



UNIUNEA EUROPEANĂ



GUVERNUL ROMÂNIEI



Fondul Social European
POSDRU 2007-2013



Instrumente Structurale
2007-2013



GUVERNUL ROMÂNIEI
MINISTERUL MUNCII, FAMILIEI,
PROTECȚIEI SOCIALE
ȘI PERSOANELOR VÂRSTNICE
OIRPOSDRU REGIUNEA CENTRU



UNIVERSITATEA DE MEDICINĂ ȘI
FARMACIE "CAROL DAVILA"
BUCUREȘTI

«AD-COR Program inovativ de formare in domeniul cardiologiei pediatrice POSDRU/179/3.2/S/152012»

Iunie 2015

MODUL TEORETIC

INTRODUCERE IN ECOCARDIOGRAFIE

Continut documentat/ validat/ prezentat de:

- ⇒ Expert formare medici: NICOLESCU Alin
- ⇒ Expert formare medici: VEDUTA Alina
- ⇒ Expert formare asistente: FILIP Cristina

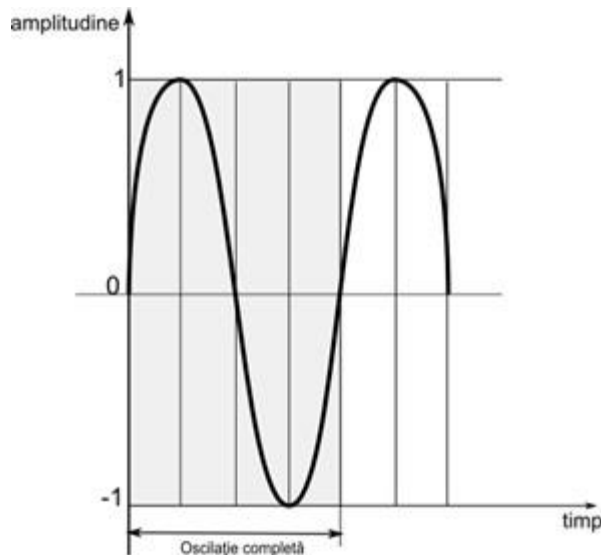
Ecoul

- daca strigam intr-un put, ecoul se intoarce dupa cateva momente;
- ecoul apare pentru ca undele sonore se reflecta pe o suprafata (fie apa din fundul putului, fie peretii putului), si se intorc spre noi;
- un principiu similar se aplica si in ultrasonografia cardiaca



Notiuni despre fizica ultrasunetelor(1)

- Sunetul = unda mecanica transmisa printr-un mediu elastic ce contine particule care vibreaza, permitand propagarea sunetului
- Sunetele cu o frecventa $> 20.000\text{Hz}$ = ultrasunete

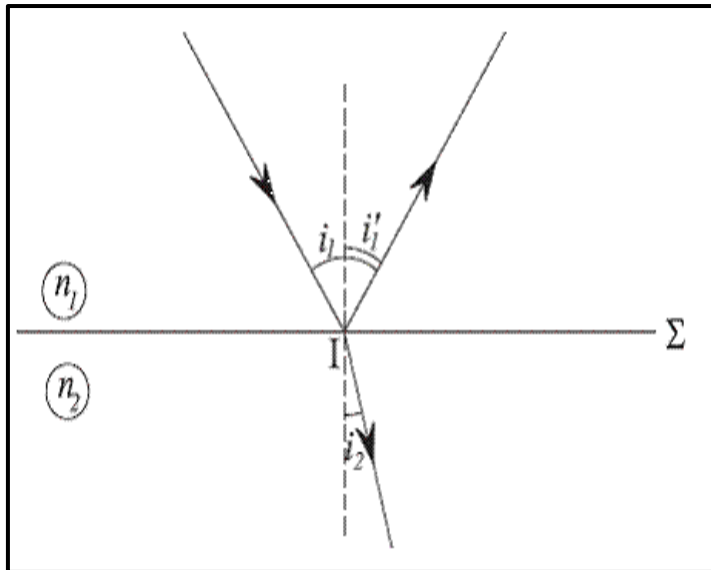


- **Reprezentarea grafica a undei acustice:**
 - sinusoida, cu zone de compresie si rarefactie;
 - 1 compresie+ 1 rarefactie= 1ciclu;
 - numarul de cicluri/sec= frecventa undei sonore;
 - distanța dintre 2 puncte similare= lungimea de unda;
 - lungime de unda mica $\Leftrightarrow$ frecventa mare;
 - unitatea de masura pentru frecventa=Hz=1 ciclu/secunda;
 - gama de frecvente folosite in medicina: 2MHz-40MHz (2-5MHz in ecografia transtoracica).

Notiuni despre fizica ultrasunetelor(2)

Viteza cu care ultrasunetele emise de transductor se propaga prin tesuturi este proportionala cu densitatea acestora. Viteza medie de propagare a ultrasunetelor in corpul uman=1540m/s.

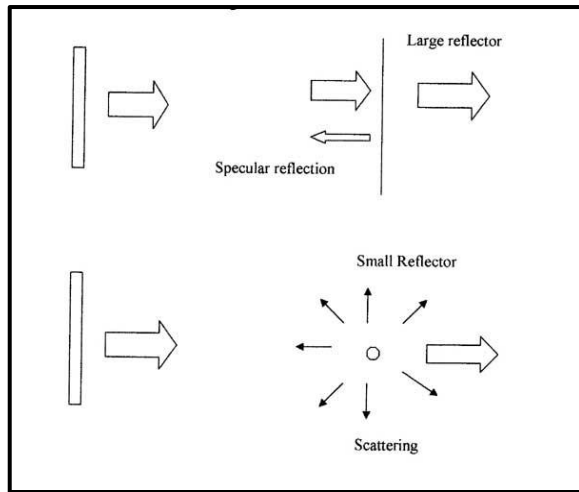
$\lambda = v/f$ λ =lungimea de unda a ultrasunetelor
 v =viteza de propagare a ultrasunetelor in tesut
 f =frecventa ultrasunetelor emise de transductor



La interfata dintre doua medii cu densitati diferite, **ultrasunetele se reflecta si se refracta**, ceea ce sta la baza formarii imaginii ecocardiografice.

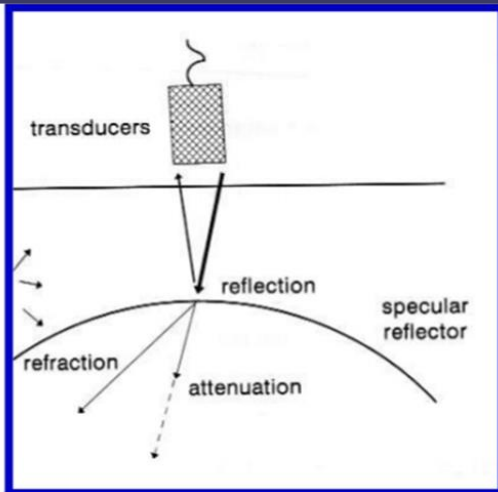
Reflectia depinde de impedanta acustica dintre 2 medii: cu cat acesta este mai mare, cu atat se reflecta mai mult din fasciculul incident (gelul reduce diferenta de impedanta dintre medii).

Notiuni despre fizica ultrasunetelor(3)



- **Reflectia speculara:** lungimea de unda intalneste o structura mare si neteda => reflectia se produce pe aceeasi directie
- **Fenomenul de scattering:** lungimea de unda intalneste o suprafata rugoasa => reflectia nu se produce pe aceeasi directie; se imprastie.
- **Fenomenul de scattering** sta la baza imagisticii Doppler. Permite vizualizarea particulelor paralele cu fasciculul; permite vizualizarea in scale de gri.
- **Efectul Doppler:** 2 obiecte in miscare relativa: frecventa undei emise este mai inalta daca obiectul se apropie, si invers

Ultrasunetele trimise dinspre peretele toracic

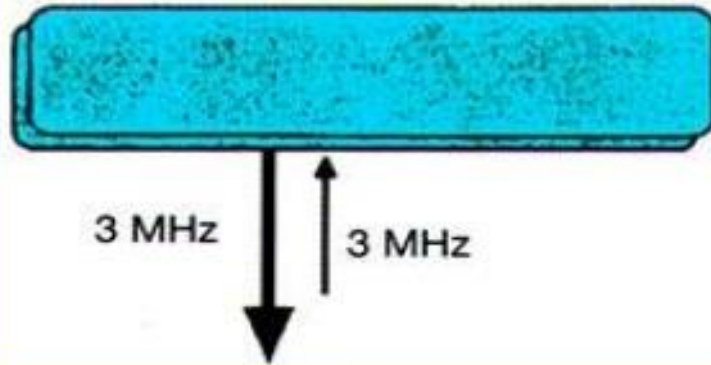


- **Atenuare:** puterea semnalului se reduce progresiv datorita absorbtiei energiei US prin conversie catre caldura
- Aerul are o impedanta acustica inalta cu atenuare semnificativa in contrast cu lichidul
- ❖ Pneumotorax/pleurezie

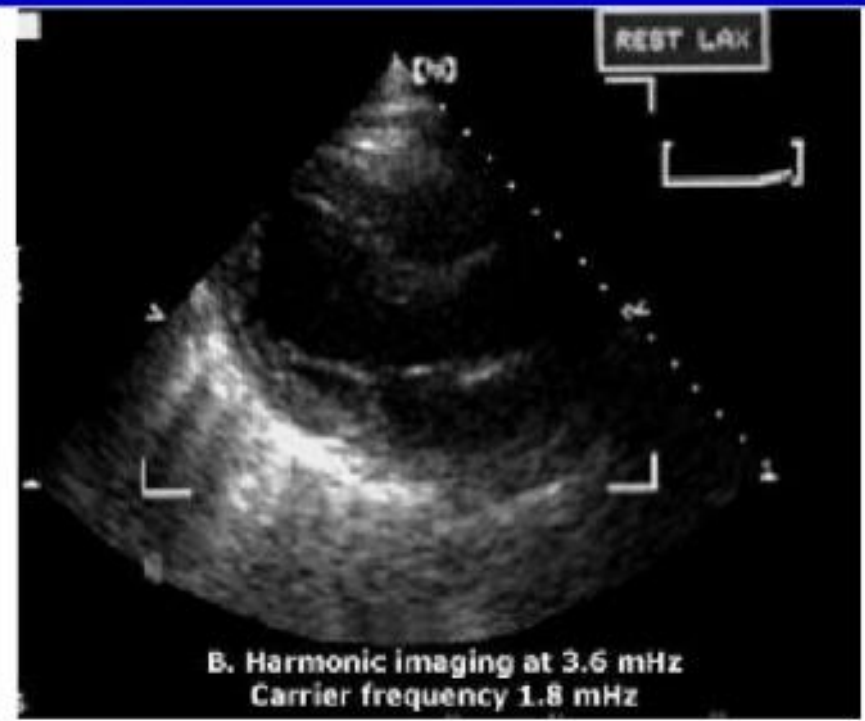
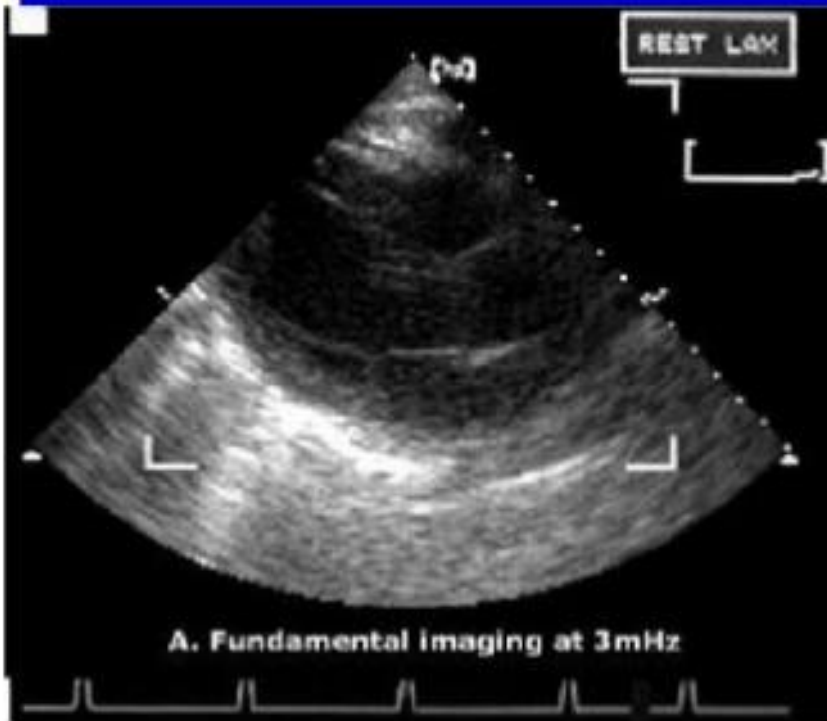
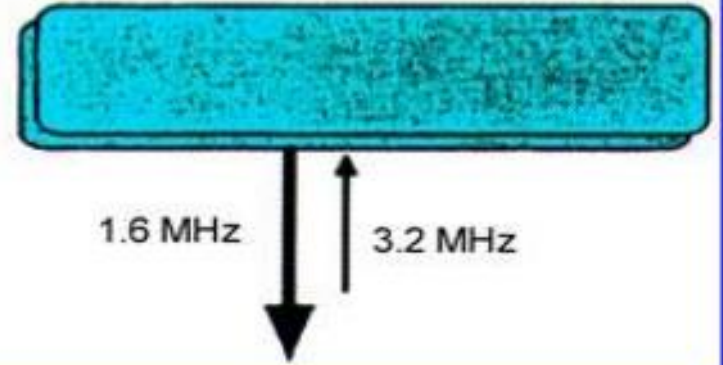
Armonici

- Unda de US trecand prin tesut devine distorsionata, generandu-se frecvente sonore aditionale care sunt armonici ale frecventei originale
- Se folosesc transductoare care pot receptiona transmisia acestor frecvente
- Imaginea este mult imbunatatita

Conventional imaging



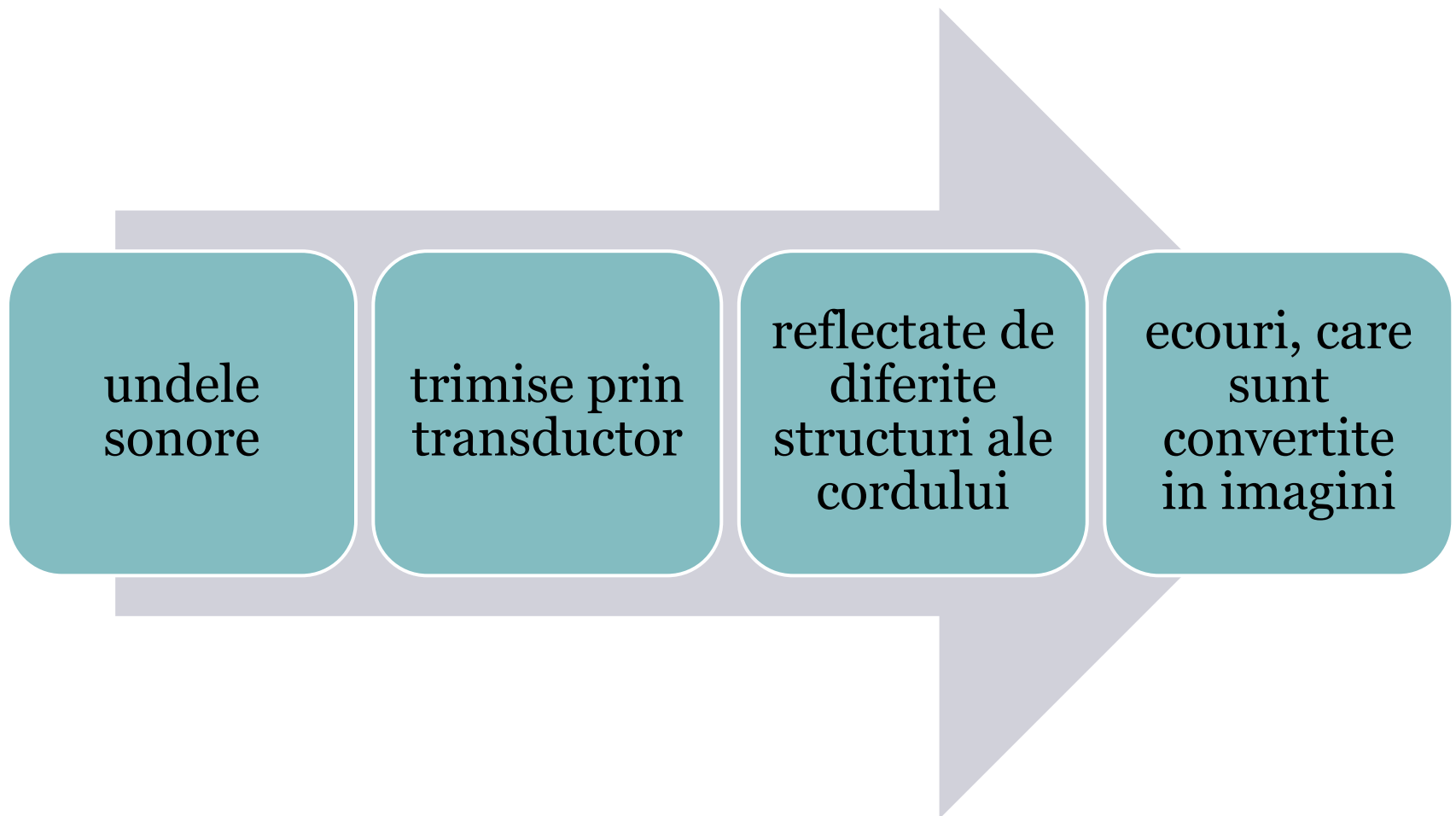
Harmonic imaging



Optimizarea imaginii 2-D -factori tehnici-

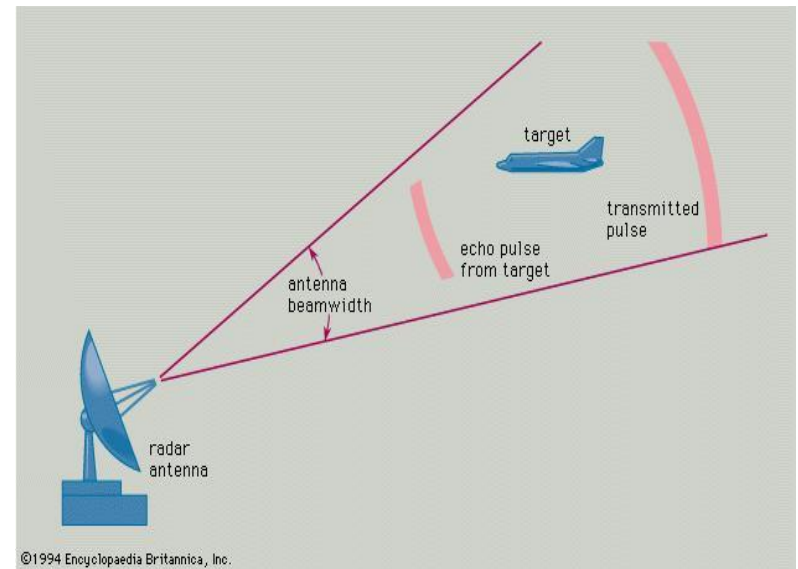
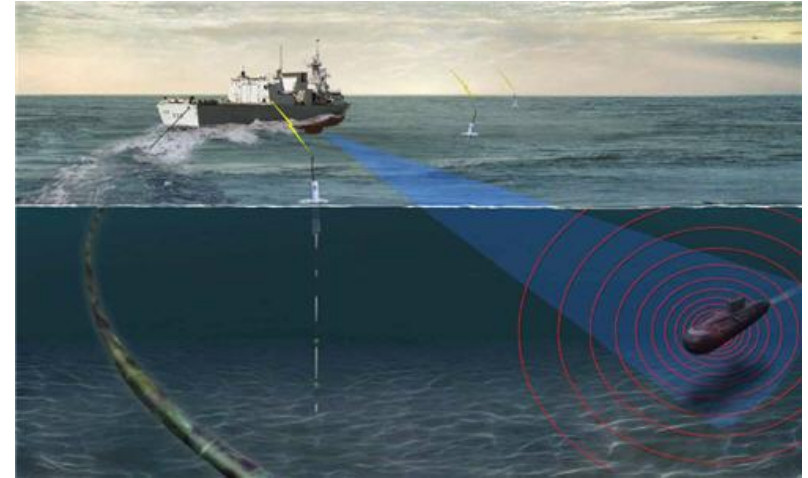
- **Transductorul:**
 - frecventa inalta: creste retrodifuziunea si rezolutia, dar nu are o buna penetrare;
 - frecventa joasa: permite o buna penetrare, dar reduce rezolutia imaginii;
- **Adancimea:**
 - cu cat este mai mare adancimea, cu atat este mai mic frame-rate-ul;
 - cautam cea mai mica adancime care permite afisarea regiunii de interes ;
- **Focusul:** indica zona imaginii in care raza ultrasunetului este cea mai ingusta; rezolutia este cea mai buna in aceasta regiune;
- **Gain-ul:** ajusteaza amplitudinea tuturor semnalelor afisate.

Pe scurt



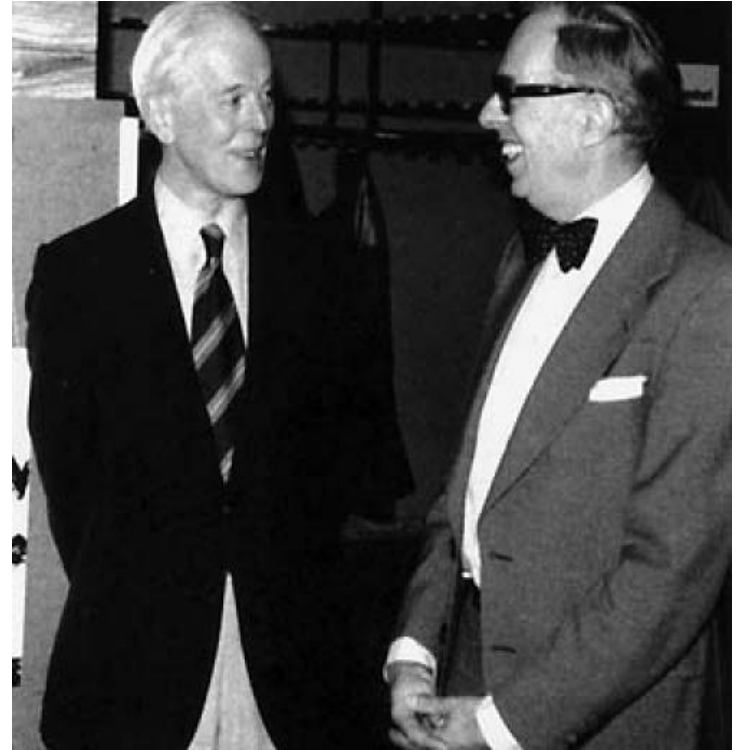
Originea ecocardiografiei(1)

- 1842-Christian Johann Doppler- noteaza ca frecventa unei sonore variaza daca sursa sunetului se misca;
- Lazzaro Spallanzani- arata ca ecourile reflectate ale sunetelor neauzibile permit liliecilor sa navigheze;
- Langevin in 1915, dezvoltă sistemul SONAR (Sound navigation and ranging) folosit pentru detectarea submarinelor inamice in primul razboi mondial;
- In 1941 in cel de-al 2 lea razboi mondial, armata Statelor Unite foloseste undele radio pentru detectarea avioanelor, o tehnologie numita RADAR (Radio detection and ranging);



Originea ecocardiografiei(2)

- In 1946- Andre Denier propune folosirea ultrasunetelor pentru vizualizarea organelor interne ale corpului uman
- In 1953 Edler si Hertz, in laboratorul Universitatii din Lund pun sonda de ultrasunete deasupra inimii lui Hertz, si, spre fascinatia lor, vad un ecou miscandu-se inainte si inapoi de-a lungul axei-X a ecranului osciloscopului la o adancime de 8-9cm de la peretele toracic
- In octombrie 1953 cu Ultraschall Impulsgerat, Inge Edler si Helmuth Hertz au inregistrat prima imagine in miscare a cordului, inaugurand ecocardiografia (Ultrasound cardiography)



- Inge Edler (stanga) and Carl Hellmuth Hertz, echipa cardiolog-fizician care a dat lumii ecocardiografia, la un simpozion in Lund, Suedia, 1977.

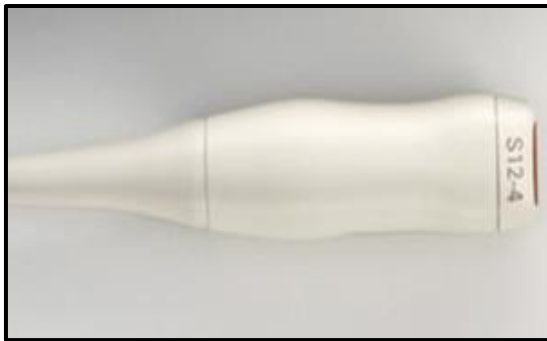
Aparatul

Are 5 componente de baza:

1. **generatorul de impuls** foloseste voltaj de mare amplitudine pentru a energiza cristalele
2. **transductorul** converteste energia electrica in energie mecanica
3. **receptorul**: detecteaza si amplifica semnalele slabe
4. **monitorul**: prezinta semnalele in variate moduri
5. **memoria**

take home message

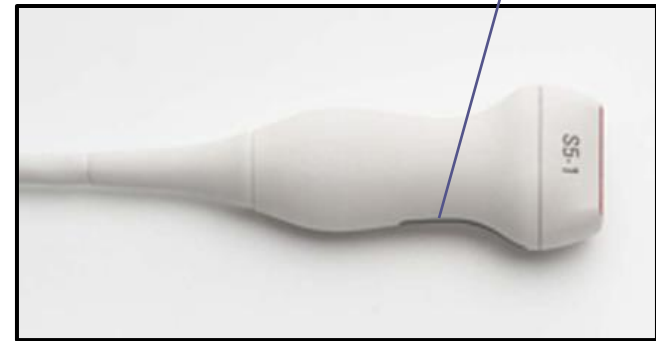
- se recomanda selectarea sondei cu cea mai mare frecventa care permite o penetrare adecvata a structurilor de examinat;
- la pacientii slabi/copii, la care penetranta nu reprezinta o problema sunt optime sondele de frecventa mai inalta, care permit o buna rezolutie;
- in cazul unui perete toracic mai gros (pacienti obezi), devine necesara folosirea unei frecvente joase.



