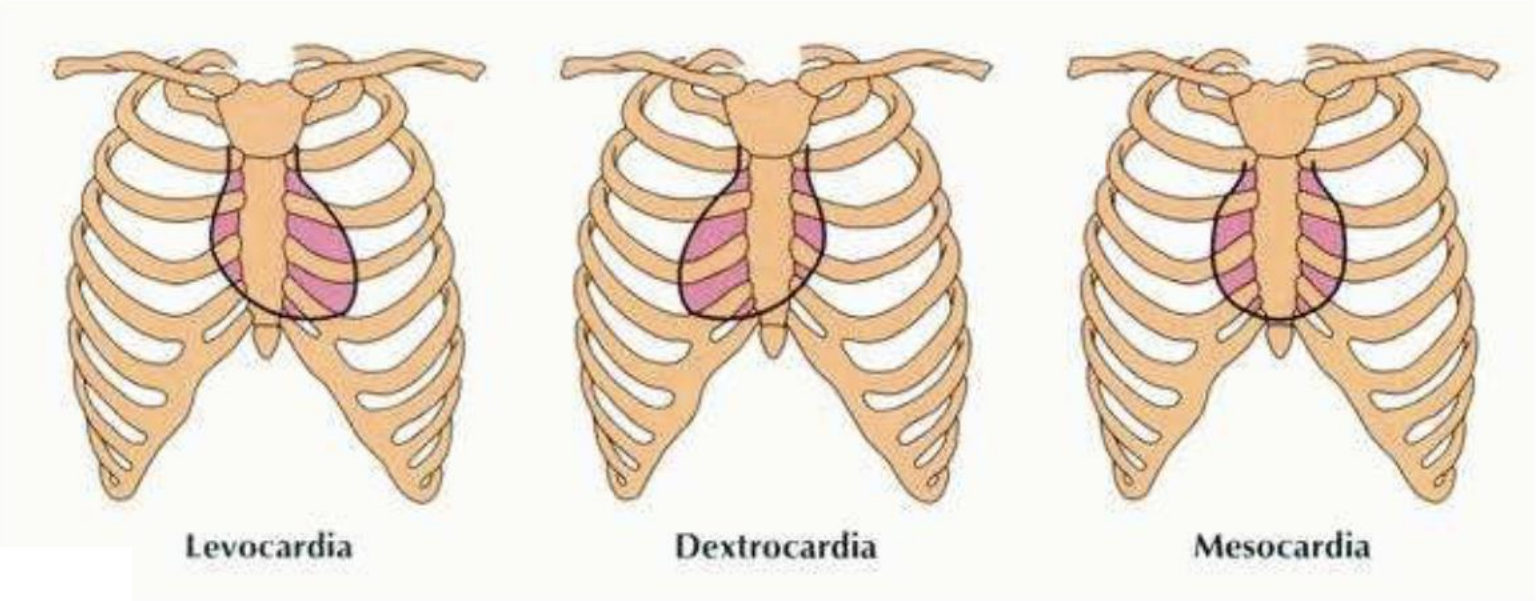


ANALYSE SEGMENTAIRE

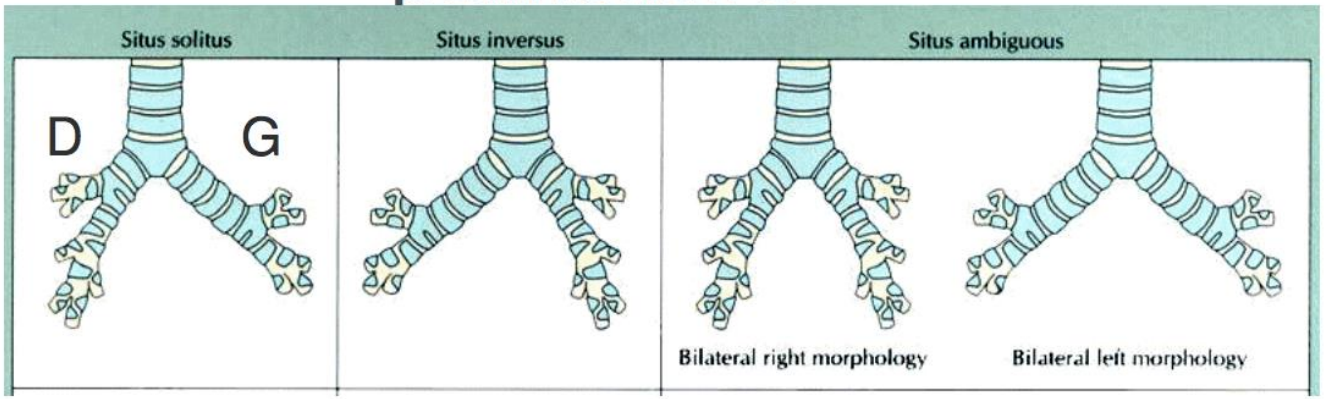
- 3 SEGMENTS CARDIAQUES PRINCIPAUX :
  - oreillettes (situs viscéro-atrial)
  - ventricules (loop = boucle ventriculaire)
  - gros vaisseaux (conotruncus)
- 2 SEGMENTS « DE CONNEXION » :
  - valves auriculoventriculaires
  - infundibulum ou conus



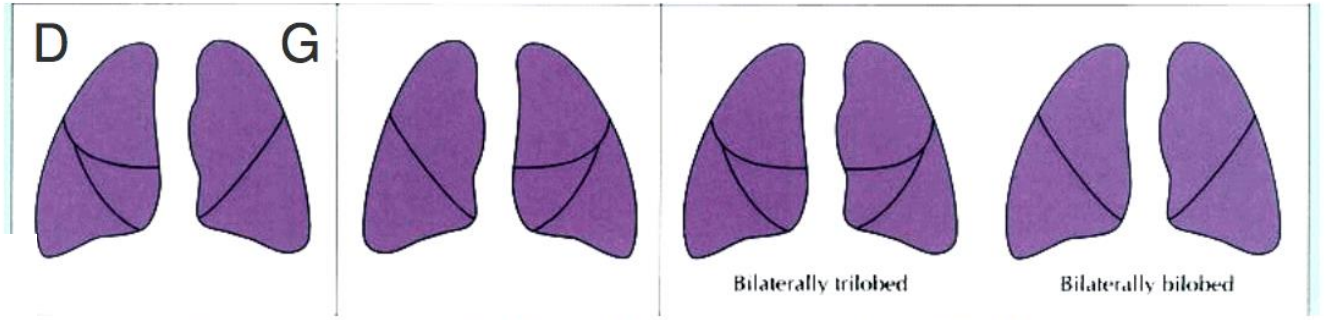
Position du cœur dans le thorax



Situs viscéral bronchique et pulmonaire

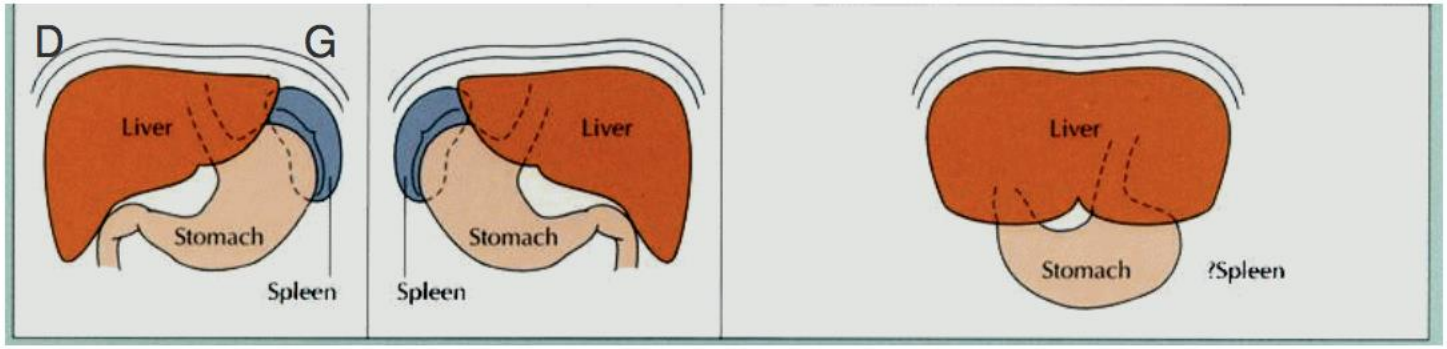


Bronche droite = épartérielle ; Bronche gauche = hypartérielle



Poumon droit = 3 lobes ; Poumon gauche = 2 lobes

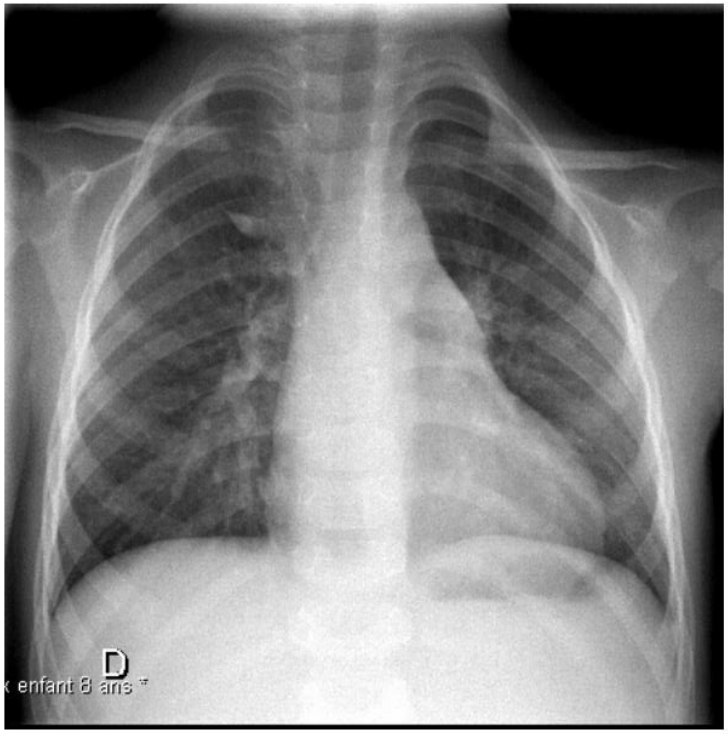
Situs viscéral abdominal



Situs solitus

Situs inversus

Situs ambiguus
Foie médian
Asplénie ou polysplénie


D
enfant 8 ans

LE SITUS ATRIAL: définir l'oreillette de morphologie droite

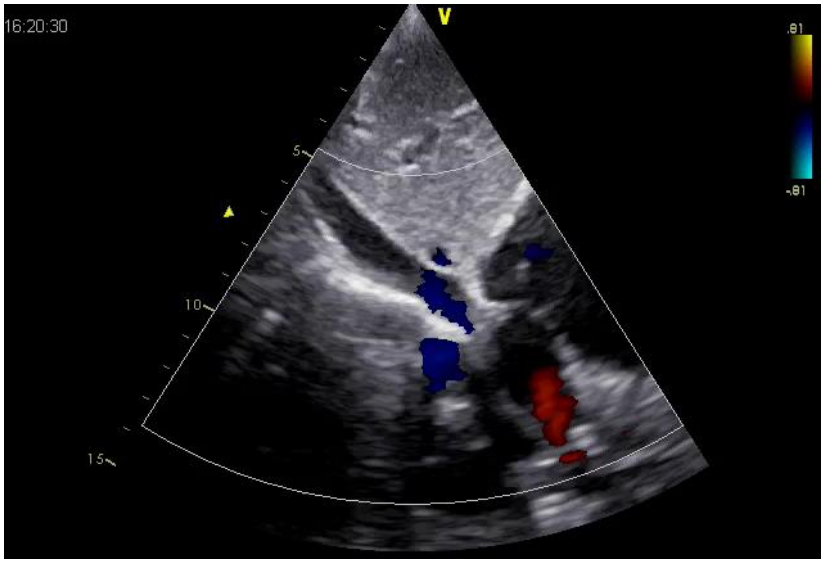
- Le segment supra-hépatique de la VCI est
  - Toujours présent
  - Toujours unilatéral
  - Toujours connecté à l'OD
- Exceptions :
  - interruption de la VCI : veines sus-hépatiques
  - VCI se drainant dans le sinus coronaire (unroofed)
- Autre marqueur fiable de l'OD, quand il existe = orifice du sinus coronaire

