



# FOCUS SULL' ECOCARDIOGRAFIA IN ETÀ PEDIATRICA Percorso Sequenziale



**Agata Privitera**

**Cardiologia Pediatrica**

**AOU Policlinico Presidio San Marco Catania**

**18/04/2024**

# Ecocardiografia Indicazione: Sospetto di cardiopatia congenita



Soffio con  
caratteristiche di  
cardiopatia (A9)



Cianosi:  
dopo 24 ore < 90%  
≠ SAO2 tra braccio dx e  
gambe > 3% (A9)



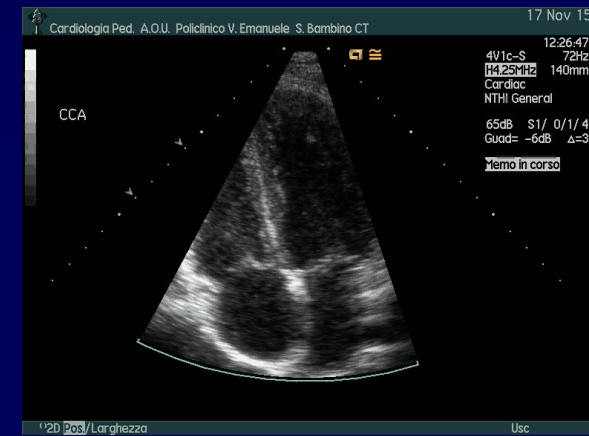
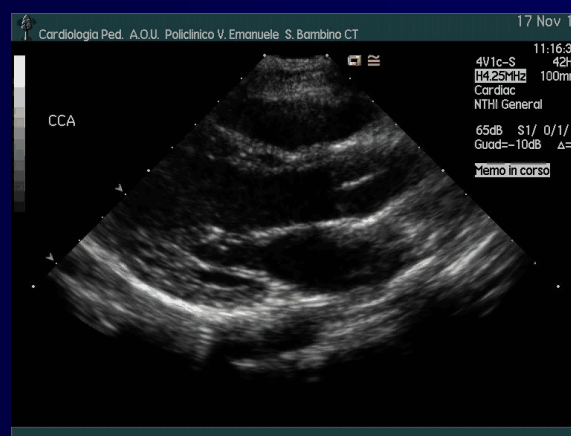
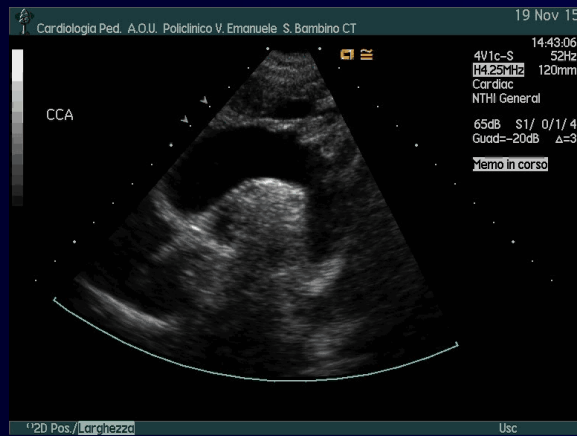
Scompenso  
cardiaco/aritmia (A9)

A 7-9 = appropriata; M 4-6 = potrebbe  
essere appropriata; R 1-3 = raramente  
appropriata

ACC/AAP/AHA/ASE/HRS/  
SCAI/SCCT/SCMR/SOPE  
2014 Appropriate Use Criteria for  
Initial Transthoracic Echocardiography  
in Outpatient Pediatric Cardiology

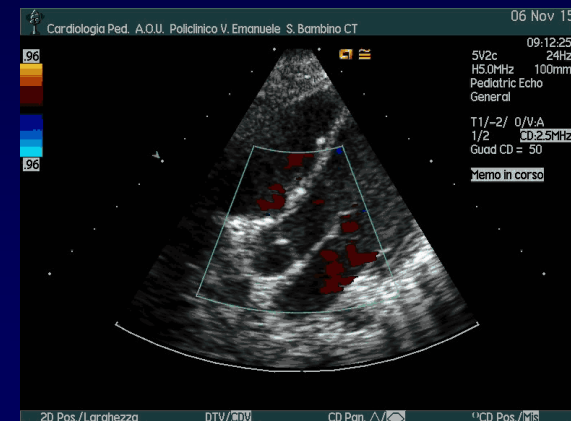
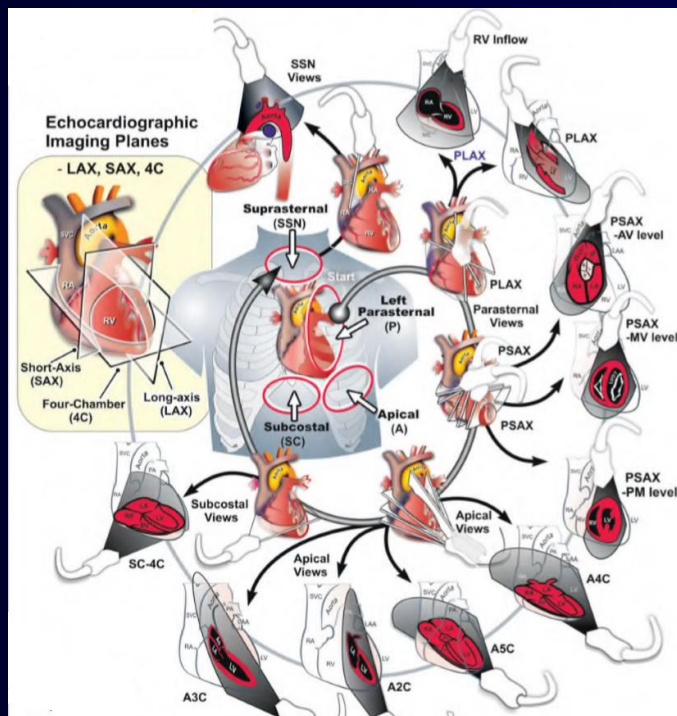
# Ecocardiografia B mode

In ecocardiografia, in tempo reale, vengono generate immagini in movimento del cuore. Nella funzione bidimensionale gli ultrasuoni si muovono su due dimensioni, così è possibile ottenere sezioni del cuore che si avvicinano alla sua reale configurazione anatomica

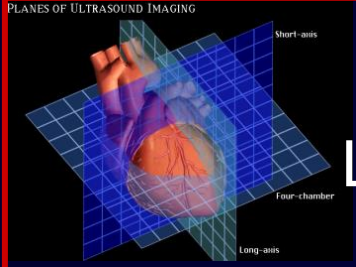


# Ecocardiografia

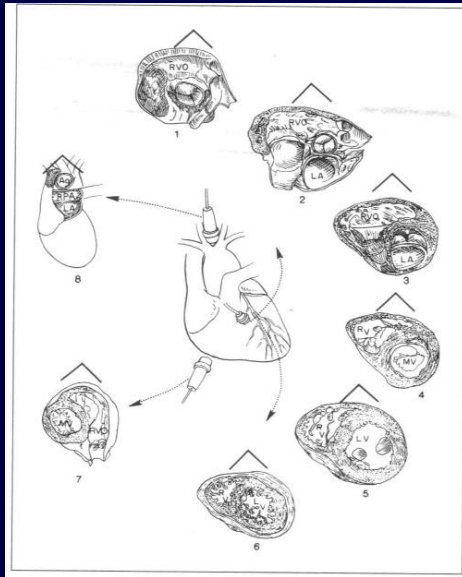
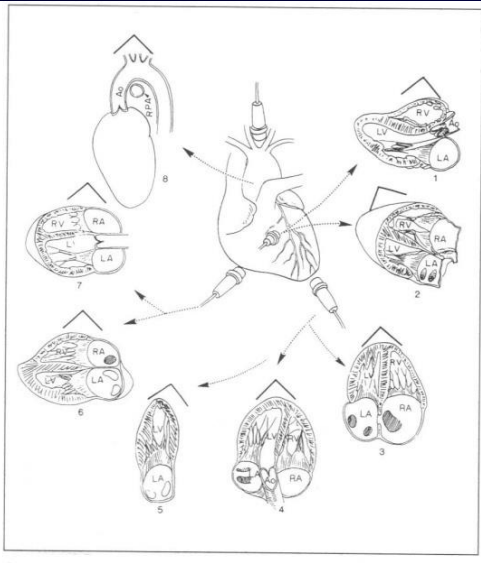
Importante, nell'approccio delle cardiopatie congenite, è seguire un metodo, cioè un PERCORSO SEQUENZIALE



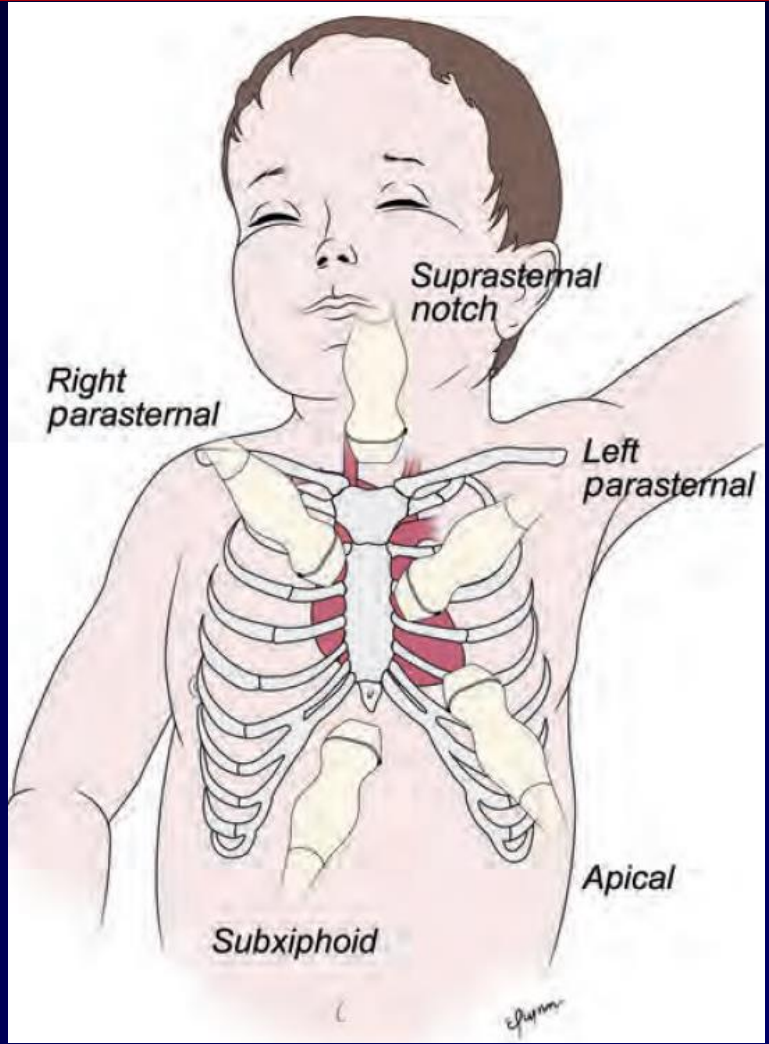
# Proiezioni



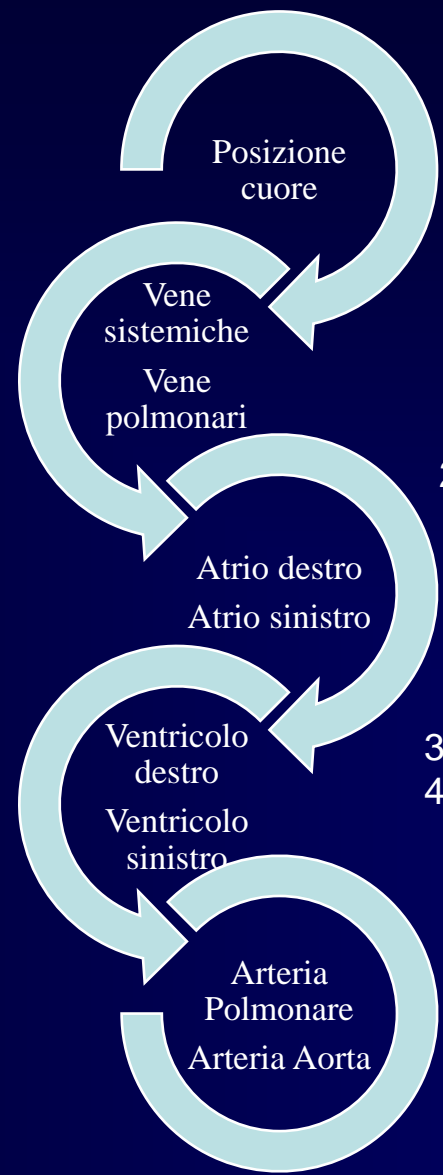
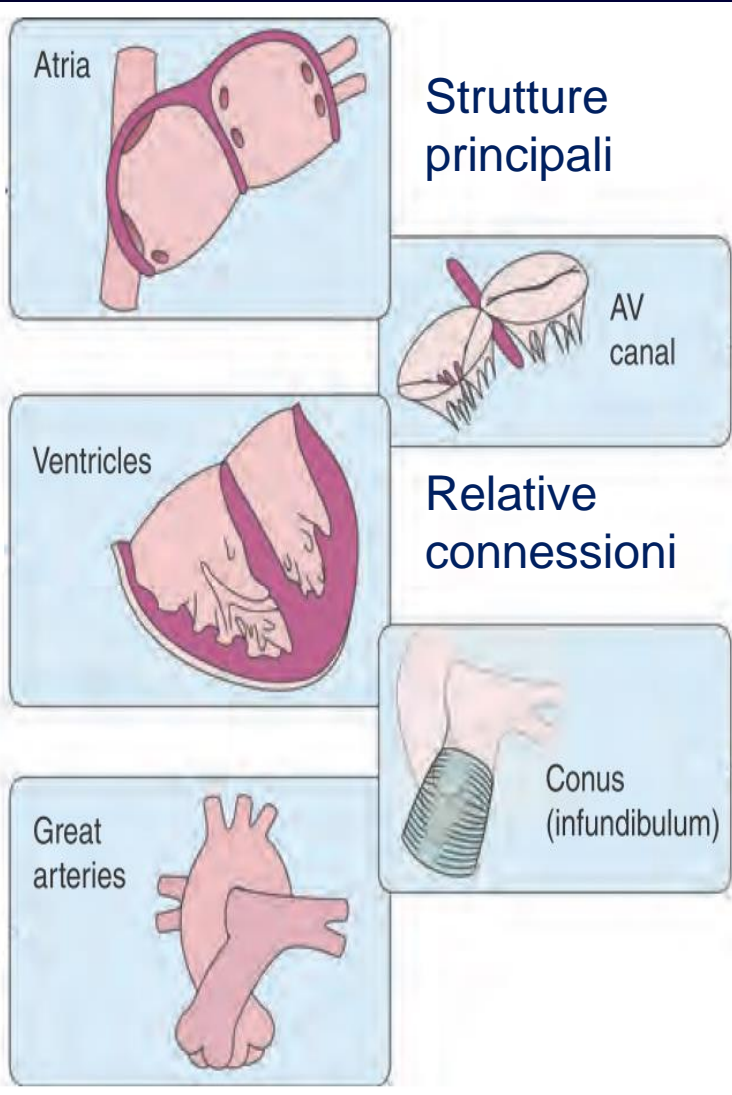
## Longitudinali e Trasversali