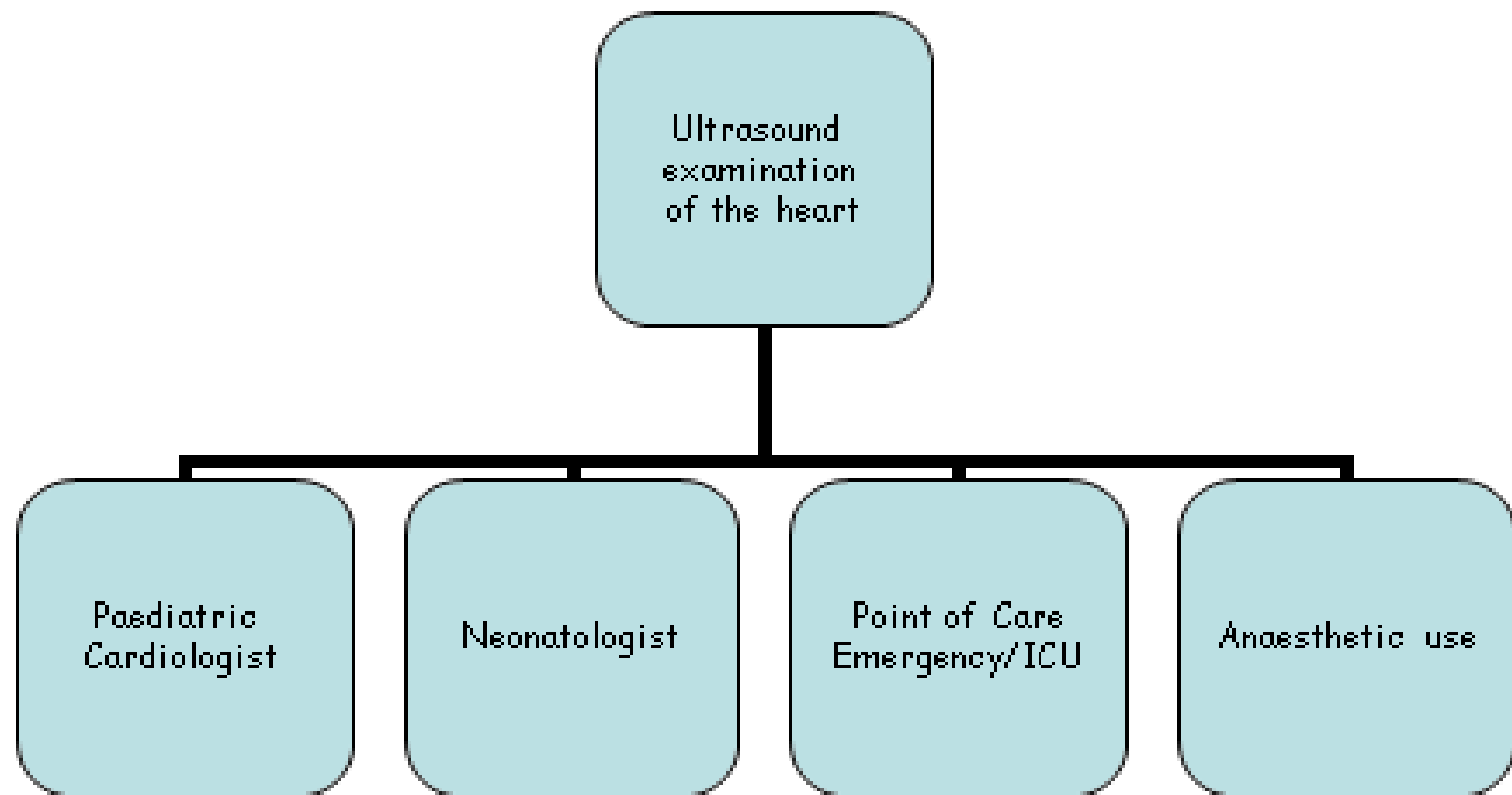
Sonda nou-nascuti 12-4



Sonda copii mici 8-3



Sonda copii mari/adulti 5-1



ultrasound examination of the heart

pediatric
cardiologist

diagnosis

research

neonatologist

PDA/
pulmonary
hypertension

functional

emergency/
ICU

point of care

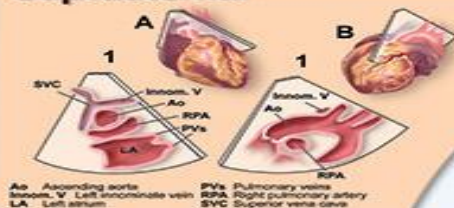
haemodynamic

anaesthetic
use

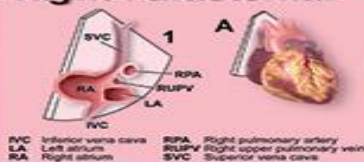
haemodynamic/
residual defects



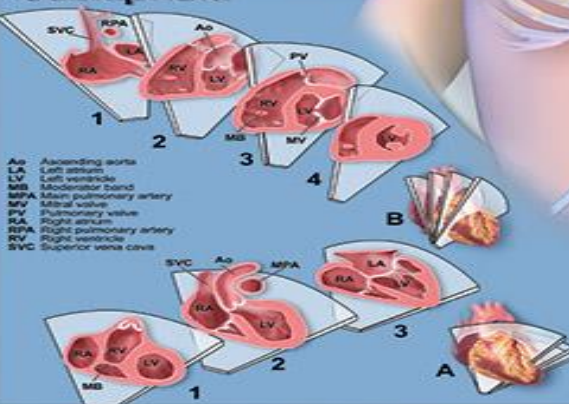
Suprasternal



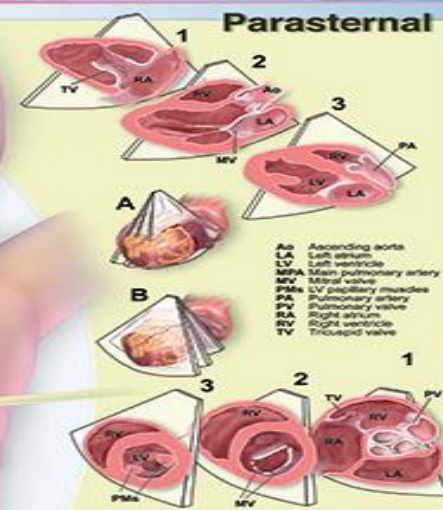
Right Parasternal



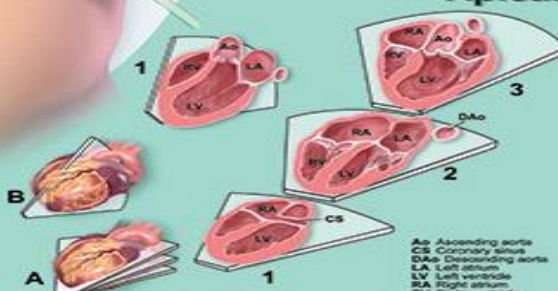
Subxiphoid



Parasternal



Apical



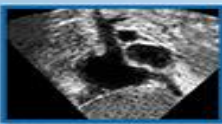
A1 Suprasternal transverse



B1 Suprasternal aortic arch



A1 Right parasternal



B1 Subxiphoid short-axis



B2 Subxiphoid short-axis



B3 Subxiphoid short-axis



B4 Subxiphoid short-axis

A1 Subxiphoid long-axis

A2 Subxiphoid long-axis

A3 Subxiphoid long-axis

A1 Apical 4-chamber

A2 Apical 4-chamber

A3 Apical 4-chamber

B1 Apical long-axis

Measurements of Structures

Measurement	Timing	View(s)
Tricuspid Valve Annulus	Diastole	Apical 4
Pulmonary Valve Annulus	Systole	PLAX/PLAX
Main Pulmonary Artery	Systole	PSAX/PLAX
Left/Right Pulmonary Artery	Systole	PSAX/PLAX
Left Atrial Diameter	Diastole	PLAX
Mitral Valve Diameter	Diastole	PLAX/Apical 4
Aortic Valve Annulus	Systole	PLAX
Aortic Root	Systole	PLAX
Ascending Aorta	Systole	PLAX
Transverse Aortic Arch	Systole	SSN
Aortic Isthmus	Systole	SSN

Apical 4-chamber (Apical 4), Parasternal long axis (PLAX), Parasternal short axis (PSAX), Suprasternal notch view (SSN)

Doppler Measurements

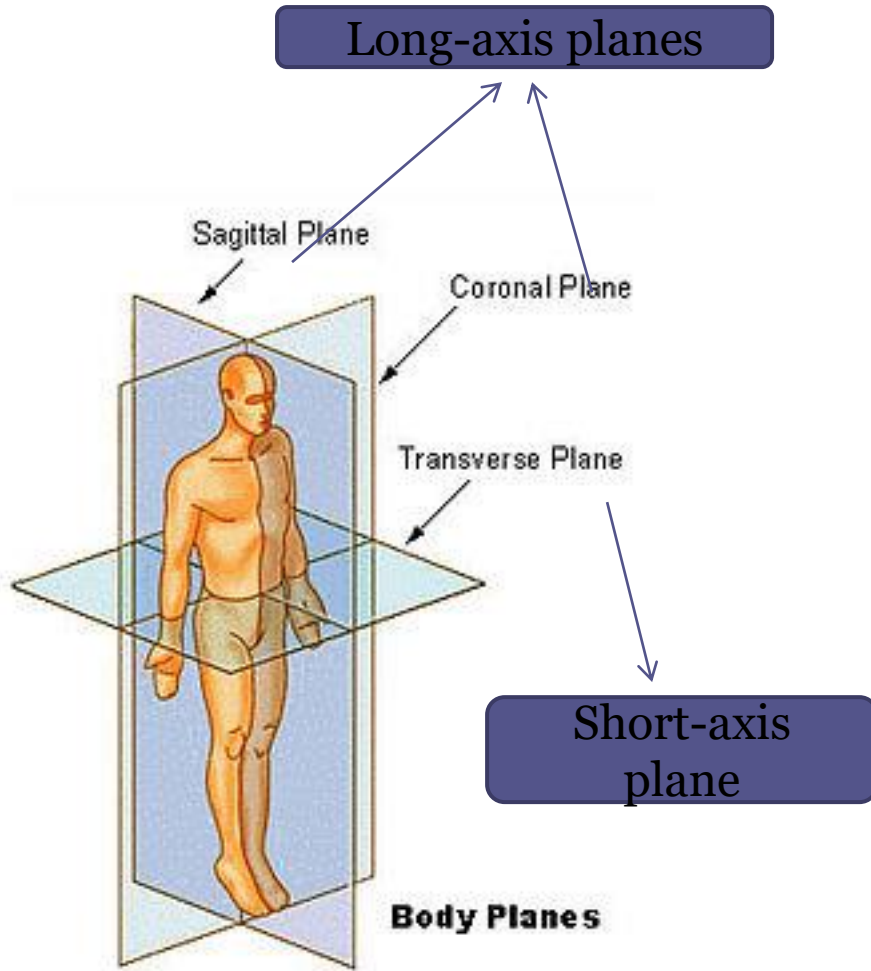
Structure	Measurements*
Tricuspid Valve	E wave velocity, A wave velocity, deceleration time, IVRT, mean gradient, regurgitant jet velocity, peak gradient, mean gradient, VTI
RV Outflow	peak gradient, mean gradient, VTI
Pulmonary Valve	peak gradient, mean gradient, regurgitant jet velocity, VTI
Branch Pulmonary Artery	peak gradient, mean gradient, VTI
Mitral Valve	E wave velocity, A wave velocity, deceleration time, IVRT, mean gradient
LV Outflow	peak gradient, mean gradient, VTI, pressure half-time
Aortic Valve	peak gradient, mean gradient, VTI, pressure half-time
Aortic Arch	peak gradient, mean gradient, VTI

Isovolumic relaxation time (IVRT), Velocity time integral (VTI)
*Recording of images adequate for the measurements listed should be considered for inclusion in a complete examination protocol. This is not intended to be a comprehensive list of recommended Doppler measurements.

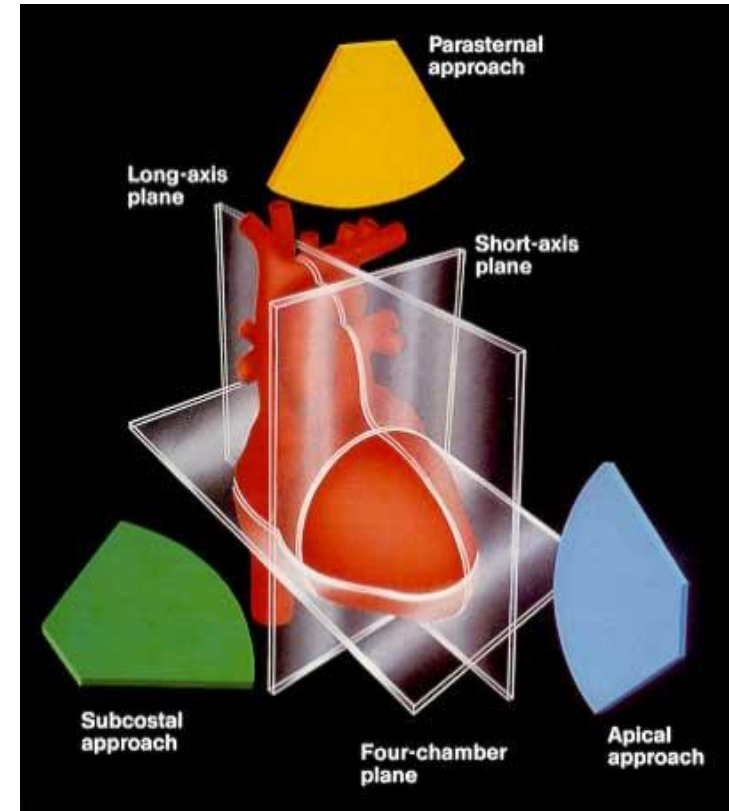
Report Elements

- Patient identifier data - Name - Date of birth - Medical record identifier - Date of study - Location of study - Referring physician - Patient height & weight (for body surface area calculation) - Sedation used - Indications for pediatric echocardiographic study - Sonographer/Physician who performed the study - Findings section - Structural/anatomic features - Quantitative data - Doppler (hemodynamic) findings - Summary section
--

Planurile ortogonale

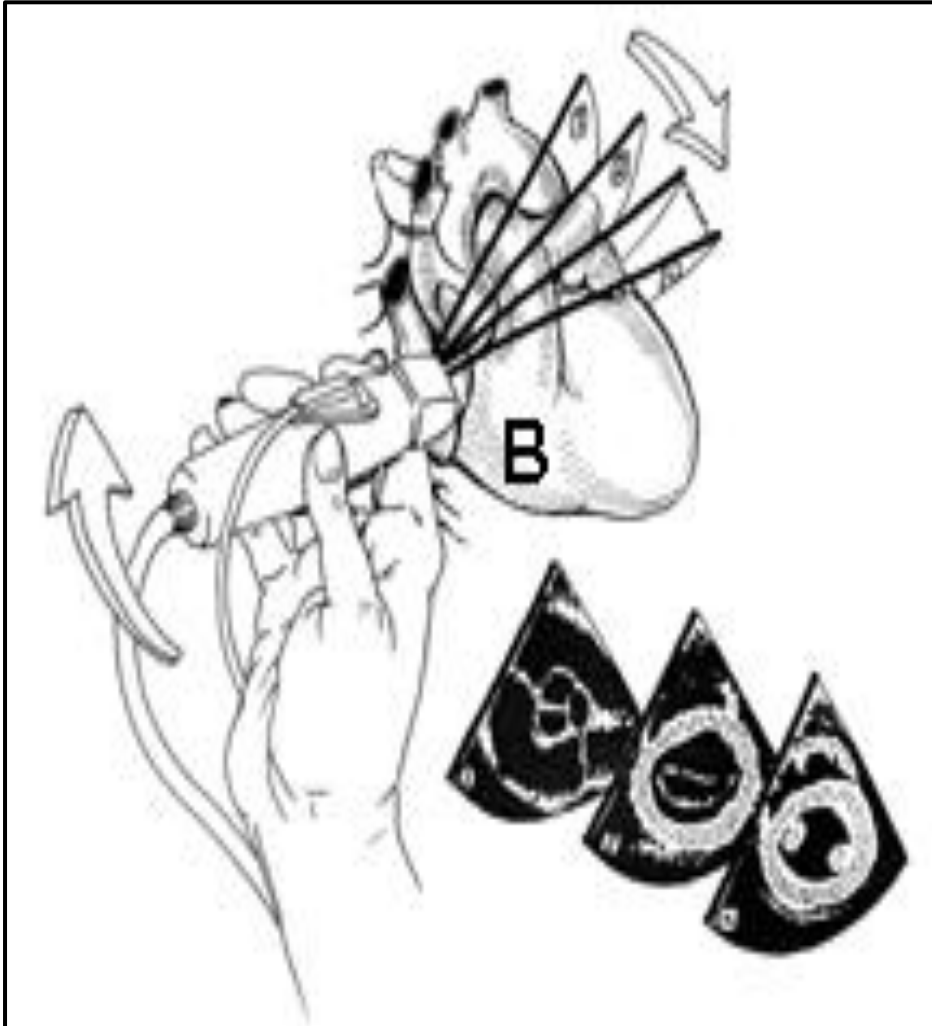


Planurile ortogonale ale
corpului



Planurile ortogonale ale
cordului

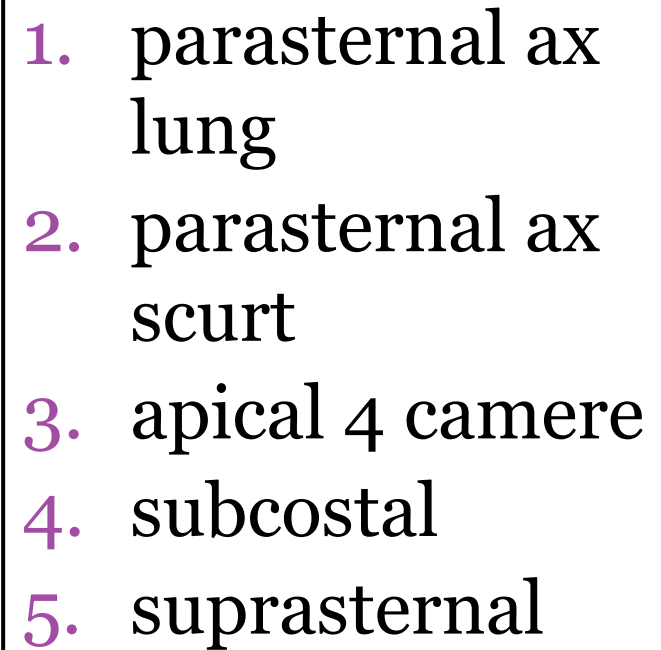
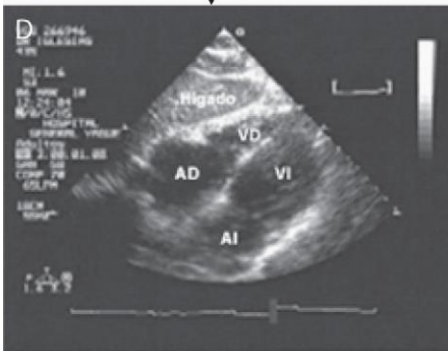
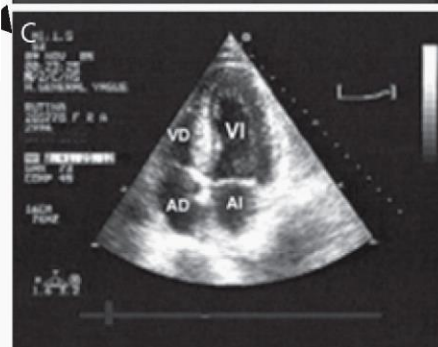
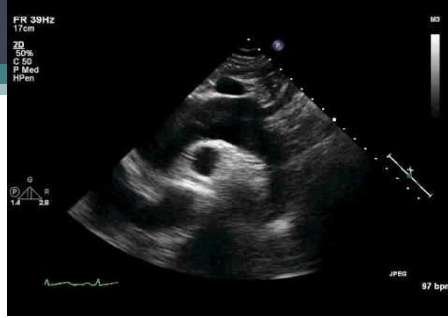
Miscari ale transductorului:



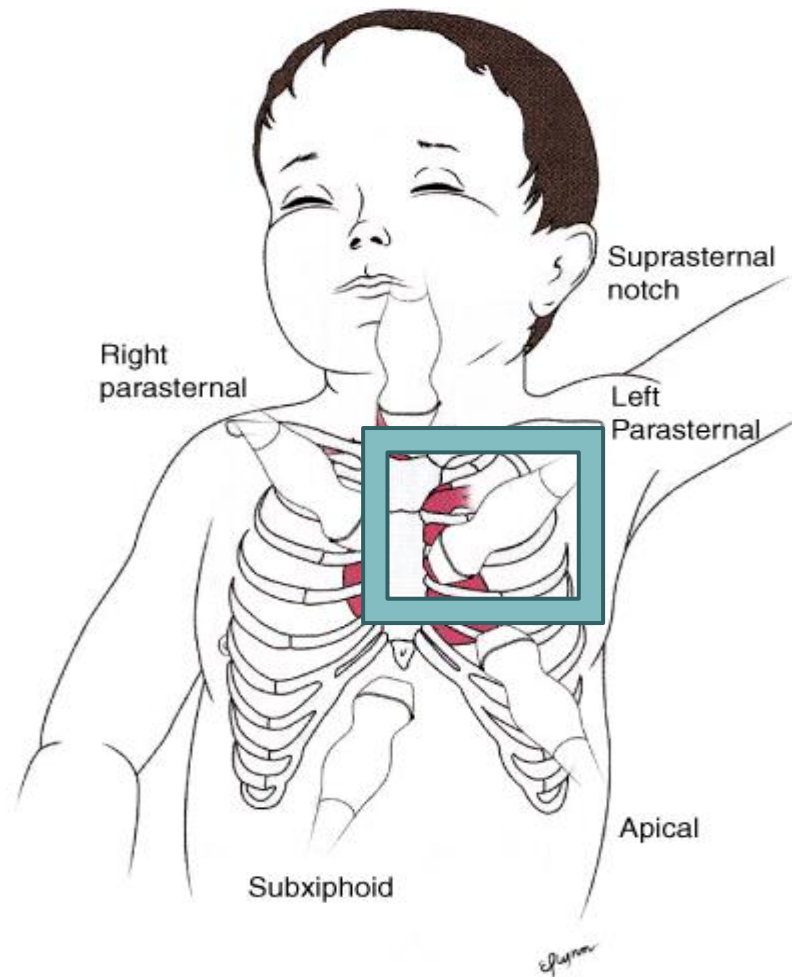
- **Rotatie:** in sens orar/antiorar;
- **Angulare:** in directie craniala, caudala, spre stanga sau spre dreapta.
- **Translatie:** un spatiu mai sus/mai jos/lateral/medial

Sectioni standard in ecocardiografie





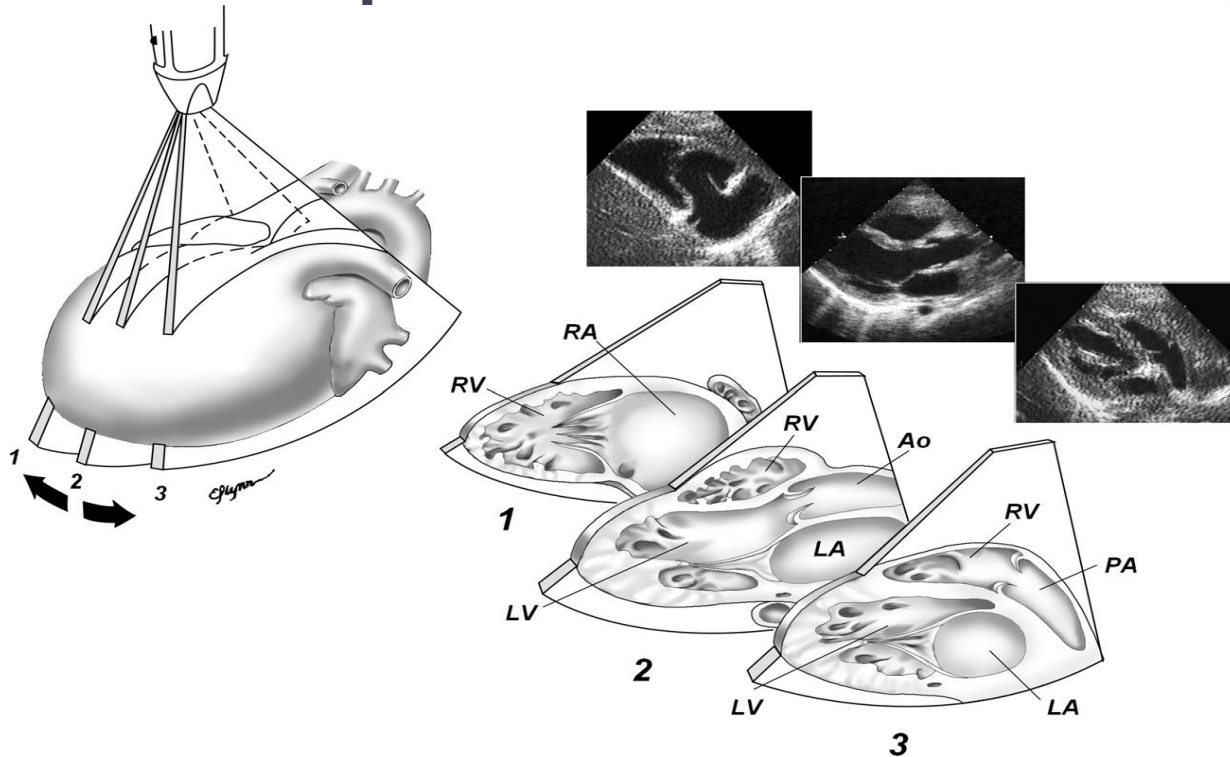
Secțiunea parasternal ax lung



Source: Gleason MM, Rychik J, Shaddy R: *Pediatric Practice: Cardiology*:
www.accesspediatrics.com

Copyright © The McGraw-Hill Companies, Inc. All rights reserved.

Sectiunea parasternal ax lung(2)



Sectiuni modificate ax lung:

- pentru tractul de intrare VD: prin angulare spre superior si lateral fata de pozitia necesara obtinerii sectiunii parasternale ax lung;
- pentru tractul de iesire VD: angulare in sens invers.

Guidelines and Standards for Performance of a Pediatric Echocardiogram: A Report from the Task Force of the Pediatric Council of the American Society of Echocardiography

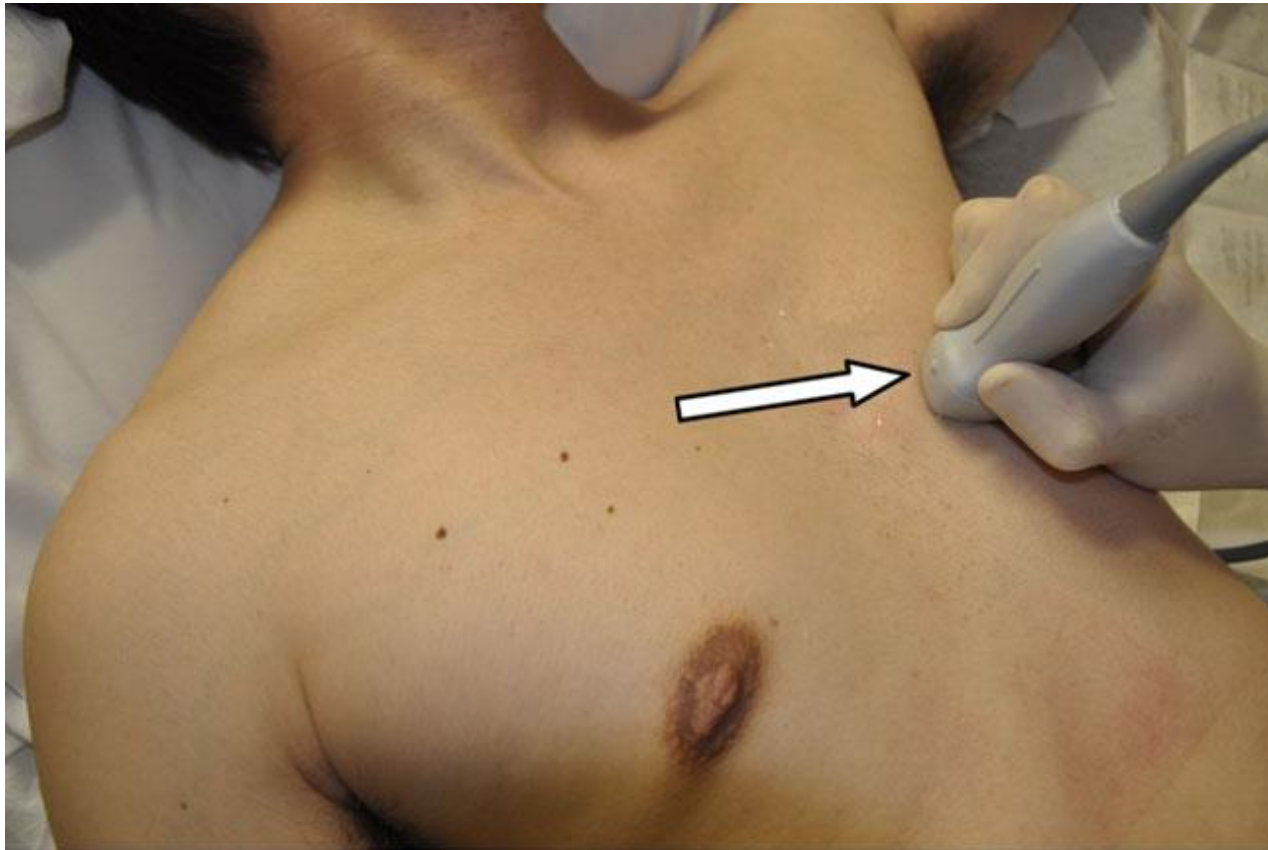
Wyman W. Lai, MD, MPH, FASE, Tal Geva, MD, FASE, Girish S. Shirali, MD, Peter C. Frommelt, MD, Richard A. Humes, MD, FASE, Michael M. Brook, MD, Ricardo H. Pignatelli, MD, and Jack Rychik, MD, Writing Committee, New York, New York; Boston, Massachusetts; Charleston, South Carolina; Milwaukee, Wisconsin; Detroit, Michigan; San Francisco, California; Houston, Texas; and Philadelphia, Pennsylvania