ıcordance VCI-OD +++

SITUS ATRIAL

3 types :

- S = Solitus (normal)
- I = Inversus (image en miroir)
- A = Ambiguus (asplénie, polysplénie : syndromes d'hétérotaxie)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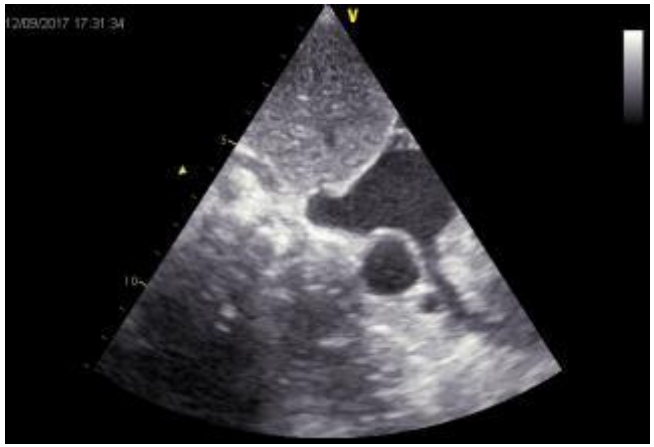
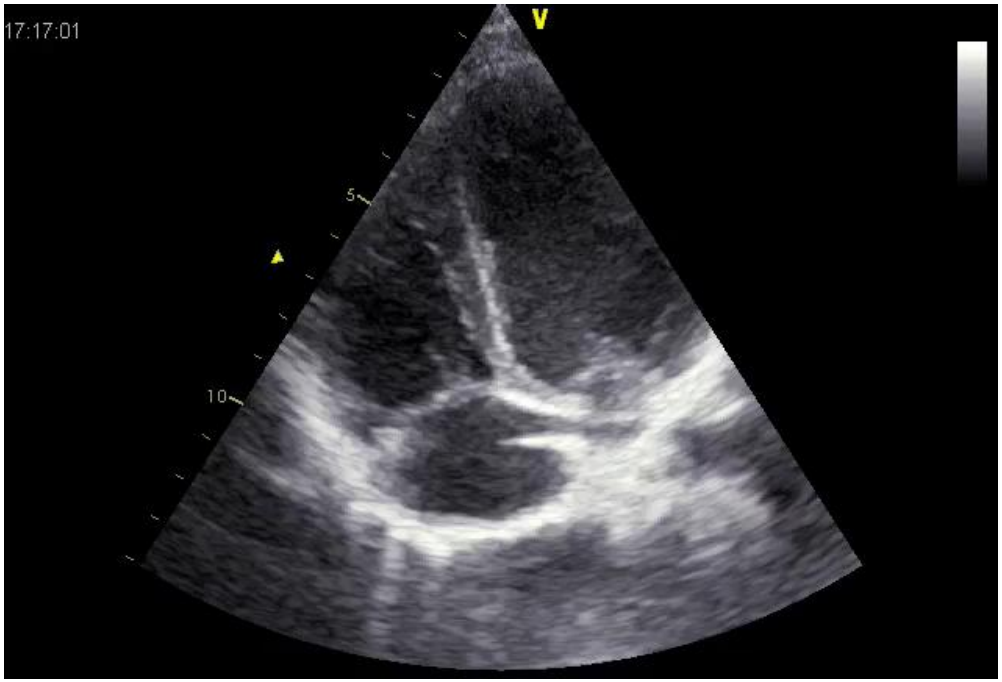
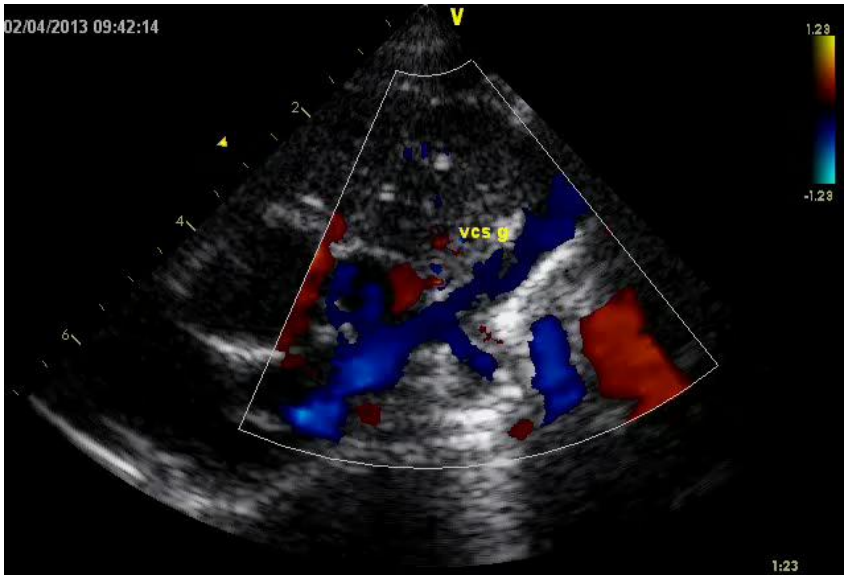
VCI à droite
VCI à l'OD
Auricules

Les retours veineux systémiques

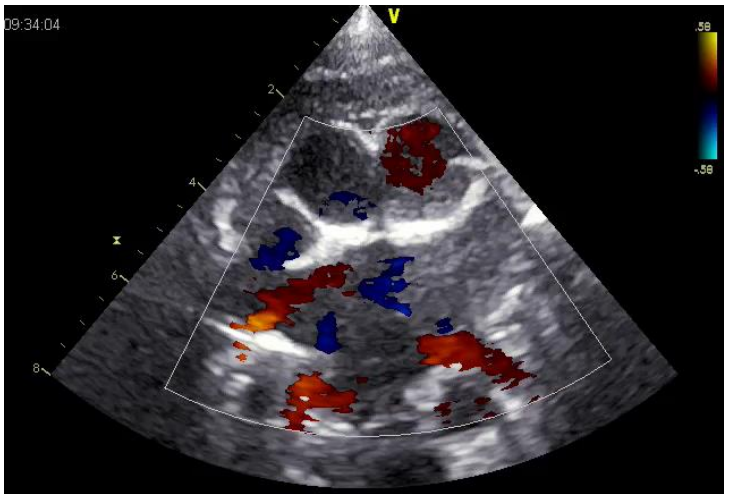




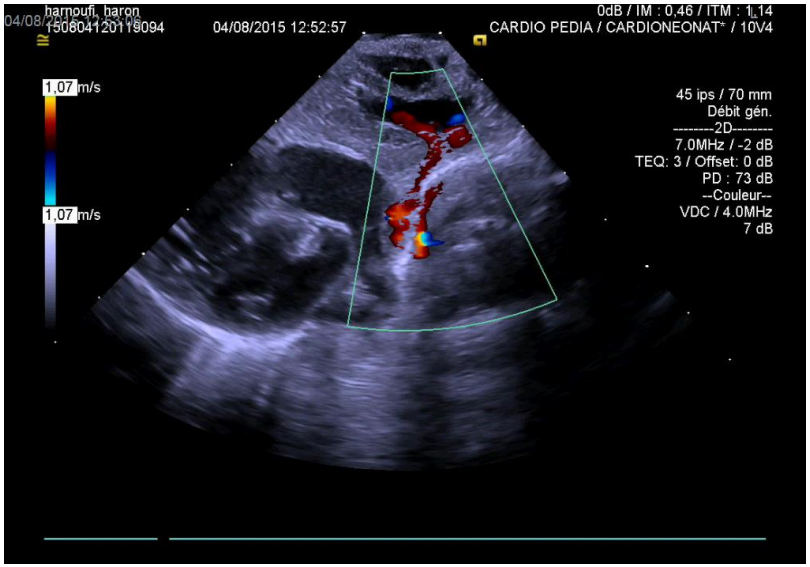
Anomalie des retours veineux systémiques