In età neonatale è possibile eseguire un esame completo utilizzando le sole proiezioni sottocostali e soprasternale



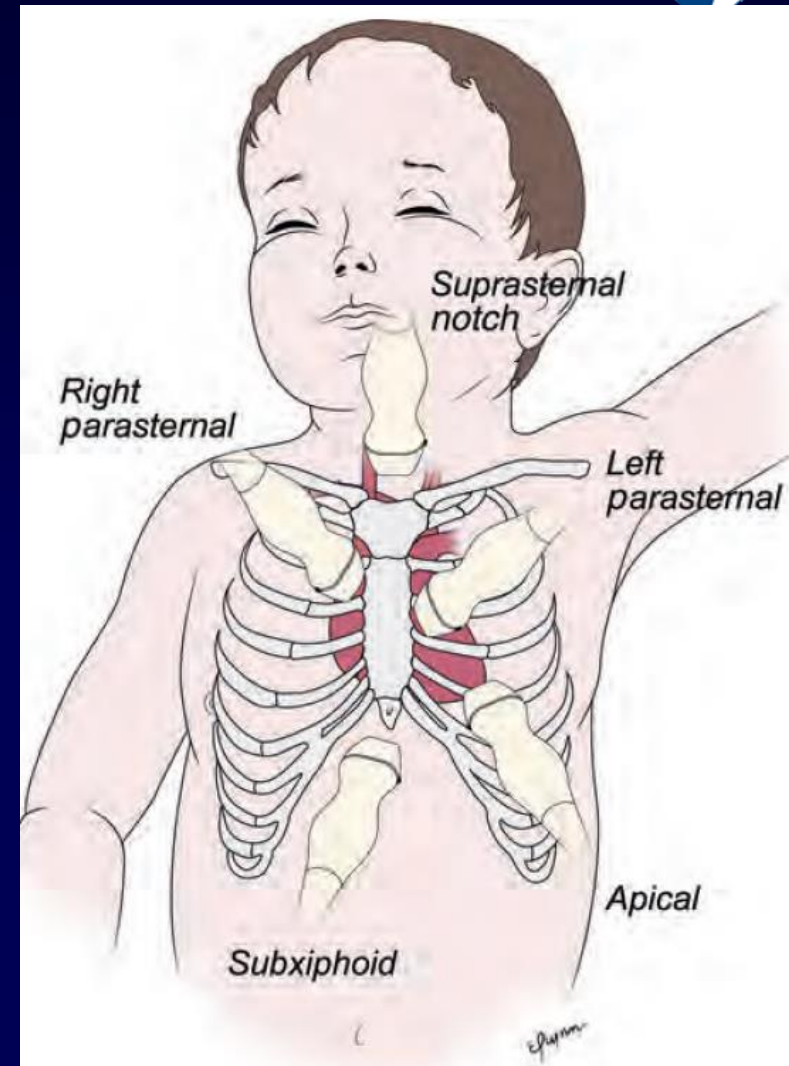
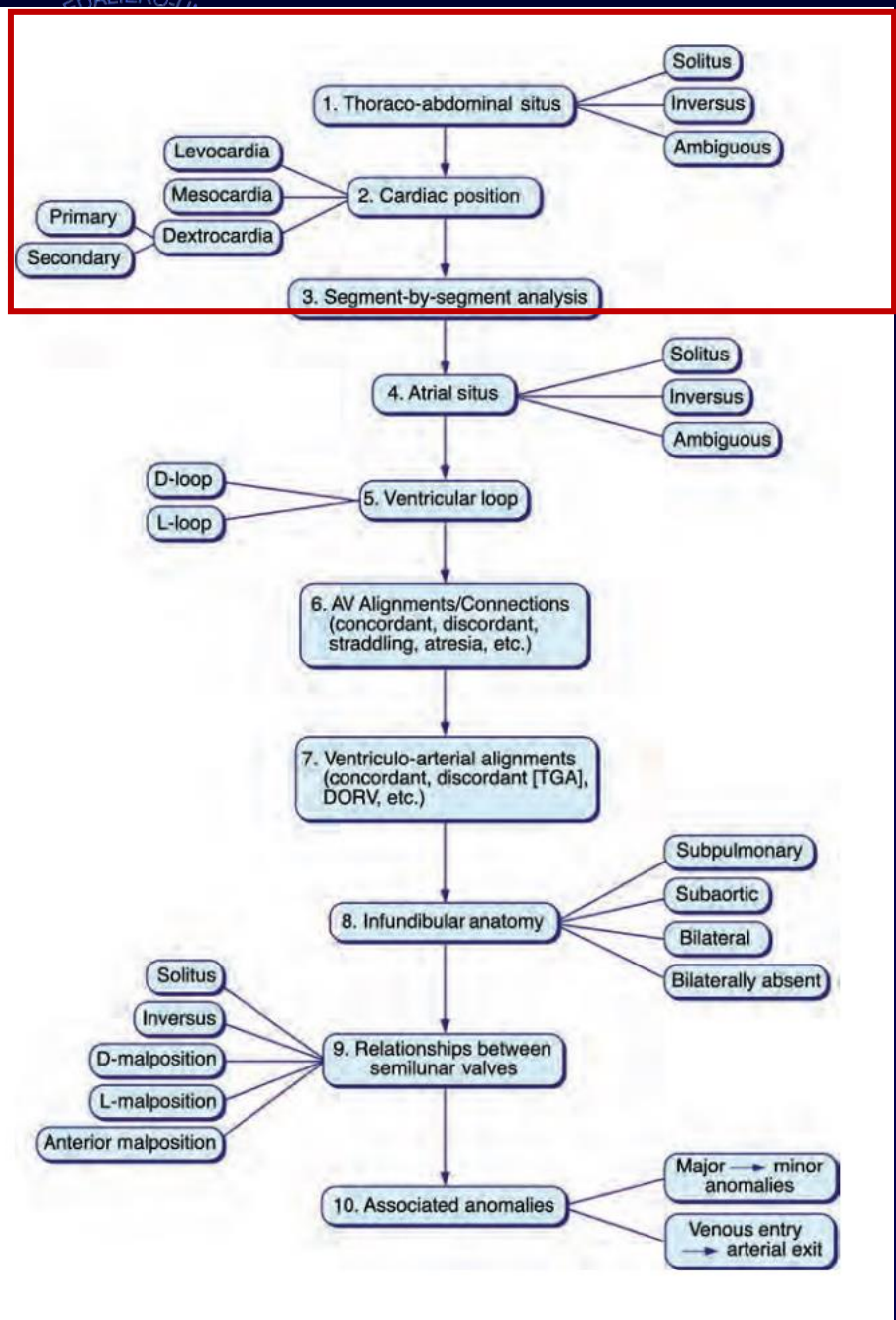
# Approccio Sequenziale



1. Relazione con organi addominali (situs)
2. Connessione veno-atriale
3. Connessione atrio-ventricolare
4. Studio delle valvole atrioventricolari
5. Connessione ventricolo-arteriosa
6. Studio delle valvole semilunari
7. Origine arterie coronarie



# flow-chart



# Definizione Situs

## Corrispondenza

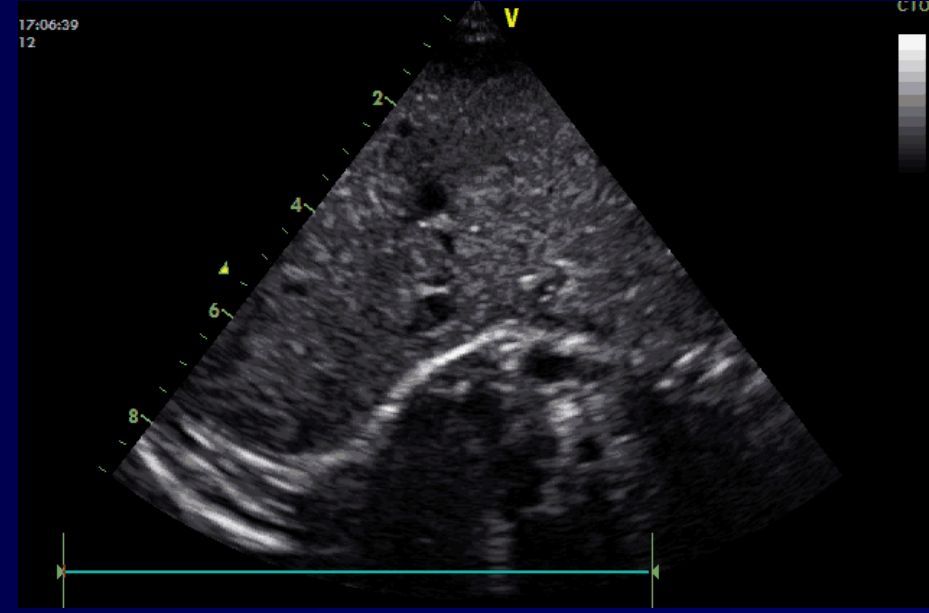
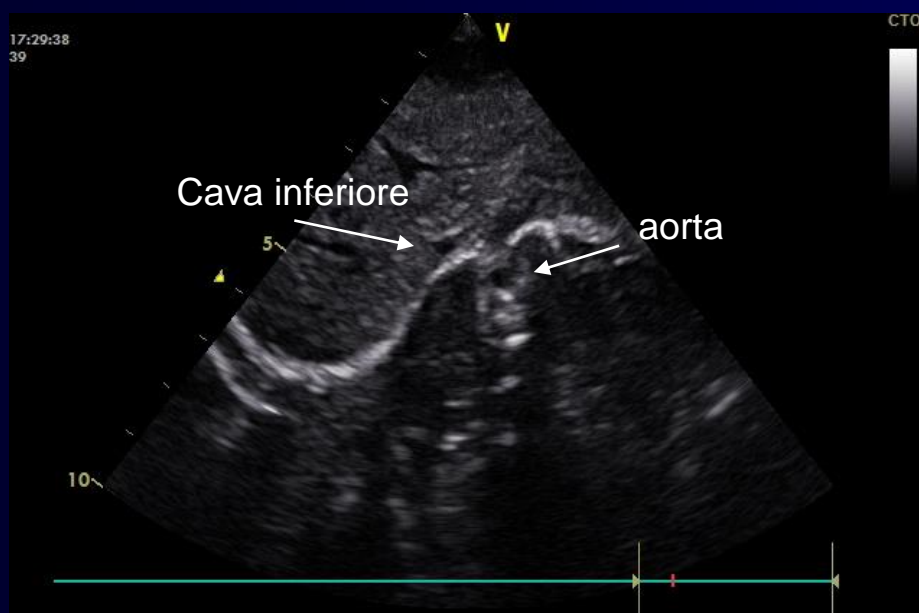
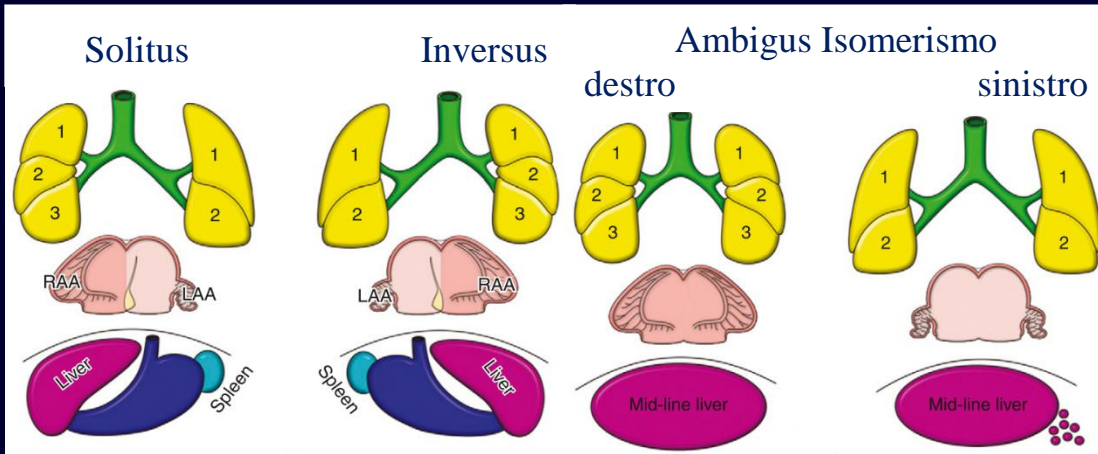
Sito toracico:

Bronchi – polmoni- **Cuore**

Sito Addominale:

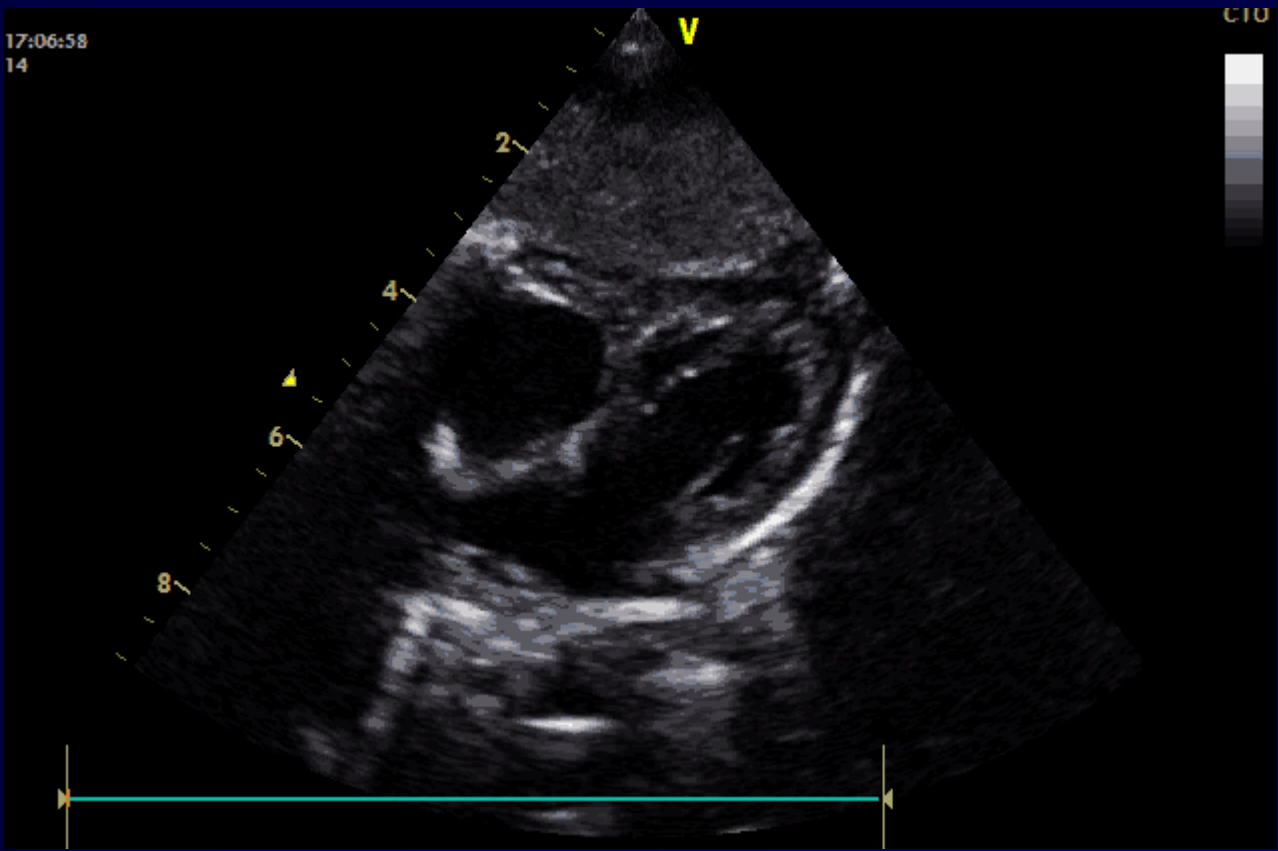
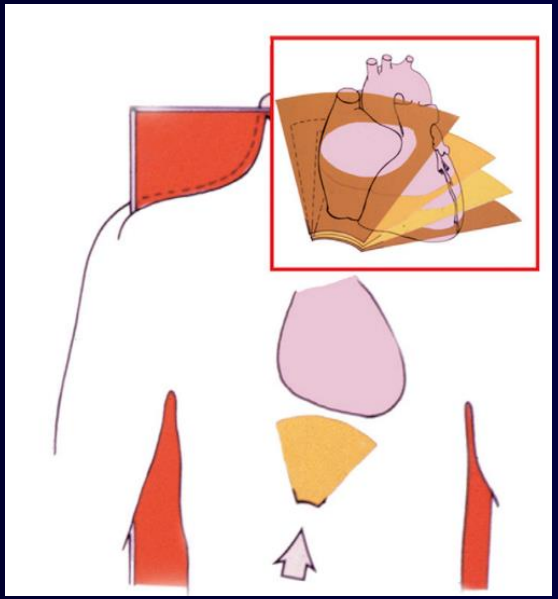
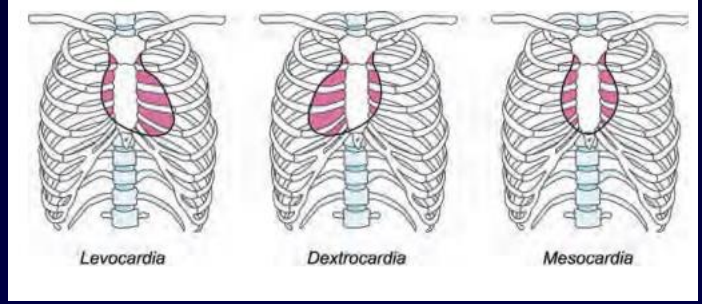
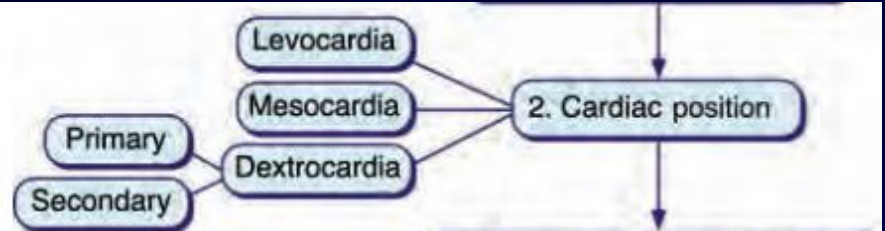
Fegato-stomaco- milza

## Sito addominale

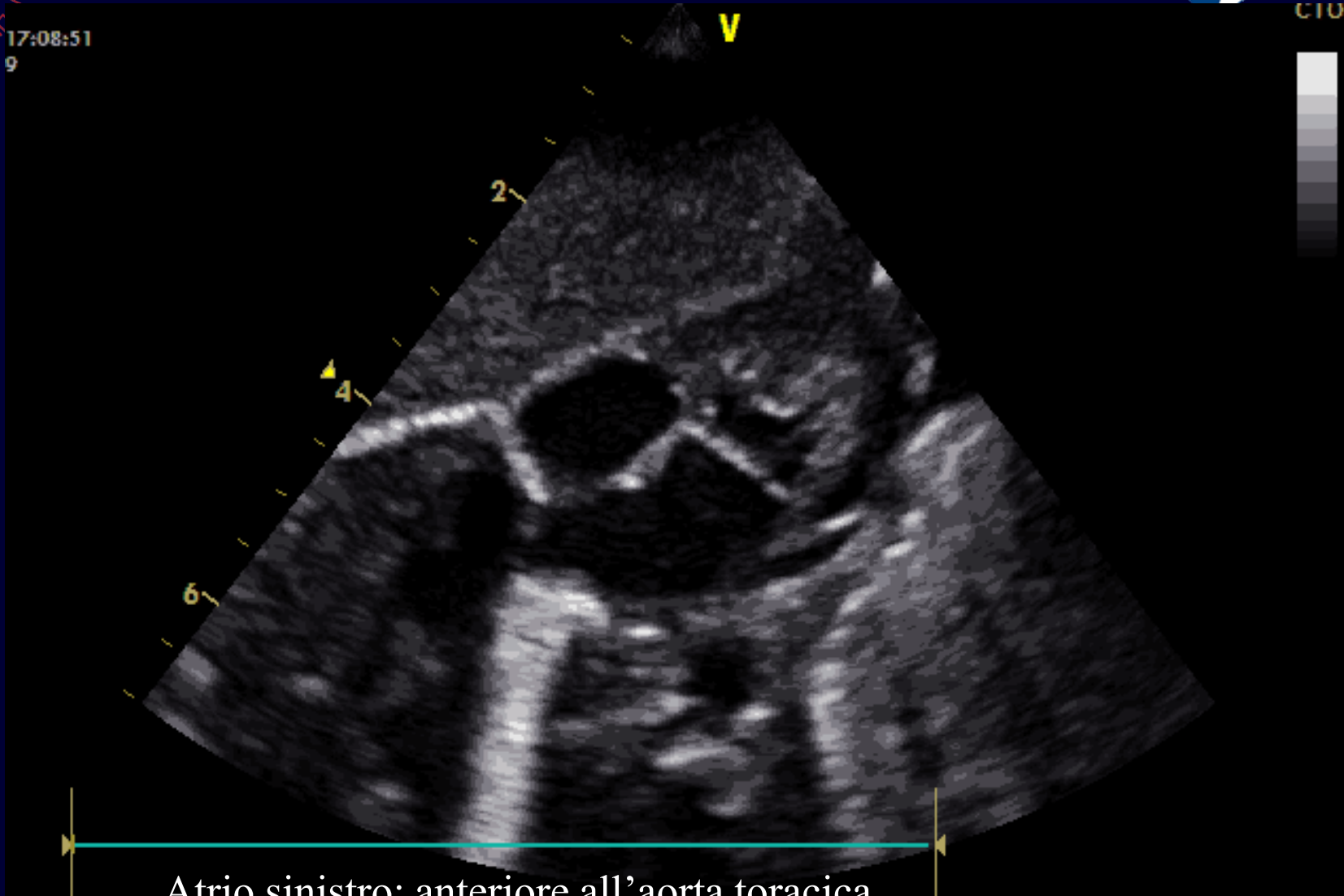




# Posizione Cuore

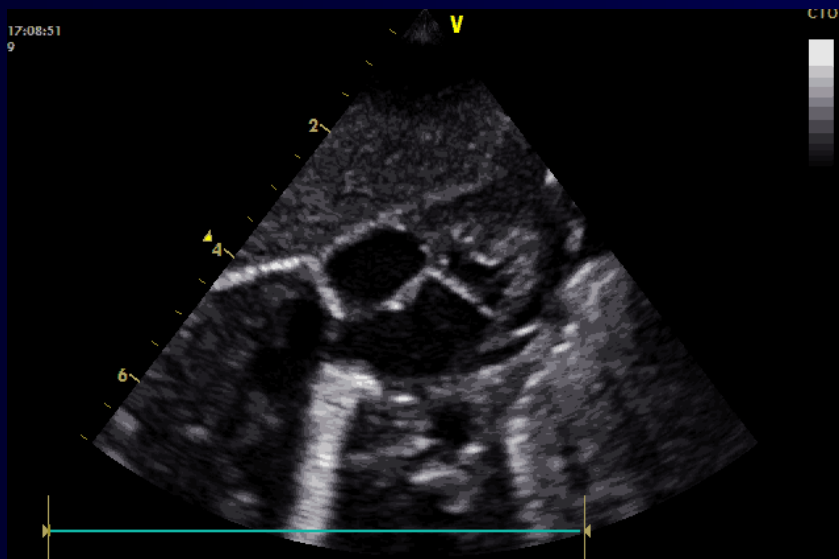
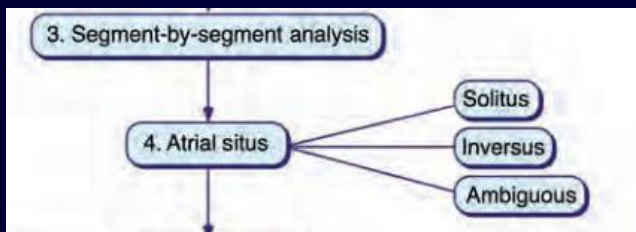
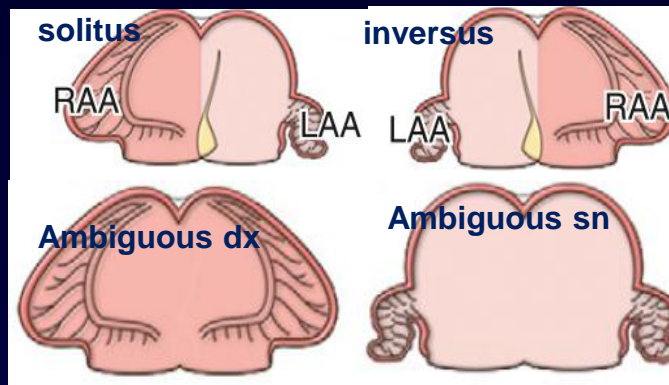


# Atri

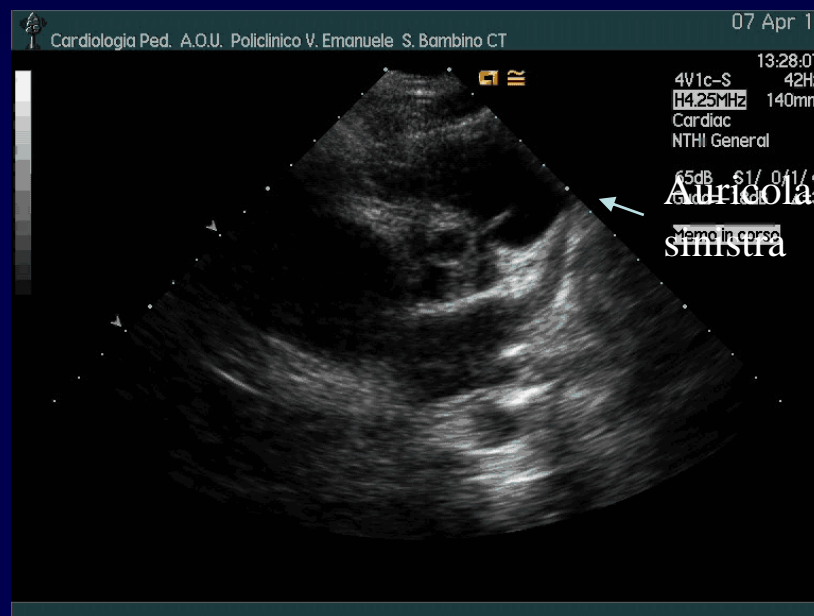


Atrio sinistro: anteriore all'aorta toracica  
Atrio destro: anteriore all'atrio sinistro