ULTRASOUND
CRITICAL CARE

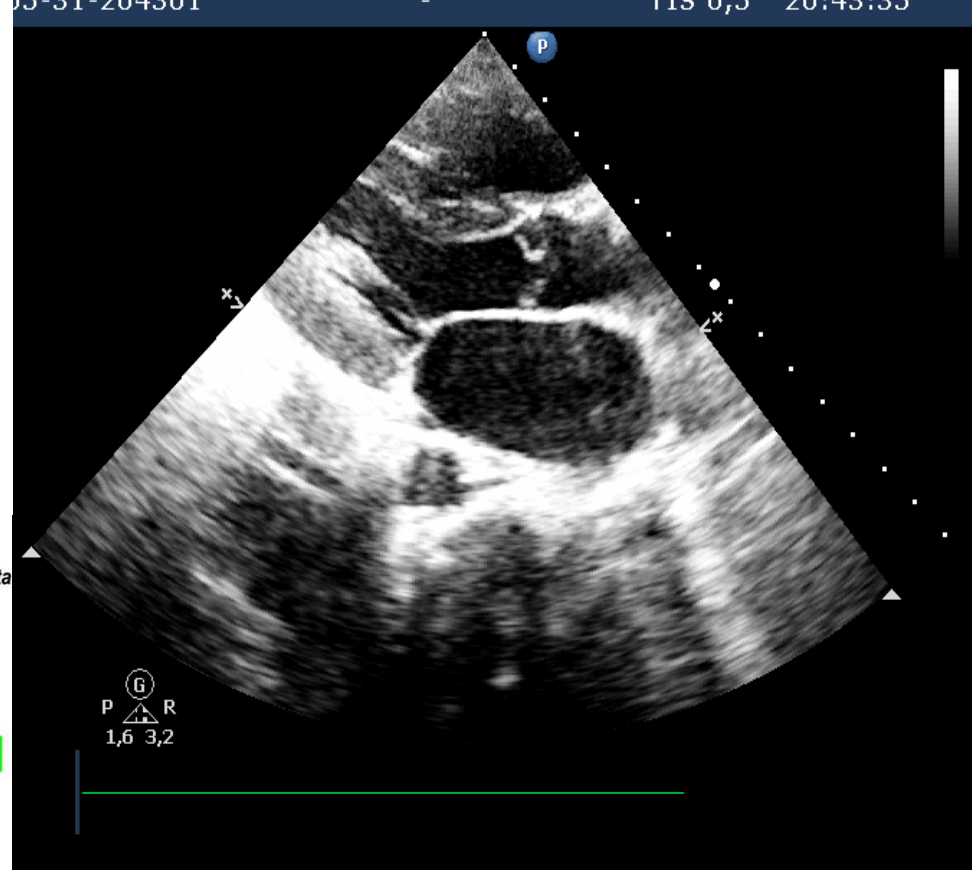
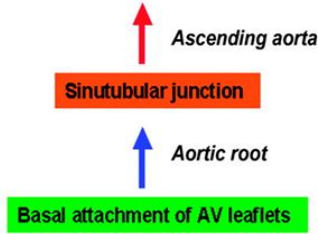
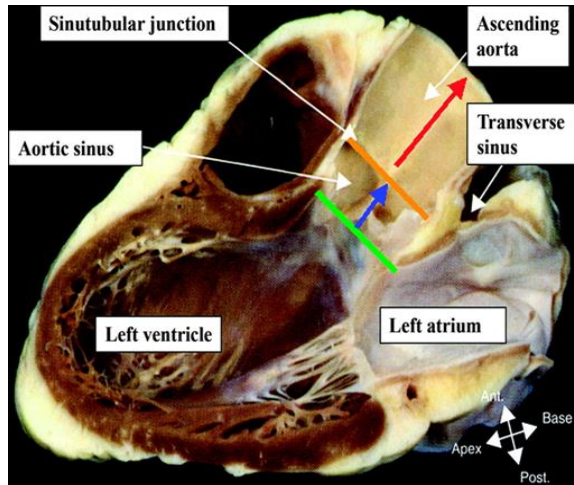
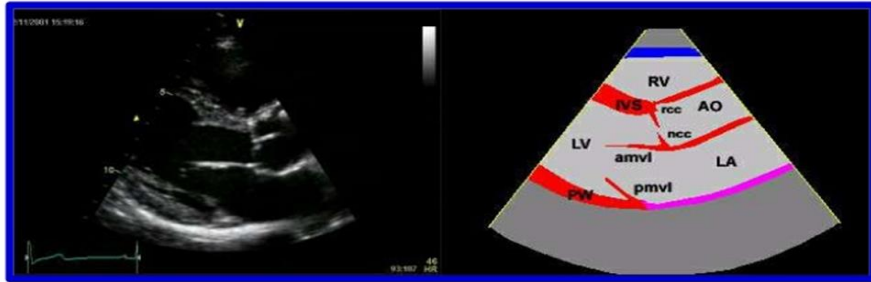
UltraSound Critical Care Copyright © 2013, All Rights Reserved

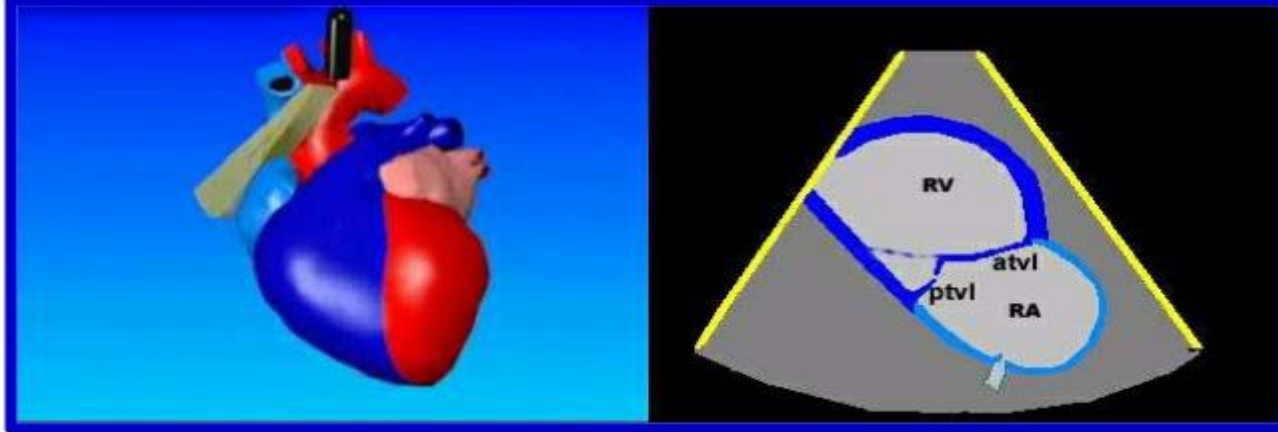
Sectionea parasternal ax lung(1)



Sonda se plaseza in spatiul III, IV sau V intercostal stang; markerul sondei orientat catre clavicula dreapta a pacientului, ora 11.

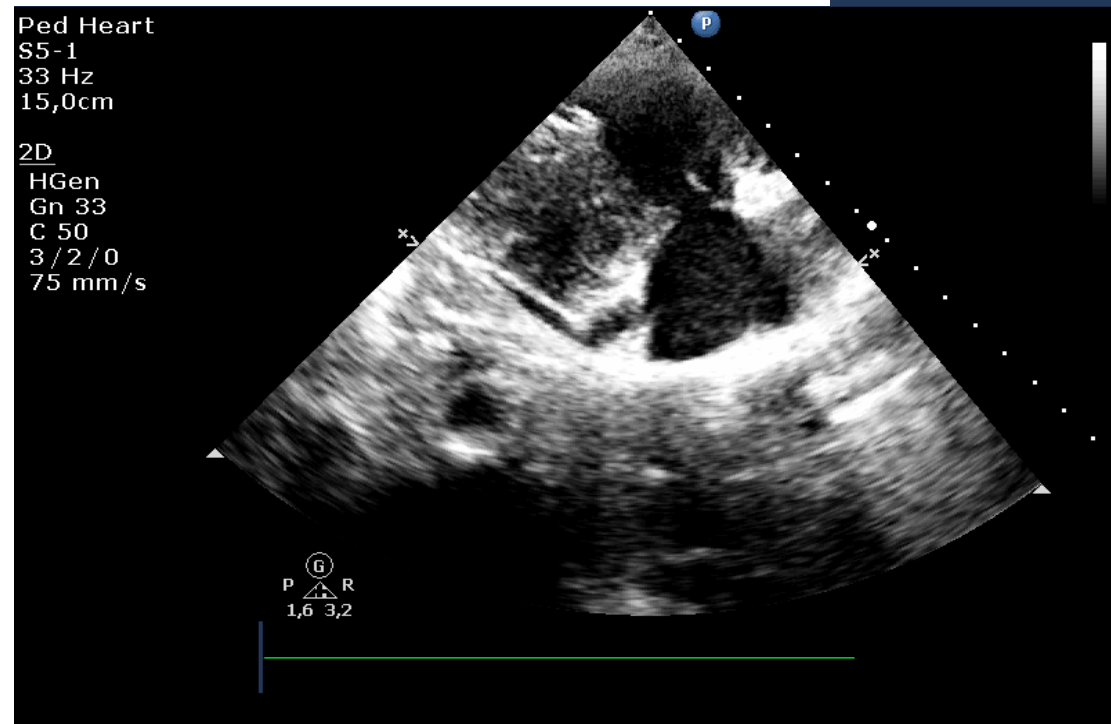
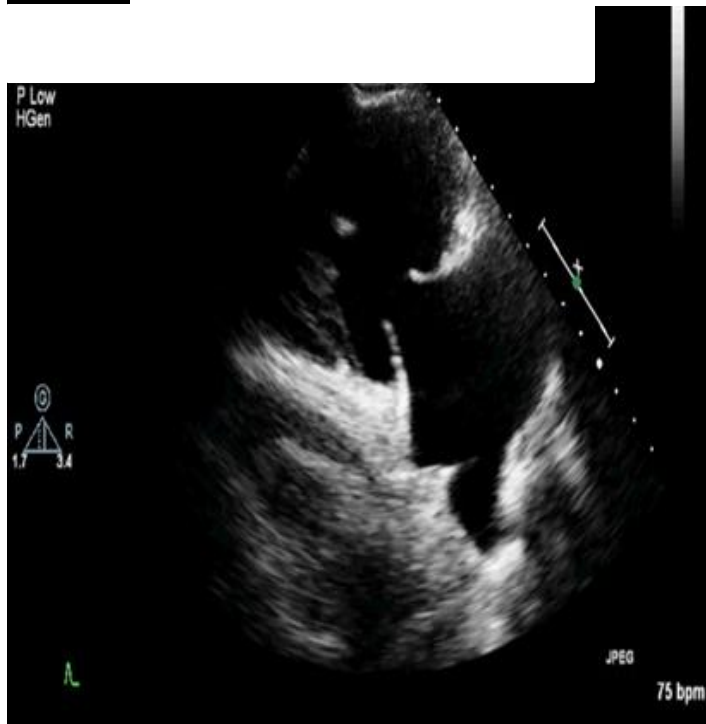
 Probe Orientation Marker





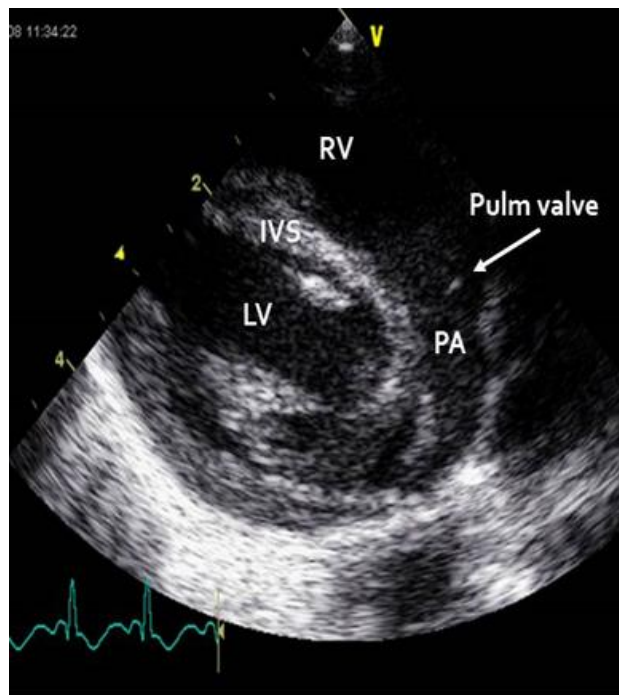
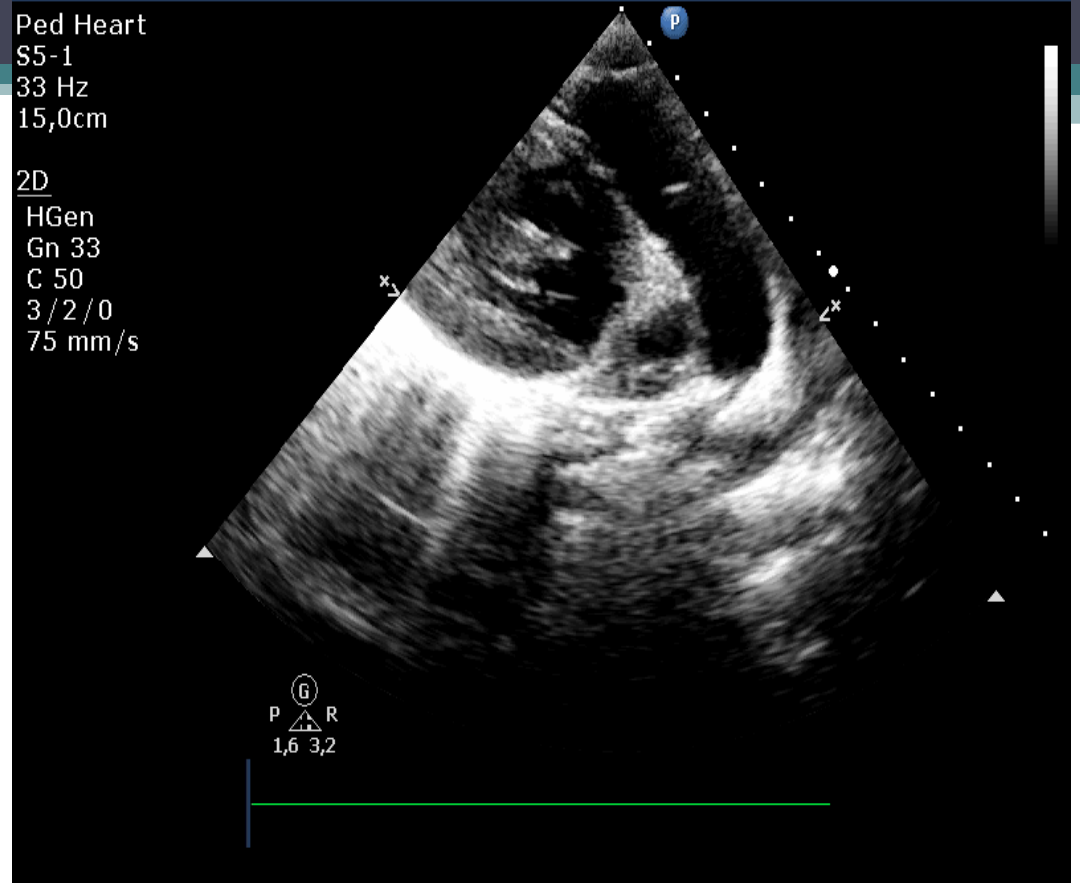
PHILIPS
362
FR 49Hz
18cm

I 1,3 31.05.2015
S 0,5 20:43:49

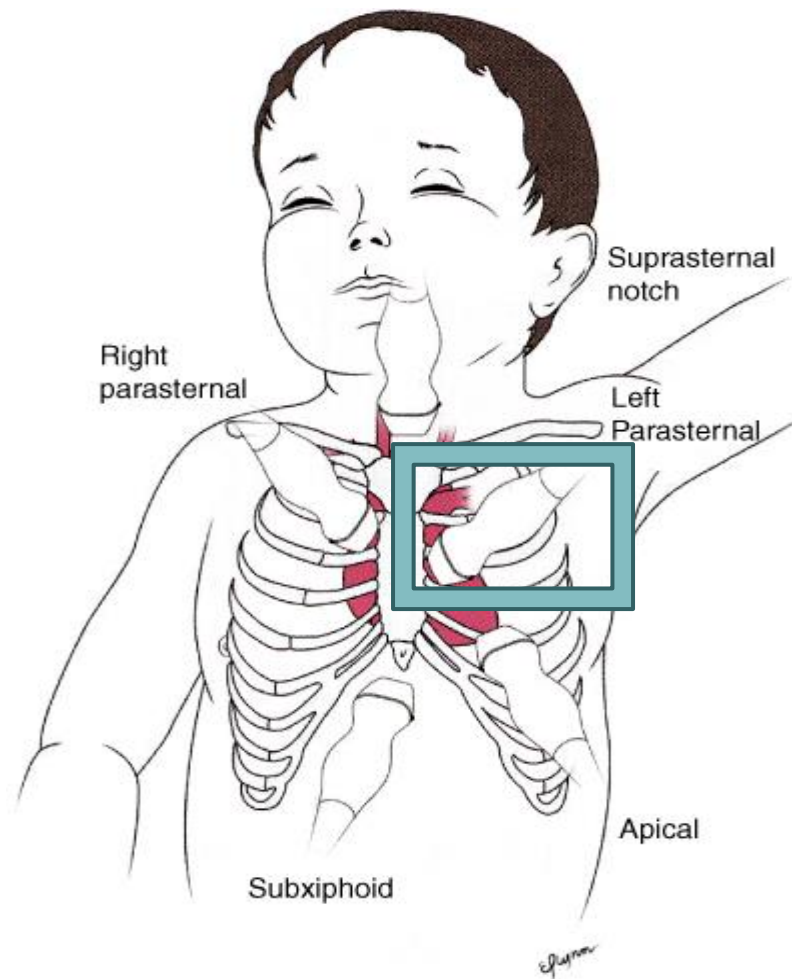


Ped Heart
S5-1
33 Hz
15,0cm

2D
HGen
Gn 33
C 50
3/2/0
75 mm/s



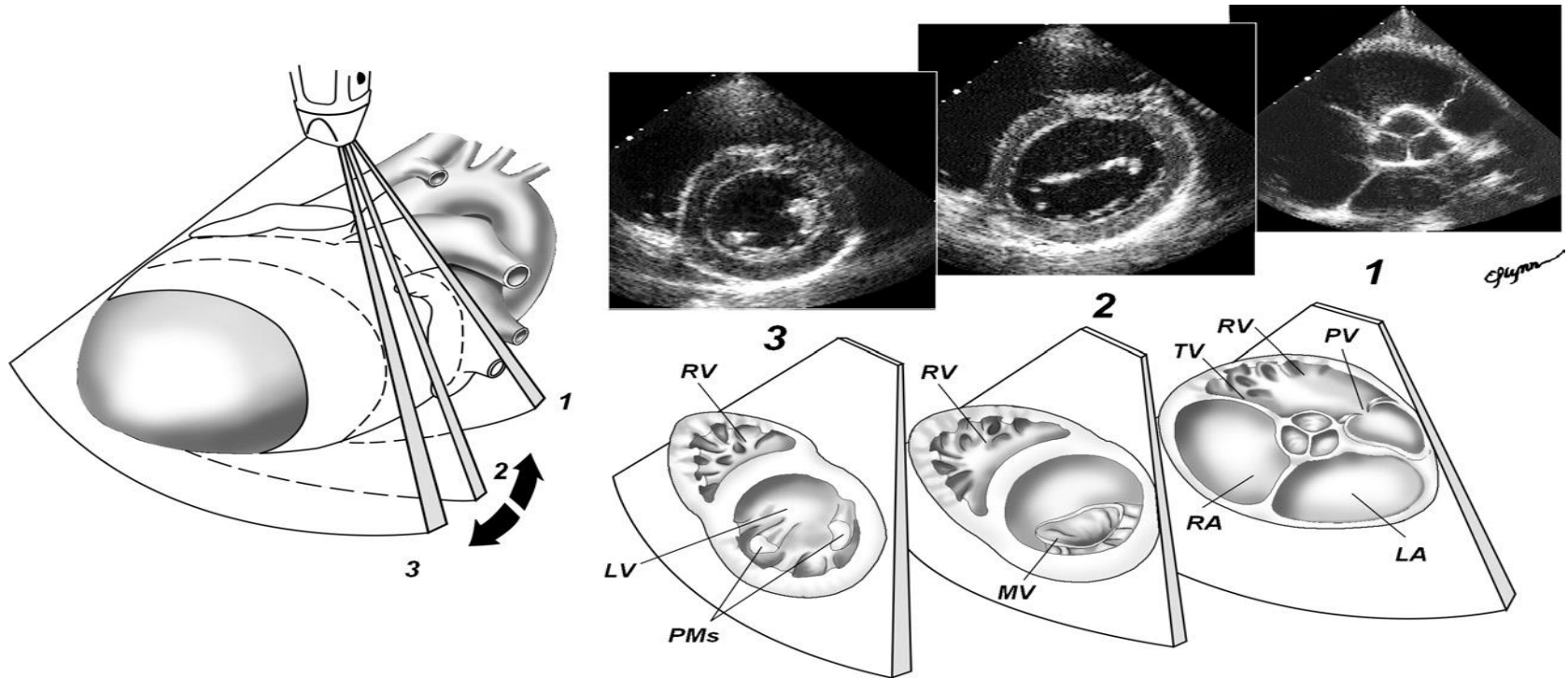
Sectiunea parasternal ax scurt



Source: Gleason MM, Rychik J, Shaddy R: *Pediatric Practice: Cardiology*:
www.accesspediatrics.com

Copyright © The McGraw-Hill Companies, Inc. All rights reserved.

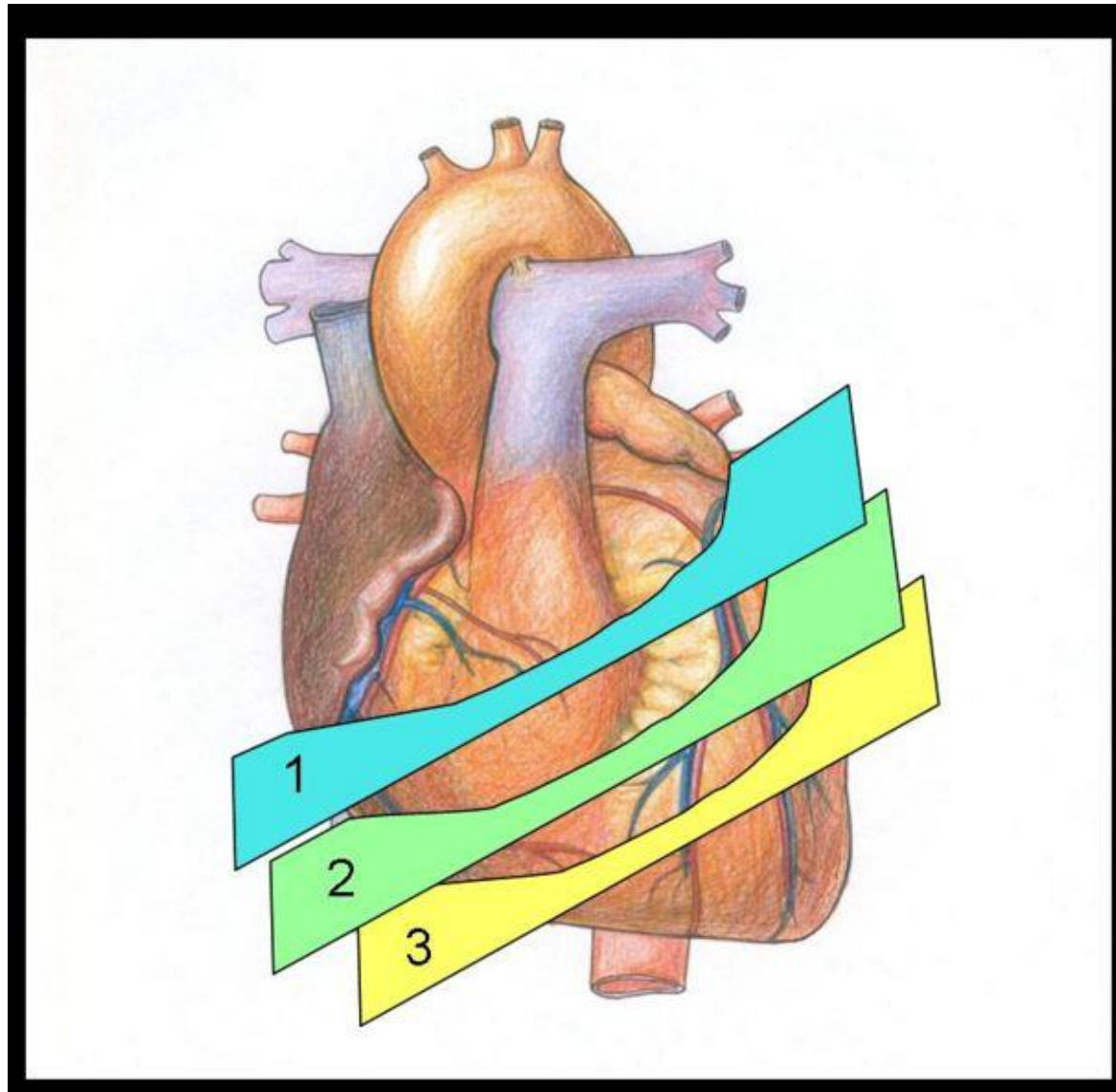
Sectiunea parasternal ax scurt(2)

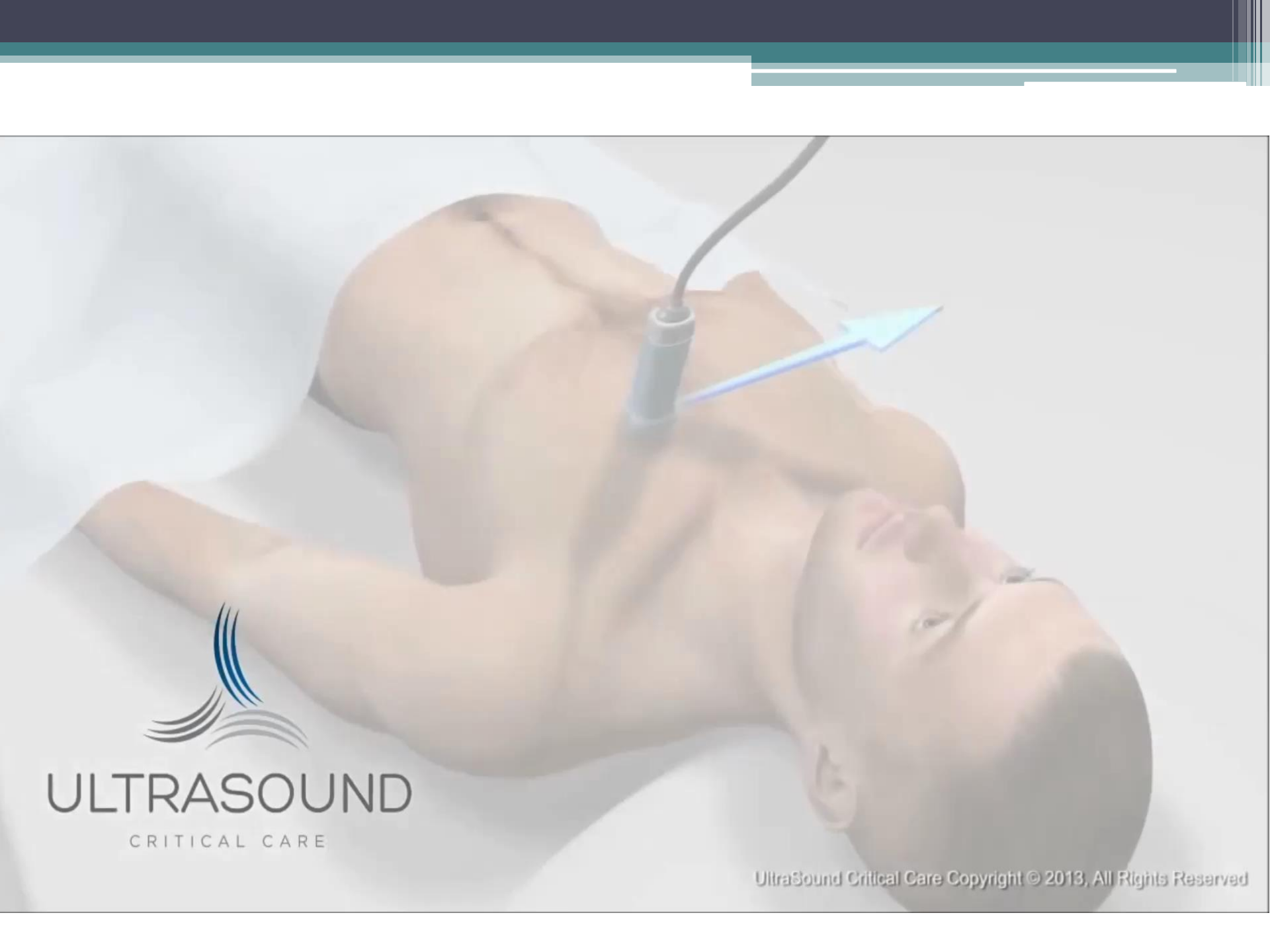


- Prin angularea catre inferior si lateral, fata de pozitia anterioara a sondei, se poate vizualiza axul scurt al VS la diferite niveluri: valvei mitrale; muschilor papilari; apexului

Guidelines and Standards for Performance of a Pediatric Echocardiogram: A Report from the Task Force of the Pediatric Council of the American Society of Echocardiography