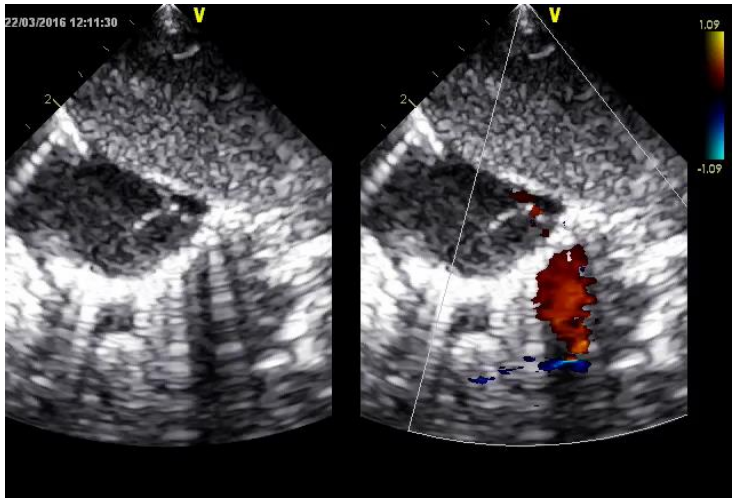


Les retours veineux pulmonaires

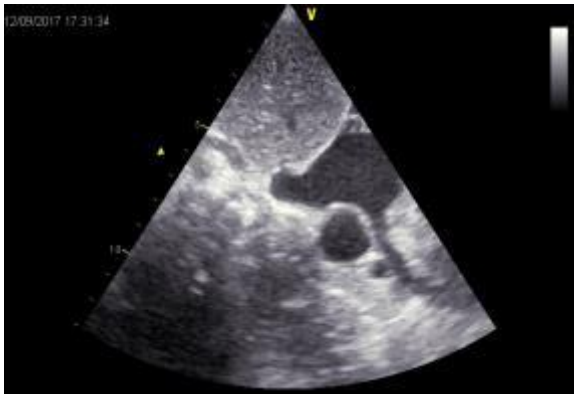


Anomalie des retours veineux pulmonaires

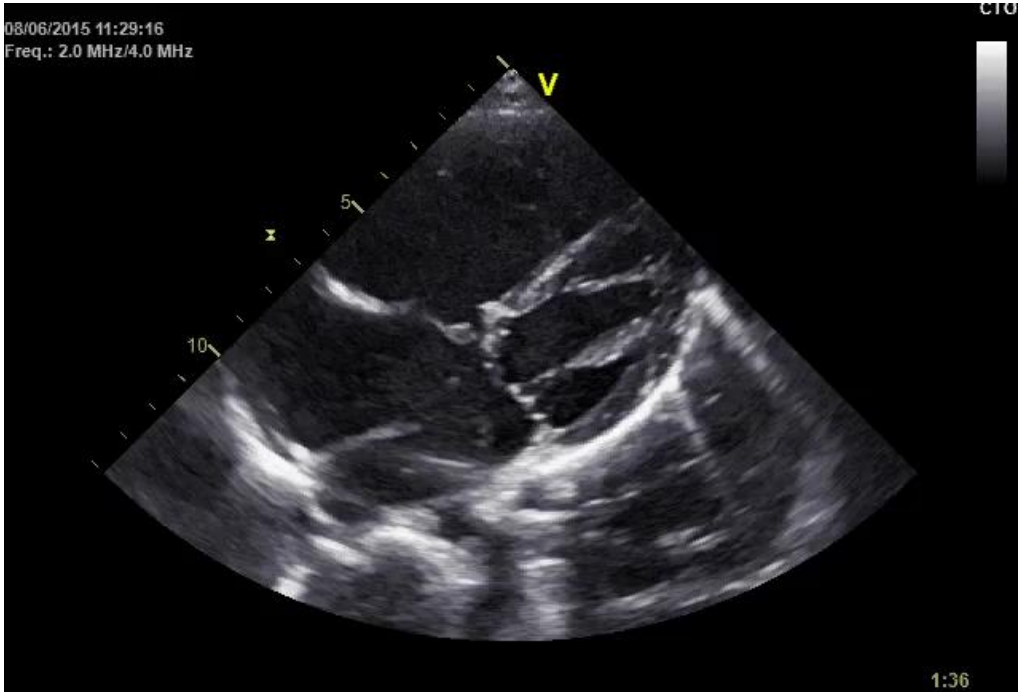


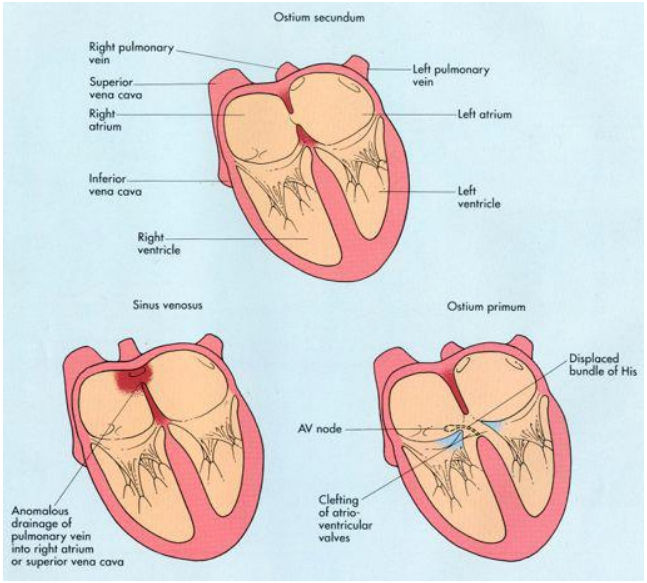


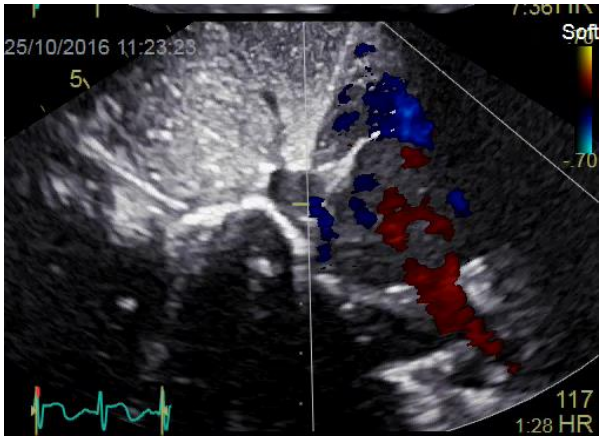
Les oreillettes et le SIA



Anomalie du SIA



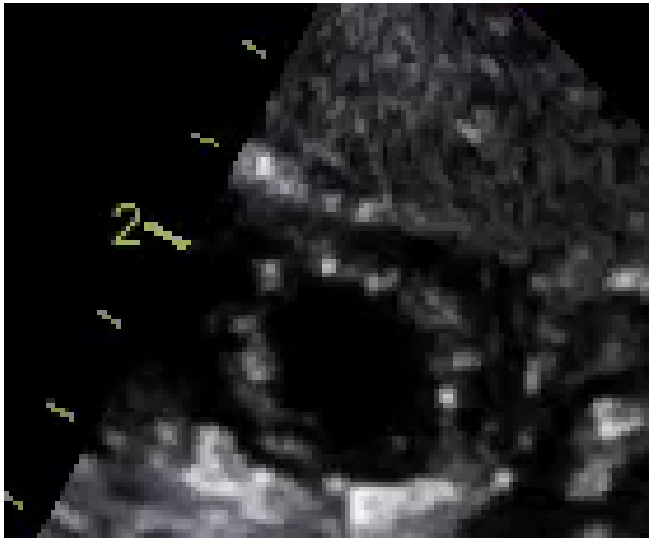




JONCTION ATRIOVENTRICULAIRE

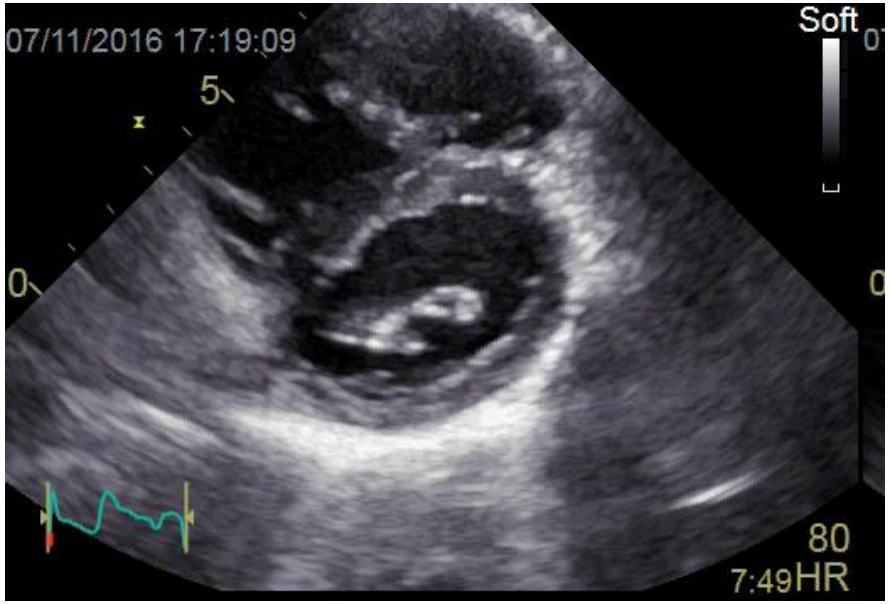
- Valve tricuspide
- Valve mitrale
- Septum atrioventriculaire :
  - « ostium primum »
  - partie adjacente du septum IV
- Classiquement le situs de la valve AV correspond à celui du ventricule sous-jacent

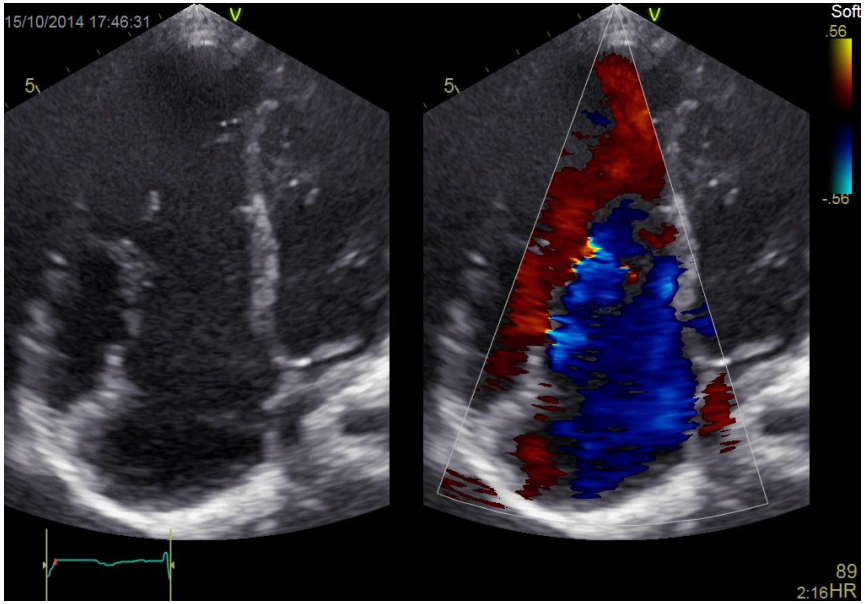
Valve mitrale/tricuspide



Anomalie des valves auriculoventriculaires

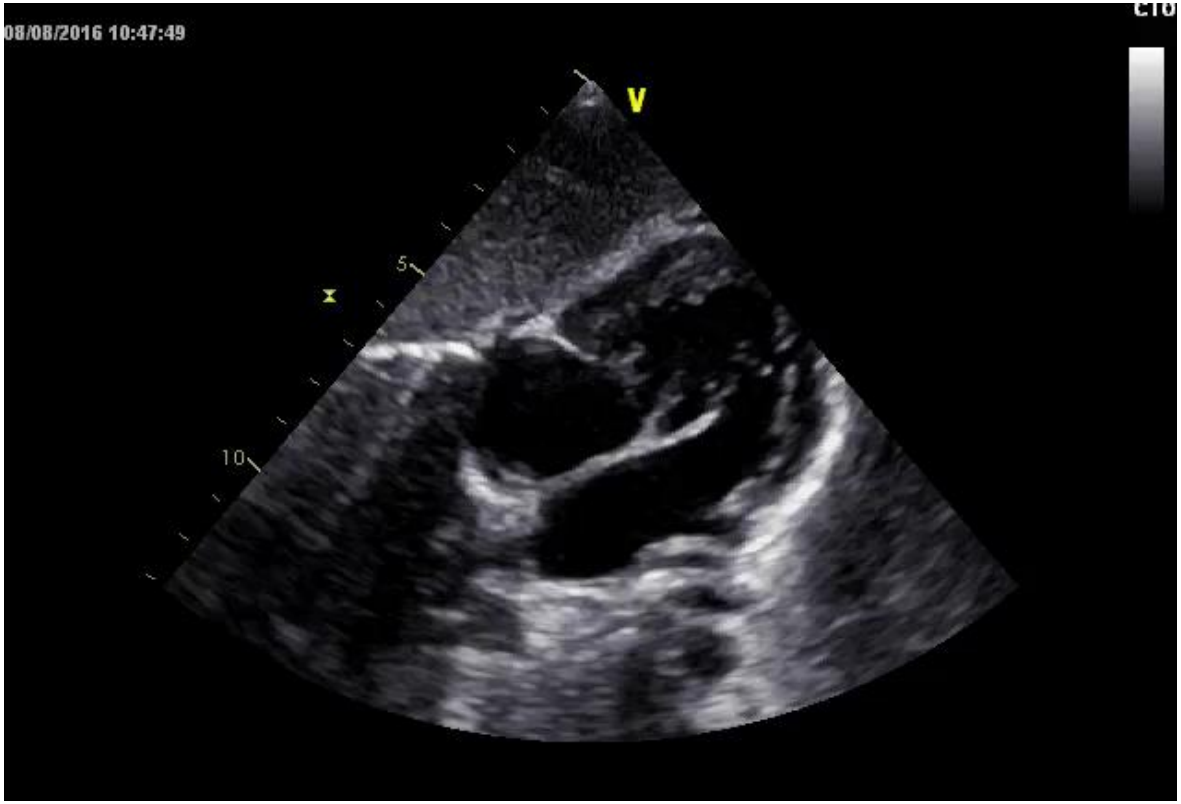
CAV,
Mitrale double orifice



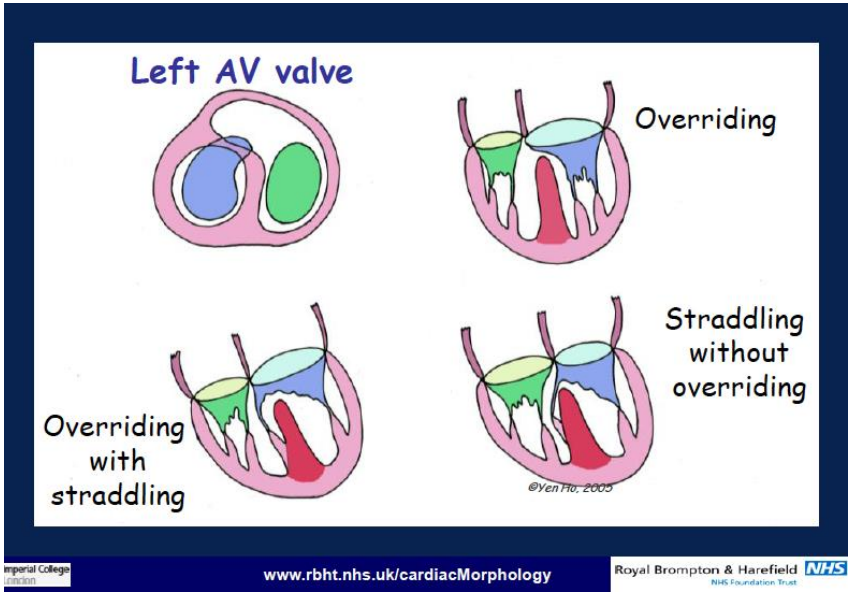


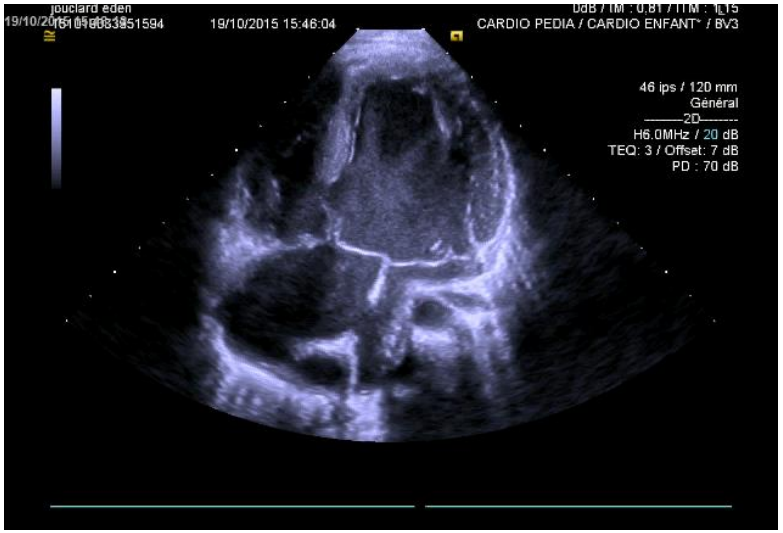
Anomalies de connexion: Atrésie

Anomalies de connexion: Double entrée (double inlet)