# Auricola Sinistra

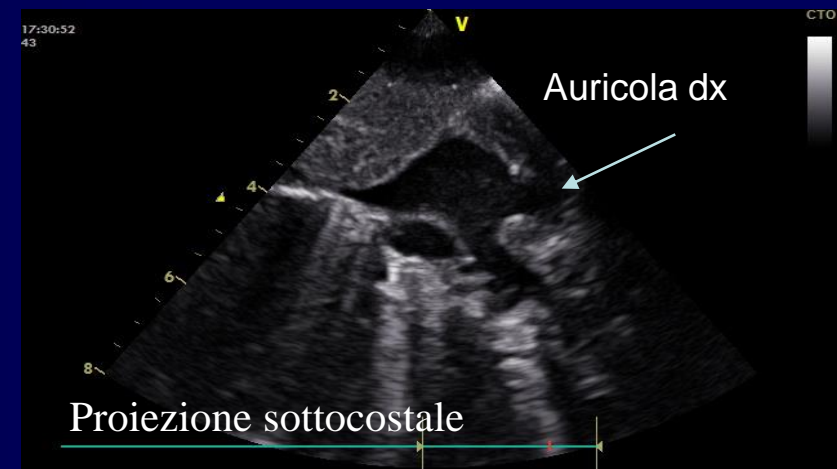
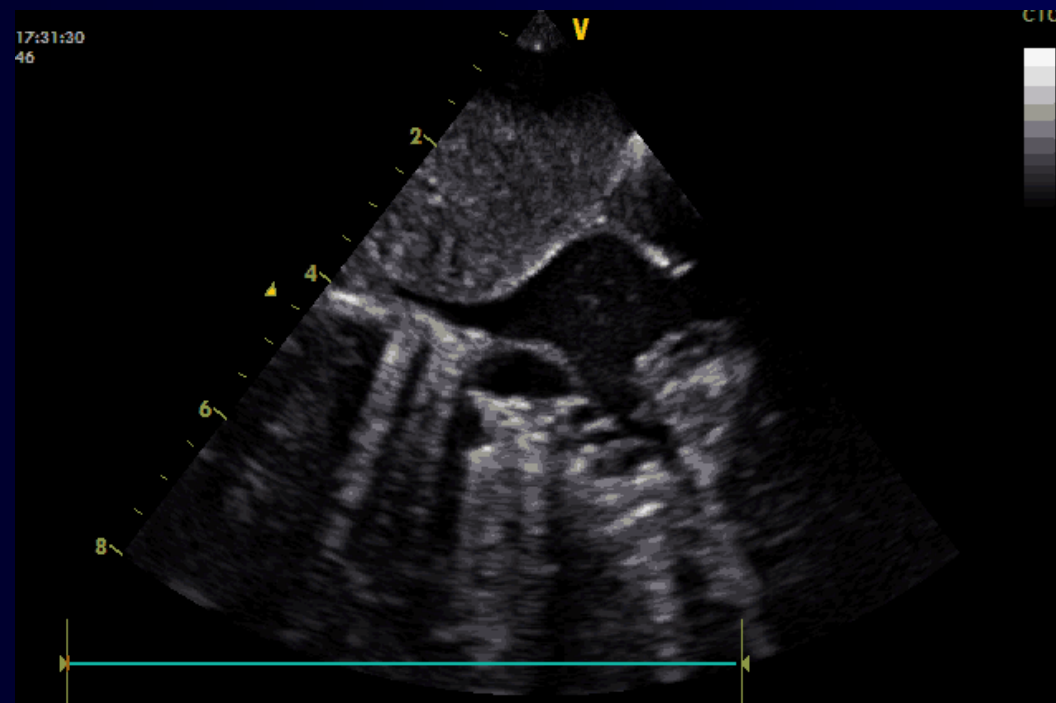
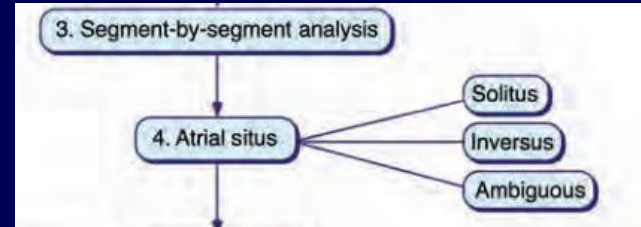
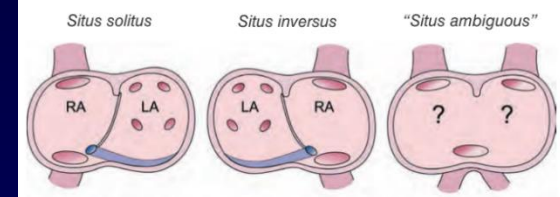
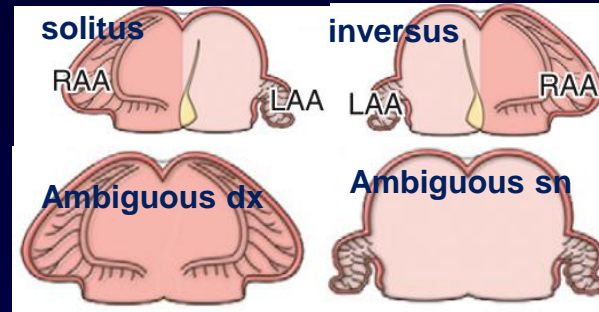
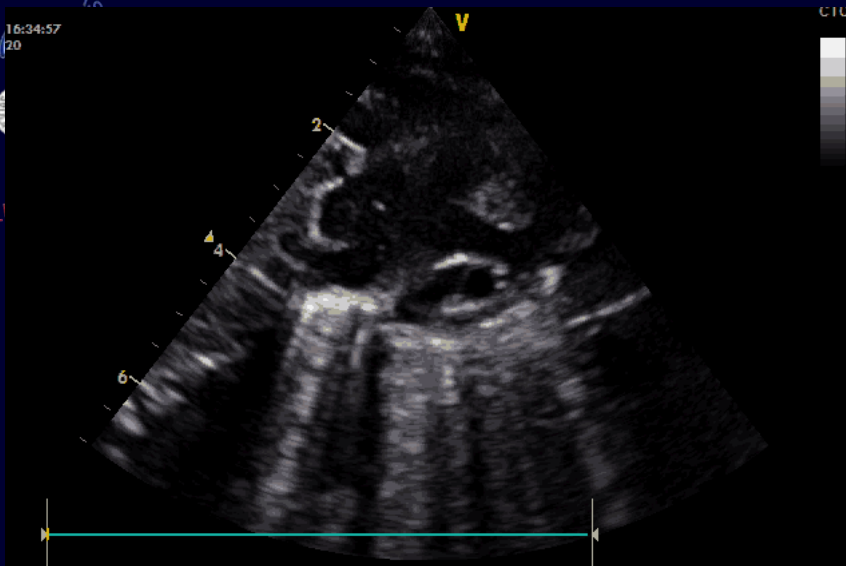


Atrio sinistro: anteriore all'aorta toracica  
 Atrio destro: anteriore all'atrio sinistro

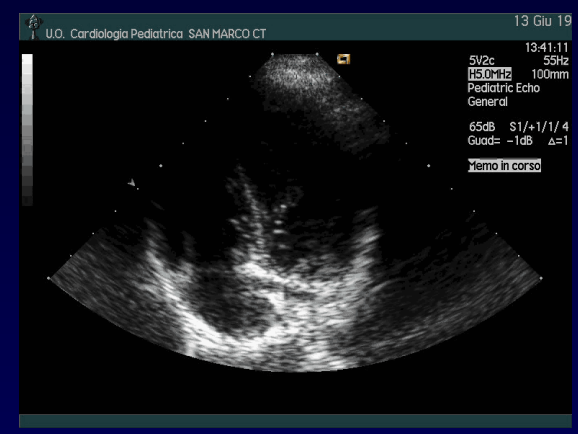
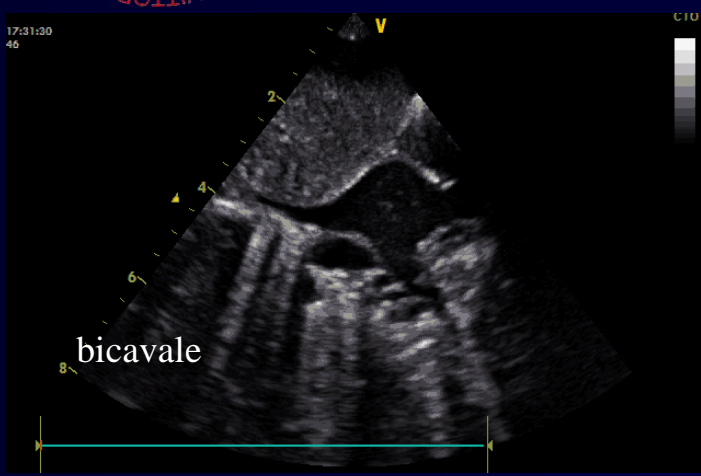


Proiezione parasternale asse corto

# Auricola destra

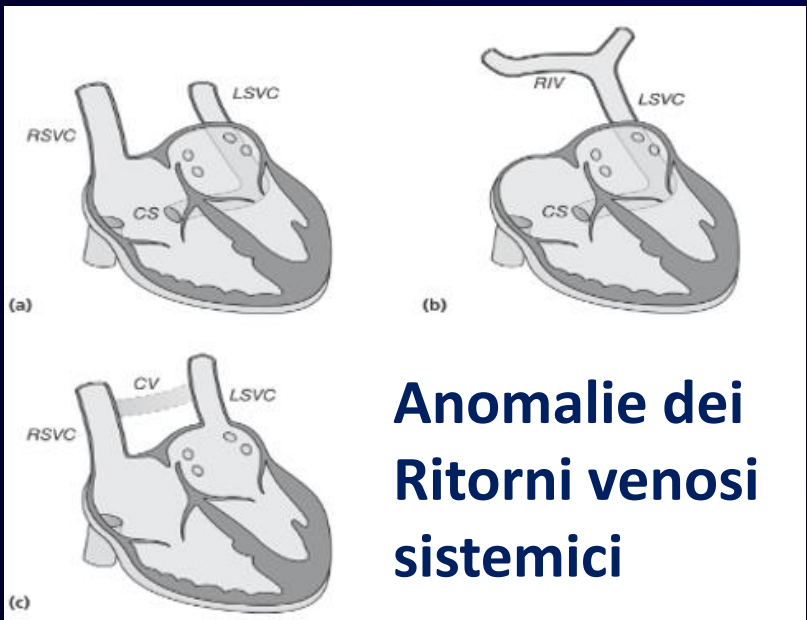


# Connessione venosa-Atro destro

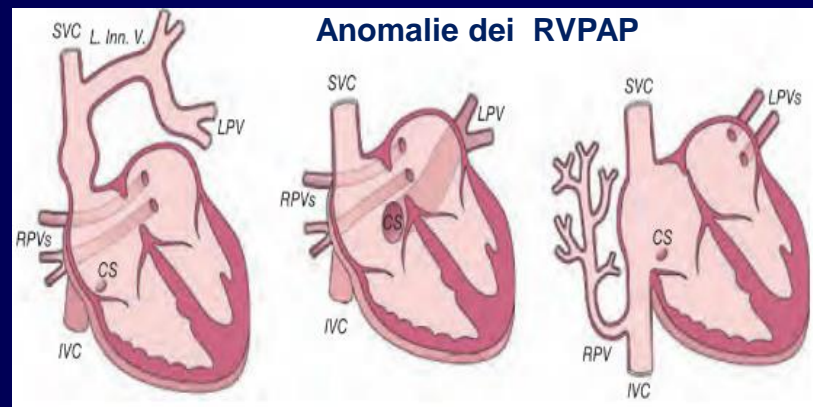
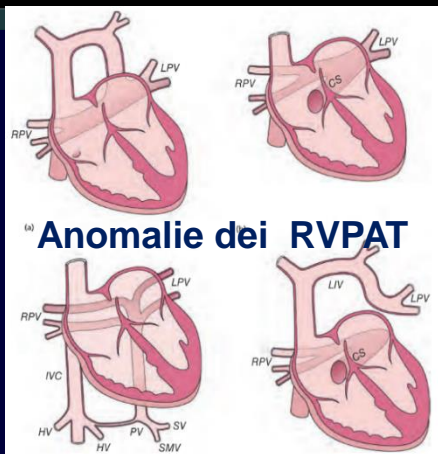
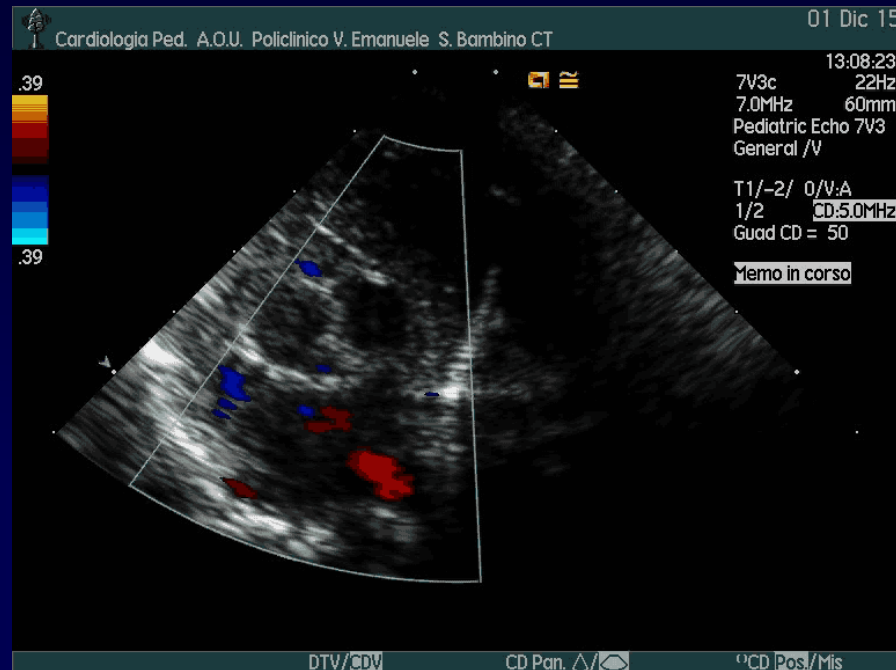