Wyman W. Lai, MD, MPH, FASE, Tal Geva, MD, FASE, Girish S. Shirali, MD, Peter C. Frommelt, MD, Richard A. Humes, MD, FASE, Michael M. Brook, MD, Ricardo H. Pignatelli, MD, and Jack Rychik, MD, Writing Committee, New York, New York; Boston, Massachusetts; Charleston, South Carolina; Milwaukee, Wisconsin; Detroit, Michigan; San Francisco, California; Houston, Texas; and Philadelphia, Pennsylvania

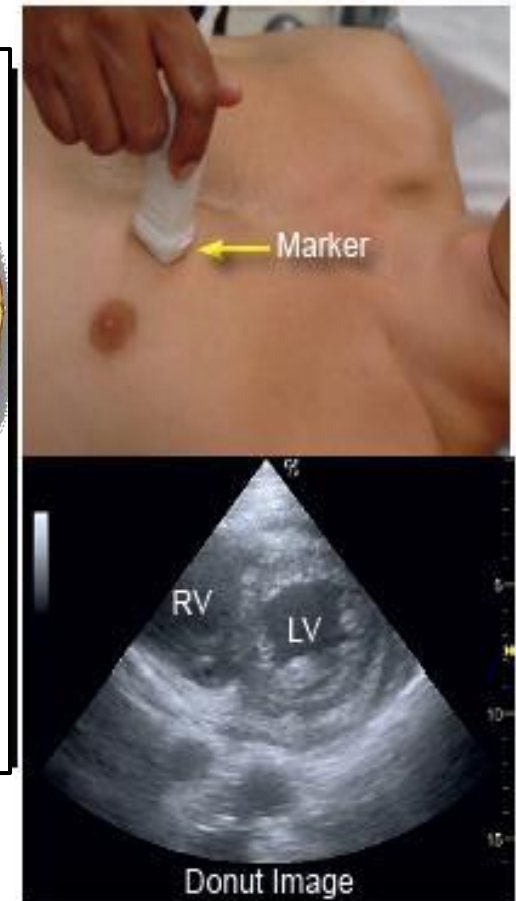
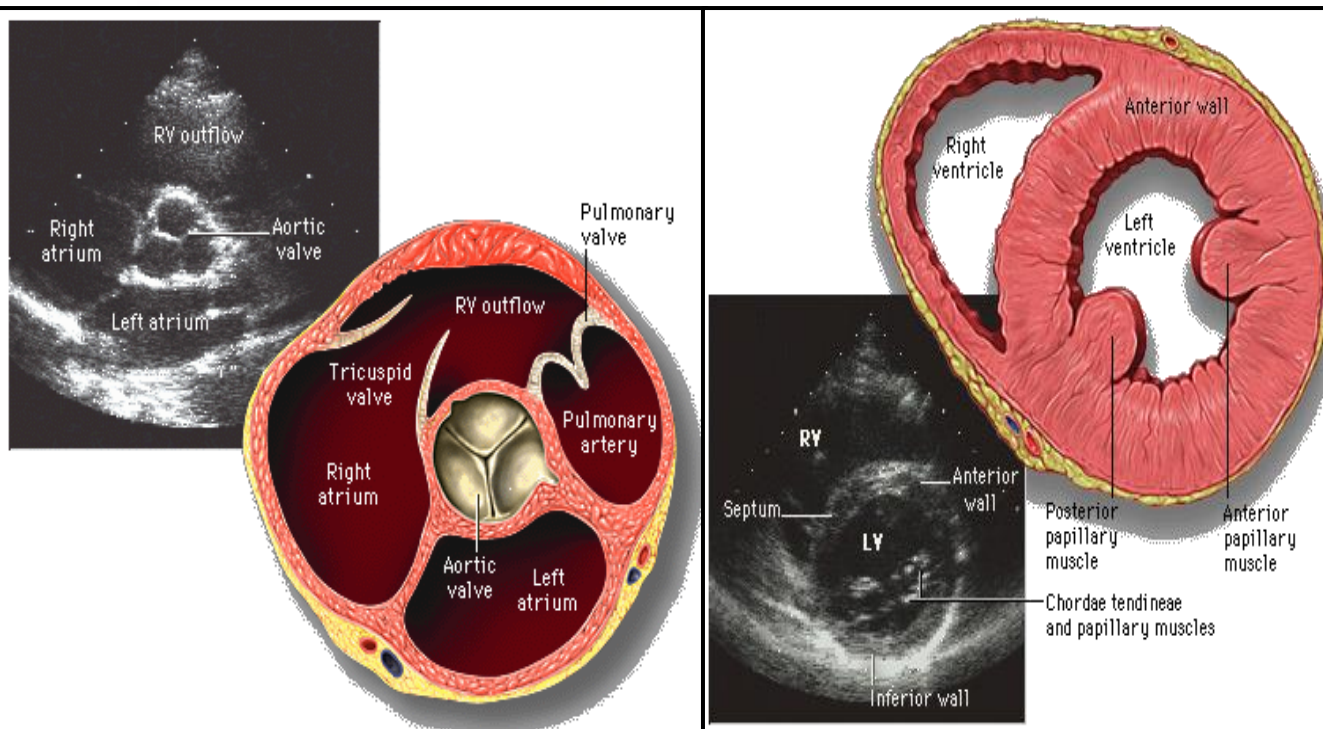




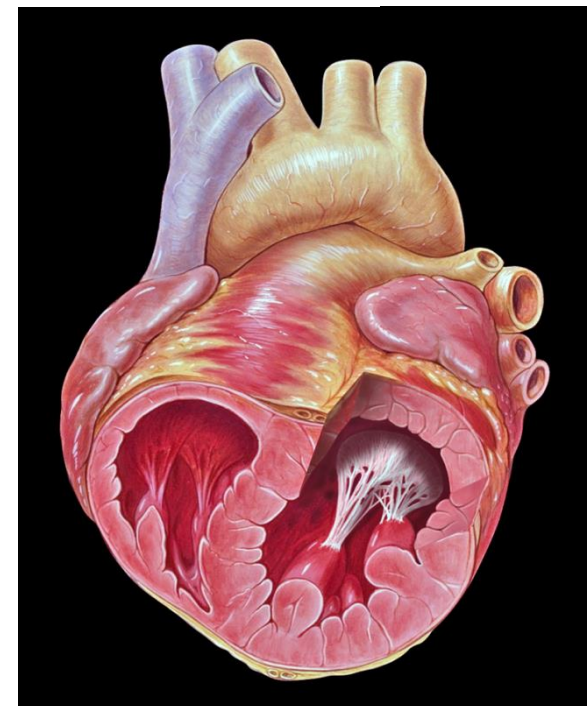
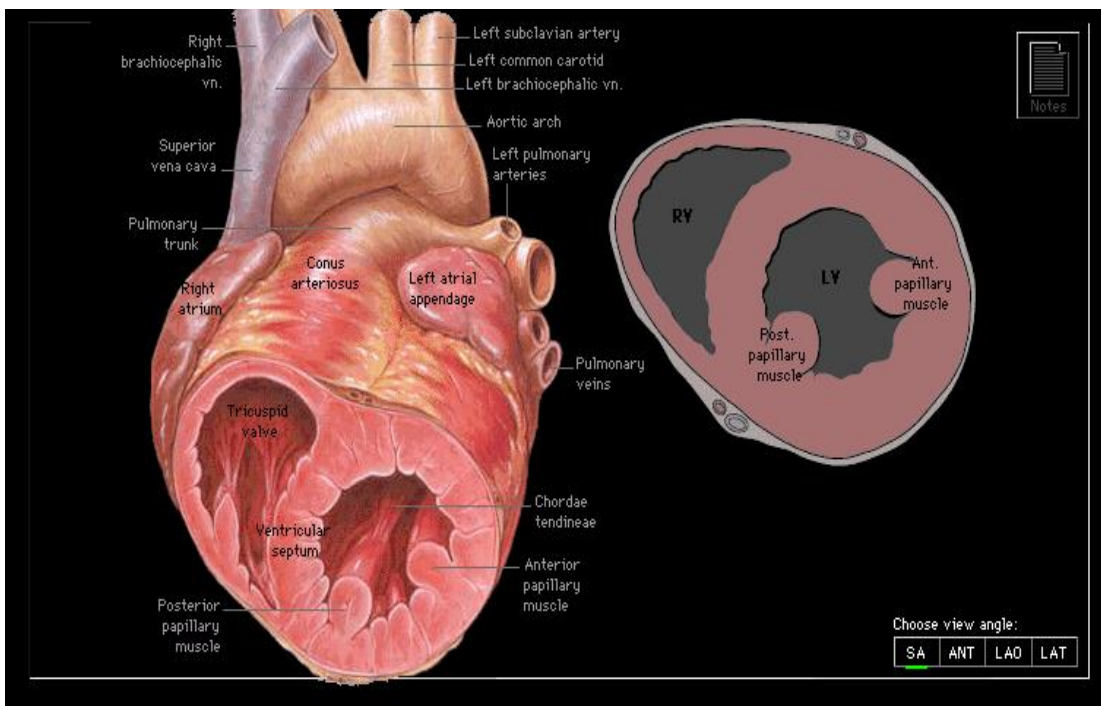
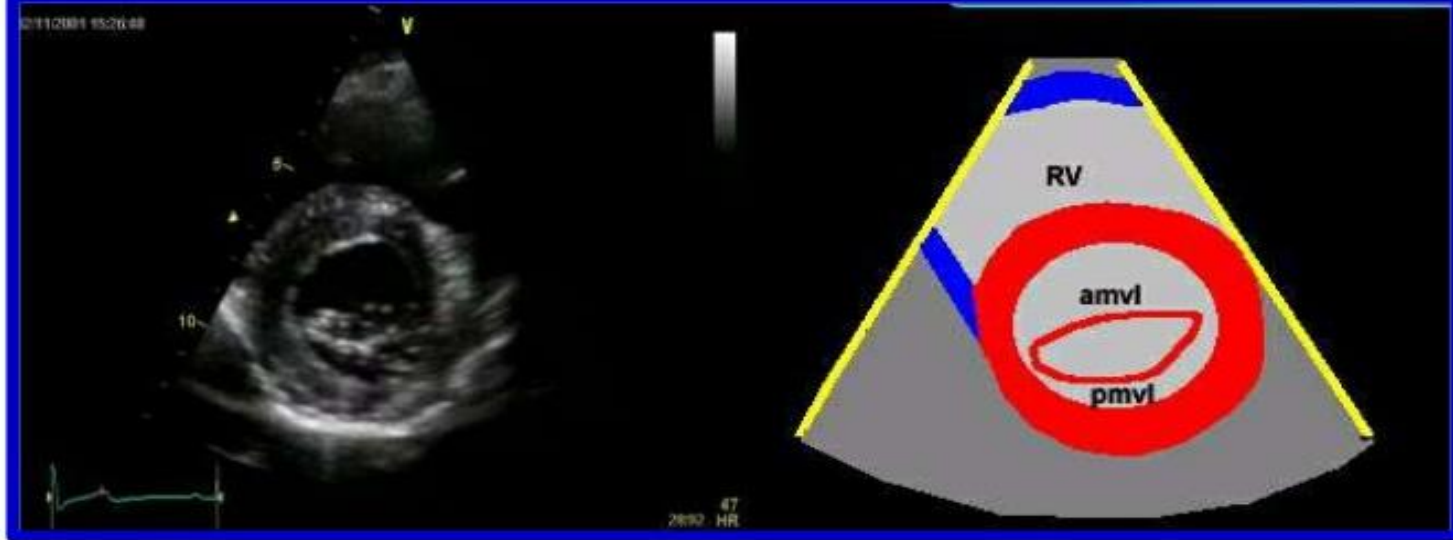
ULTRASOUND
CRITICAL CARE

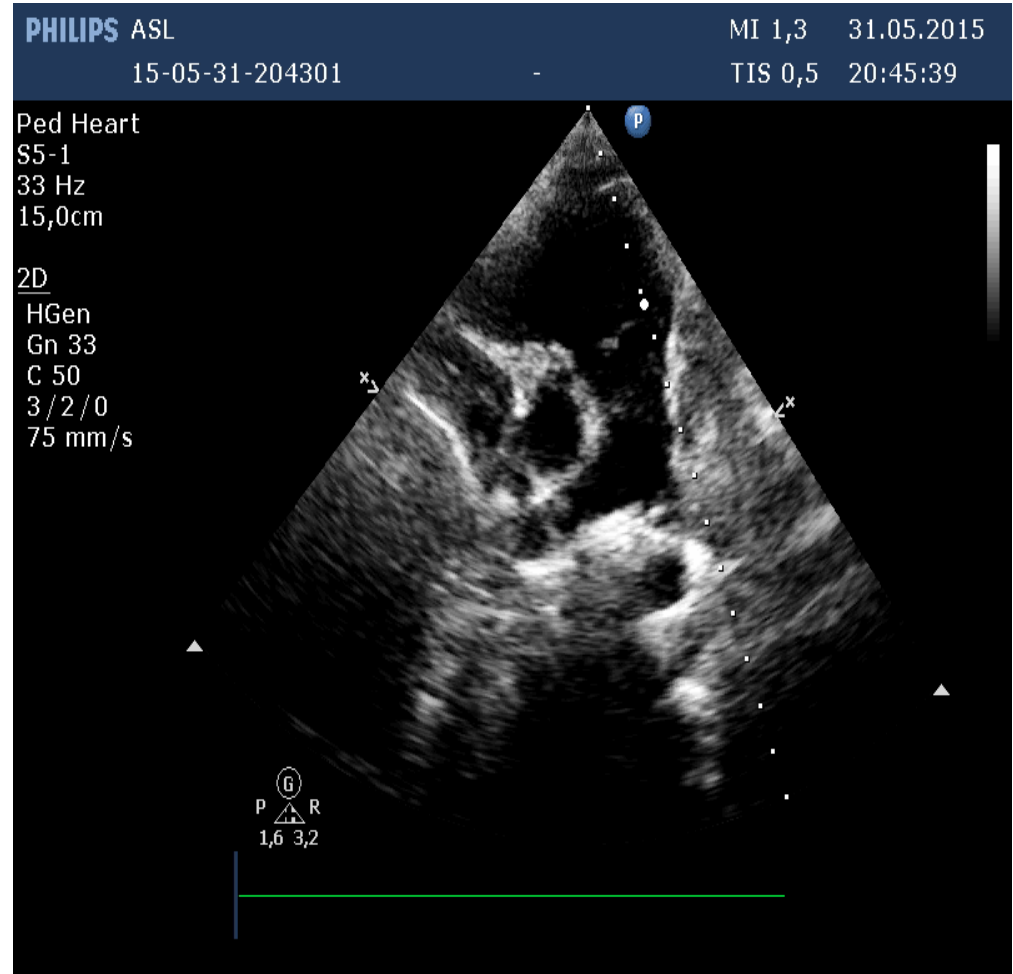
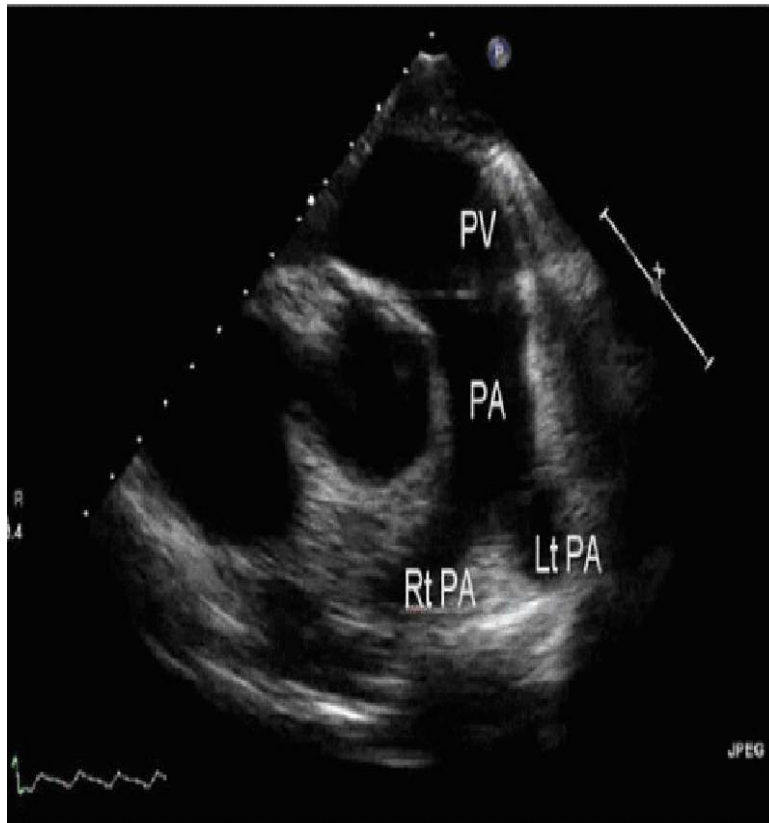
UltraSound Critical Care Copyright © 2013, All Rights Reserved

Sectiunea parasternal ax scurt(1)



fata de pozitia sondei din parasternal ax lung,
prin rotire cu aproximativ 90° in sensul acelor
de ceasornic: baza marilor

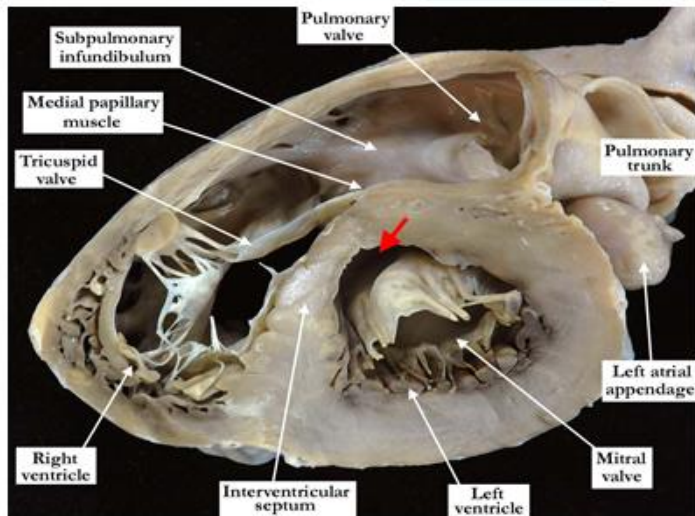
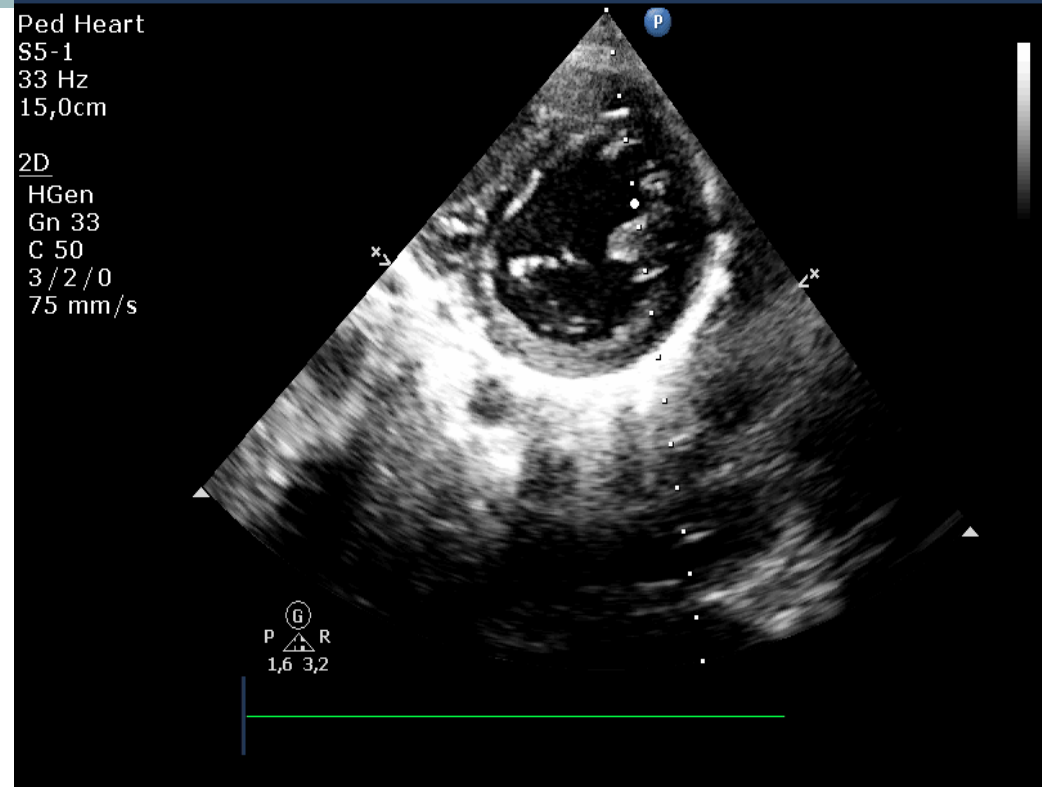


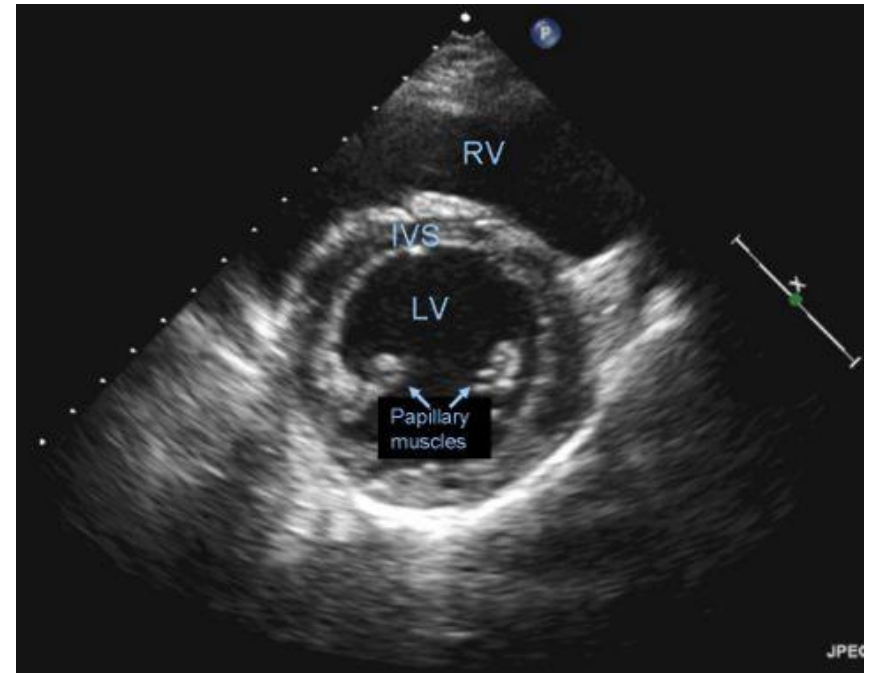




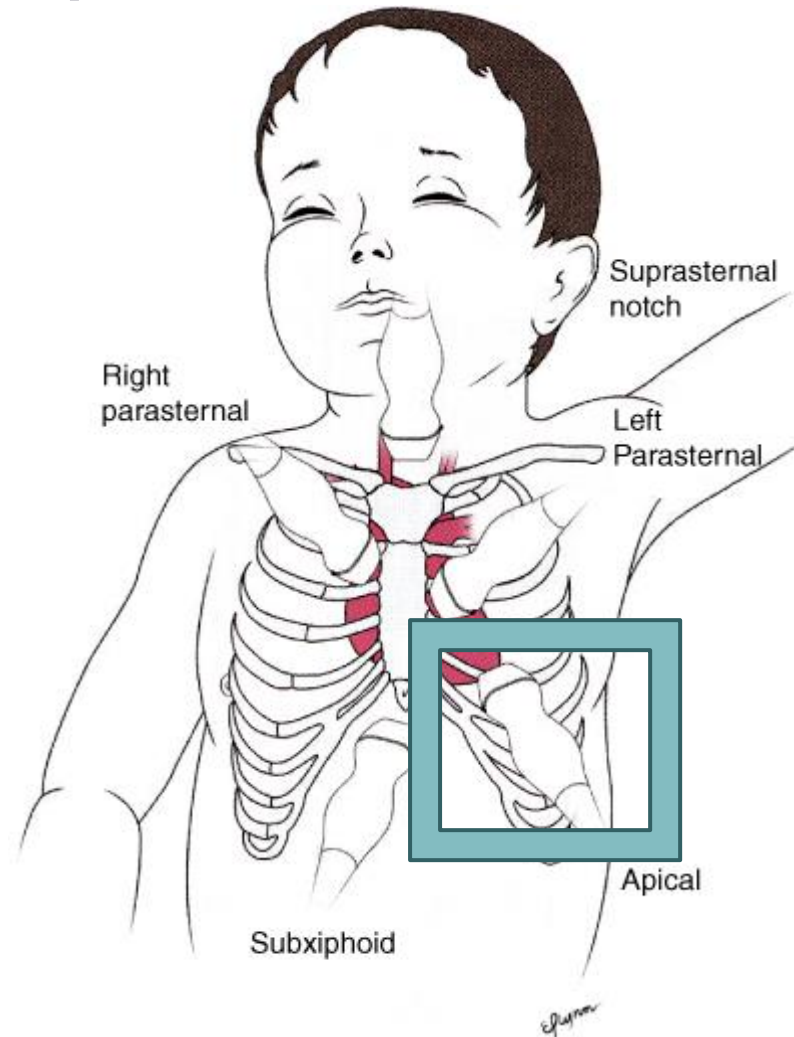
Ped Heart
S5-1
33 Hz
15,0cm

2D
HGen
Gn 33
C 50
3/2/0
75 mm/s



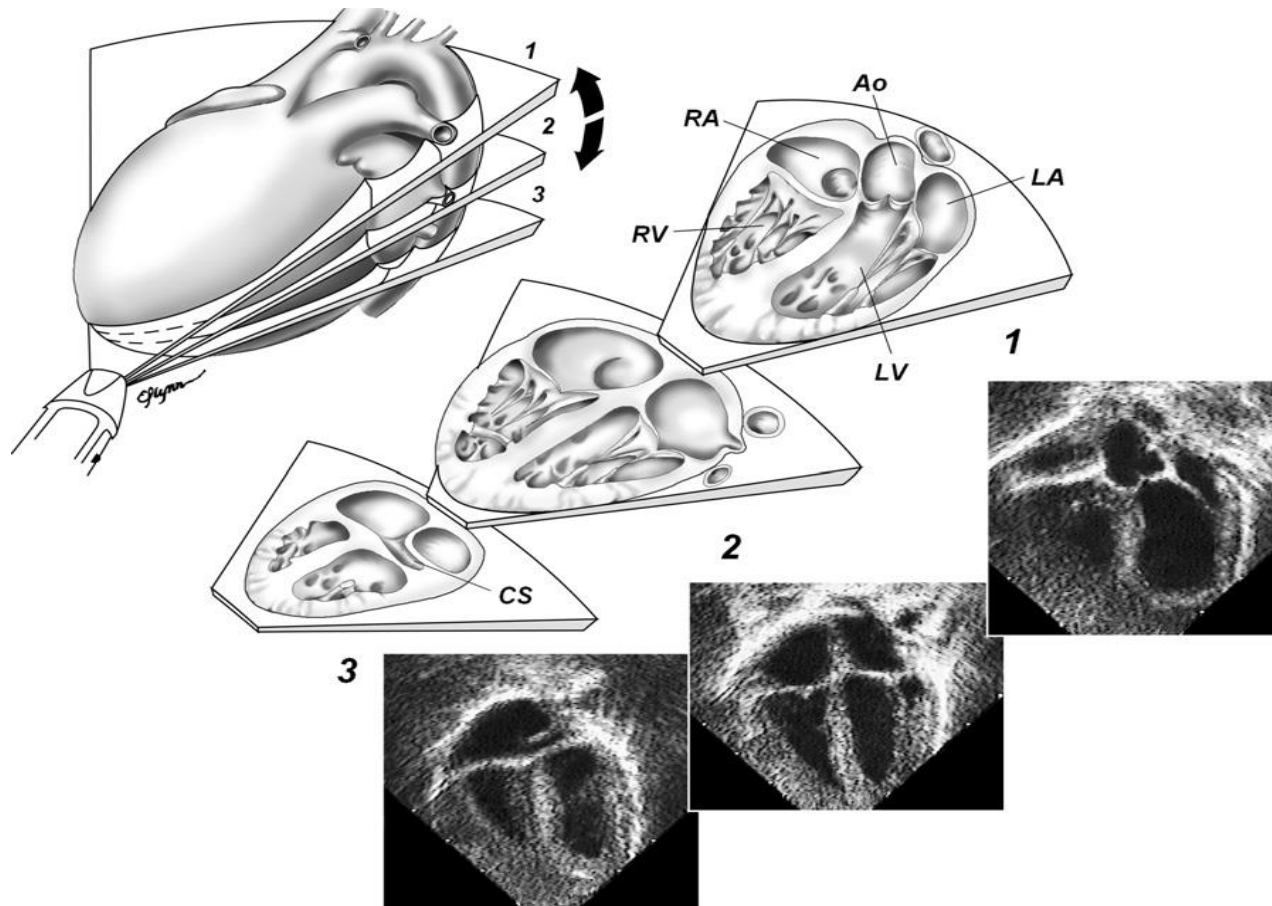


Secțiunea apical



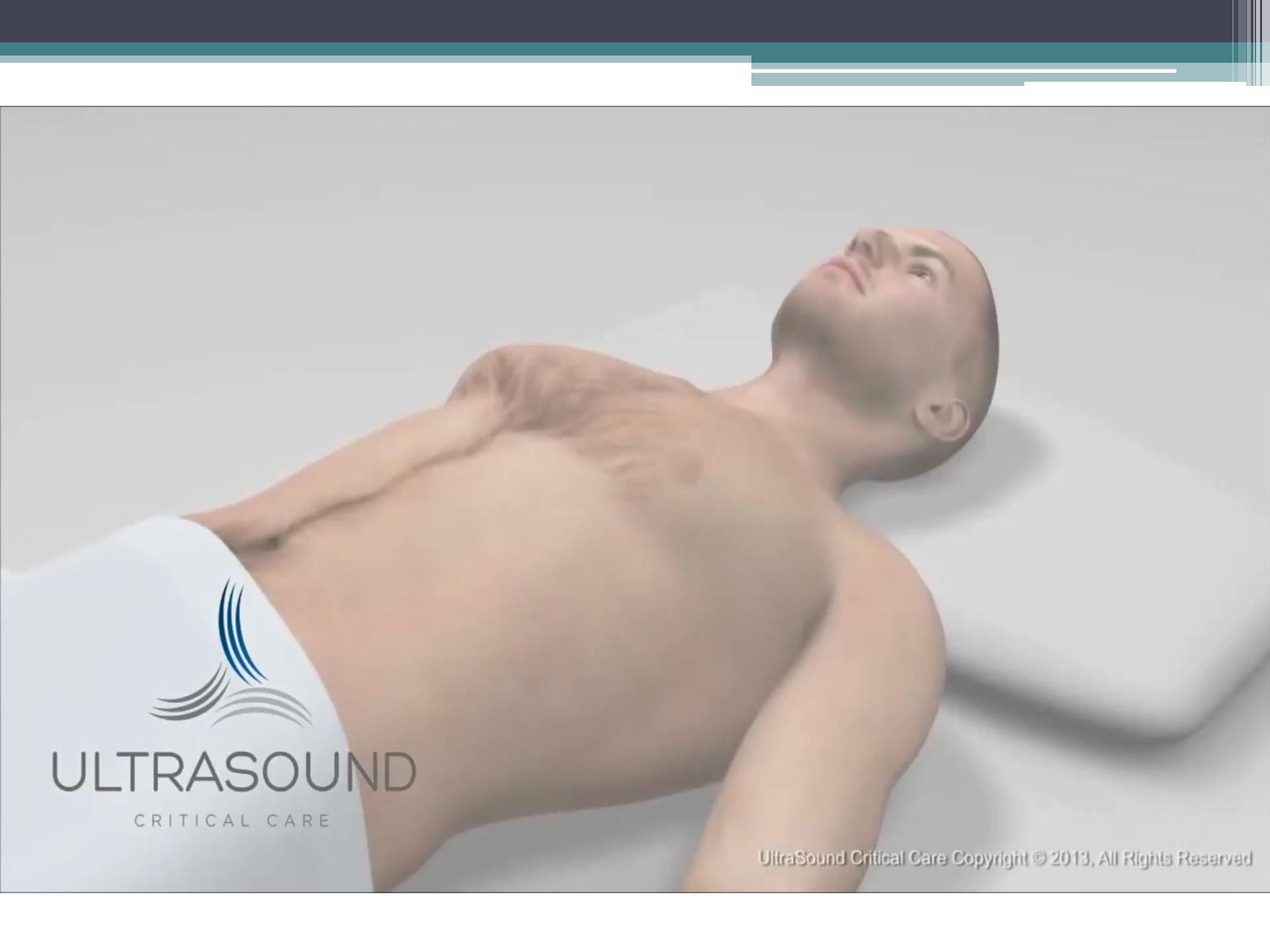
Source: Gleason MM, Rychik J, Shaddy R: *Pediatric Practice: Cardiology*:
www.accesspediatrics.com