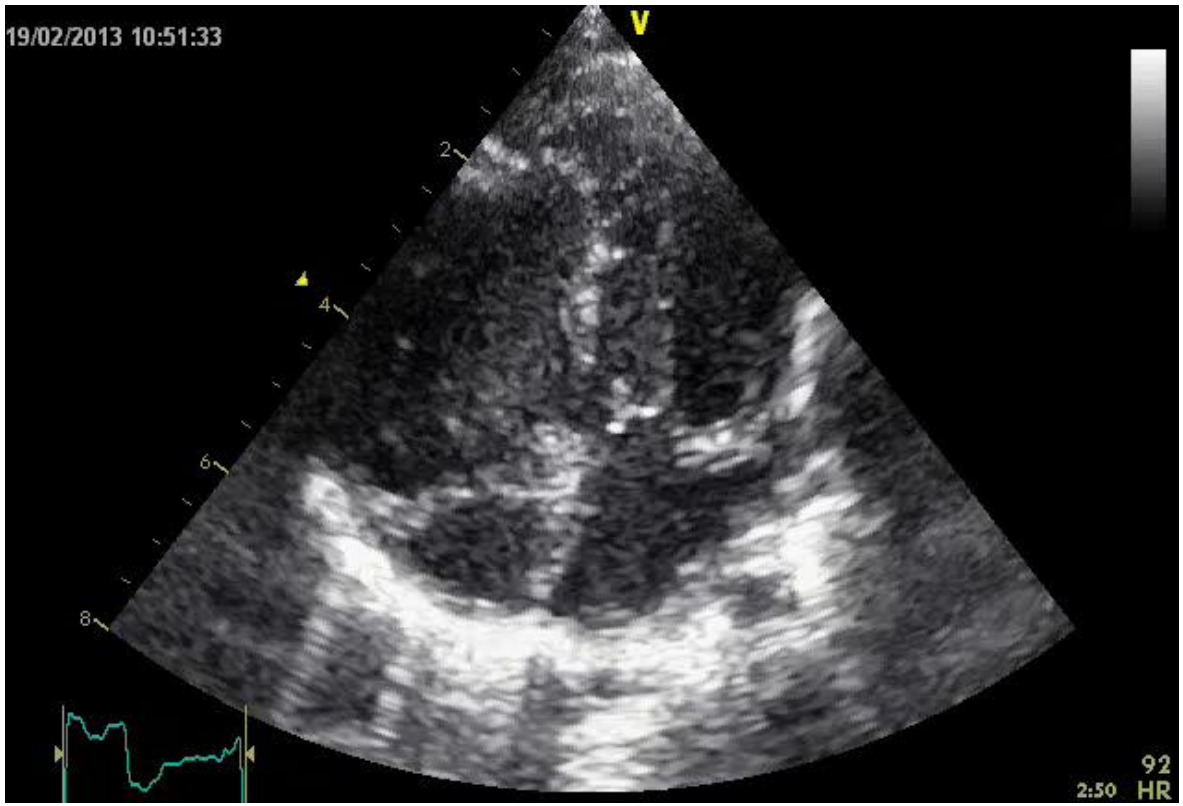


Anomalies de connexion: Straddling/overriding





Anomalies de connexion: Discordance AV

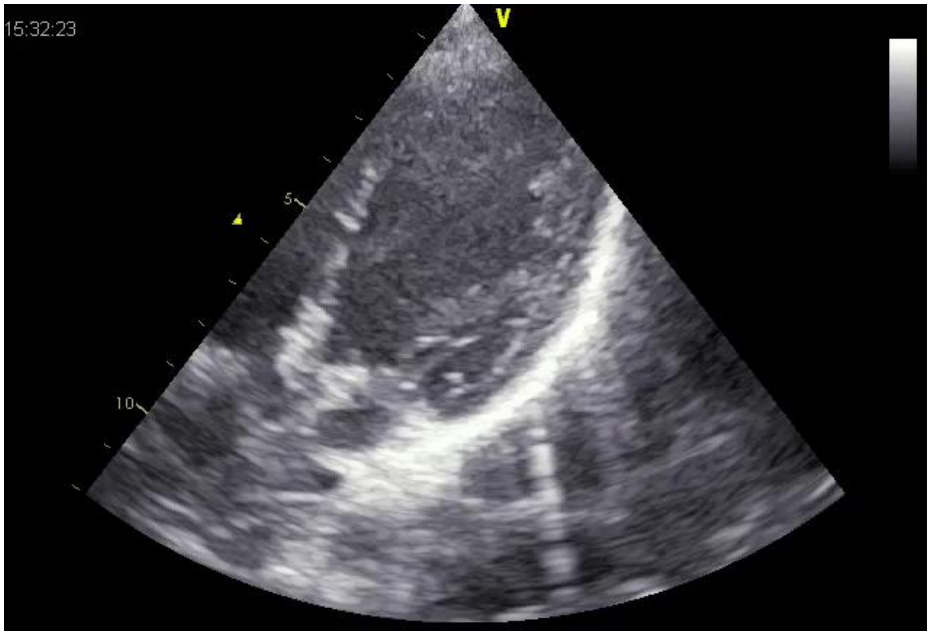


VENTRICULES

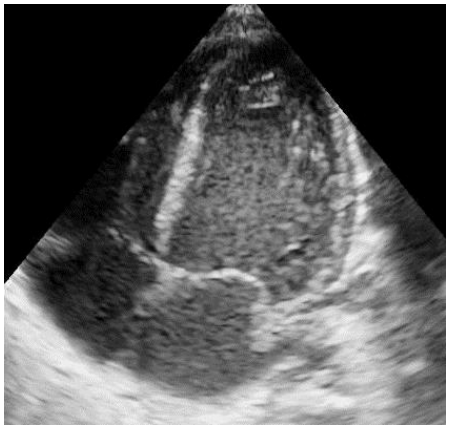
Deux types de situs ventriculaire :

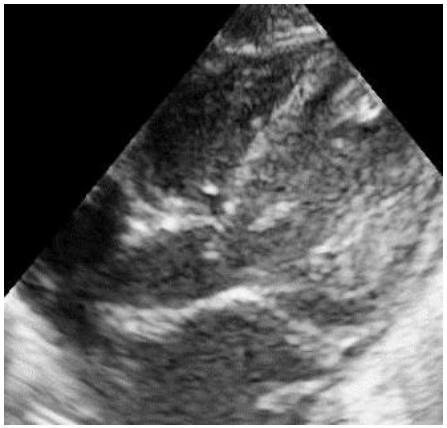
- **Solitus : D-loop**
- **Inversus : L-loop**

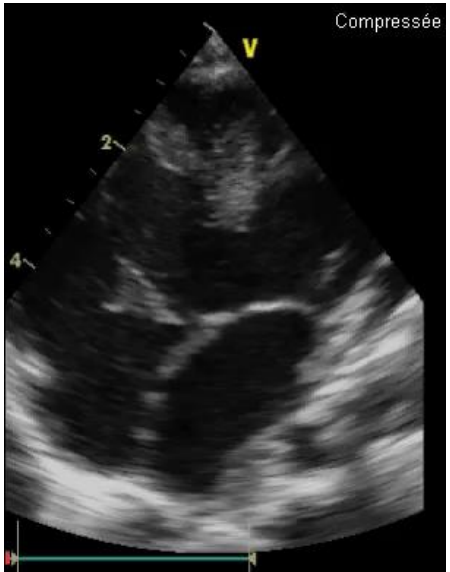
Ventricules

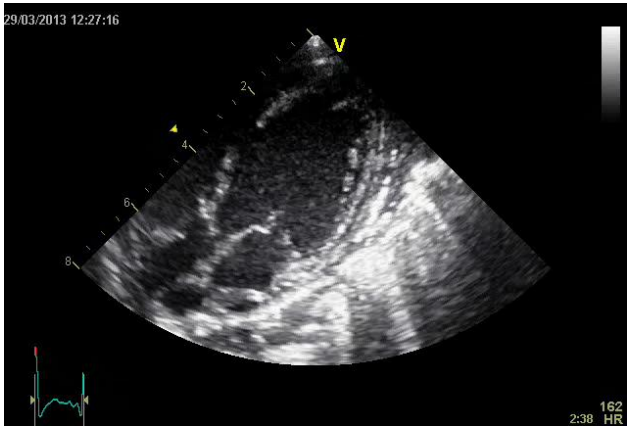


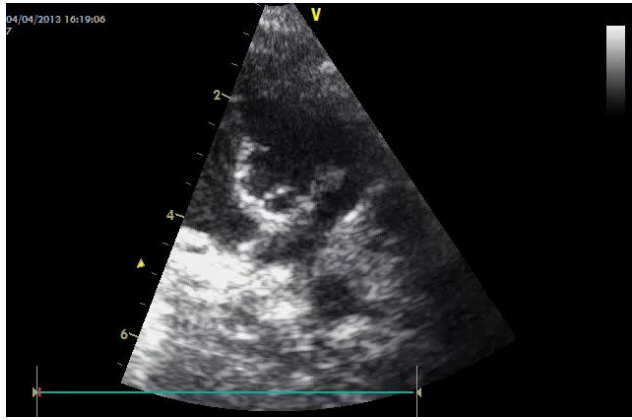
Septum interventriculaire









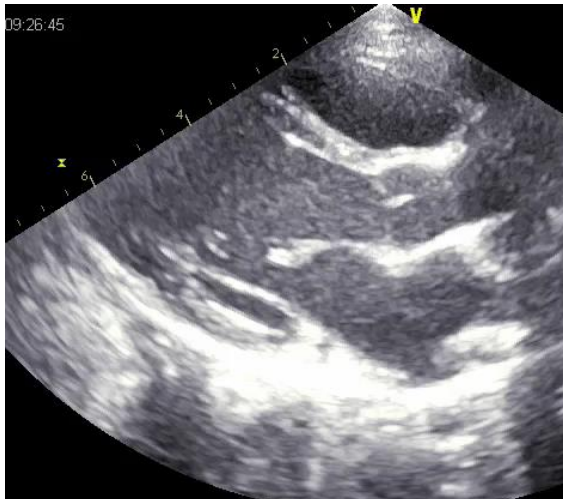


GROS VAISSEAUX

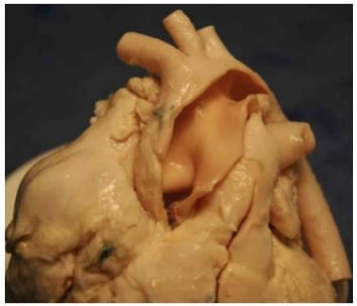
- Normoposés :

  - **S = solitus : valve AO en AR et à D / valve pulm**
  - **I = inversus : valve AO et AR et à G / valve pulm**