Tronco venoso e cava superiore

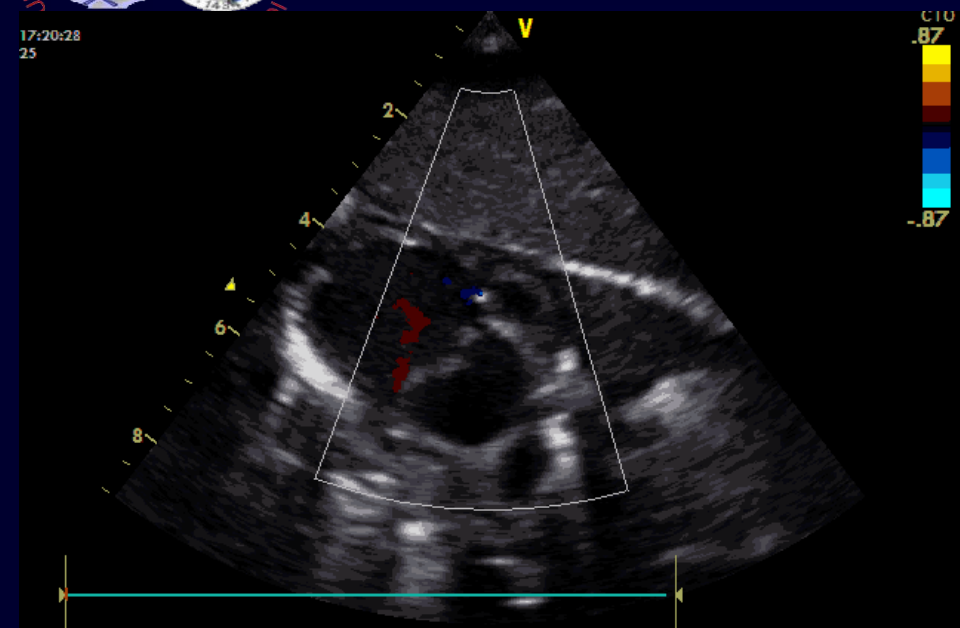
Seno coronarico



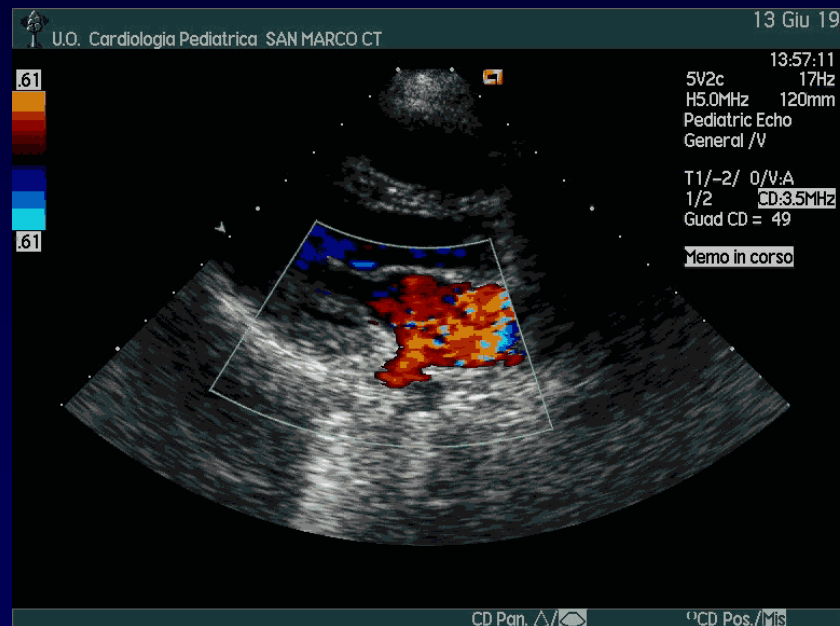
# Connessione venosa-Atrio sinistro



# Connessione venosa - Atrio sinistro

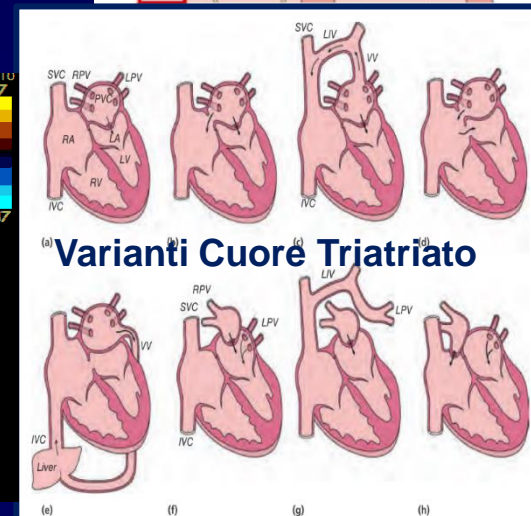
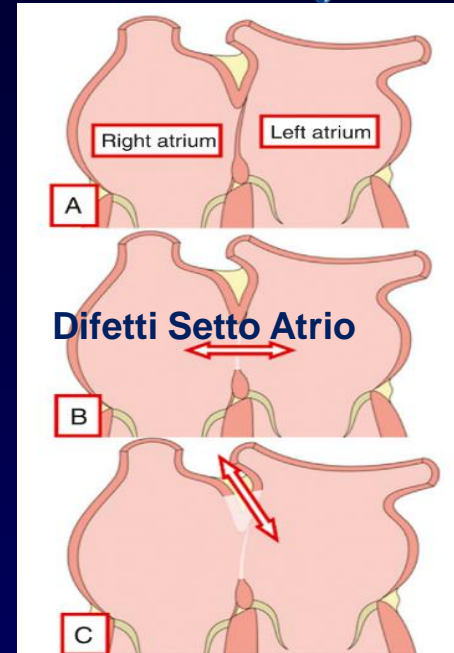
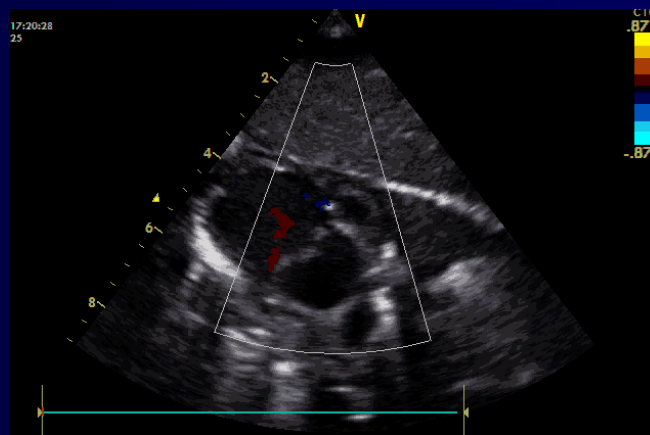
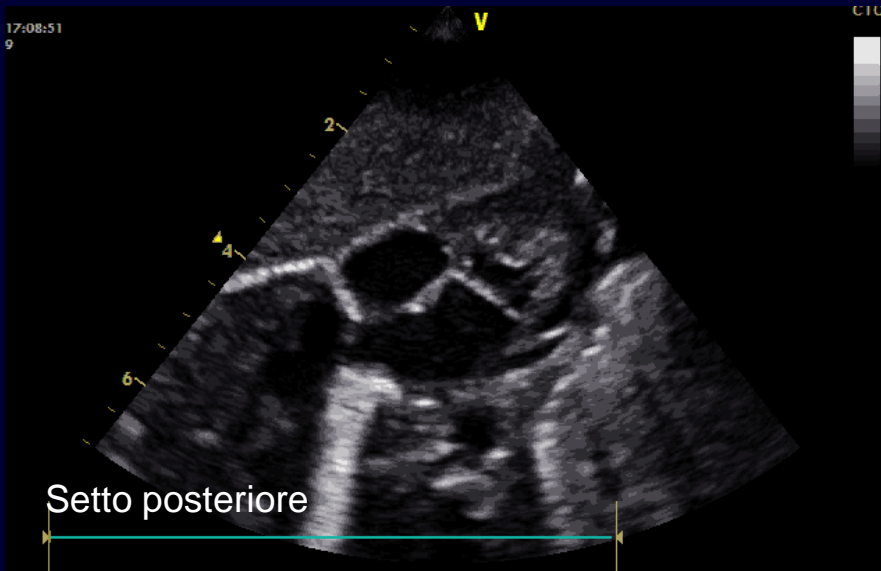


Vena polmonare superiore destra



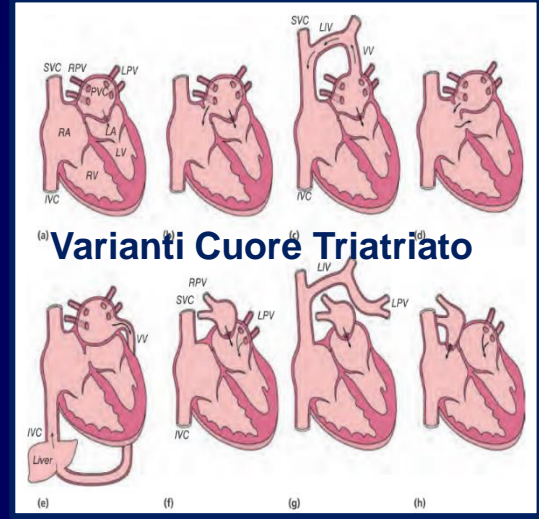
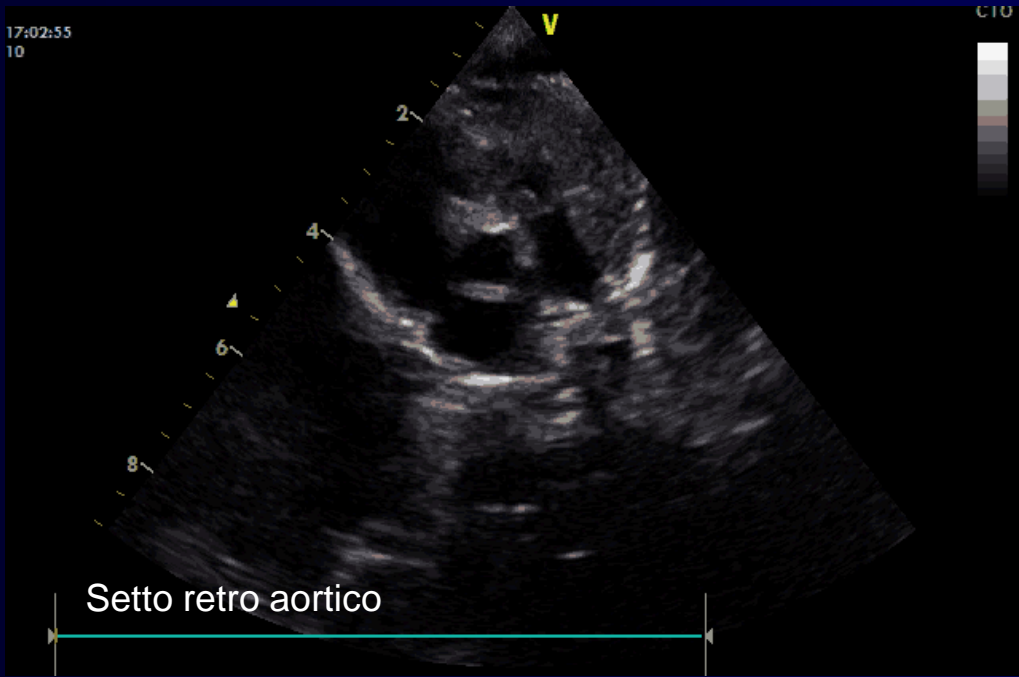
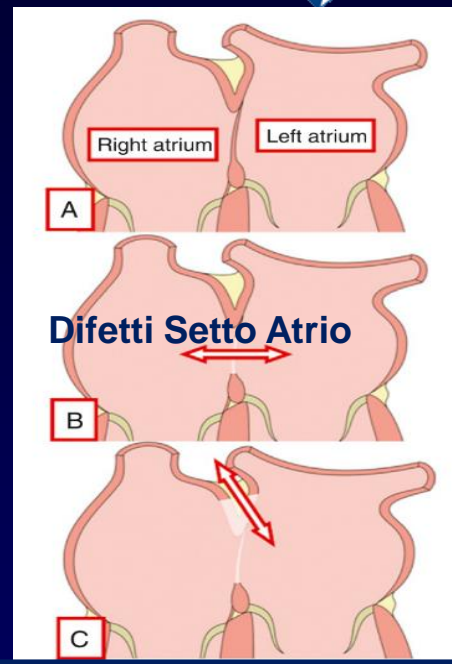
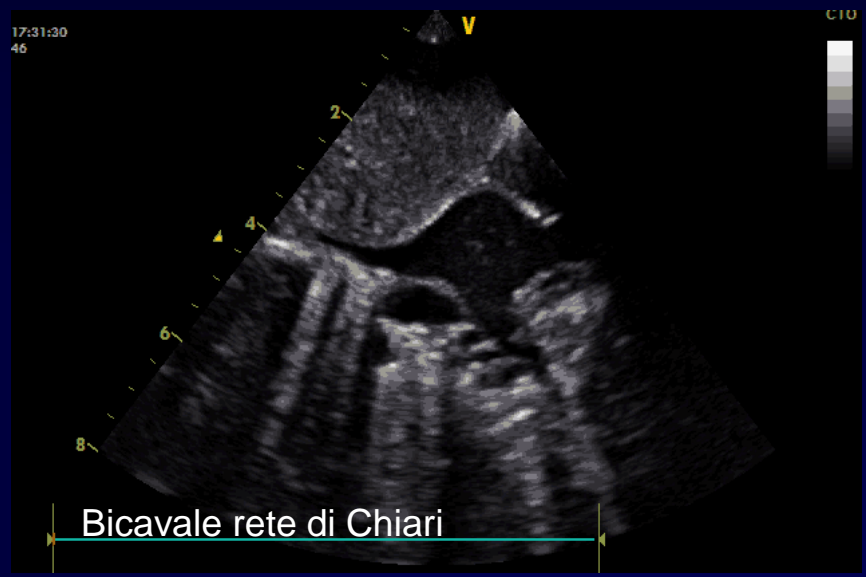
Parasternale, asse lungo ritorno venoso polmonare sinistro