Secțiunea apical patru camere



Guidelines and Standards for Performance of a Pediatric Echocardiogram: A Report from the Task Force of the Pediatric Council of the American Society of Echocardiography

Wyman W. Lai, MD, MPH, FASE, Tal Geva, MD, FASE, Girish S. Shirali, MD, Peter C. Frommelt, MD, Richard A. Humes, MD, FASE, Michael M. Brook, MD, Ricardo H. Pignatelli, MD, and Jack Rychik, MD, Writing Committee, New York, New York; Boston, Massachusetts; Charleston, South Carolina; Milwaukee, Wisconsin; Detroit, Michigan; San Francisco, California; Houston, Texas; and Philadelphia, Pennsylvania



ULTRASOUND

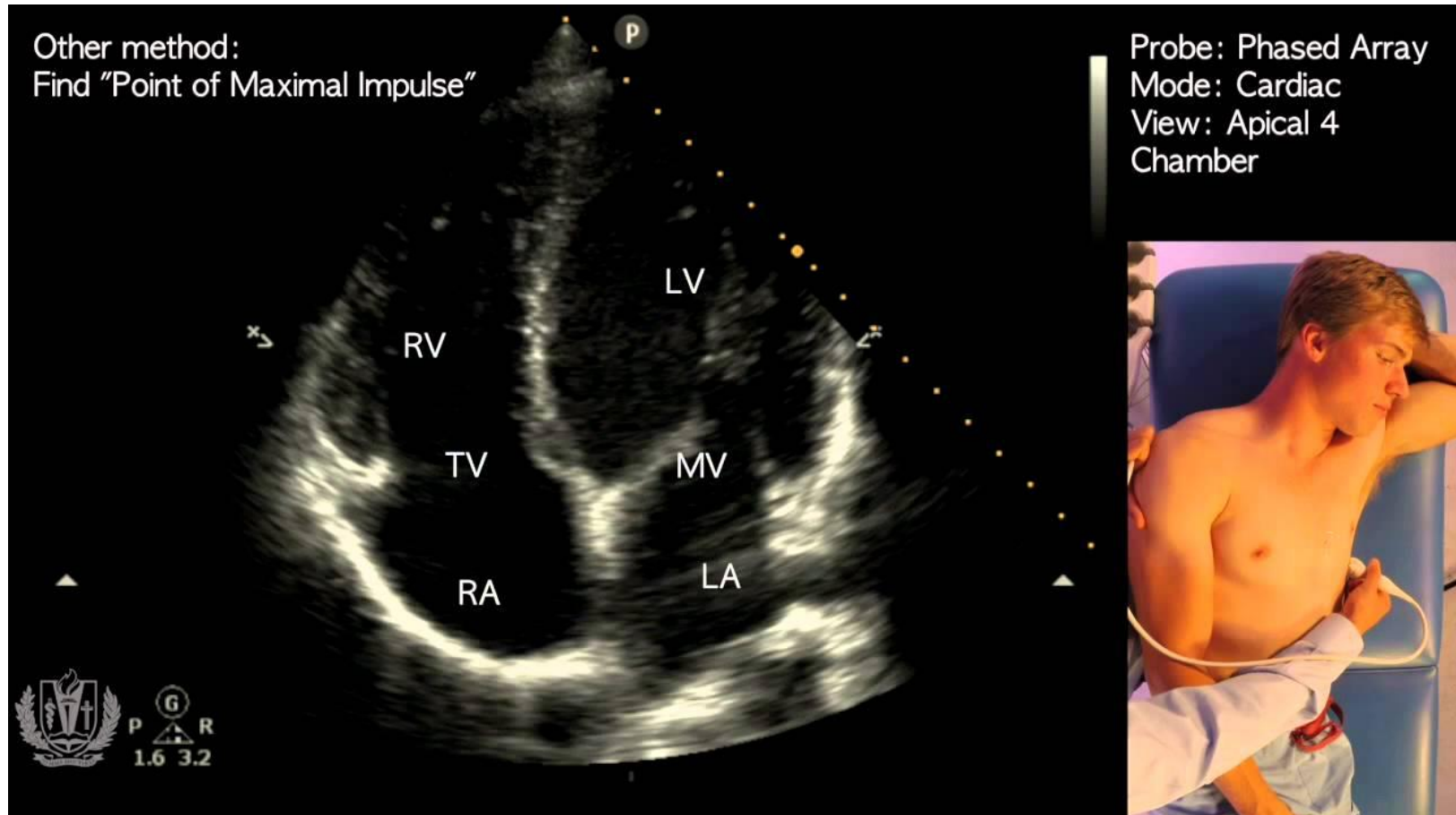
CRITICAL CARE

UltraSound Critical Care Copyright © 2013, All Rights Reserved

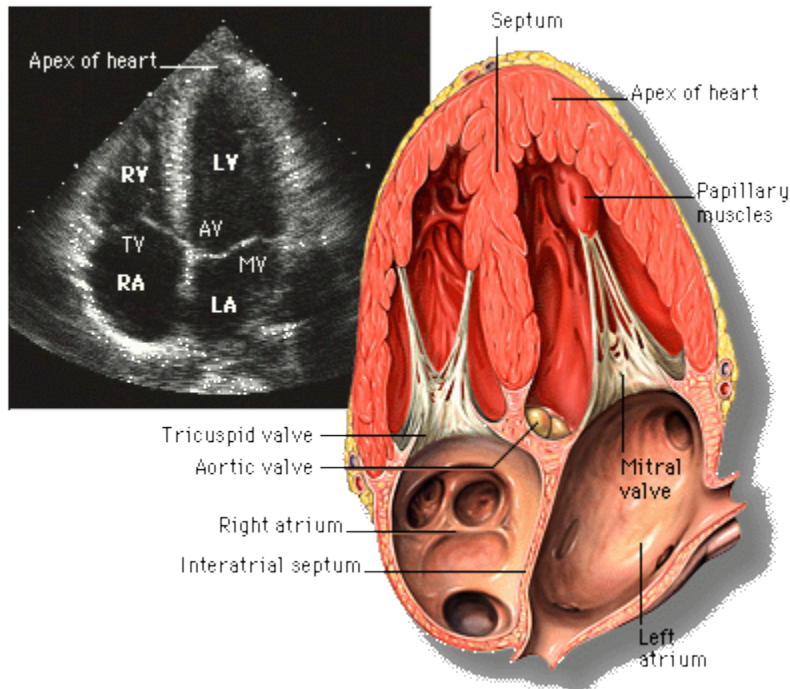
Secțiunea apical



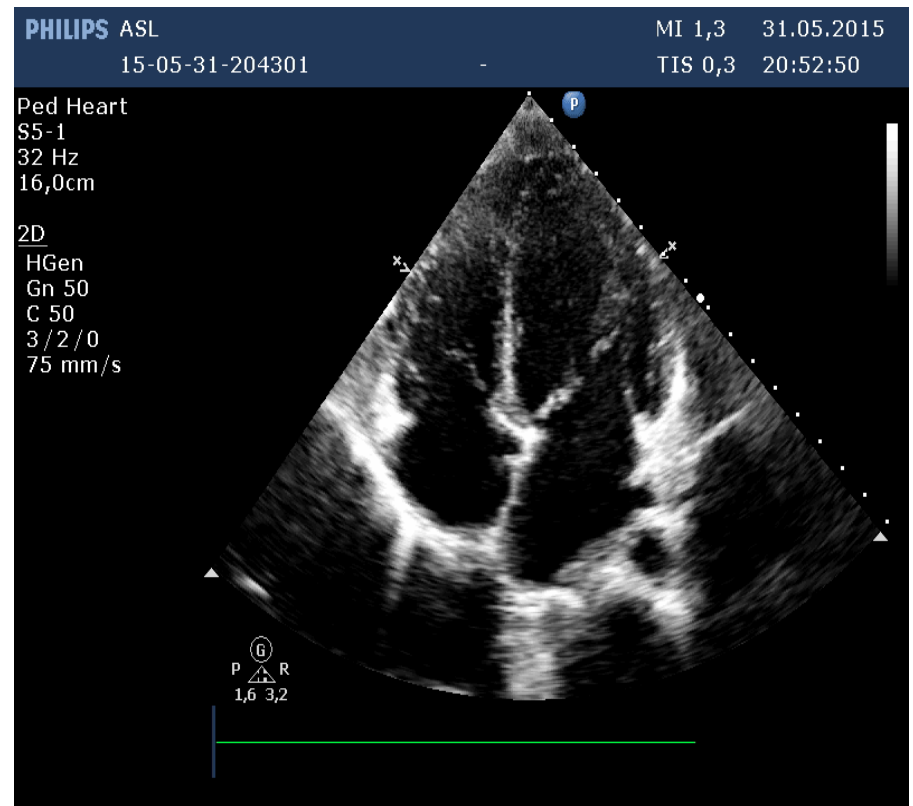
Sectione apical

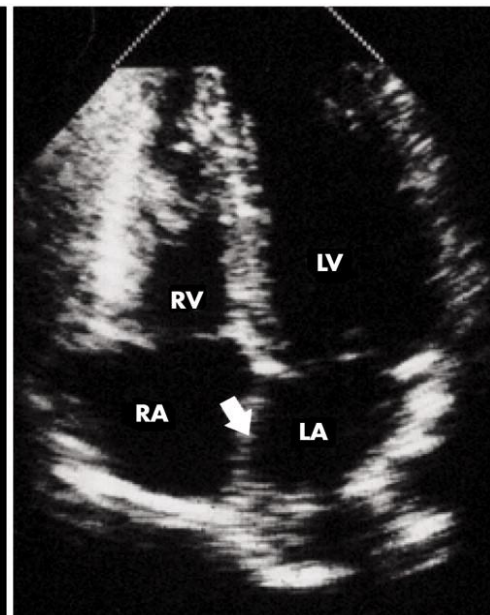
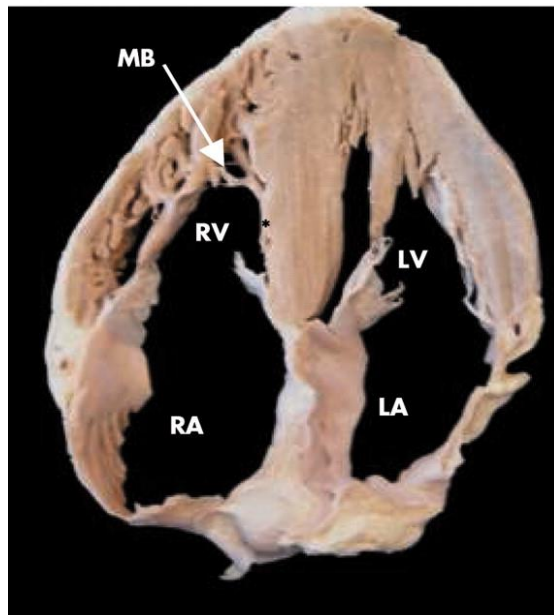
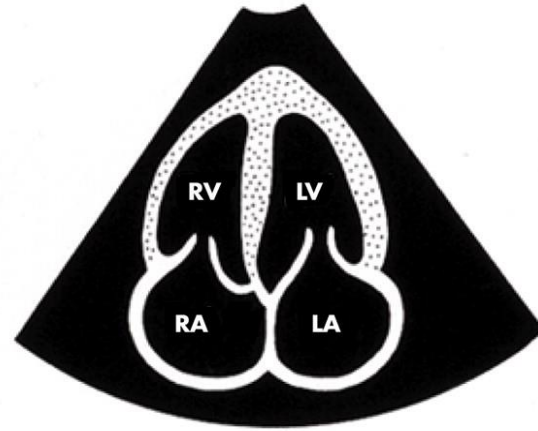
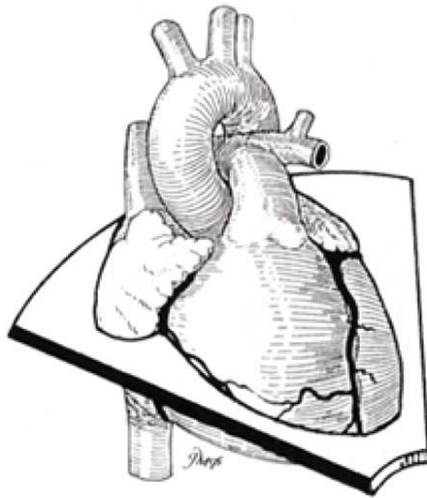


Secțiunea apical patru camere

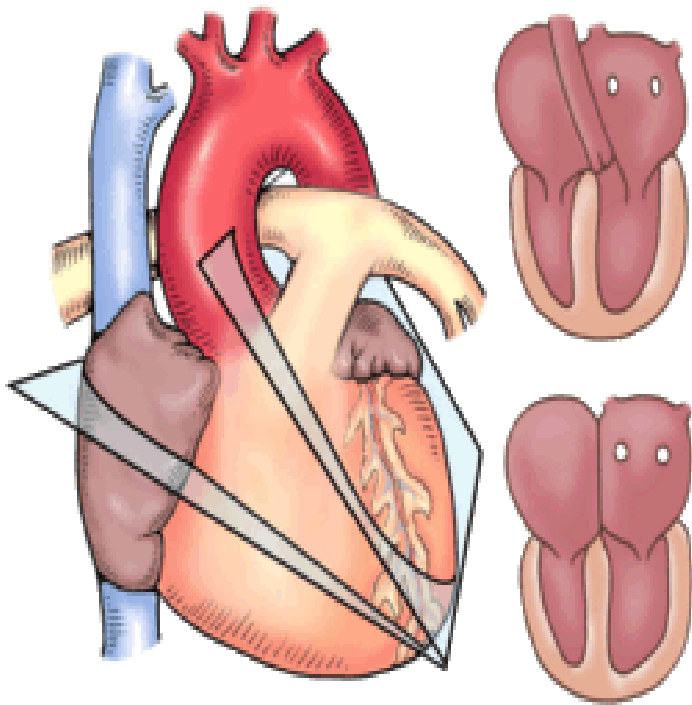


- Sonda se plaseaza cat mai posterior, in vecinatatea socului apexian, in general in spatiul V intercostal stg, pe linia axilara anterioara; markerul sondei se orienteaza catre ora 3.

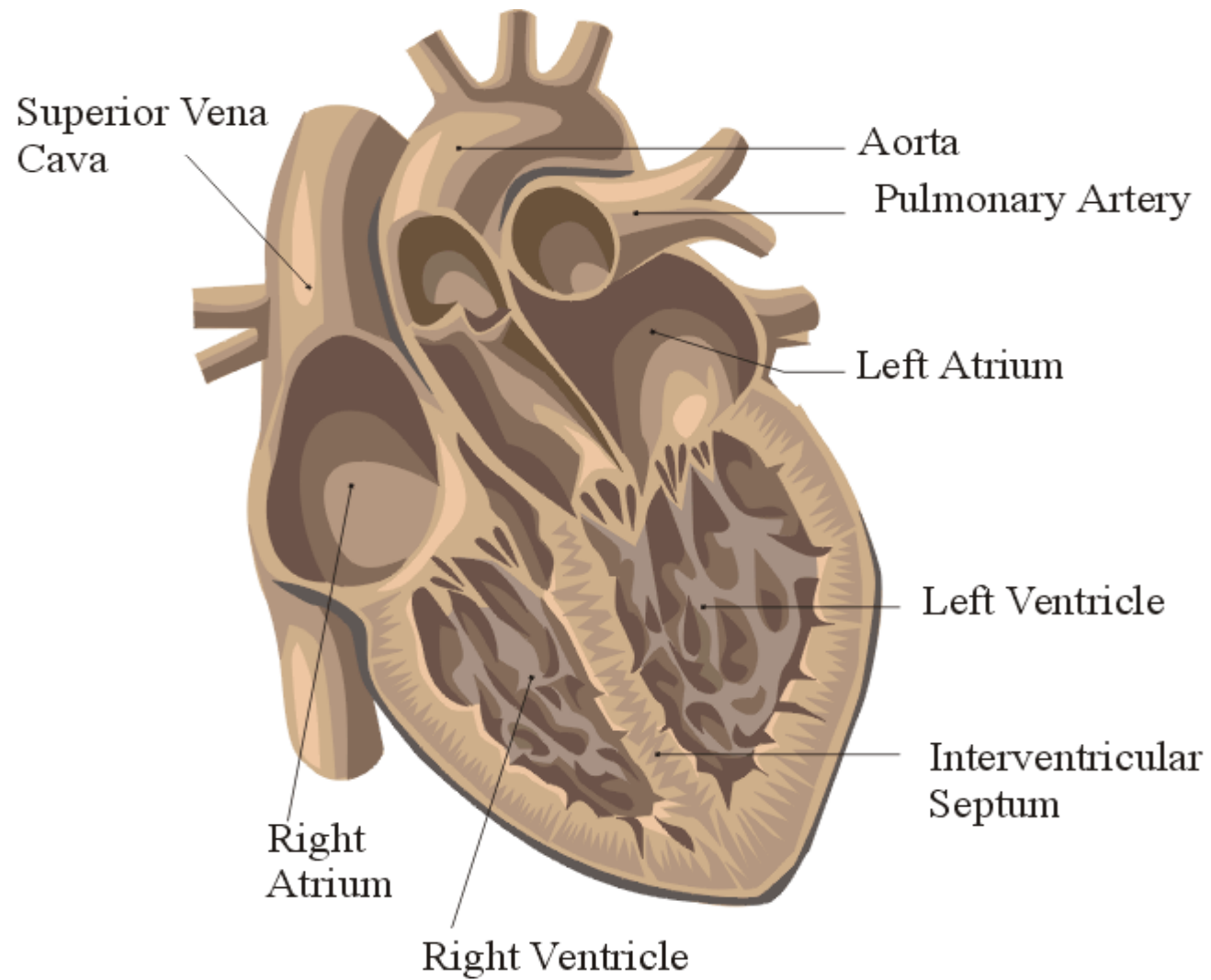




Secțiunea apical 5 camere



- Prin angulare anterioara a sondei pana la cuprinderea in imaginea 4C a tractului de ejectie VS si a valvei aortice: secțiune apical 5 camere

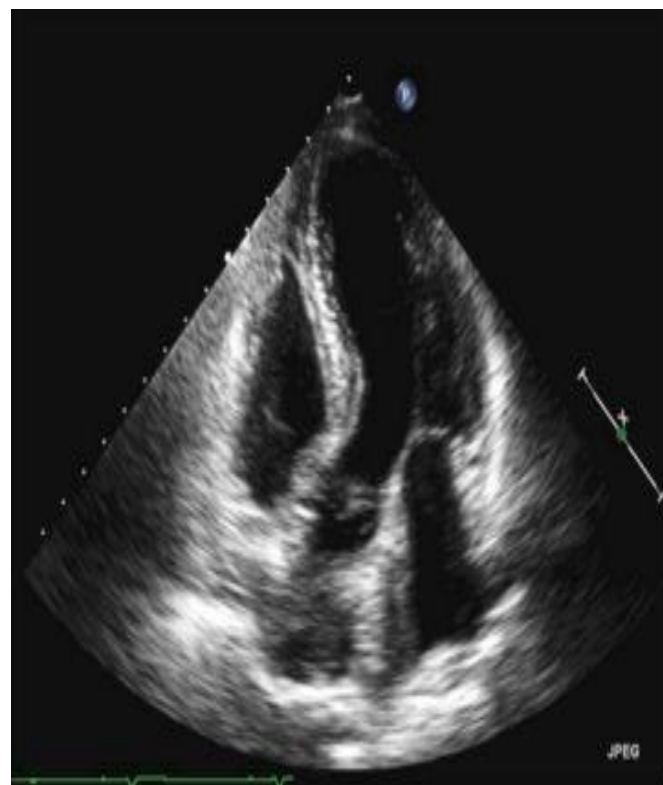
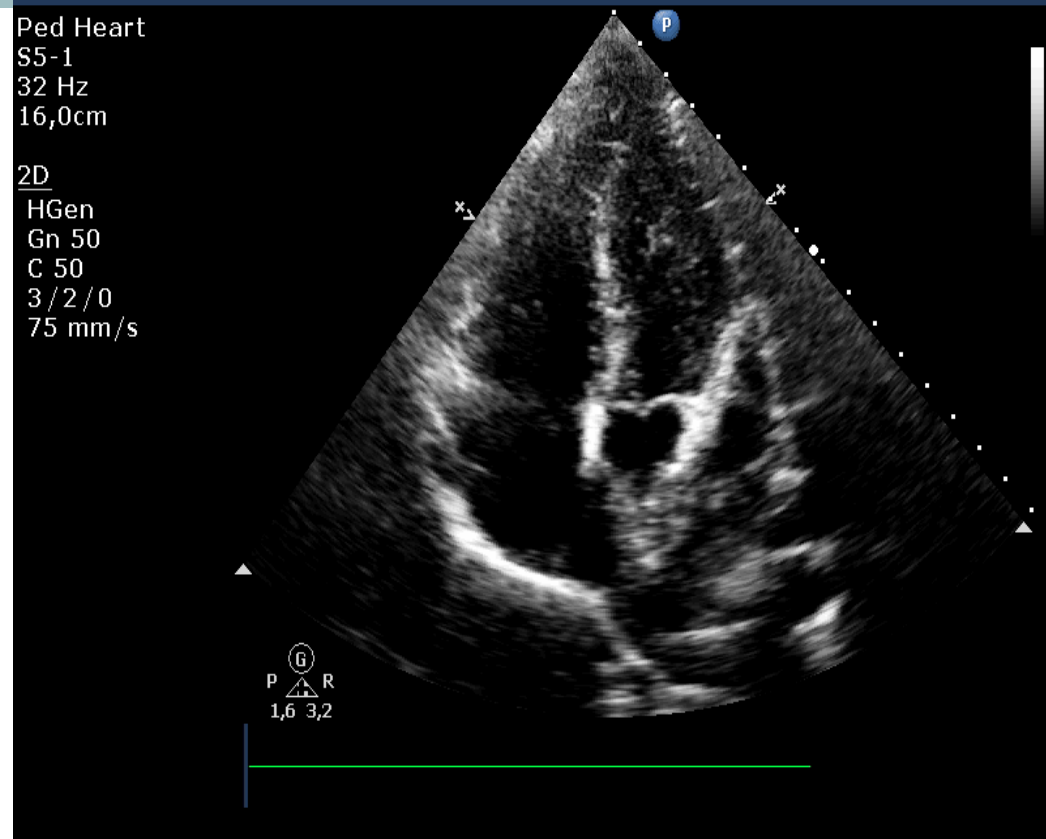