Absence de conus sous aortique: continuité mitro-aortique
Conus sous pulmonaire

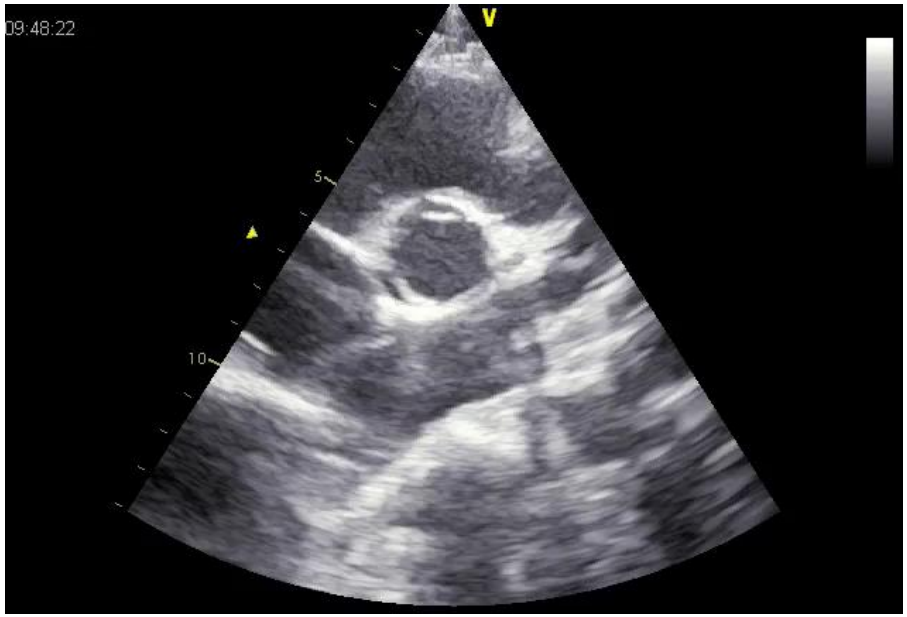


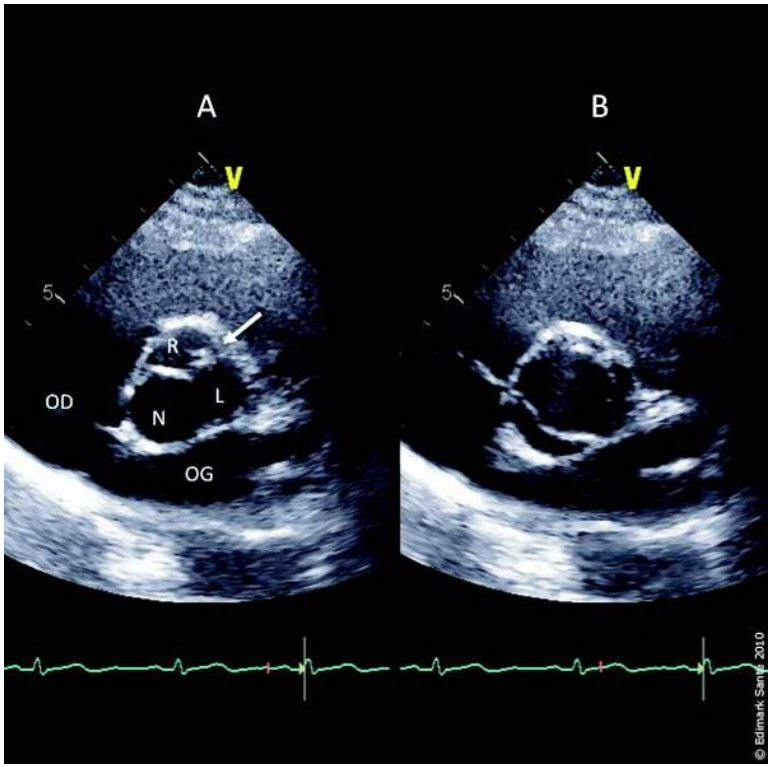
VX NORMOPOSES



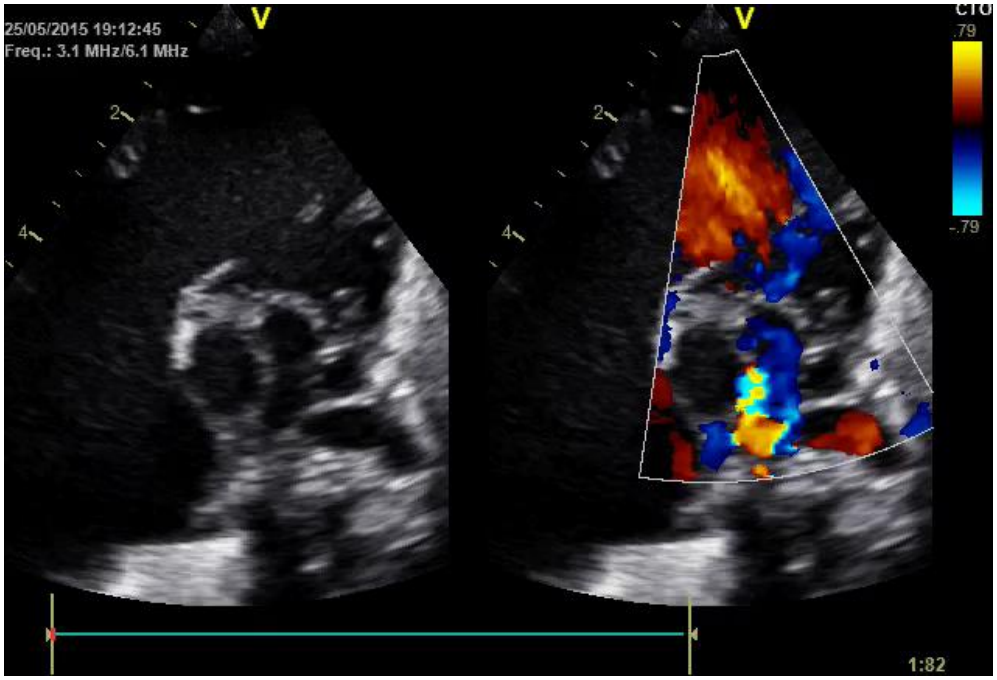
Luci

Anomalies des valves semi lunaires





Anomalies de connexion: Atrésie

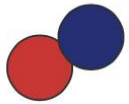


Anomalies de connexion: Discordance VA

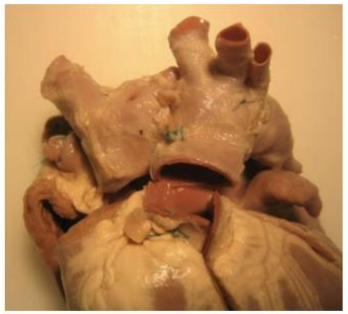
- Malposés ou Transposés :

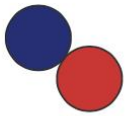
- D = valve AO à D / valve pulm
- L = valve AO à G / valve pulm
- A = antéropostérieurs : valve AO en AV de la valve pulmonaire

VX MAL (ou TRANS) POSES

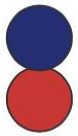


D-malpo



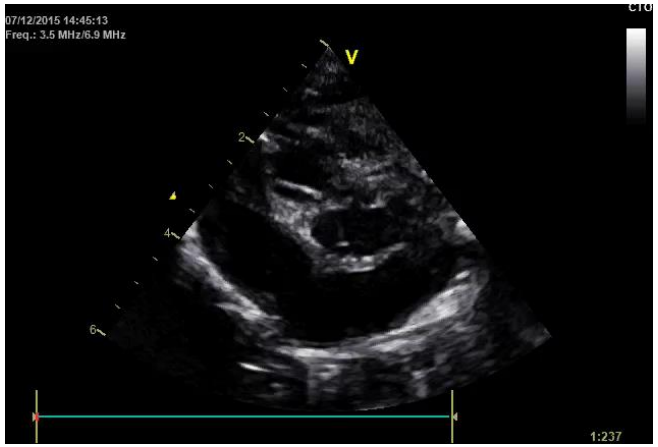


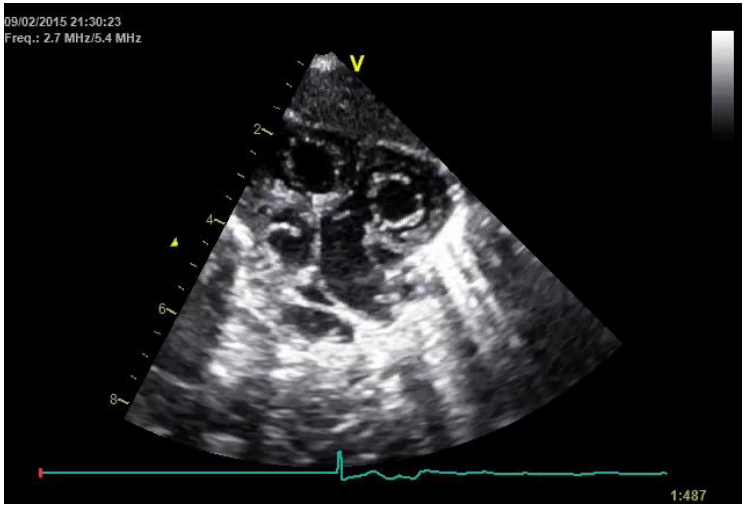
L-malpo



A = antéropostérieurs

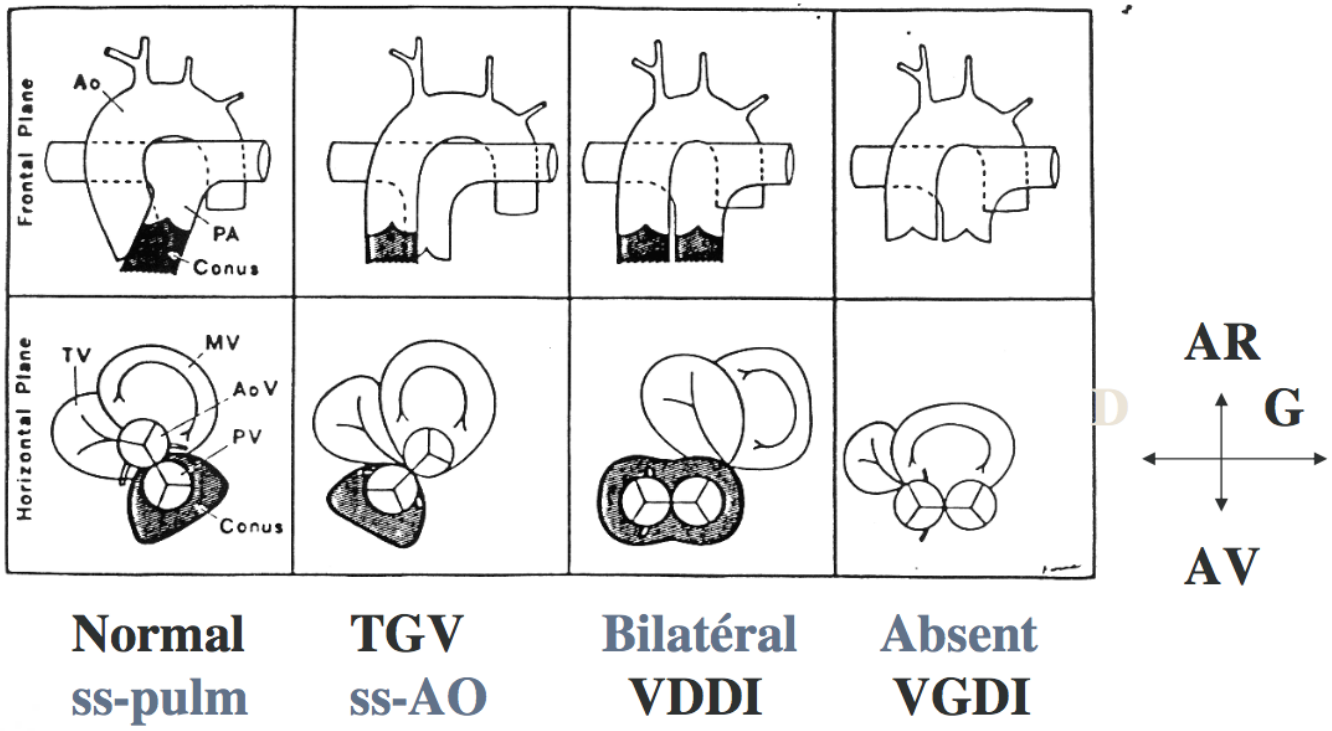
Anomalies de connexion: Discordance VA



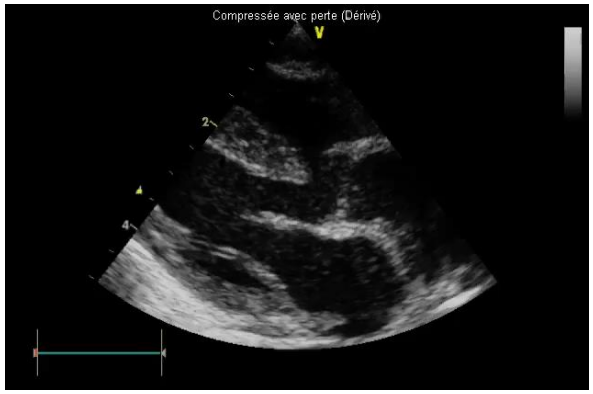


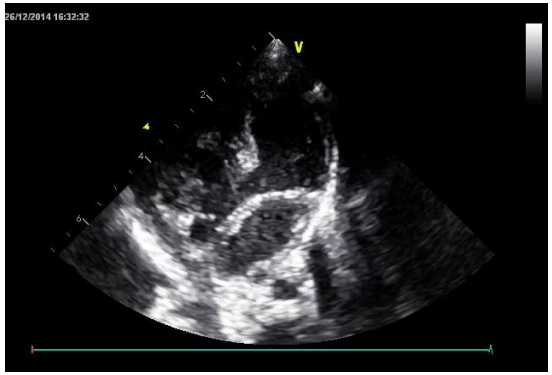
Anomalies de connexion: Anomalie du conus