# Setto Atriale



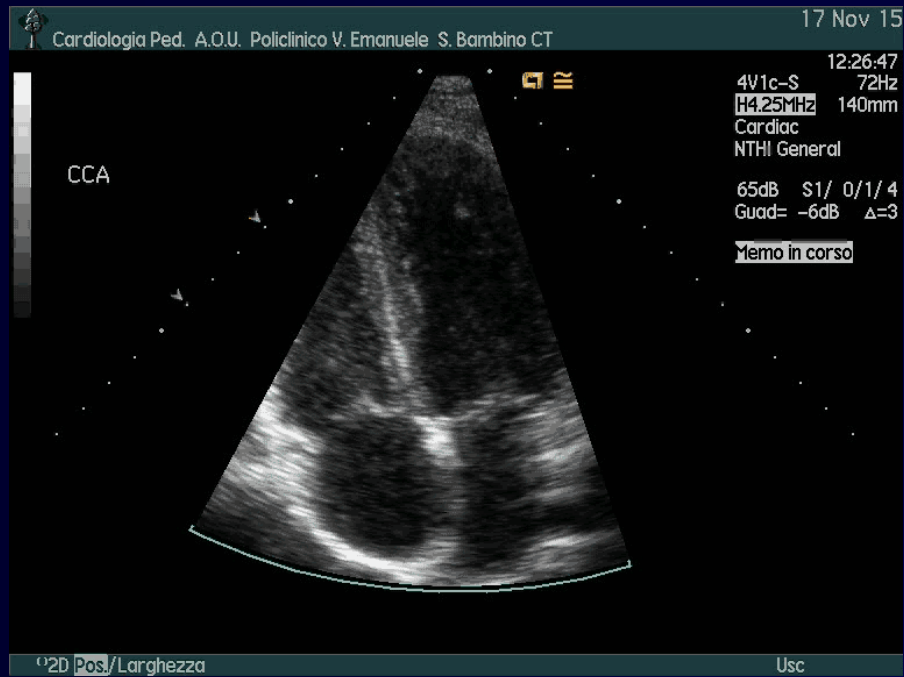


# Setto Atriale

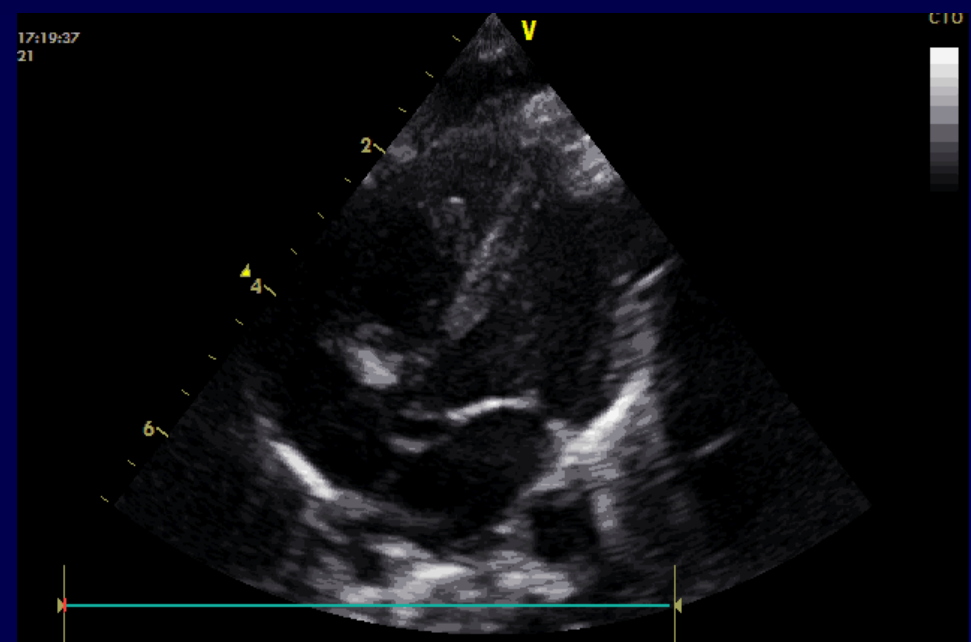


# Concordanza atrio-ventricolare

## Ventricolo Sinistro



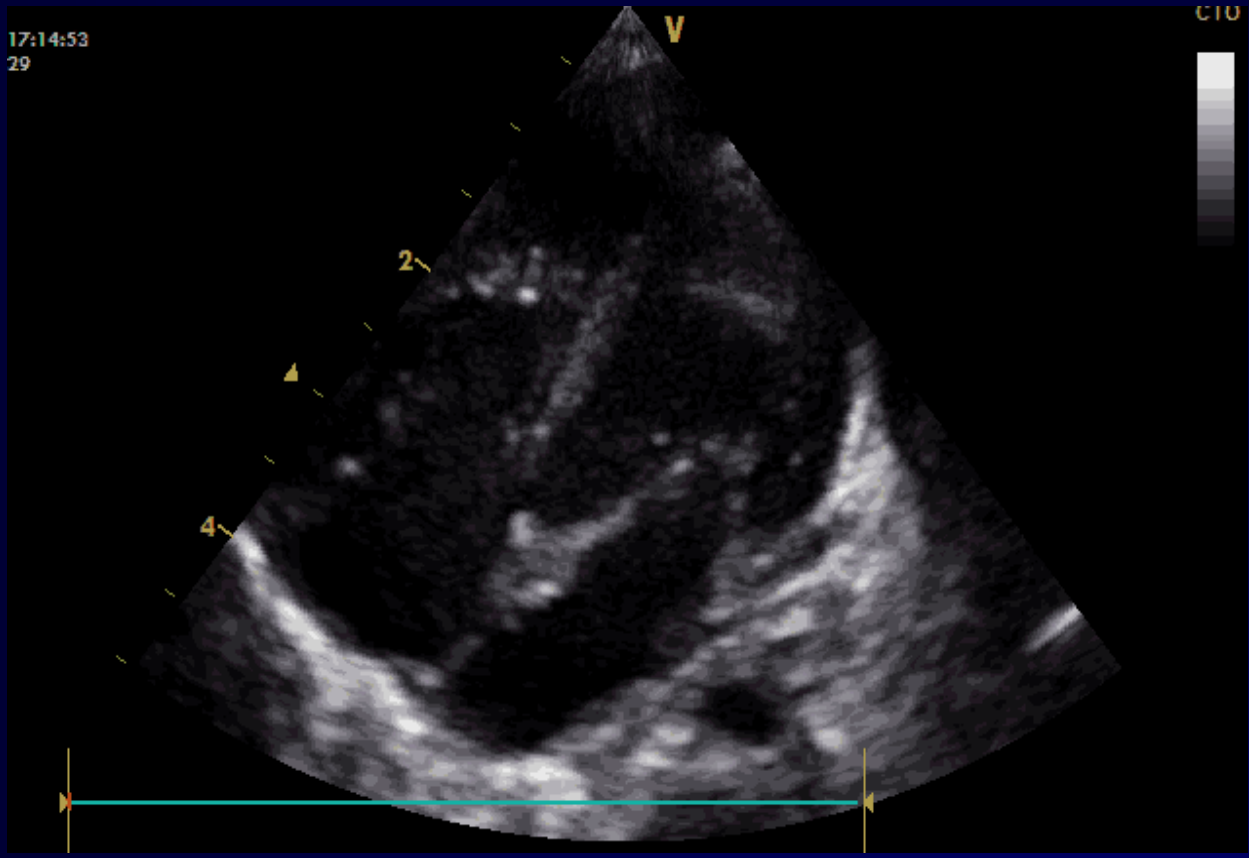
Proiezione Apicale 4 camere



Proiezione Apicale 5 camere

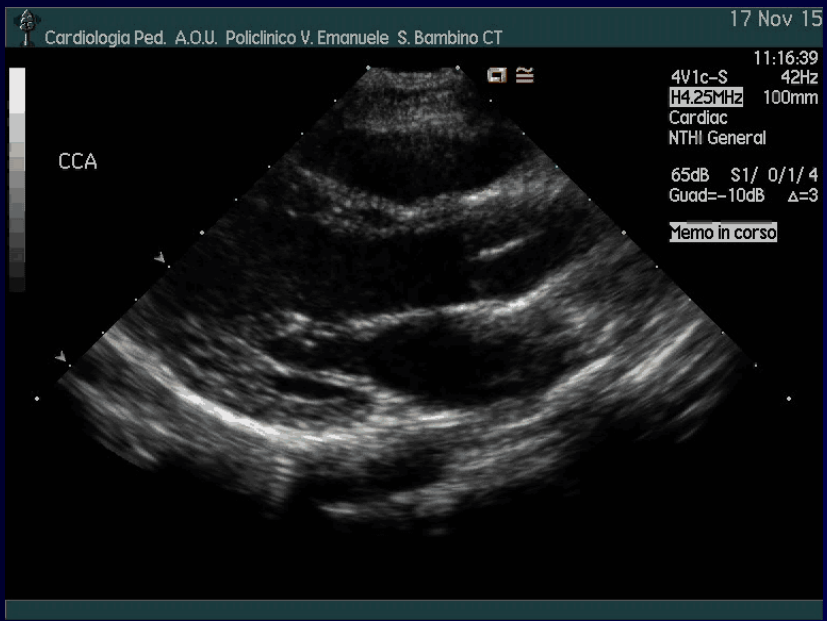
# Concordanza atrioventricolare

## Ventricolo destro afflusso ed Apice

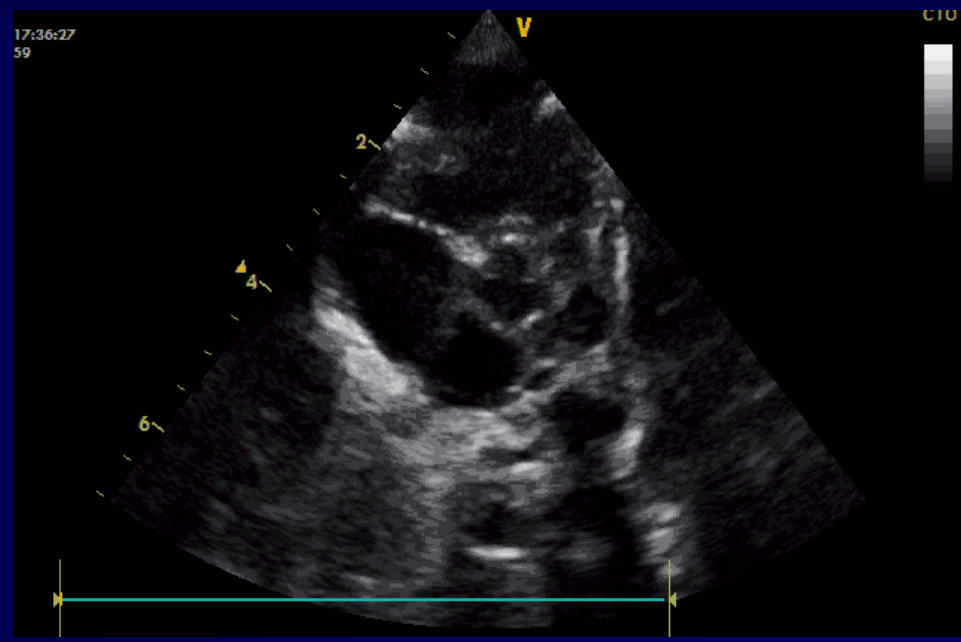


# Concordanza atrioventricolare

## Ventricolo Destro Efflusso



Parasternale asse lungo



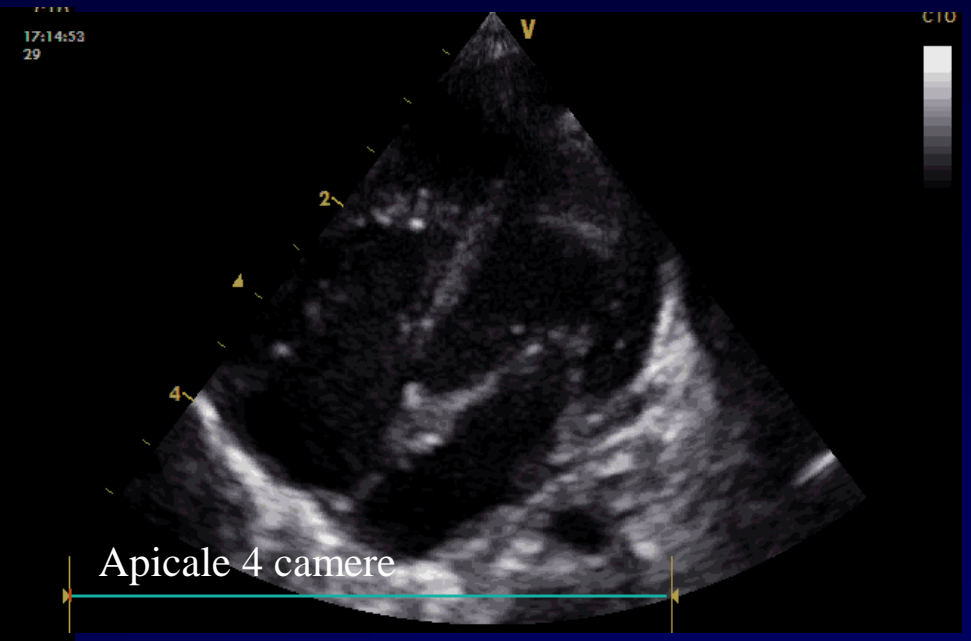
Parasternale asse corto

# Connessione atrioventricolare

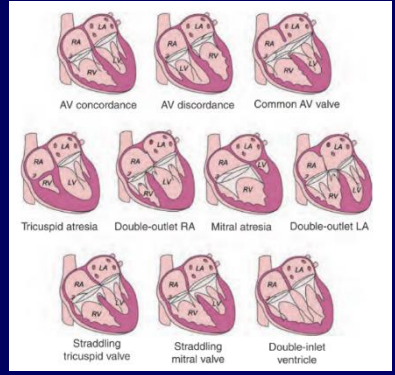
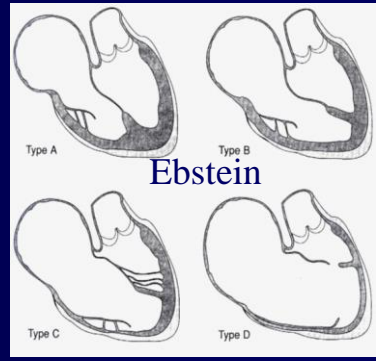
6. AV Alignments/Connections  
 (concordant, discordant,  
 straddling, atresia, etc.)