Adapted from Corel Draw 9 Library

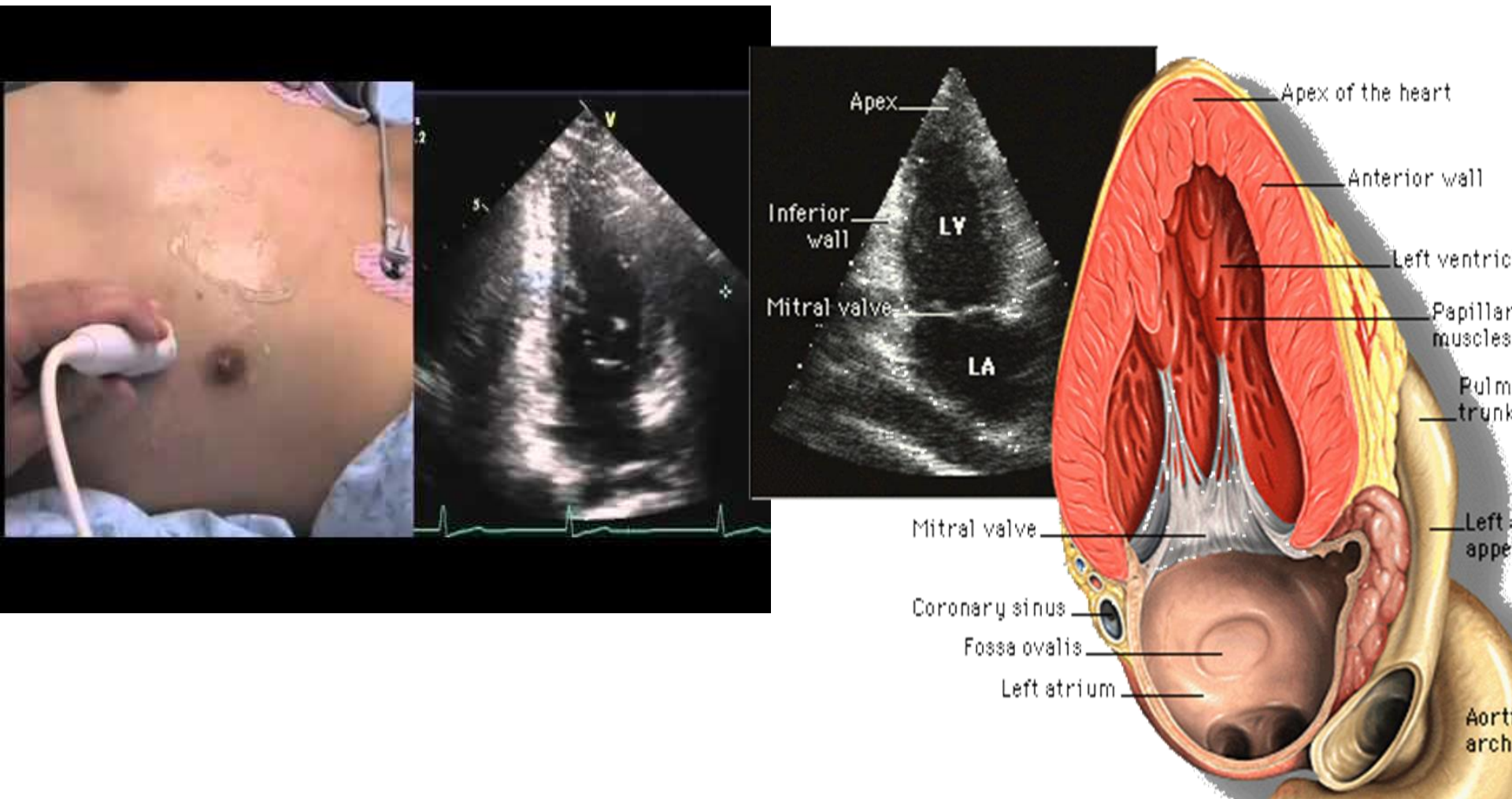
Ped Heart
S5-1
32 Hz
16,0cm

2D

HGen
Gn 50
C 50
3/2/0
75 mm/s

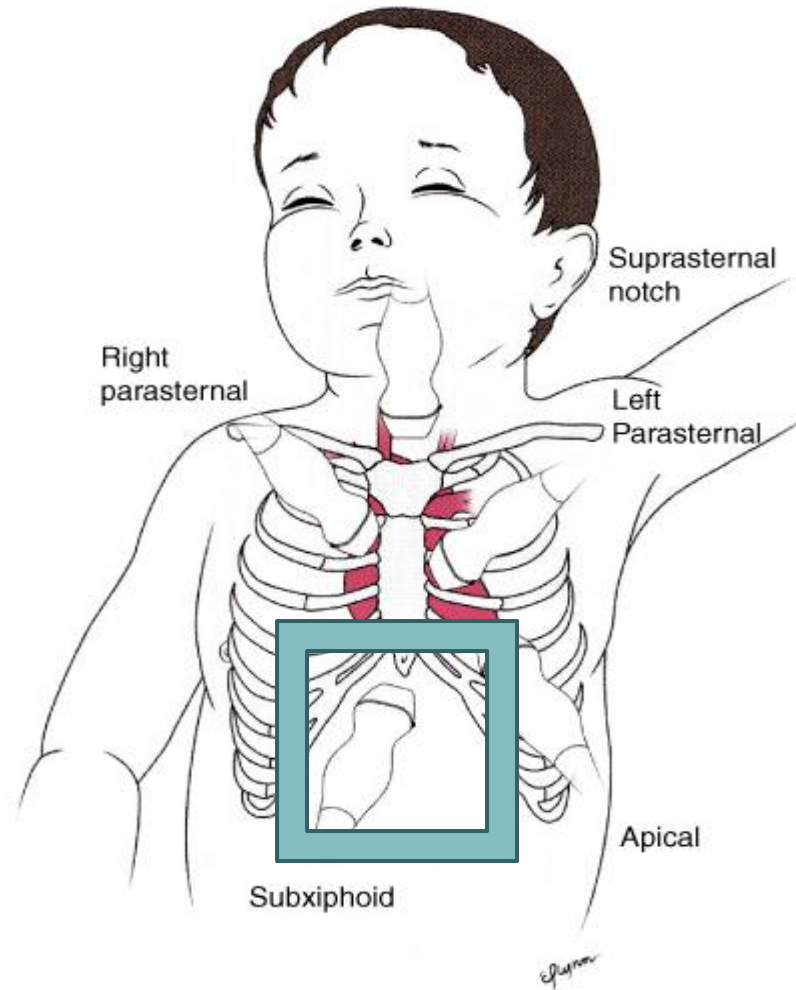


Secțiunea apical doua camere



- Fata de pozitia necesara pentru obtinerea imaginii apical 4C, se rotește sonda în sens invers acelor de ceasornic cu aproximativ 45-60°

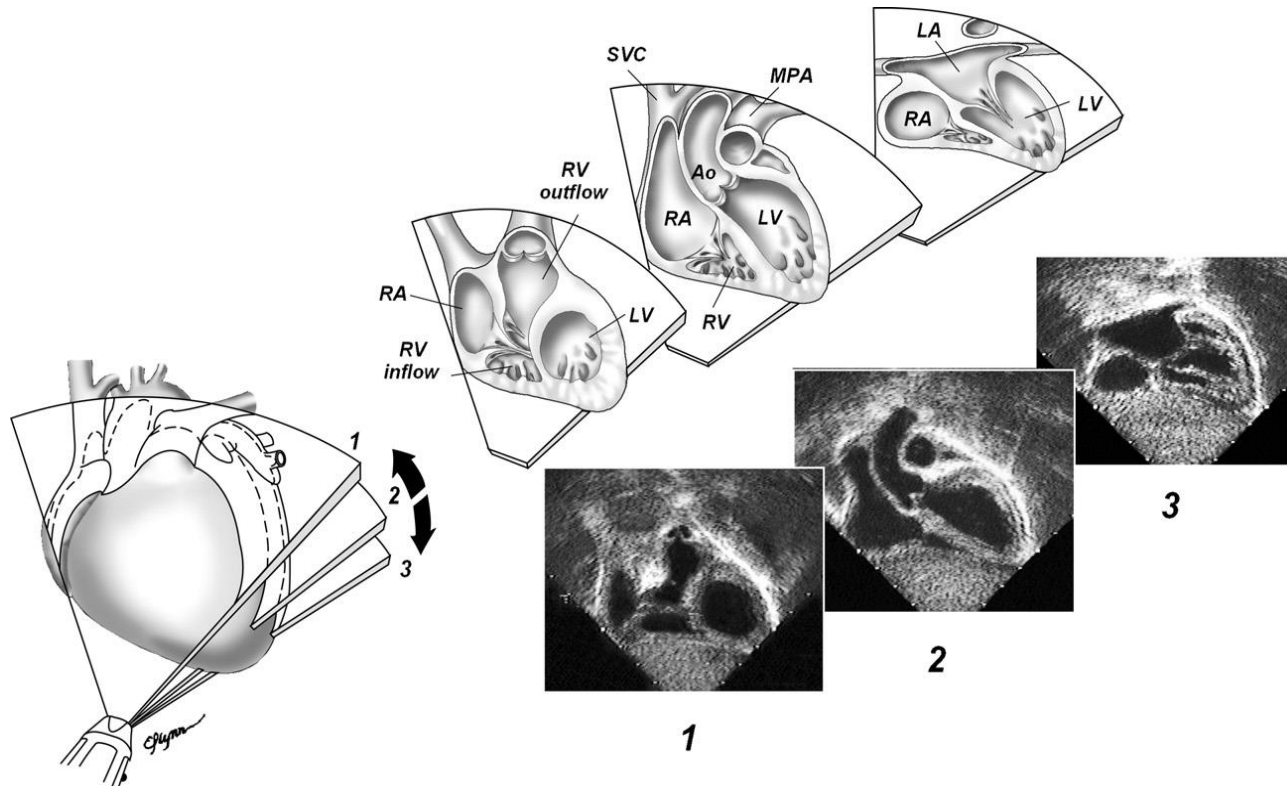
Secțiunea subcostal



Source: Gleason MM, Rychik J, Shaddy R: *Pediatric Practice: Cardiology*; www.accesspediatrics.com

Copyright © The McGraw-Hill Companies, Inc. All rights reserved.

Secțiunea subcostal ax lung



Guidelines and Standards for Performance of a Pediatric Echocardiogram: A Report from the Task Force of the Pediatric Council of the American Society of Echocardiography

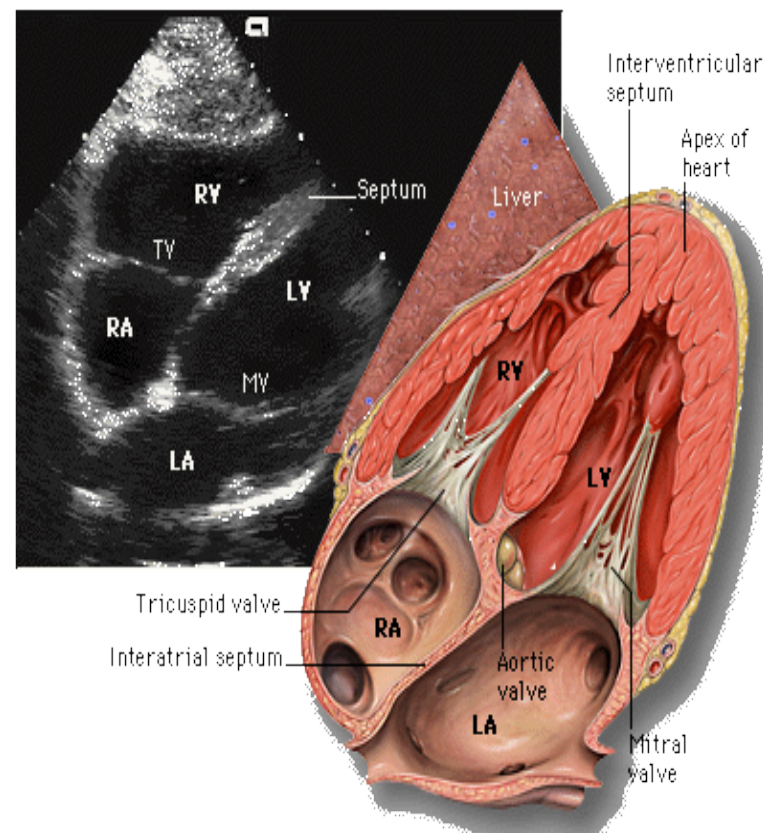
Wyman W. Lai, MD, MPH, FASE, Tal Geva, MD, FASE, Girish S. Shirali, MD, Peter C. Frommelt, MD, Richard A. Humes, MD, FASE, Michael M. Brook, MD, Ricardo H. Pignatelli, MD, and Jack Rychik, MD, Writing Committee, New York, New York; Boston, Massachusetts; Charleston, South Carolina; Milwaukee, Wisconsin; Detroit, Michigan; San Francisco, California; Houston, Texas; and Philadelphia, Pennsylvania



ULTRASOUND

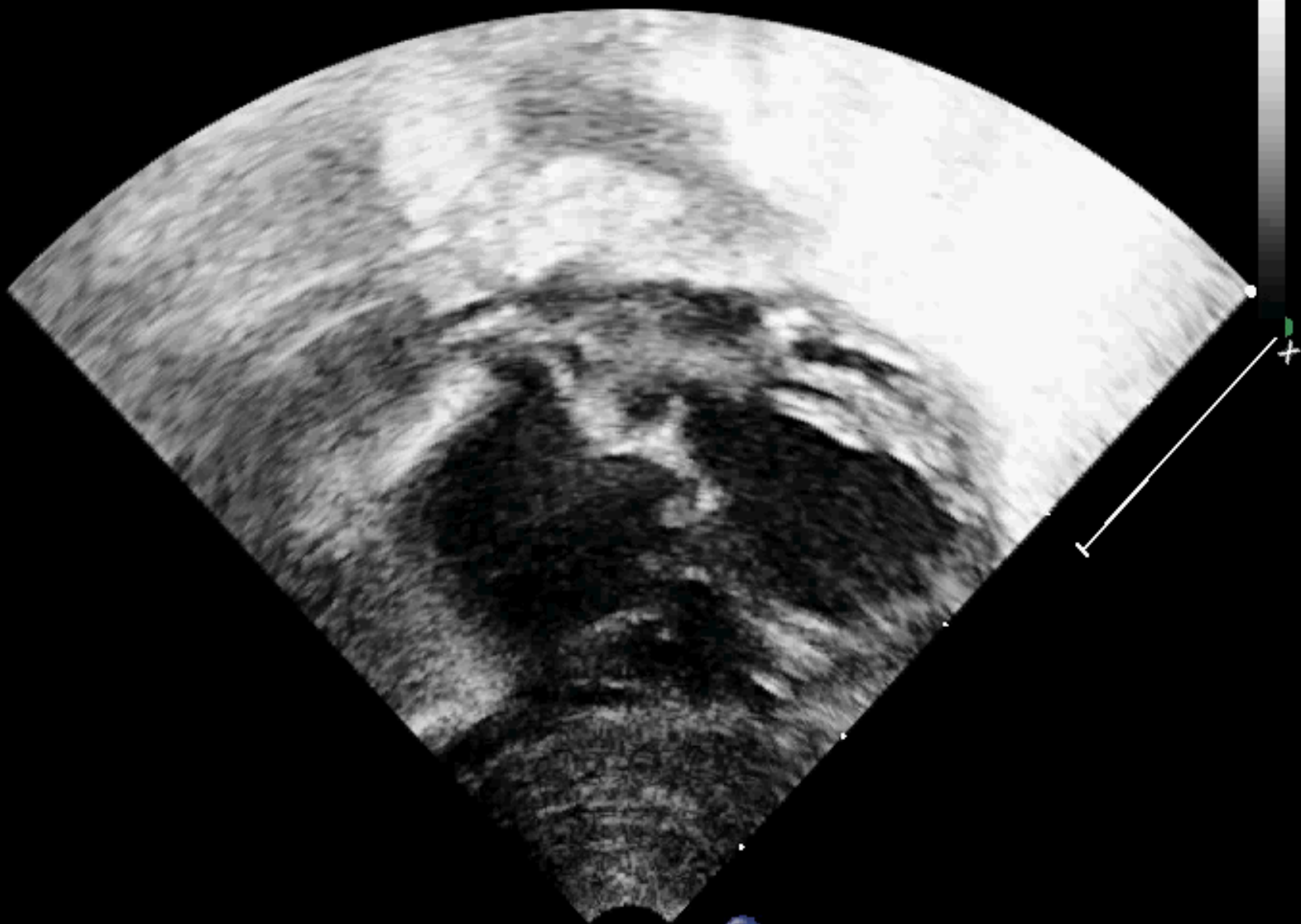
CRITICAL CARE

UltraSound Critical Care Copyright © 2013, All Rights Reserved



FR 61Hz
6.0cm

2D
73%
C 50
P Off
Res



M3

+

P

JPEG

*** bpm

6.0cm

2D
73%
C 50
P Off
Res



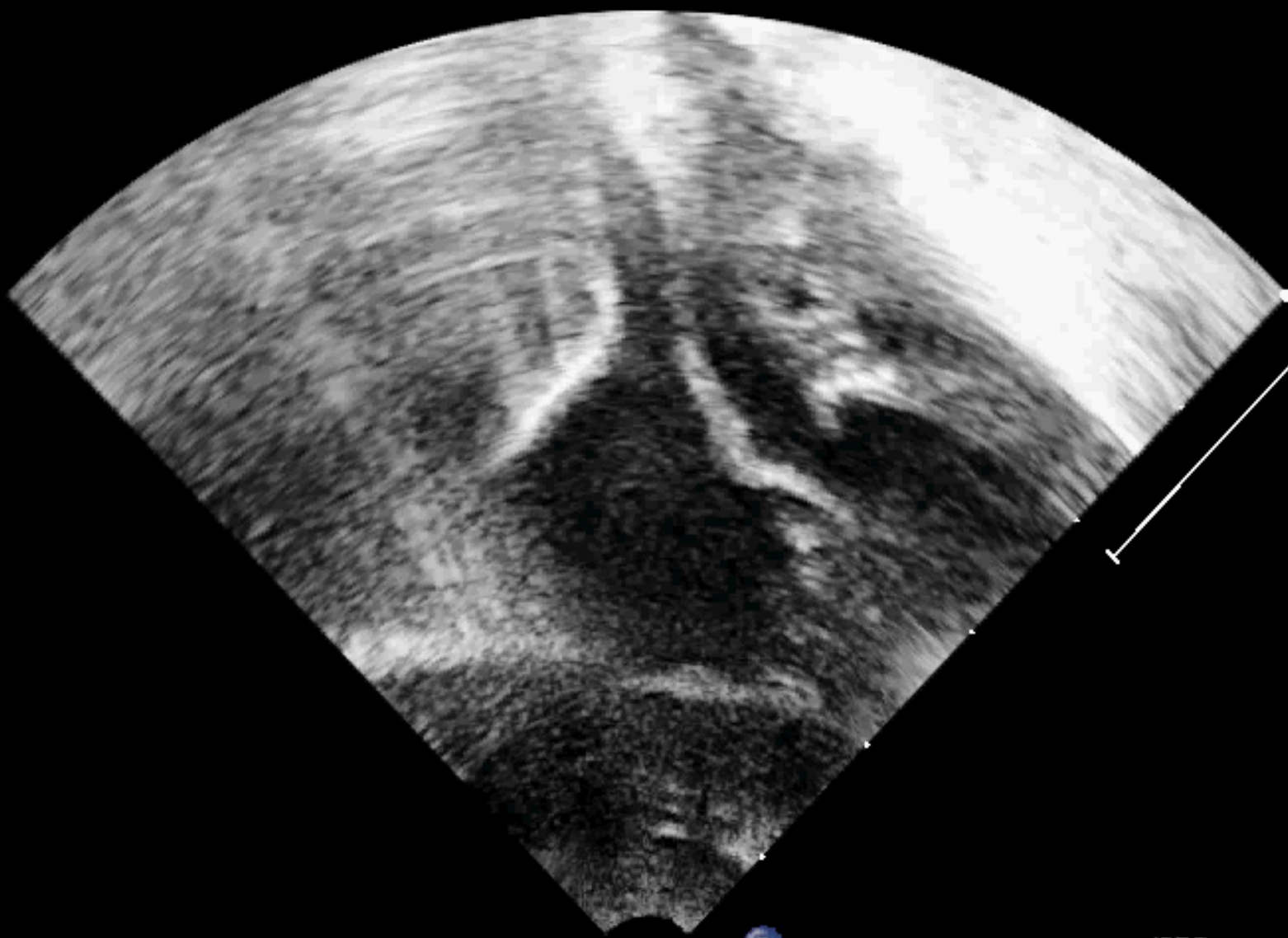
P

JPEG

*** bpm

PR 61Hz
6.0cm

2D
73%
C 50
P Off
Res



P

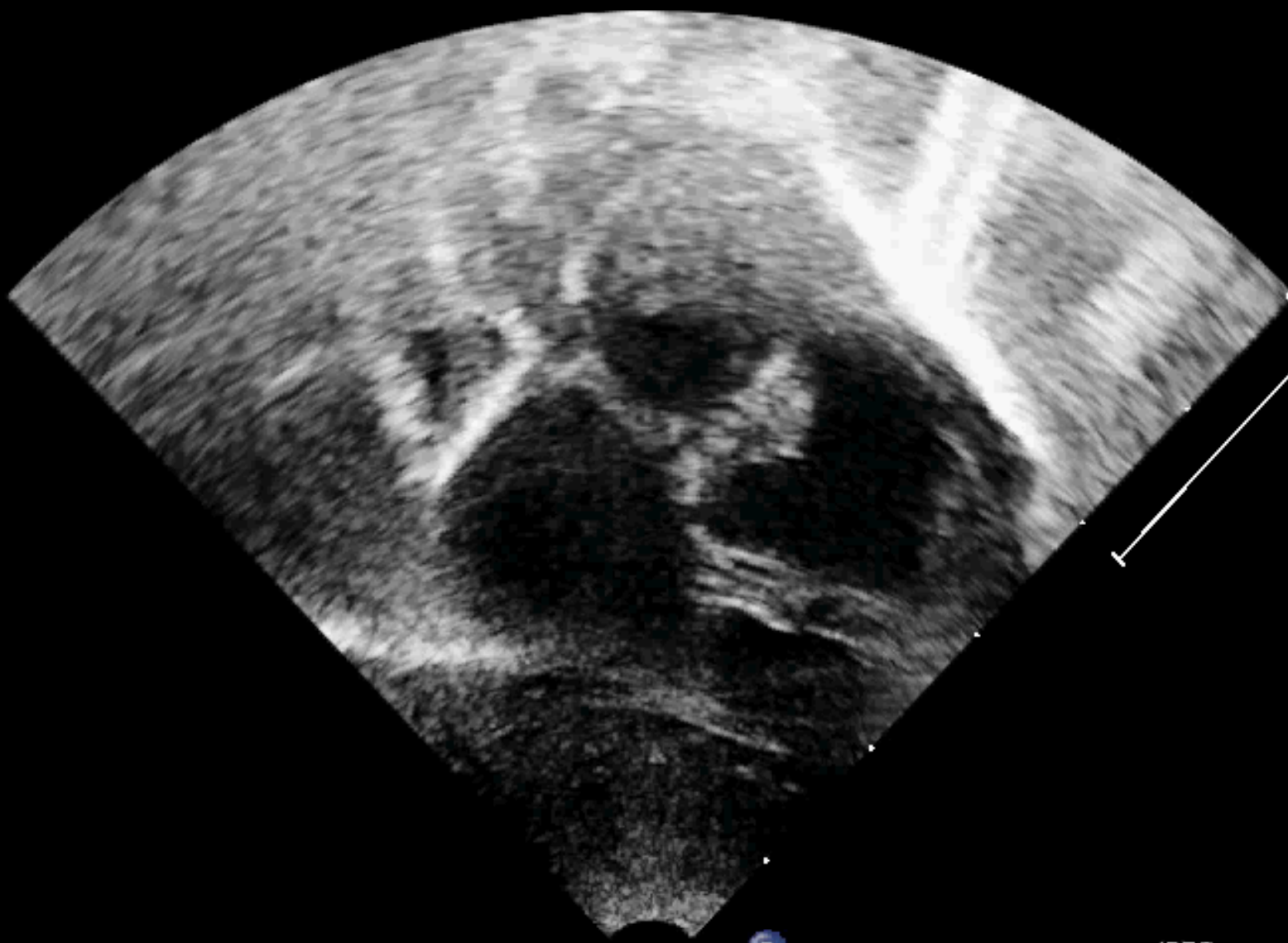
JPEG

*** bpm

FR 61Hz
6.0cm

M3

2D
73%
C 50
P Off
Res

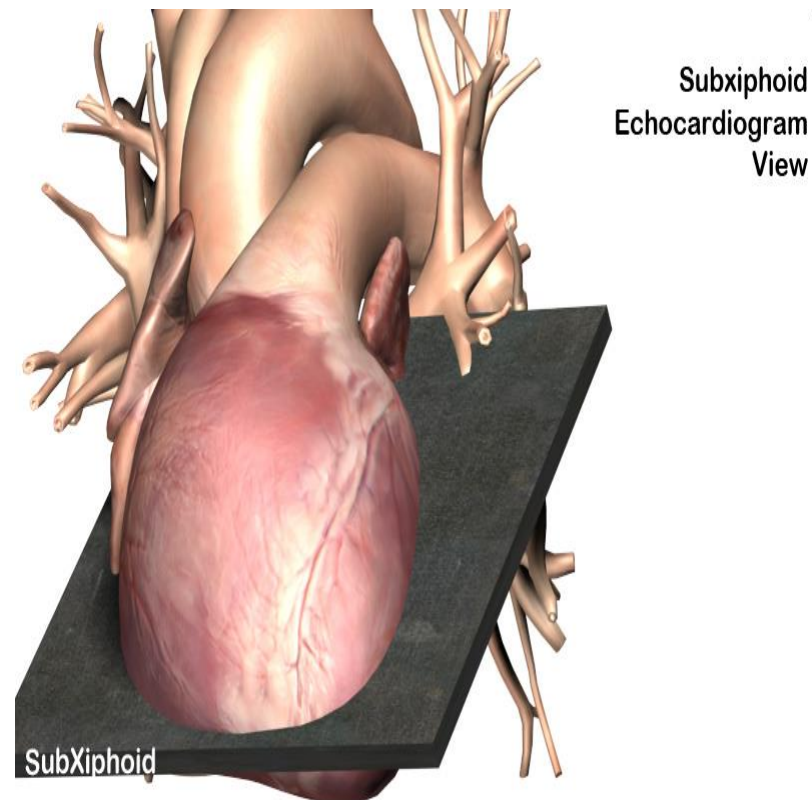
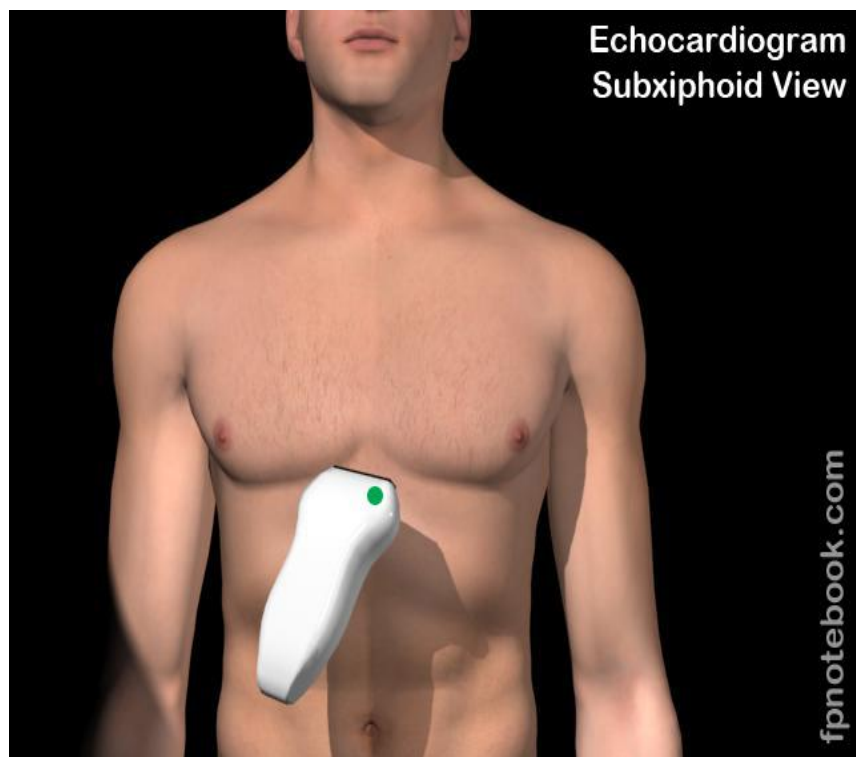


P

JPEG

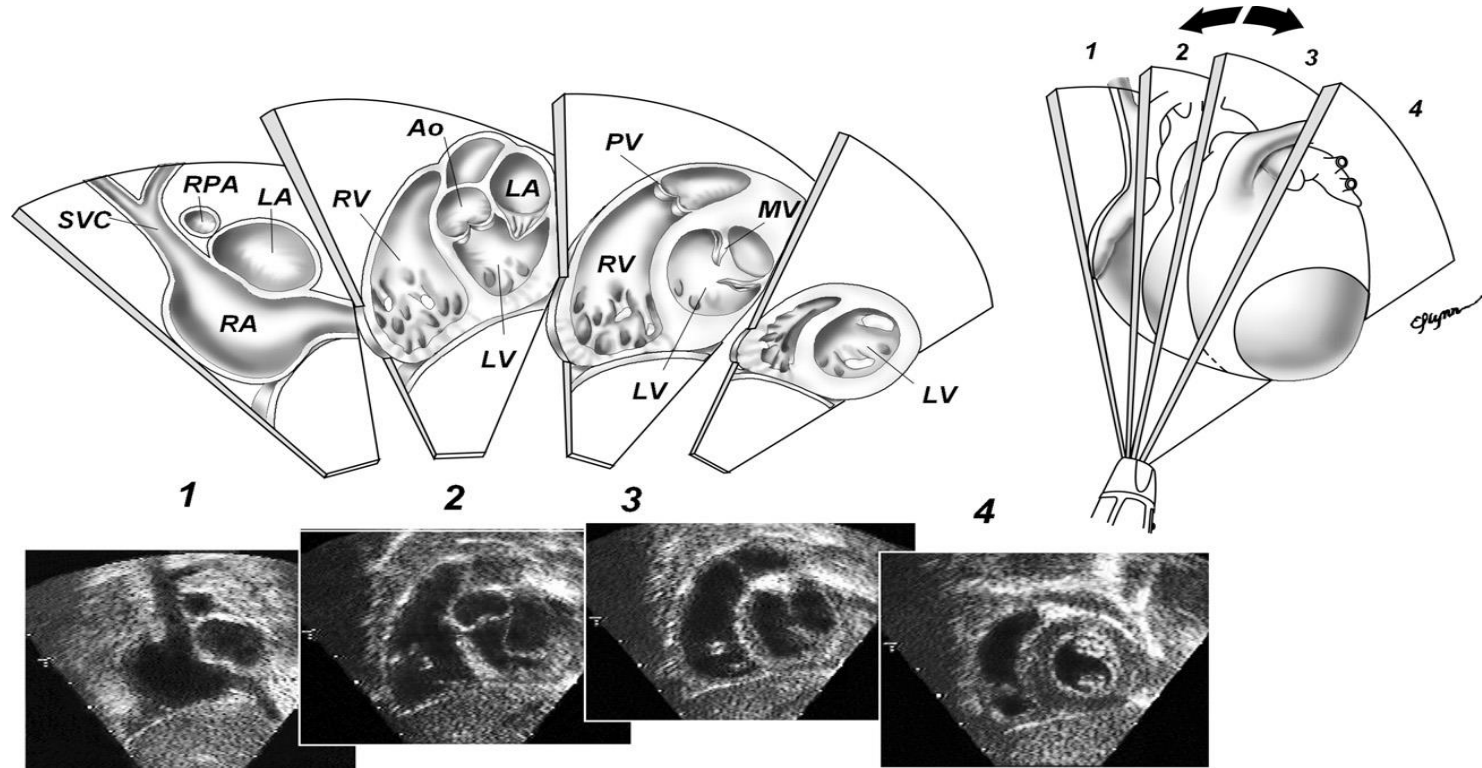
*** bpm

Secțiunea subcostal ax scurt



- Subcostal 4 camere: pacientul în decubit dorsal, genunchii în flexie pentru relaxarea abdomenului, se plasează sonda subxifoidian, pe linia mediană a corpului (eventual ușor către dreapta pacientului). Sonda este angulată către anterior și dreapta, astfel încât fasciculul de ultrasunete să fie orientat către umărul stâng. Markerul sondei este orientat către ora 3.