4 TYPES DE CONUS

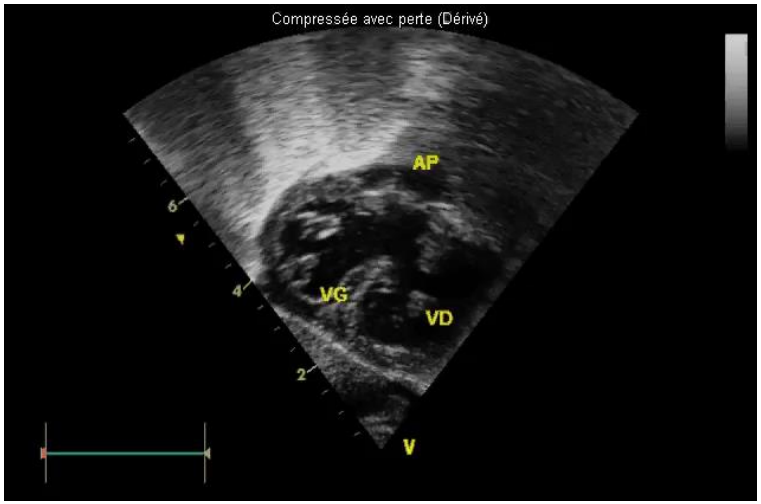


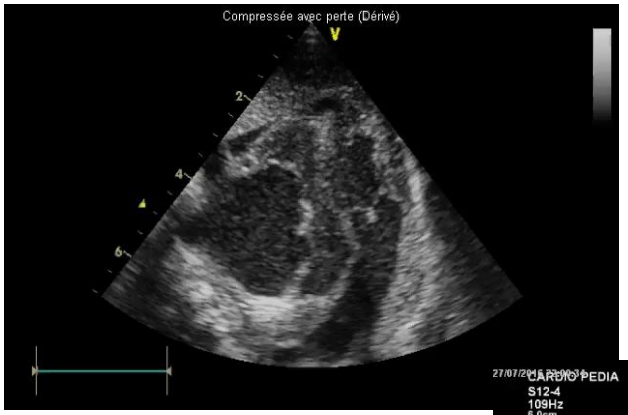
Anomalies de connexion: Anomalie du conus

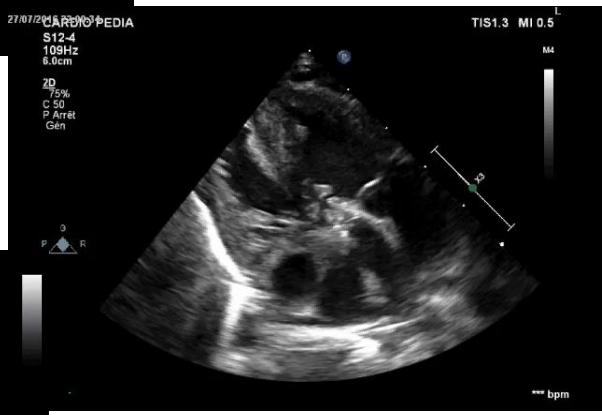


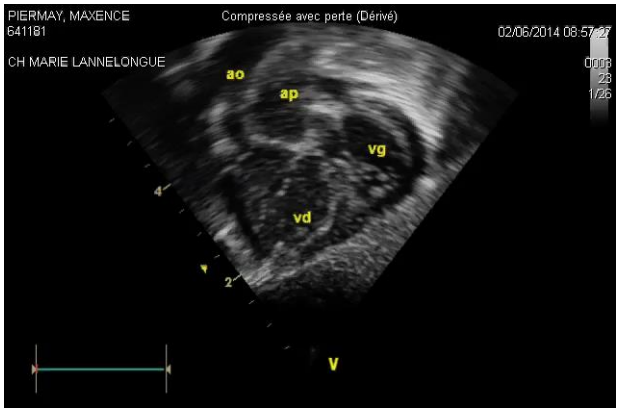


Anomalies de connexion: Anomalie du conus

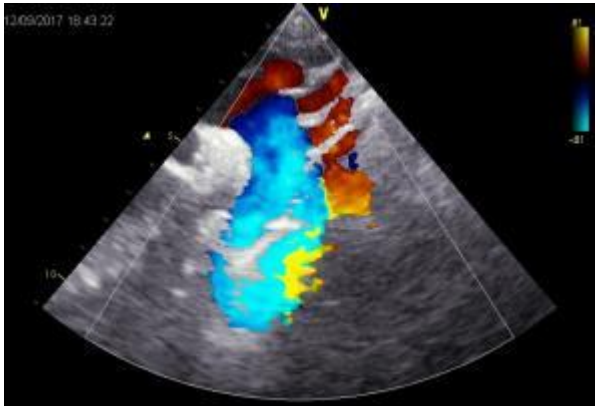


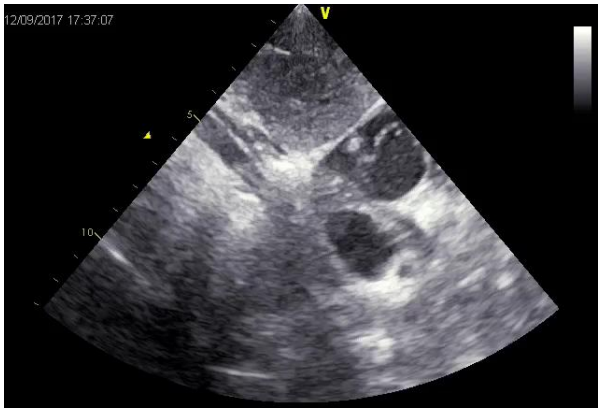


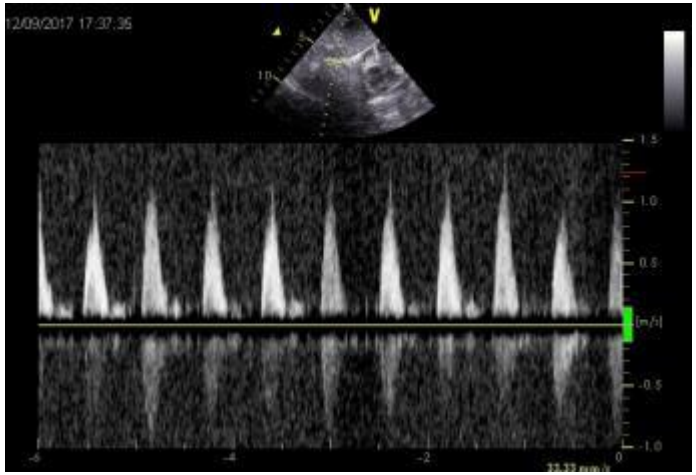




Gros vaisseaux extra-péricardiques

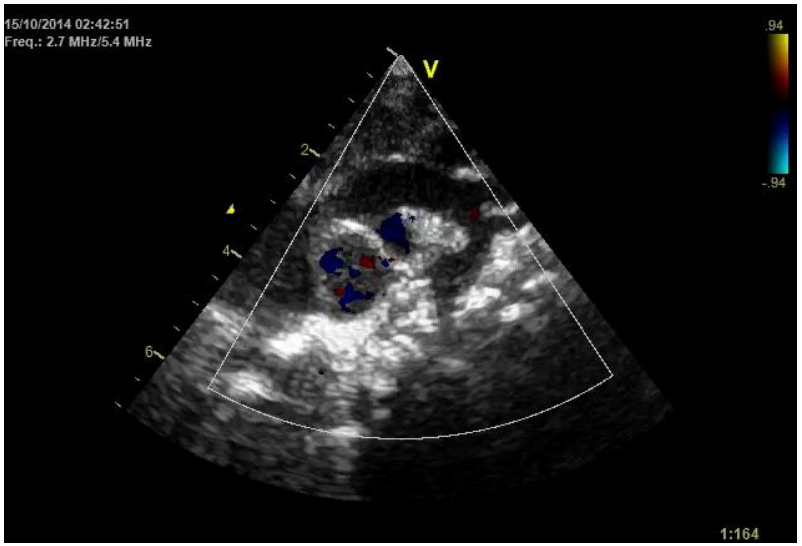


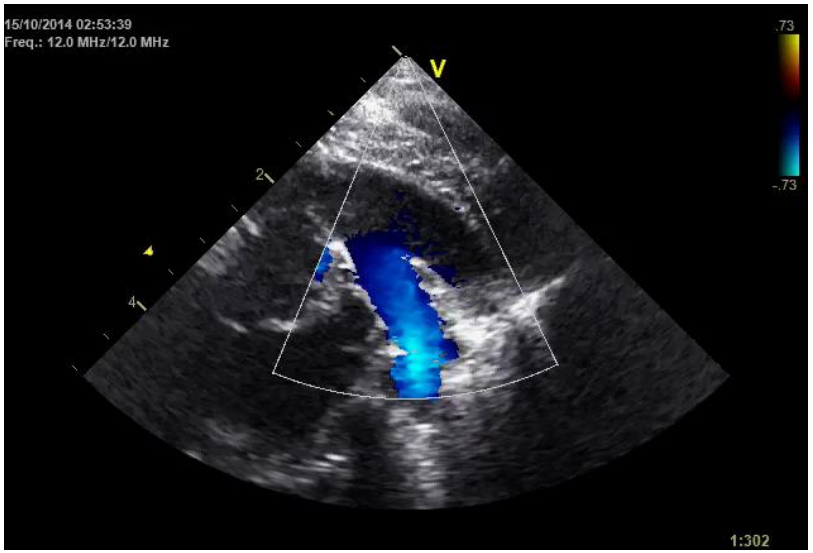




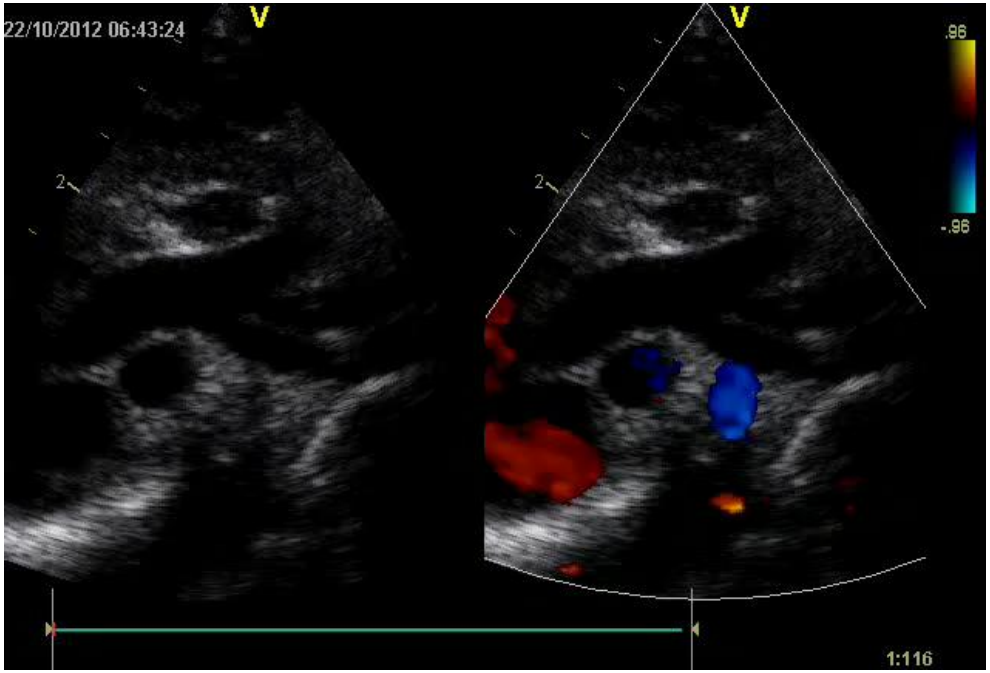
Gros vaisseaux extra-péricardiques

Anomalie des artères pulmonaires





Anomalie de la crosse et des arcs aortiques



SEGMENTS DE JONCTION
Connexions et alignements

- Connexions : définition anatomique
  - « segments de connexion » (= de jonction)
  - exemple : la tricuspide est connectée au VD
- Alignements : définition fonctionnelle
  - relation des différents segments principaux entre eux (O, V, gros vx)
  - concordants ou discordants