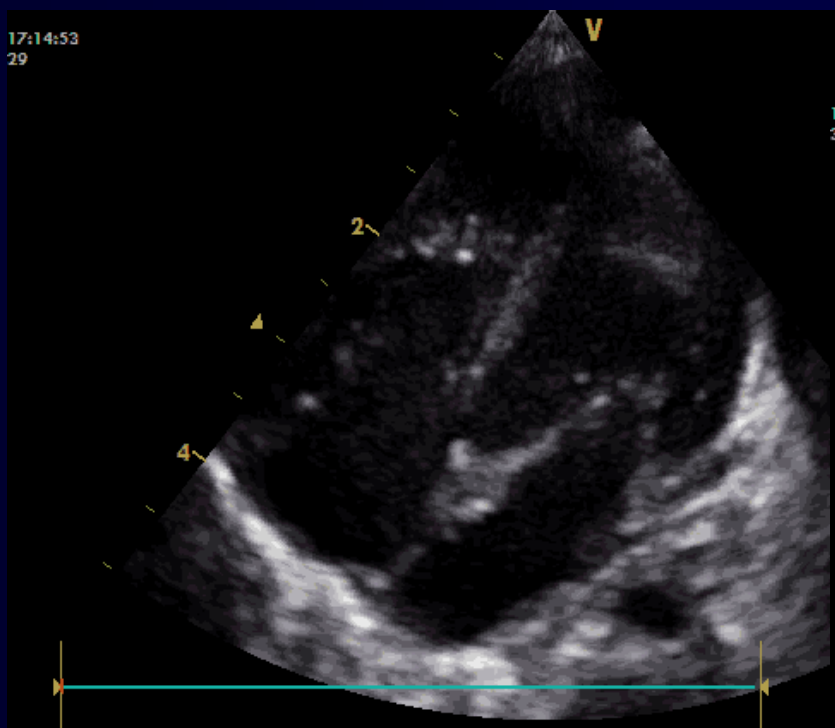
Sottocostale 4 camere



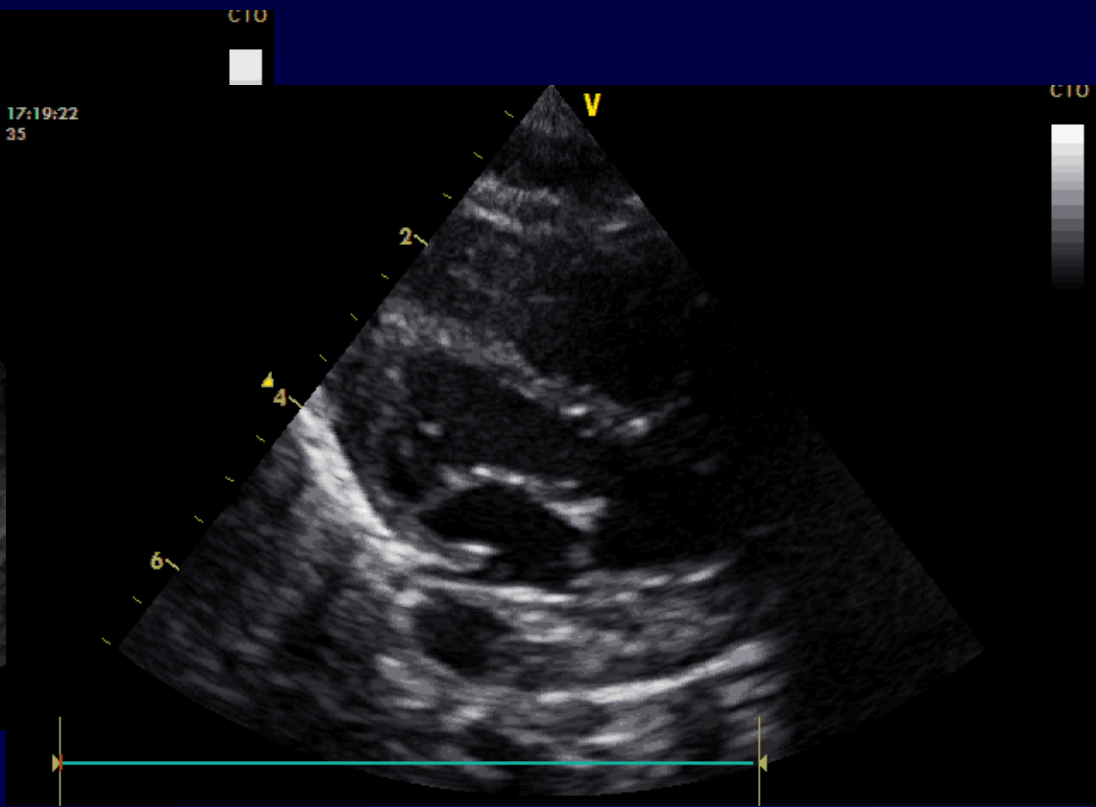
Apicale 4 camere



# Connessione atrioventricolare: studio valvola mitrale

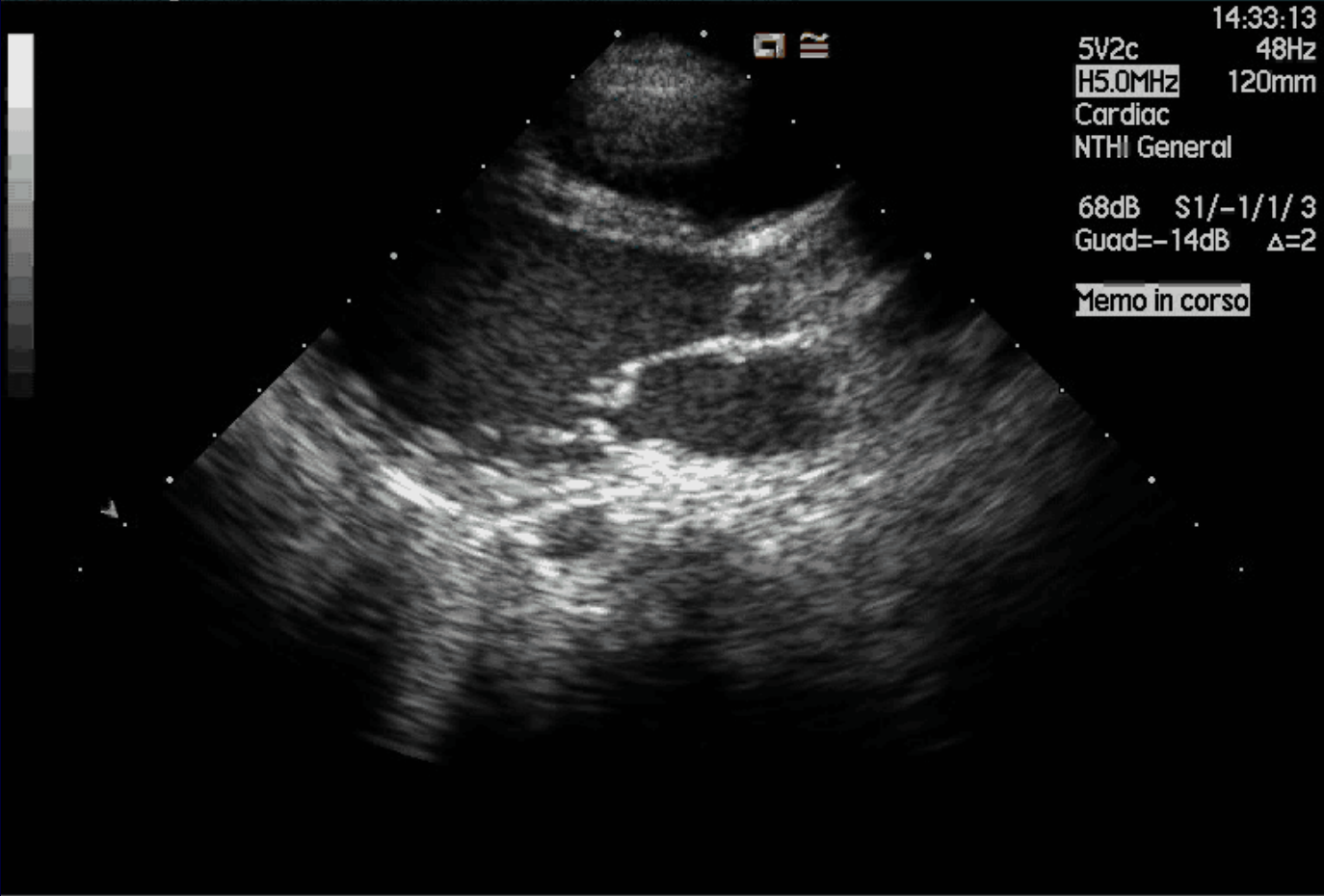


Apicale 4 camere

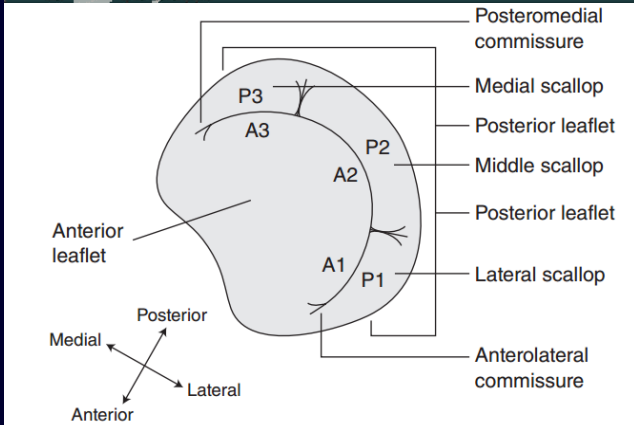
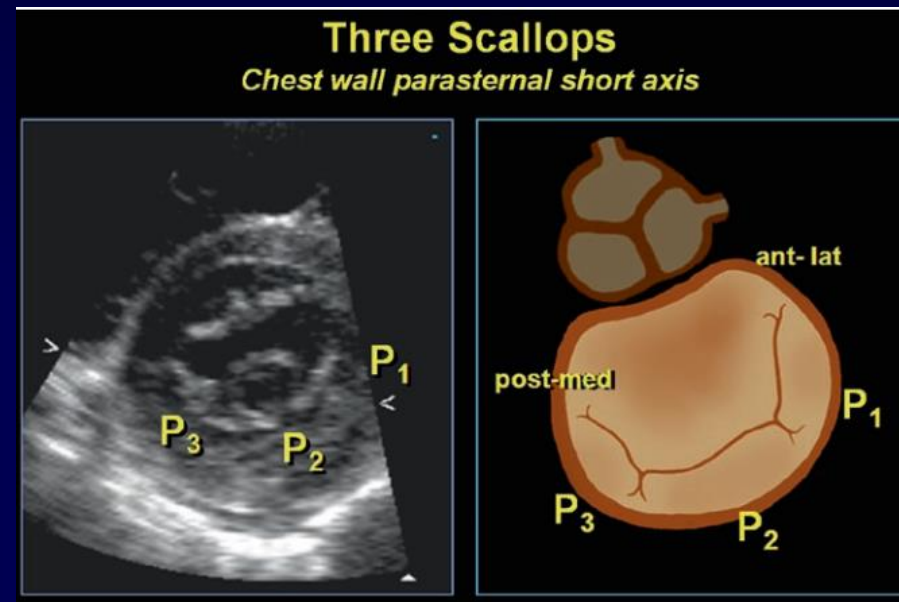
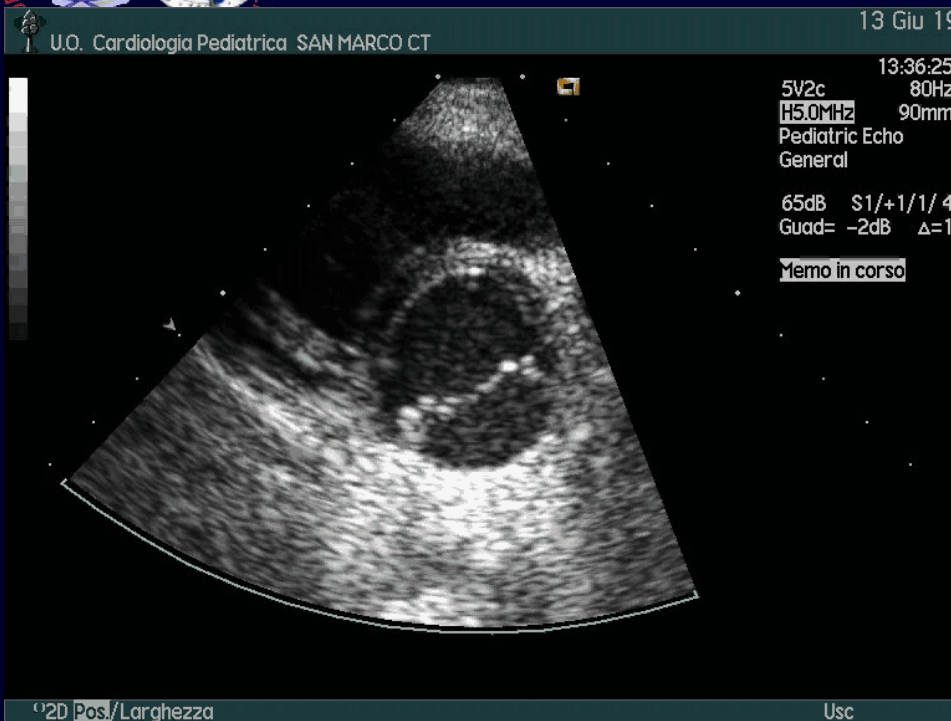