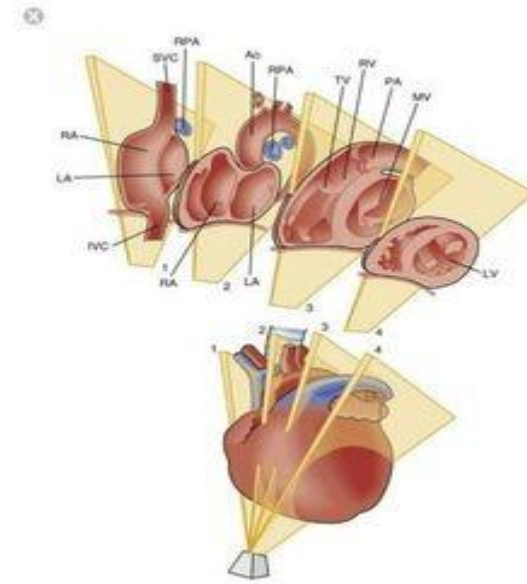
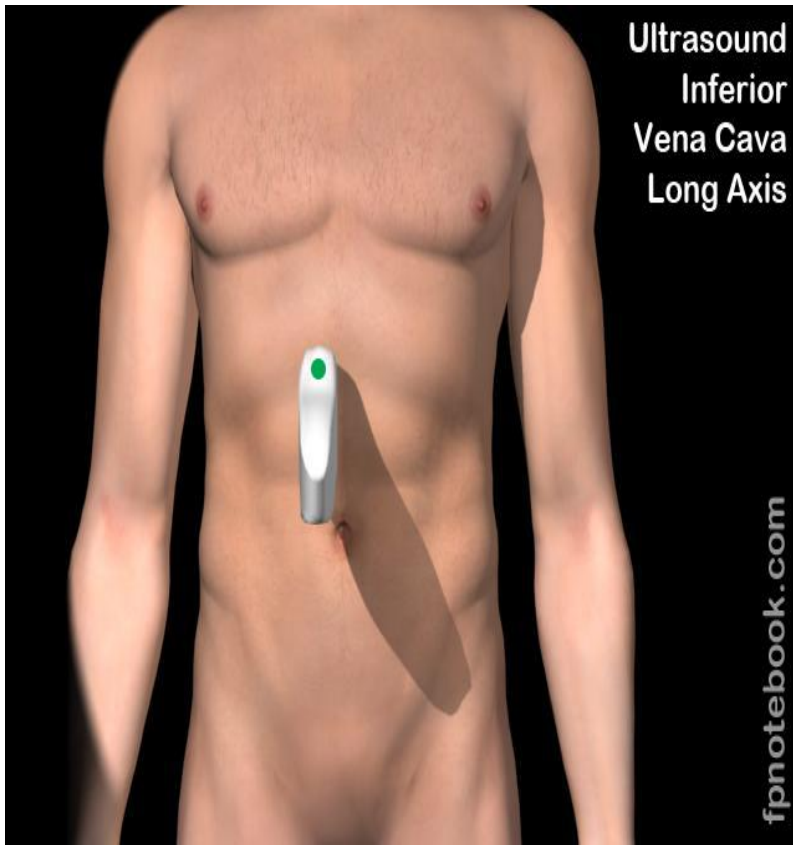
Sectionea subcostal ax scurt



Guidelines and Standards for Performance of a Pediatric Echocardiogram: A Report from the Task Force of the Pediatric Council of the American Society of Echocardiography

Wyman W. Lai, MD, MPH, FASE, Tal Geva, MD, FASE, Girish S. Shirali, MD, Peter C. Frommelt, MD, Richard A. Humes, MD, FASE, Michael M. Brook, MD, Ricardo H. Pignatelli, MD, and Jack Rychik, MD, Writing Committee, New York, New York; Boston, Massachusetts; Charleston, South Carolina; Milwaukee, Wisconsin; Detroit, Michigan; San Francisco, California; Houston, Texas; and Philadelphia, Pennsylvania

Sețiunea subcostal ax lung

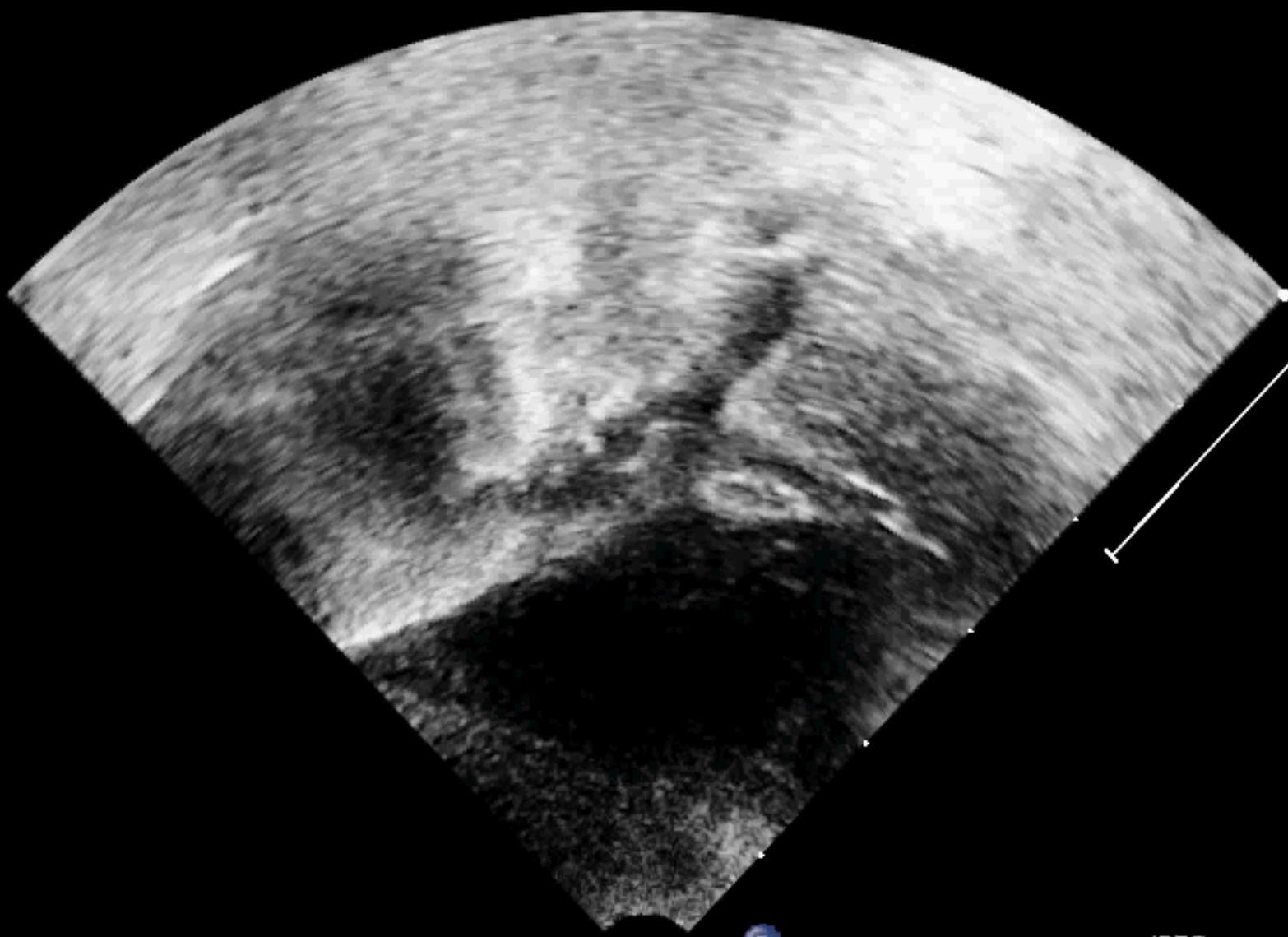


- Subcostal ax scurt: fata de pozitia anterioara, se rotește sonda cu aproximativ 90^0 in sens invers acelor de ceasornic; markerul sondei este orientat catre ora 12.

FR 61Hz
6.0cm

M3

2D
73%
C 50
P Off
Res



P

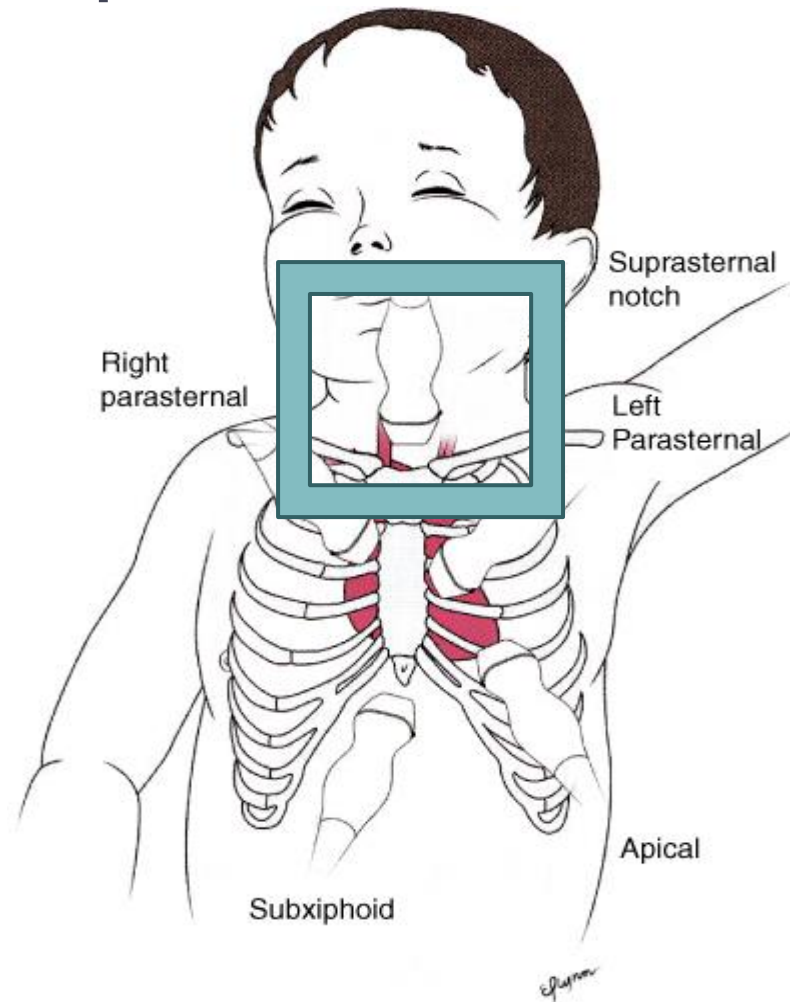
JPEG

*** bpm

6.0cm
2D
73%
C 50
P Off
Res



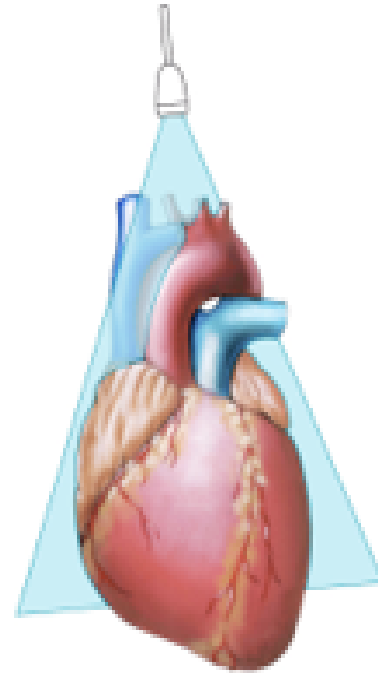
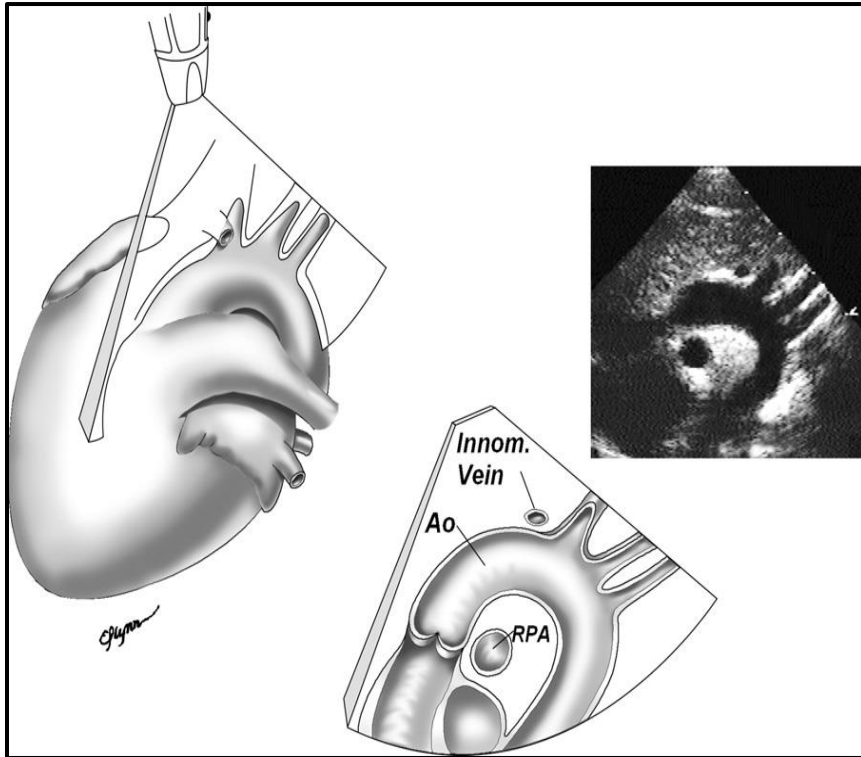
Secțiunea suprasternală



Source: Gleason MM, Rychik J, Shaddy R: *Pediatric Practice: Cardiology*:
www.accesspediatrics.com

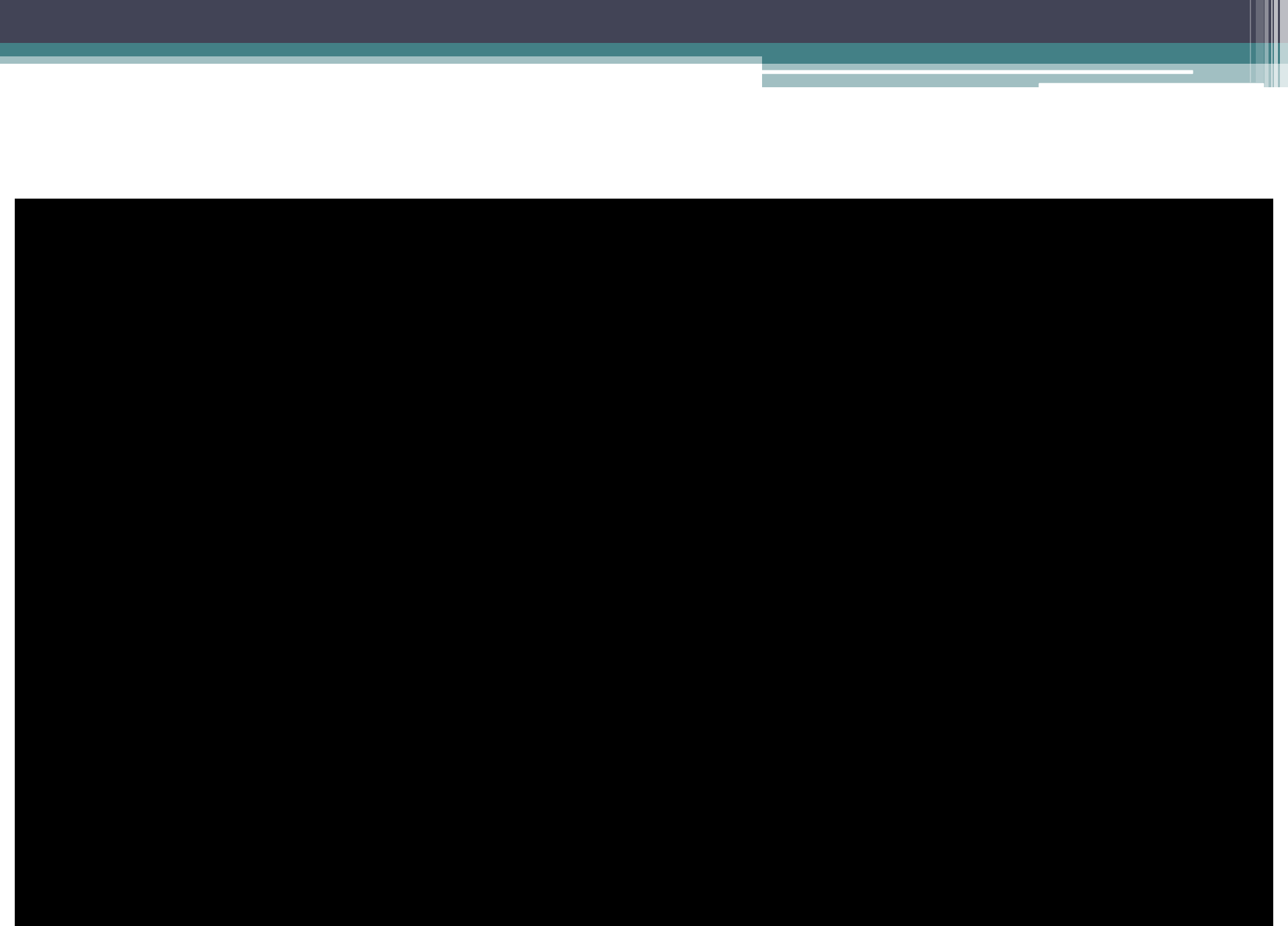
Copyright © The McGraw-Hill Companies, Inc. All rights reserved.

Sectioniunea suprasternal



Guidelines and Standards for Performance of a Pediatric Echocardiogram: A Report from the Task Force of the Pediatric Council of the American Society of Echocardiography

Wyman W. Lai, MD, MPH, FASE, Tal Geva, MD, FASE, Girish S. Shirali, MD, Peter C. Frommelt, MD, Richard A. Humes, MD, FASE, Michael M. Brook, MD, Ricardo H. Pignatelli, MD, and Jack Rychik, MD, Writing Committee, *New York, New York; Boston, Massachusetts; Charleston, South Carolina; Milwaukee, Wisconsin; Detroit, Michigan; San Francisco, California; Houston, Texas; and Philadelphia, Pennsylvania*



Secțiunea suprasternală

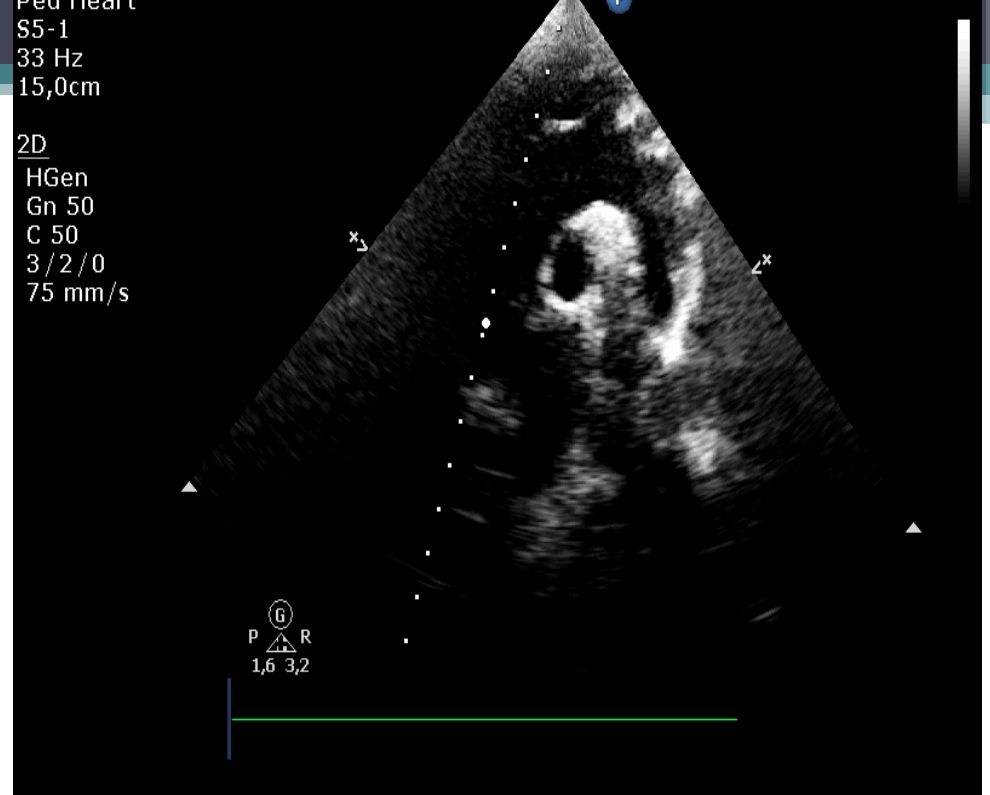


- Pacientul în decubit dorsal și gâtul în hiperextensie: se plasează sonda în incizura suprasternală, cu angularea ei către inferior și anterior astfel încât să fie aproape paralelă cu traheea. Markerul sondei este orientat către ora 1.

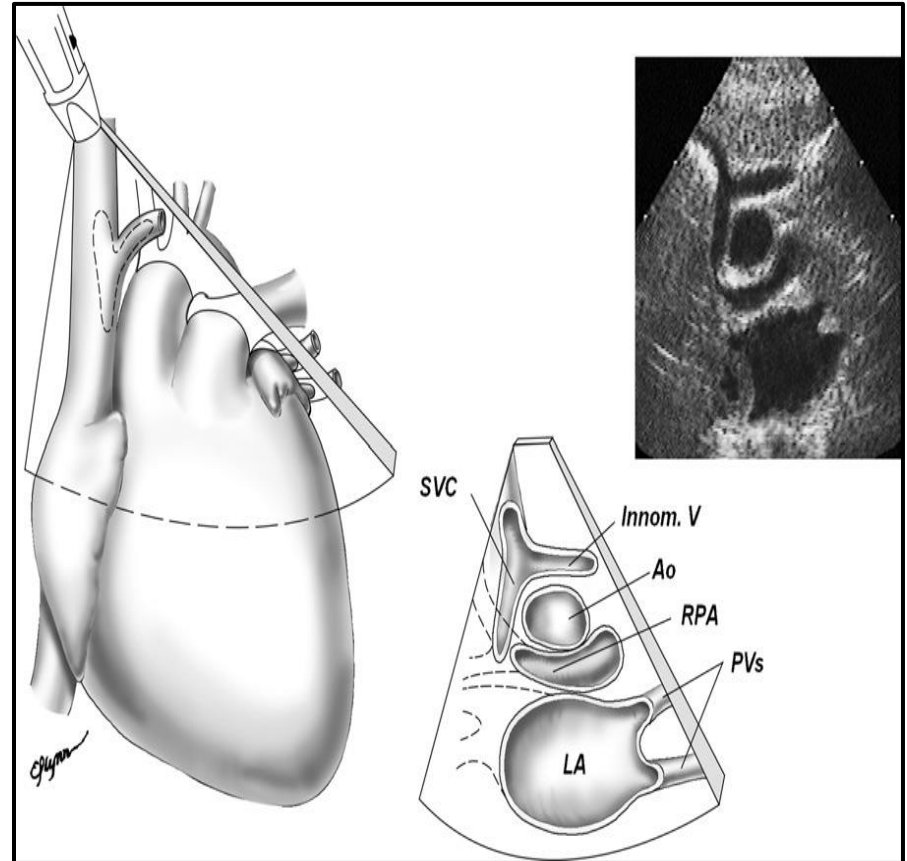
Ped Heart t
S5-1
33 Hz
15,0cm

2D

HGen
Gn 50
C 50
3/2/0
75 mm/s



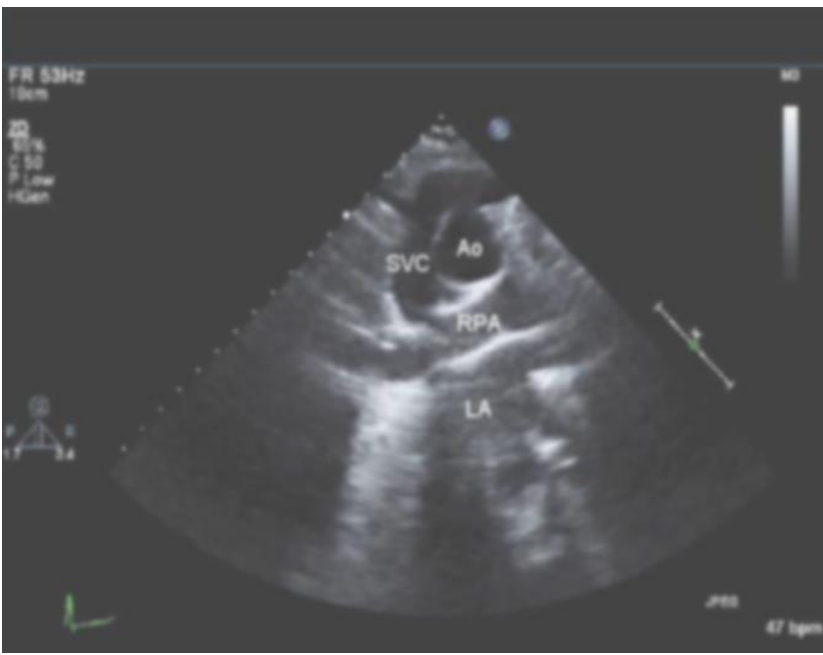
Secțiunea suprasternală



- Fata de pozitia precedenta, daca se roteste sonda cu aproximativ 90° in sensul acelor de ceasornic, se obtine sectiunea suprasternala perpendiculara pe aorta. Markerul sondei este orientat catre ora 4.