CARDIOTYPES

- « SET » : {Oreillettes, Ventricules, Gros vx} + alignements + malformations associées
- Oreillettes : S, I, A
- Ventricules : D, L
- Gros vaisseaux : normoposés : S, I
  malposés : D, L, A

CARDIOTYPES : EXEMPLES

- Cœur normal : {S,D,S}
- Situs inversus, cœur normal {I,L,I}
- TGV « classique » : TGV {S,D,D}
- TGV corrigée (dble discordance) : {S,L,L}
- VDDI type Taussig-Bing : VDDI {S,D,D} avec CIV sous-pulmonaire

Analyse fonctionnelle

Communication large = égalisation de pression entres les cavité

Communication restrictive = gradient de pression entre les cavités

Sens du shunt dépend régime de pression de part et d'autre de la communication

L'Importance du shunt dépend des résistances vasculaires, compliances ventriculaires, obstacles valvulaires

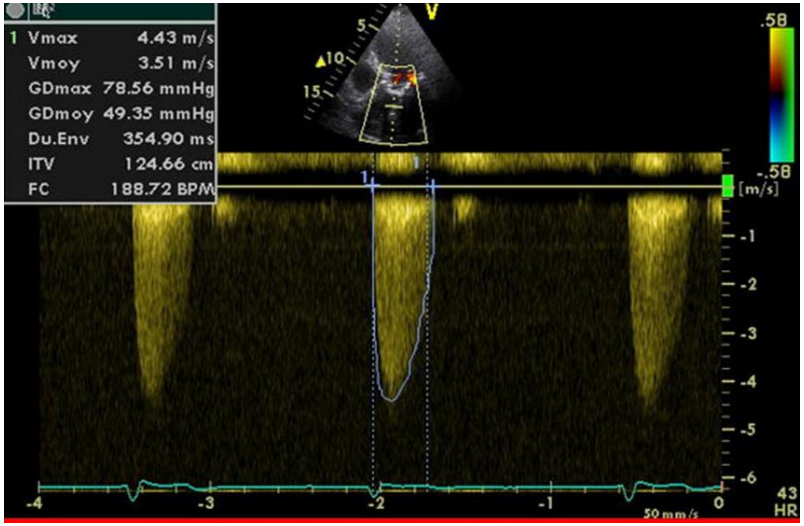
Le shunt gauche-droite pré-tricuspide est dépendant de :
-La **COMPLIANCE** des ventricules droit et gauche en diastole.
-Des lésions associées : RM, RT

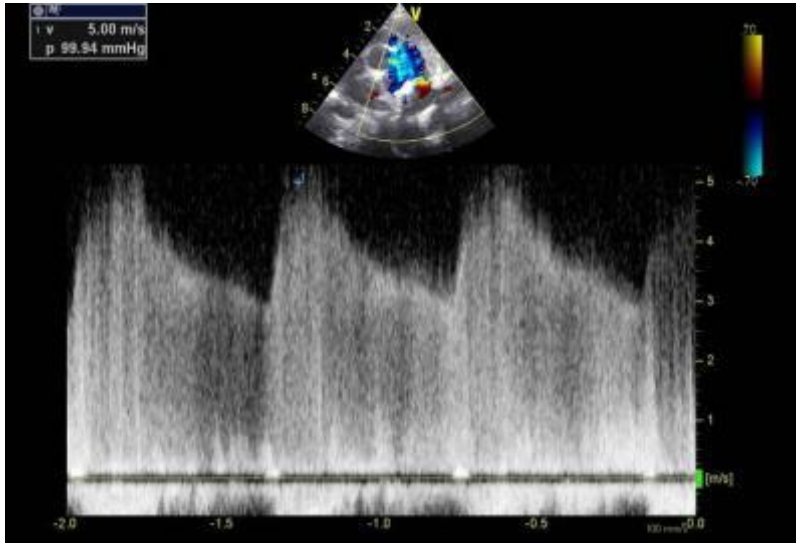
=> Surcharge volumétrique diastolique des cavités droites

Le shunt gauche-droite post tricuspide est dépendant des :
- **Résistances vasculaires** pulmonaires et systémiques en systole
- Des lésions associées : RA, SP

=> Surcharge volumétrique des cavités gauches (Sauf si CIA large associée)

Utilisation de la La loi de Bernoulli en doppler continu





$\Delta P = 4Vmax^2$

Gradient de pression entre deux cavités

NON Applicable en cas d'obstacle étagé ou tubulaire.

Mesure de la pression pulmonaire systoliques dans une CIV (en l'absence de SP)

- <u>Vélocité Doppler du shunt</u>

  PVG s – PVDs = 4 V2

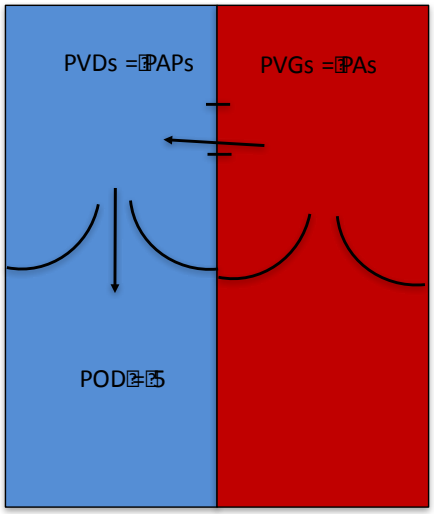
  PAPs = PVDs = PAOs – 4Vmax²)

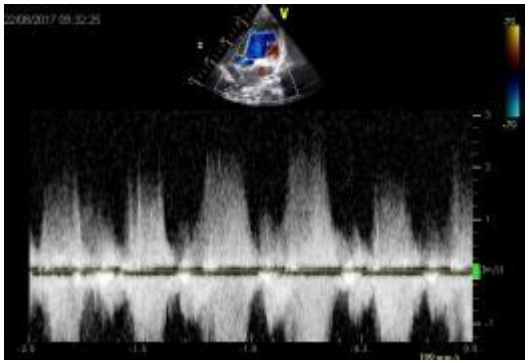
- <u>Courbure septale</u>

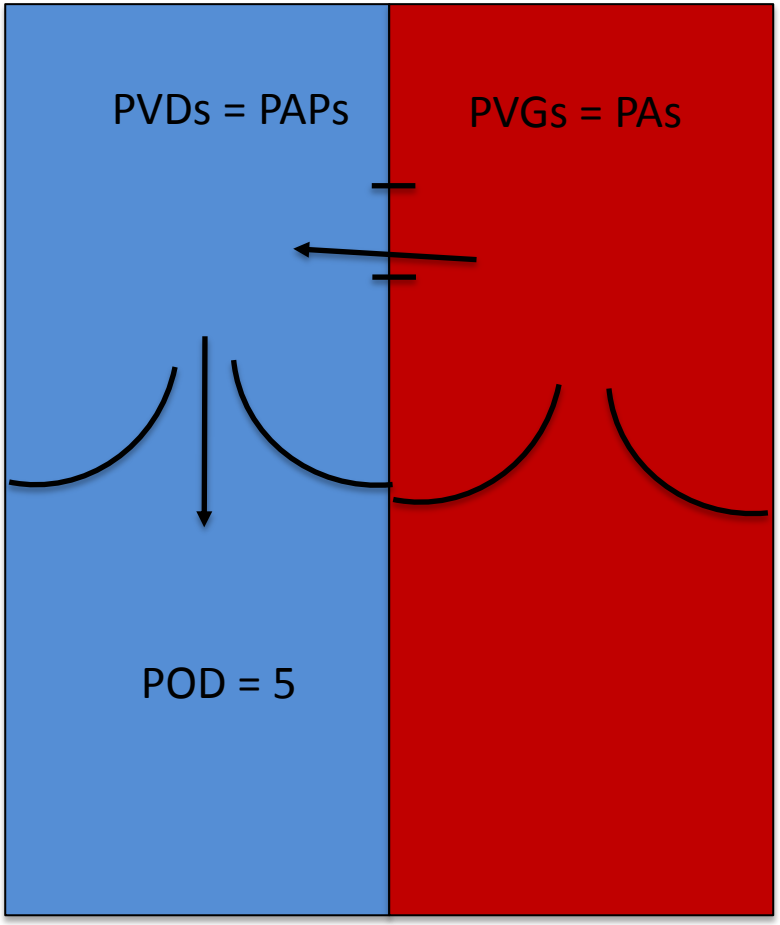
- <u>Fuite tricuspide</u>

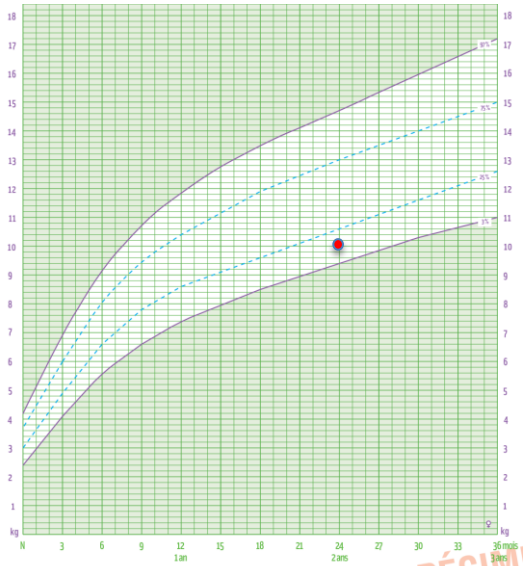
  PVDs - PODs = 4Vmax²

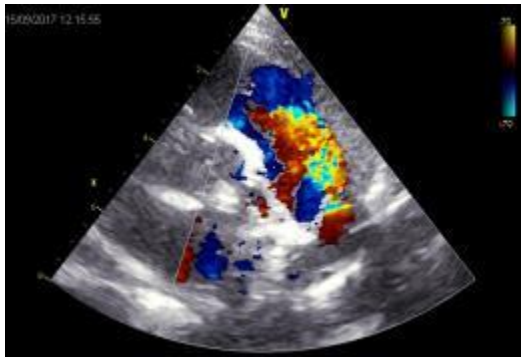
  PAPs = PVDs = 4Vmax²+ 5



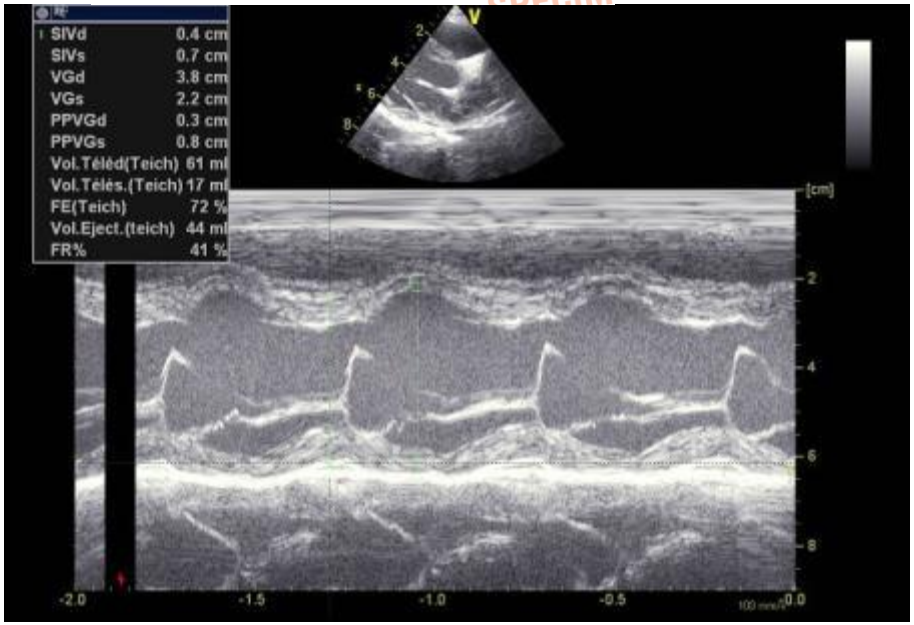



PVDs = PAPs
PVGs = PAs
POD = 5





La clinique ++++



Parameter(z)