FR 61Hz
6.0cm

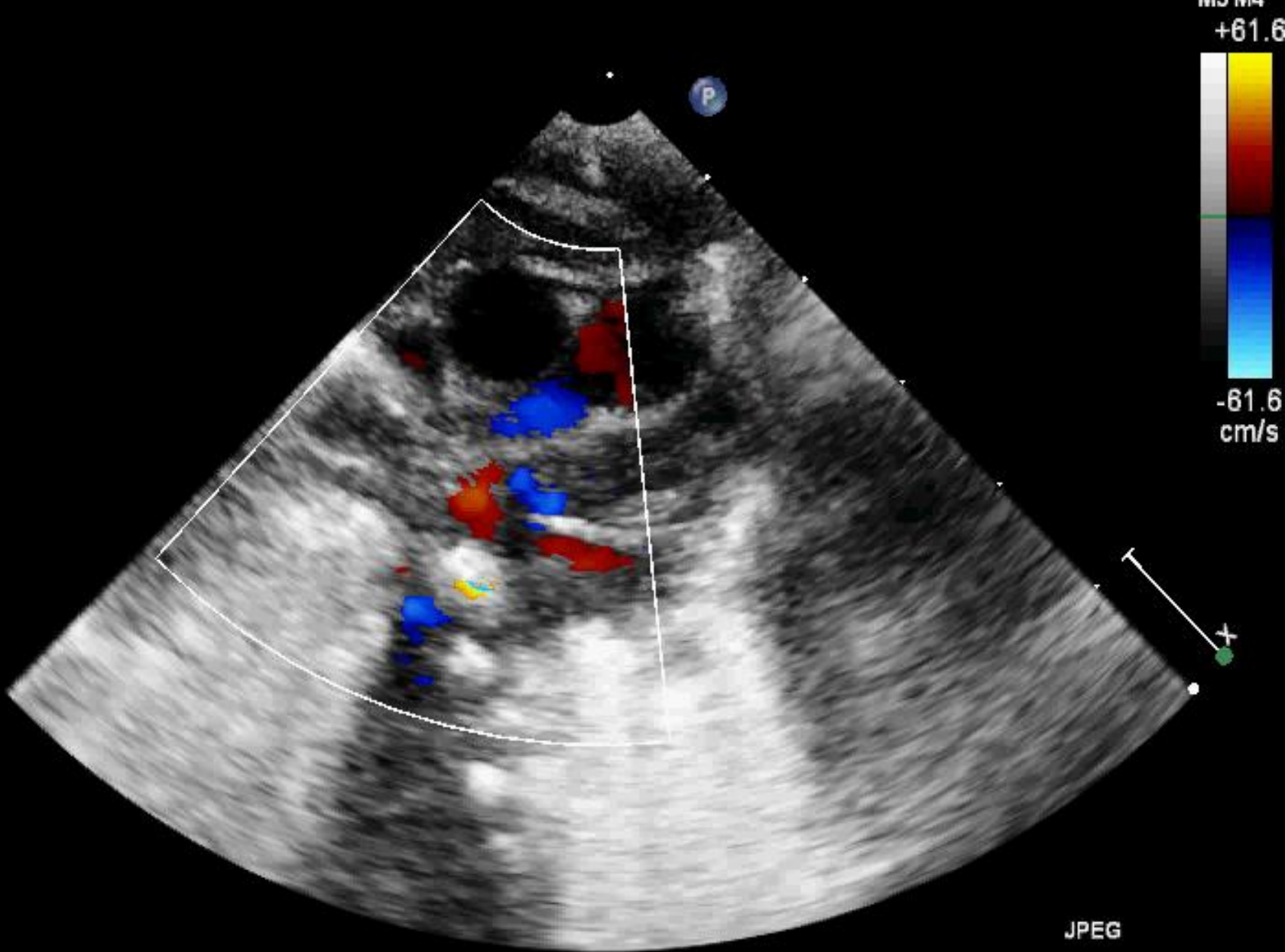
2D
73%
C 50
P Off
Res



PR 25Hz
6.0cm

2D
78%
C 50
P Off
Res

CF
77%
3.0MHz
WF High
Med



ms m4
+61.6
-61.6
cm/s

JPEG

*** bpm

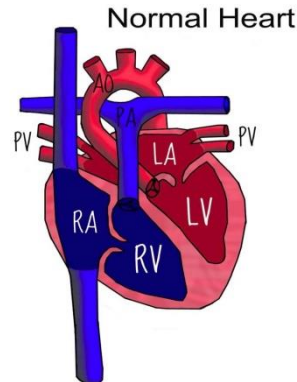
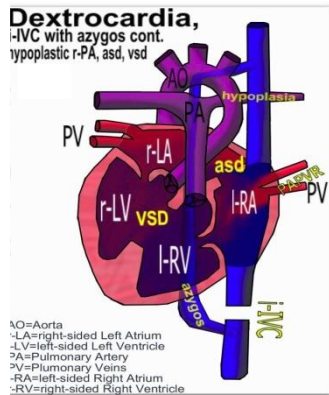
take home message

- Inainte de inceperea ecografiei:
- CONSULTATI PACIENTUL
- CONSULTATI PACIENTUL
- CONSULTATI PACIENTUL

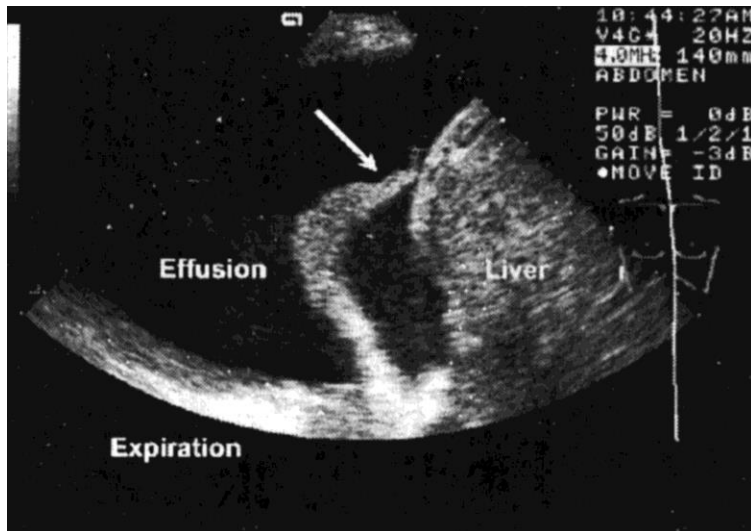
take home message

- Paralel cu ecografia: înregistrare EKG;
- O structură cardiacă se examinează întotdeauna din cel puțin din 2 planuri ortogonale;
- **Necesitatea unui algoritm de examinare** de la care să nu ne abatem: examinarea sistematică a structurilor (preferabil în ordinea curgerii sângelui) în fiecare secțiune, în secvența:
2D (+ M-mode) → Doppler color (+/- M-mode) -> Doppler spectral

Situatii particulare de obtinere a sectiunilor

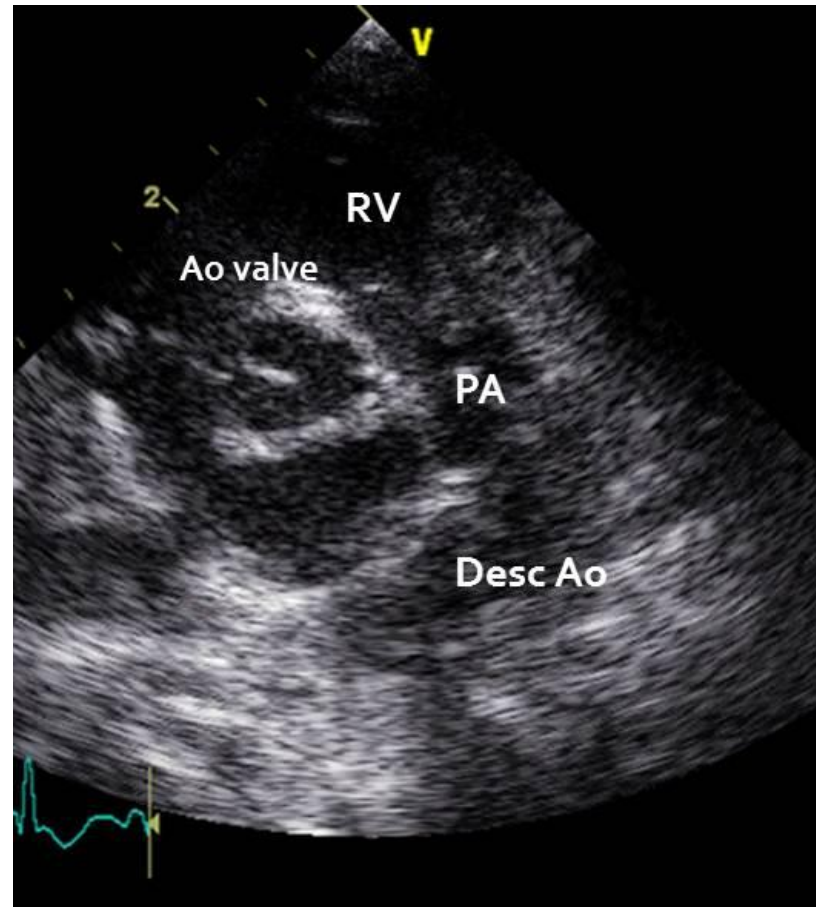


- Dextrocardie: se folosesc ferestre/sectiuni ecocardiografice “in oglinda” cu cele prezentate;

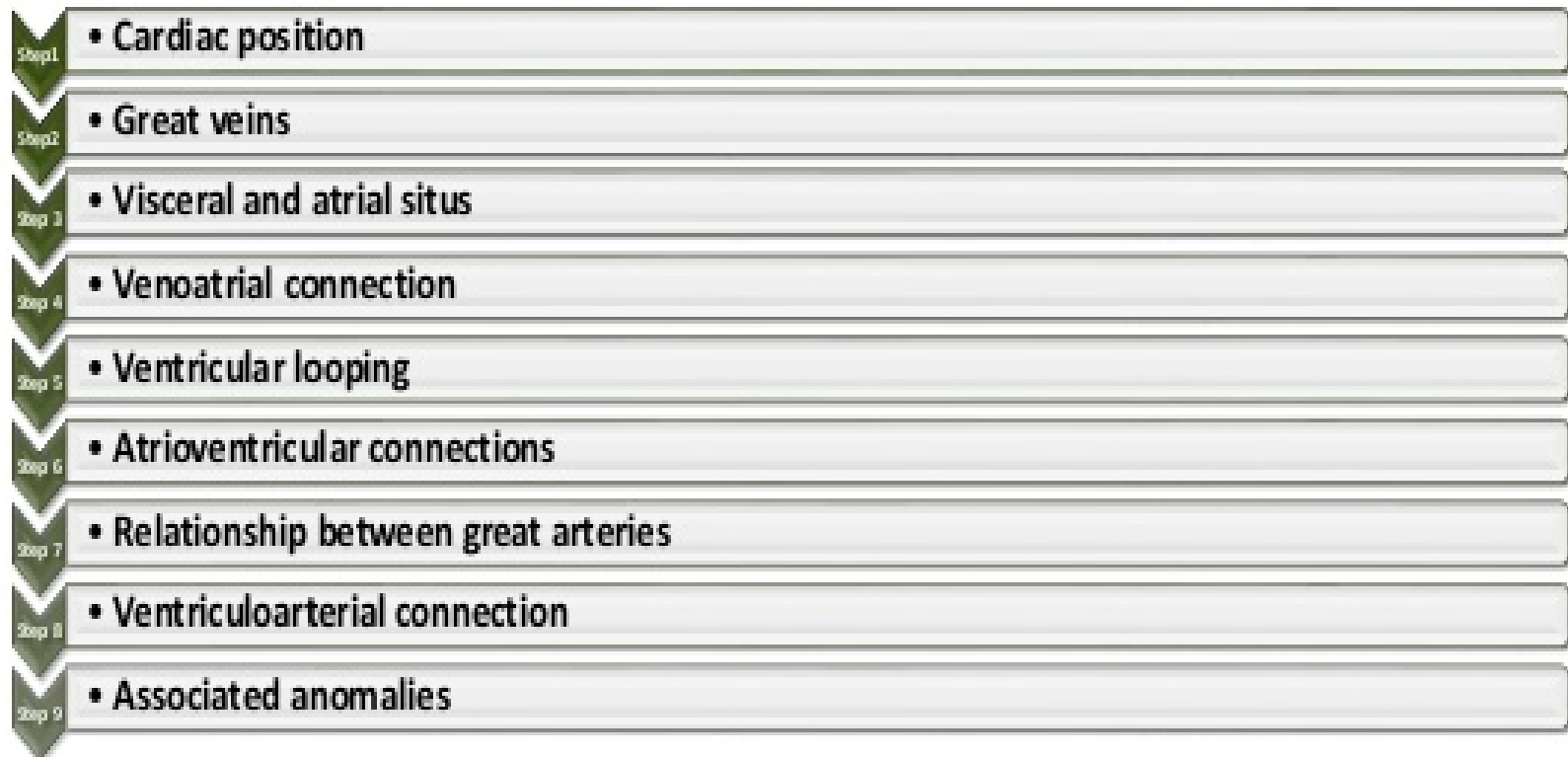


- In caz de revarsate pleurale mari: se incearca obtinerea de imagini prin plasarea sondei la nivelul peretelui toracic posterior, cu pacientul in pozitie sezanda.

Ductal cut view



Segmental approach



TREI SEGMENTE CARDIACE

ATRIU



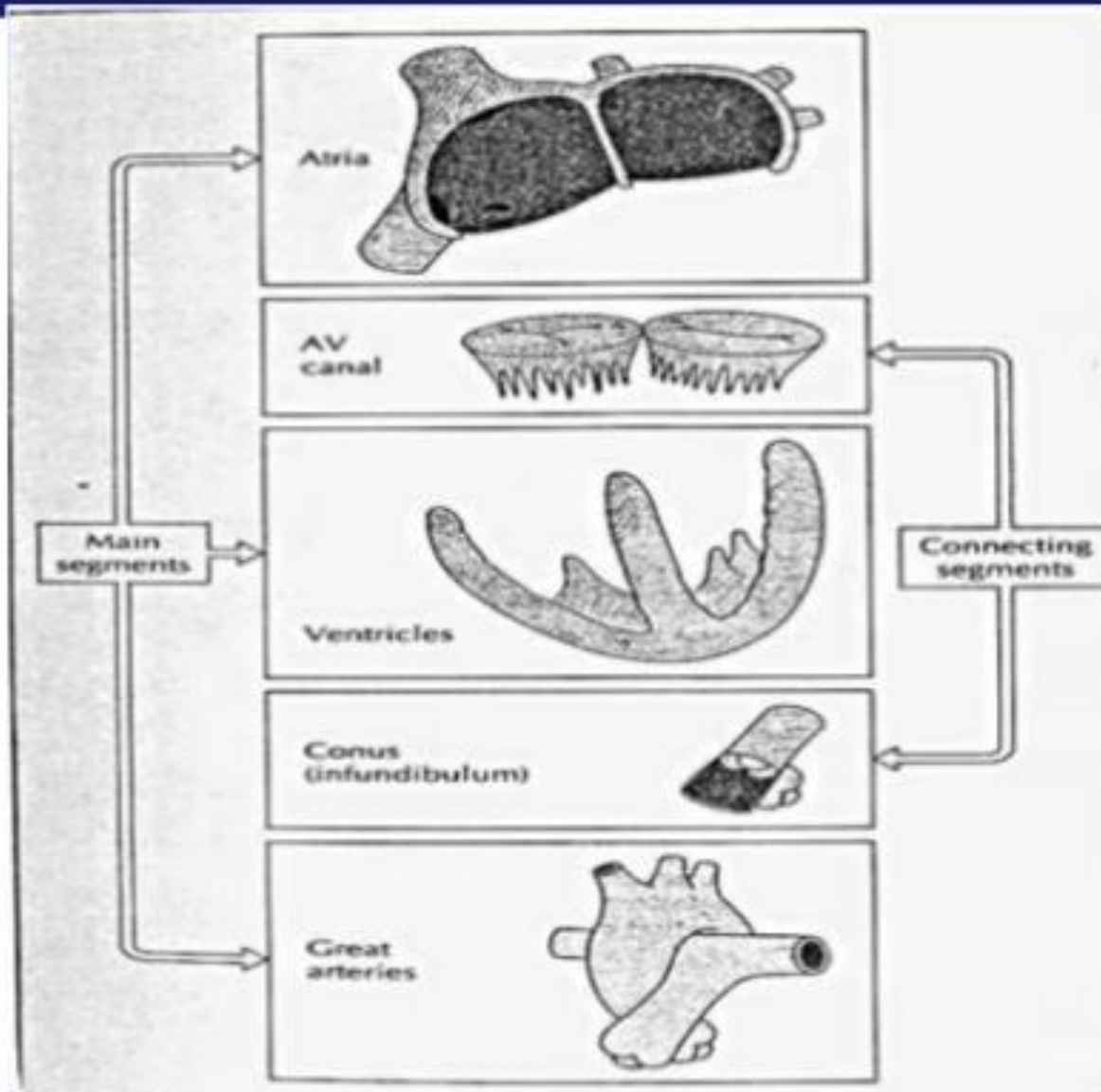
VENTRICUL



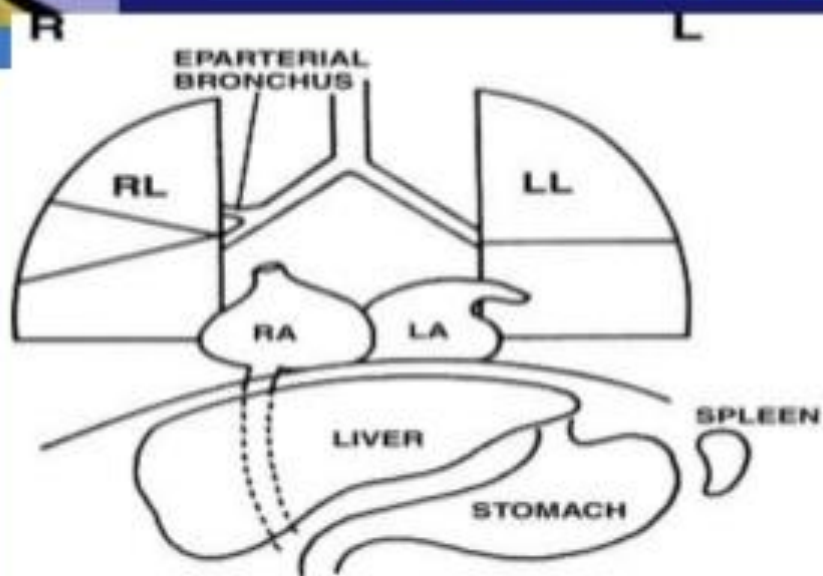
MARILE
VASE



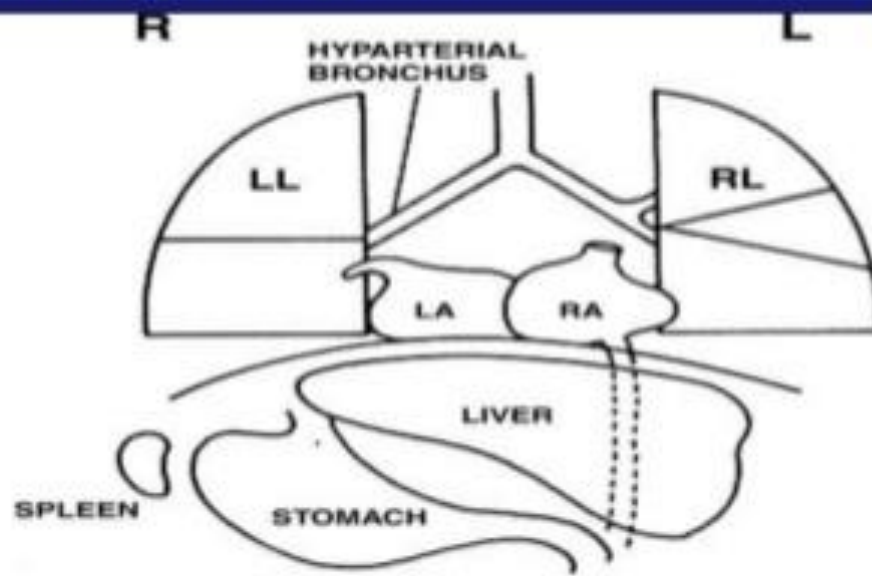
Segmental Approach



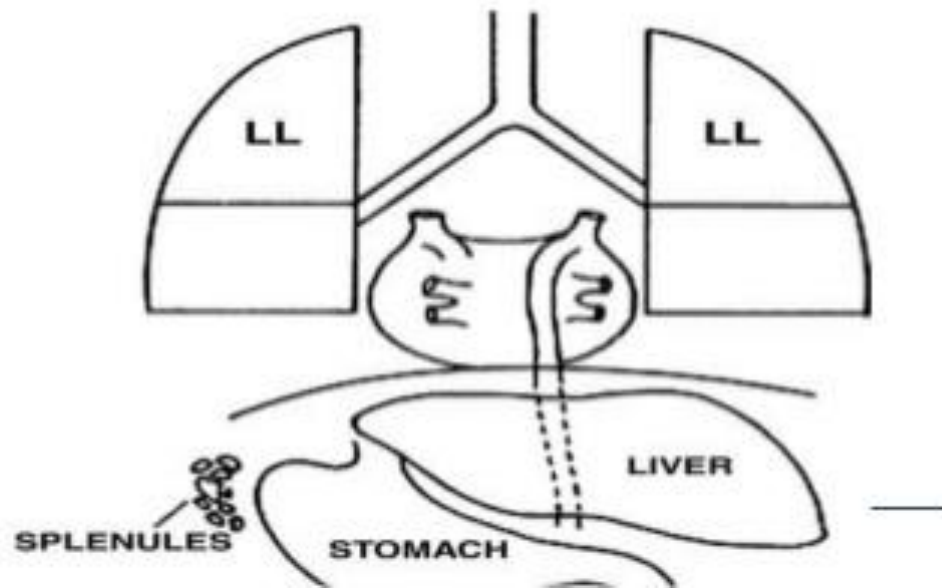
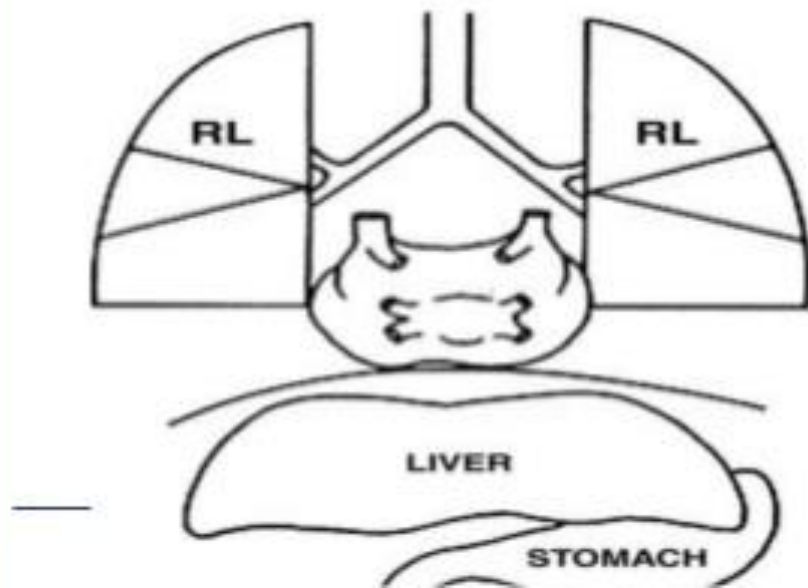
Segmental Approach



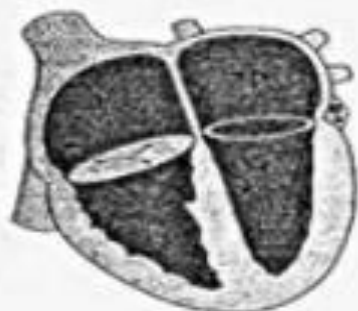
a.



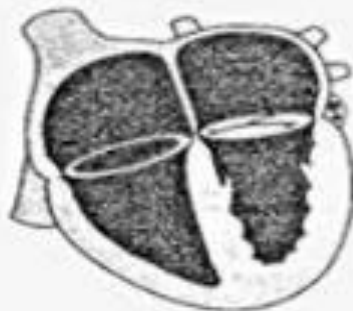
b.



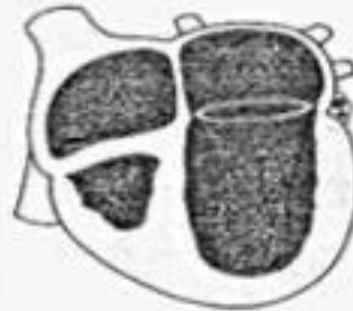
Segmental Approach



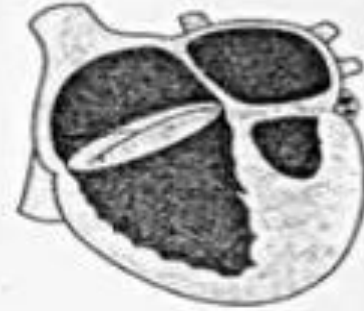
A AV concordance



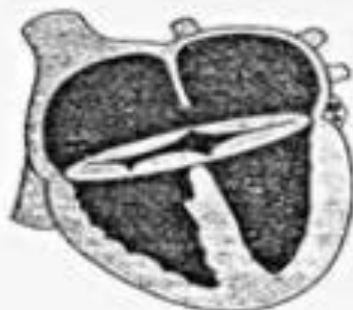
B AV discordance



C Tricuspid atresia



Mitral atresia



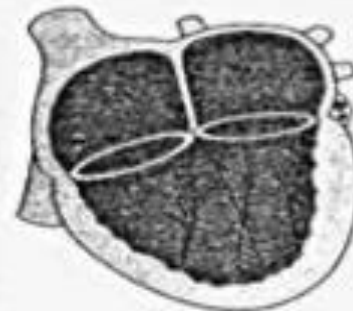
D Common AV valve



Overriding tricuspid valve



Overriding mitral valve



F Double-inlet ventricle



E Straddling tricuspid valve



Straddling mitral valve

Segmental Approach

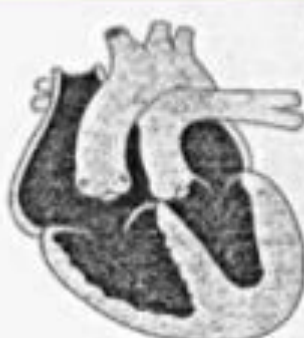
Concordant or
Discordant

Double outlet
Ventricle

Single outlet



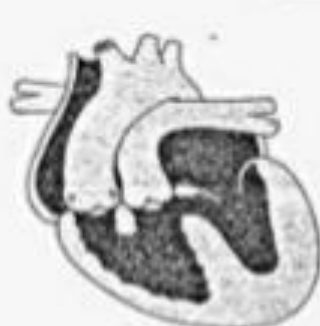
Concordant



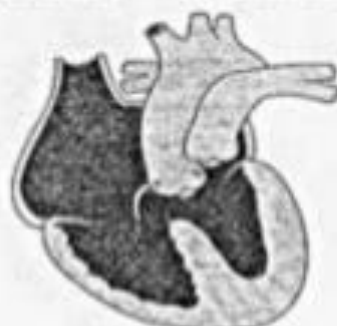
Discordant
TGA with ventricular D-loop



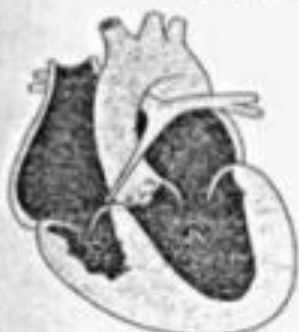
Discordant
TGA with ventricular L-loop



Double-outlet RV



Double-outlet LV



Pulmonary atresia



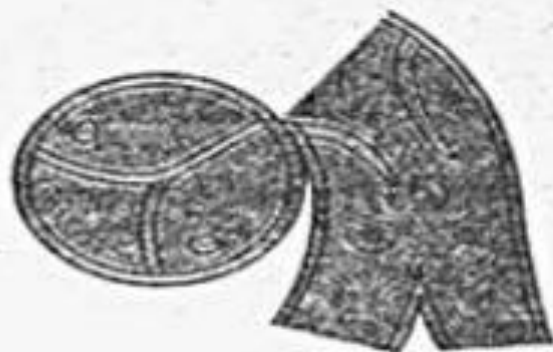
Aortic atresia



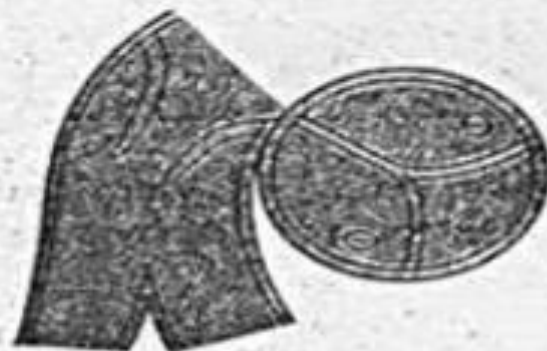
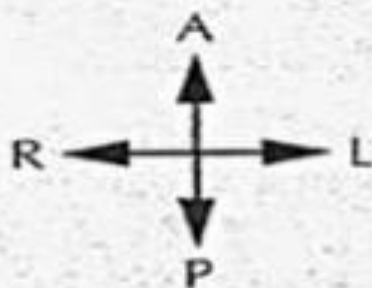
Truncus arteriosus
(single outlet)

Segmental Approach

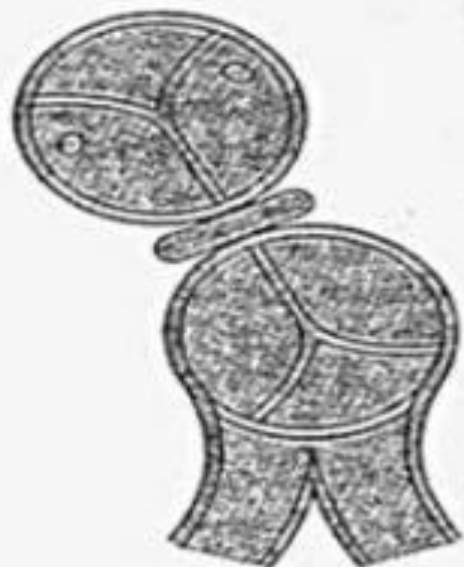
Interrelations between the semilunar valves



Solitus



Inversus



B D-malposition



Anterior malposition



L-malposition

Tipuri de examinare ecocardiografica