ECHO Z-SCORE CALCULATORS

M-Mode Z-Scores

Height (cm): 80

Weight (kg): 10

BSA formula: DuBois

0.46 M^2

Location	Measured	Mean	Range	Z-Score
RVDD (mm):		9	(4.5 - 13.5)	
IVSd (mm):		4.2	(2.6 - 5.8)	
LVEDD (mm):	38	27.1	(22 - 32.1)	4.36
LVESD (mm):		17	(13 - 21)	
LVPWd (mm):		4.6	(3.1 - 6.1)	
LAd (mm):		17.8	(13.8 - 21.8)	

Update reset

Evaluation d'une CIV: Echographie + clinique

CIV	shunt	significatif	restrictif	signes cliniques	chirurgie	délai idéal
I	G->D	non	oui	aucun	non (sauf Pezzi Laubry)	aucun
IIA	G->D	oui	oui	faibles	oui	12 mois
IIB	G->D	oui	non	IC globale	oui	< 6 mois
III	D->G	non	non	hypoxie de repos	contre-indiquée	jamais
IV «à poumons protégés»	équilibré	non	oui	aucun (ou hypoxie d'effort)	oui	18 mois

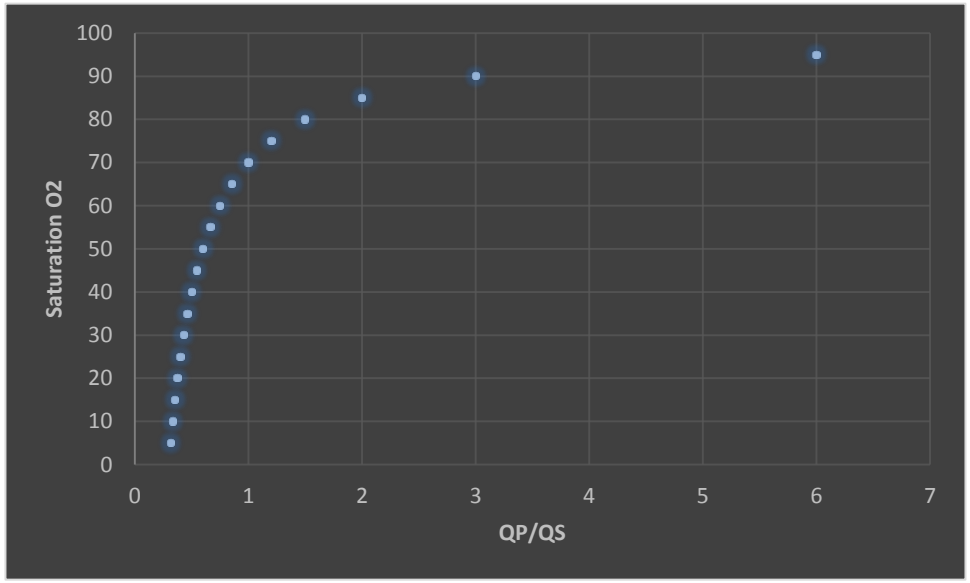
La clinique ++++

Cardiopathie à sang mélangé : Sat Ao = sat AP

Qp/Qs = (Ao-VC/VP-AP)

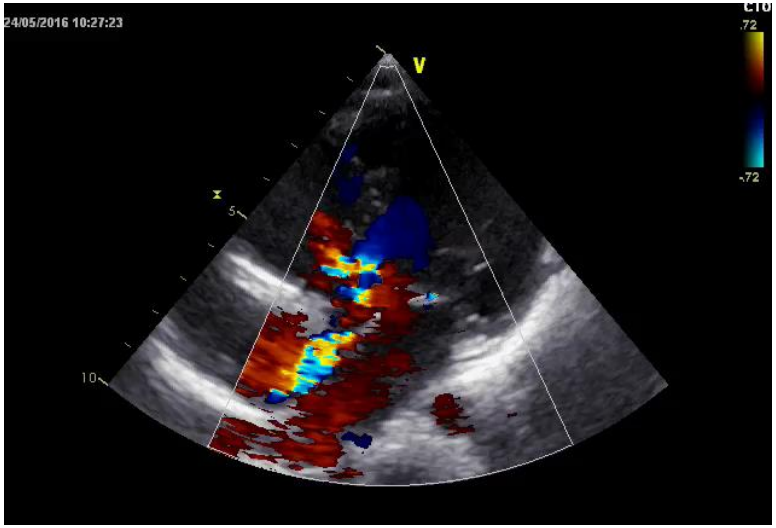
Si débit cardiaque normal DAV = 30

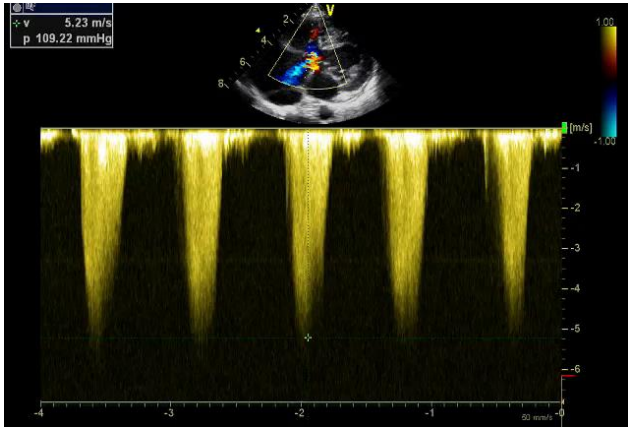
Si pas de maladie pulmonaire VP = 100%

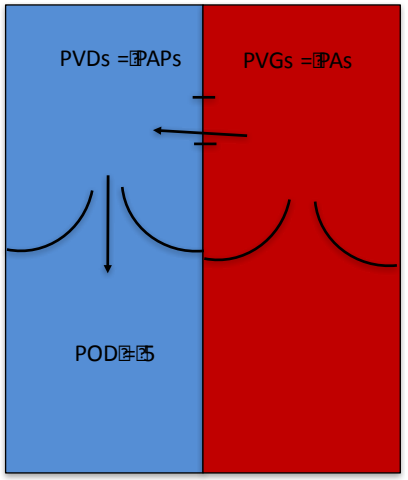


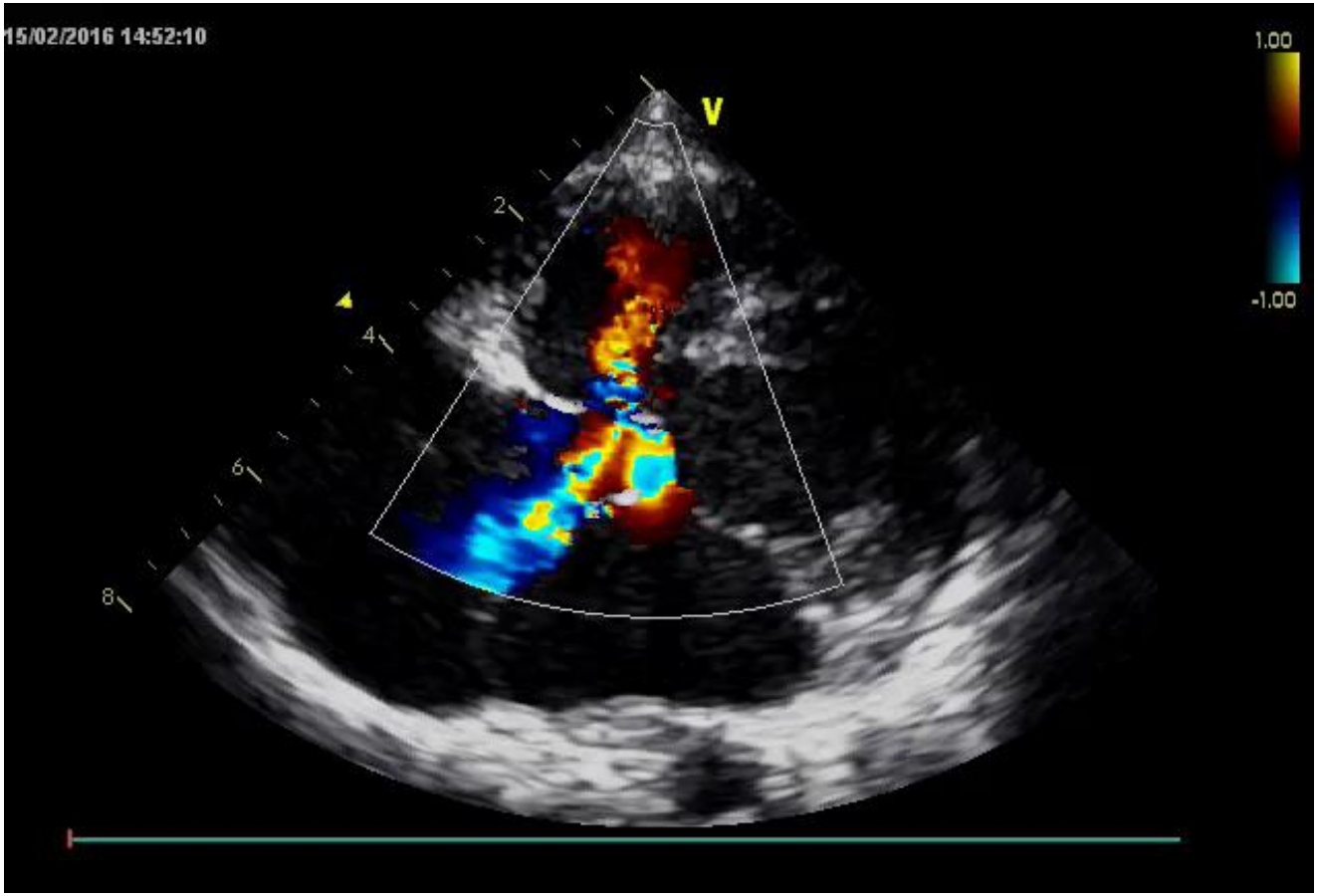
QP/QS = 30/ (100-sat)

Exemple 1: CAV opéré

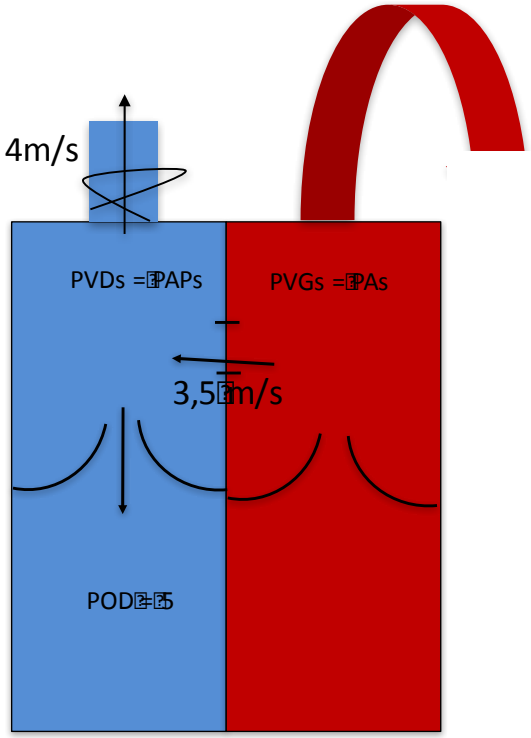







15/02/2016 14:52:10
V
2
4
6
8
1.00
-1.00

Exemple 2: Syndrome de coarctation opéré



Que retenir ?

Analyser chaque segment par sa morphologie propre et non sa localisation

Analyser les segments de jonctions et connexions

L'analyse morphologique ne permet pas de prendre de décision

Ne jamais oublier l'analyse fonctionnelle et la clinique