Parasternale asse lungo

10 Nov 16  
Cardiologia Ped. A.O.U. Policlinico V. Emanuele S. Bambino CT



# Nomenclatura utilizzata per descrivere l'anatomia dei lembi valvolari mitralici segmenti e commissure

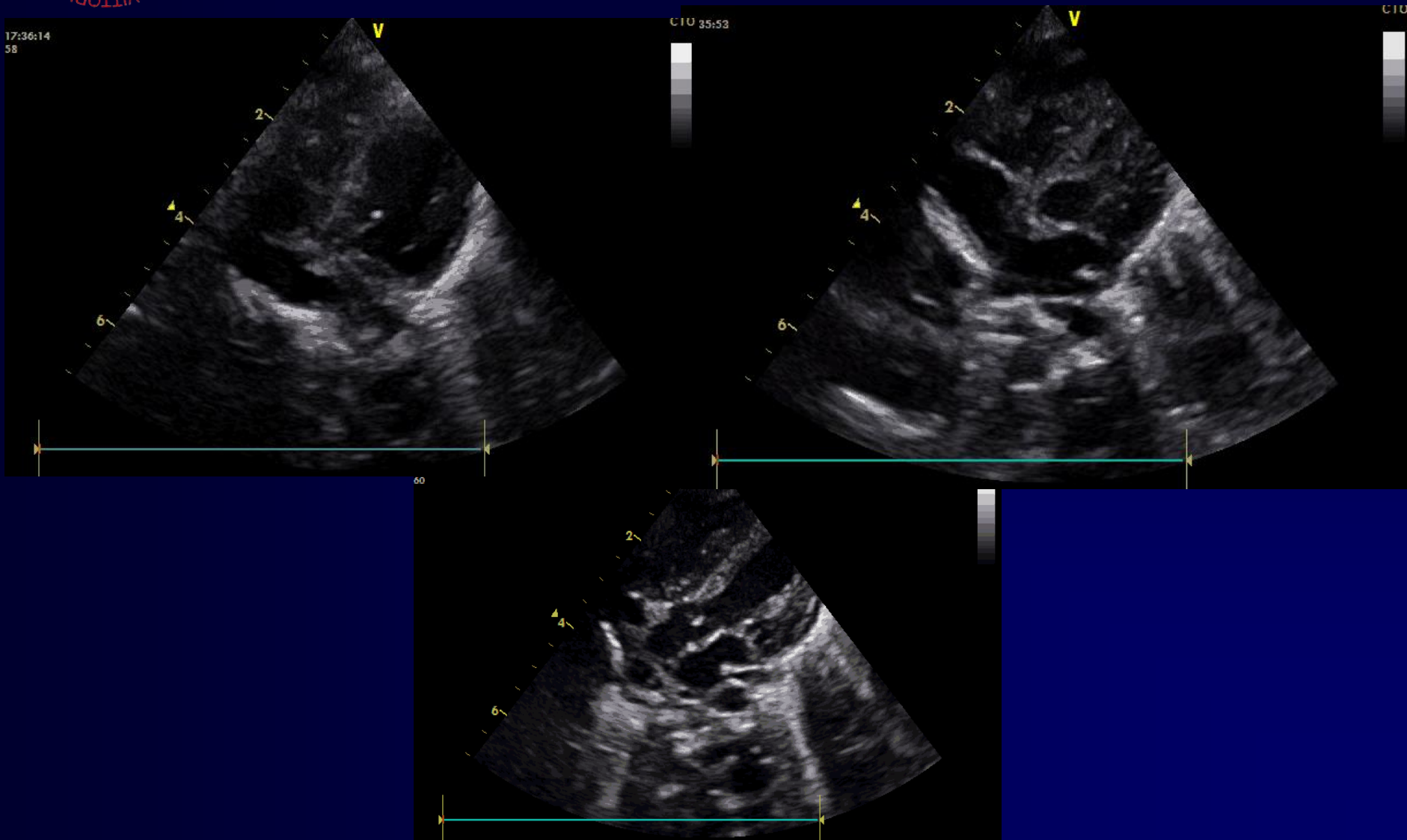


ASE/SCA guidelines 1999

anteriore	segmento	posteriore	scalloops
A1	Laterale	P1	Laterale
A2	Centrale	P2	Centrale
A3	Mediale	P3	Mediale

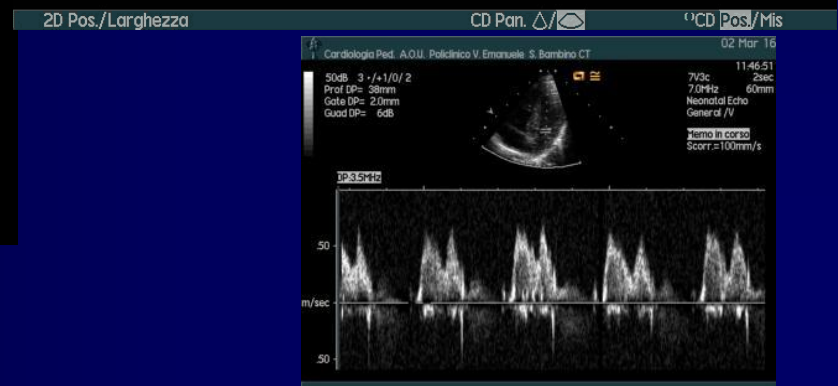
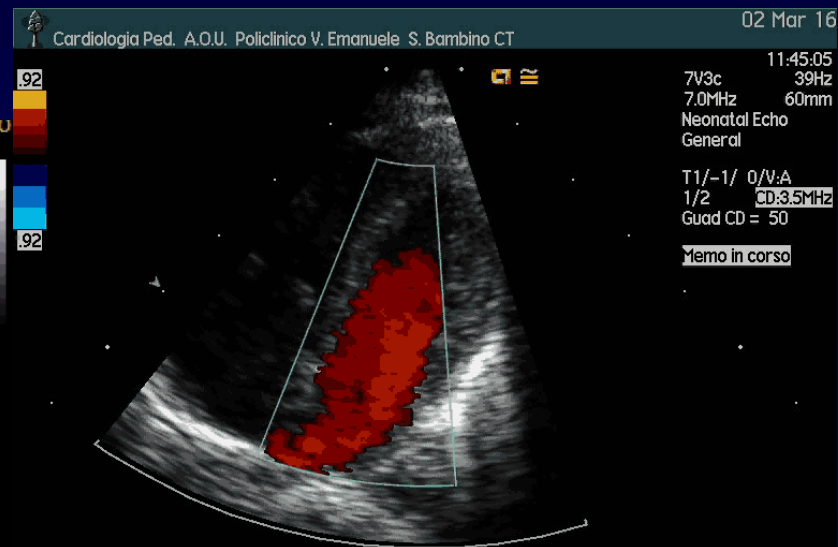
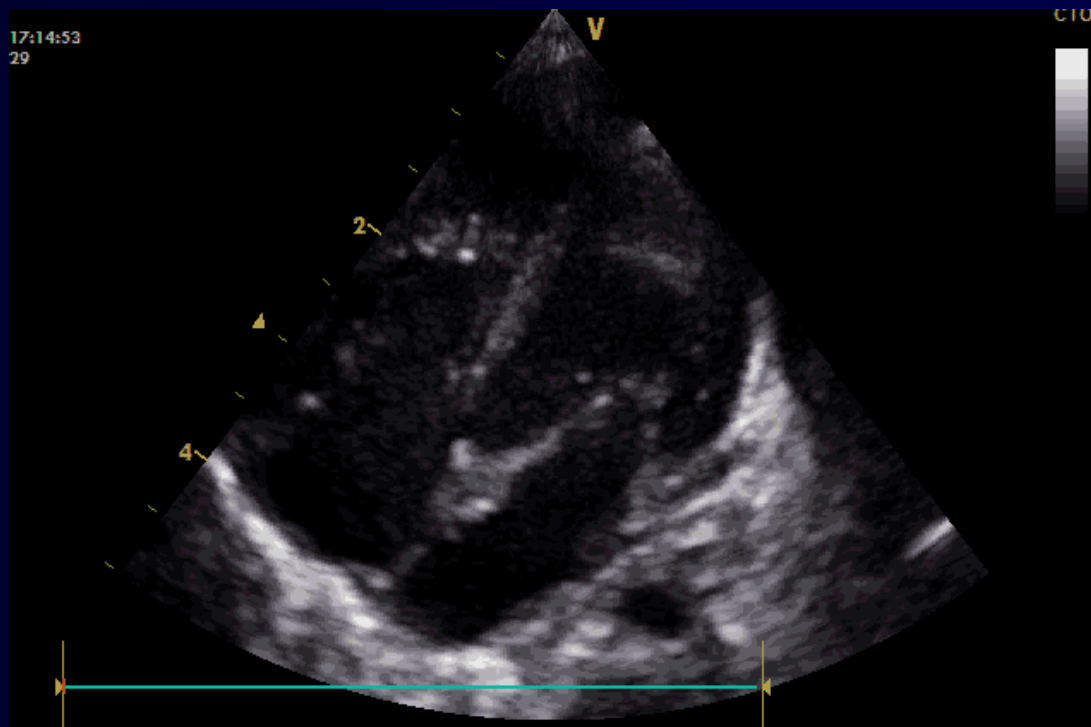


# Connessione atrioventricolare: studio valvola mitrale



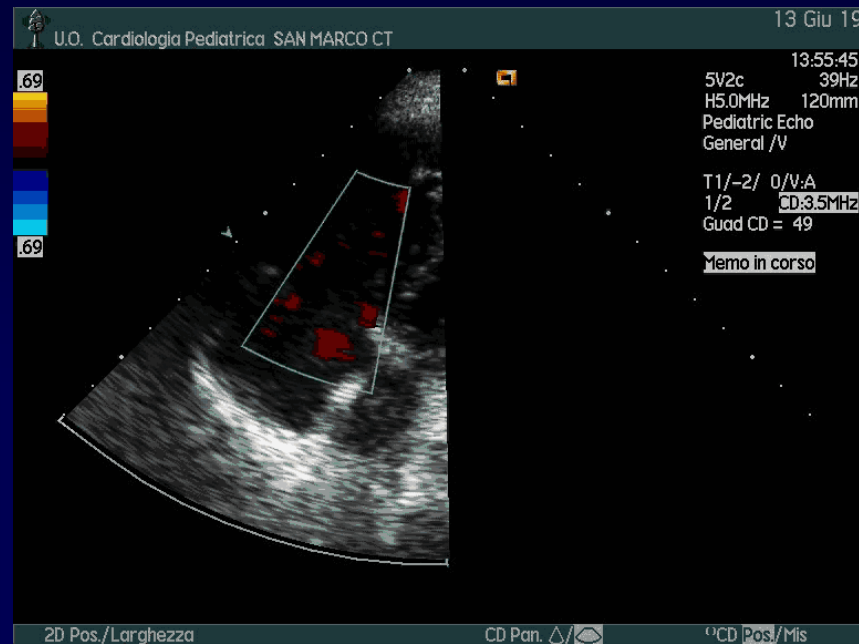
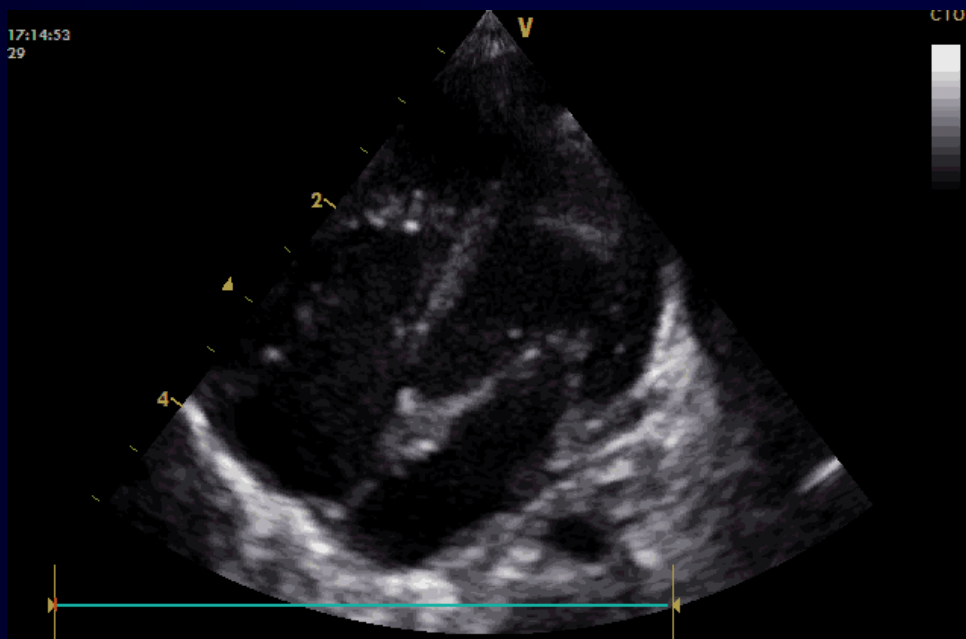
# Connessione atrioventricolare: studio valvola mitrale

6. AV Alignments/Connections  
(concordant, discordant,  
straddling, atresia, etc.)

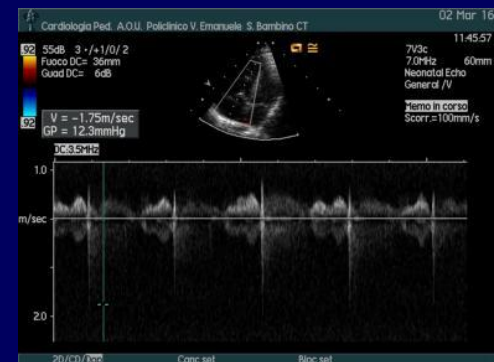
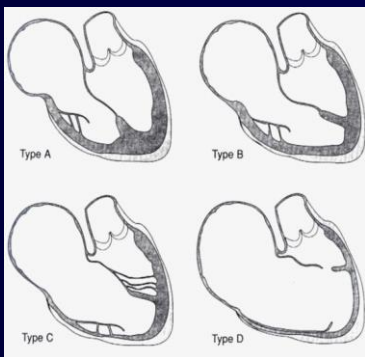


Apicale 4 camere studio valvola mitrale

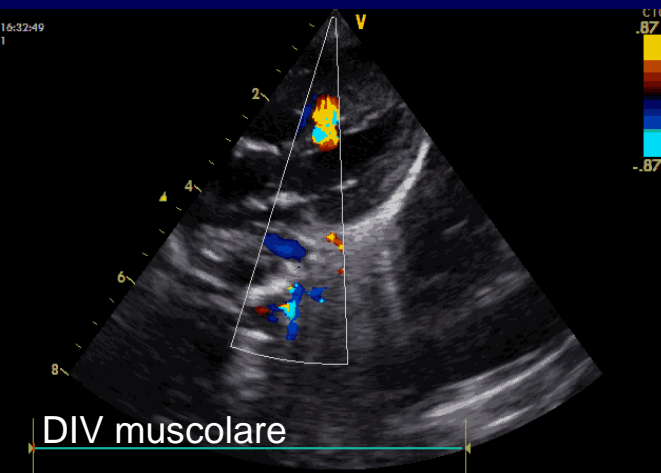
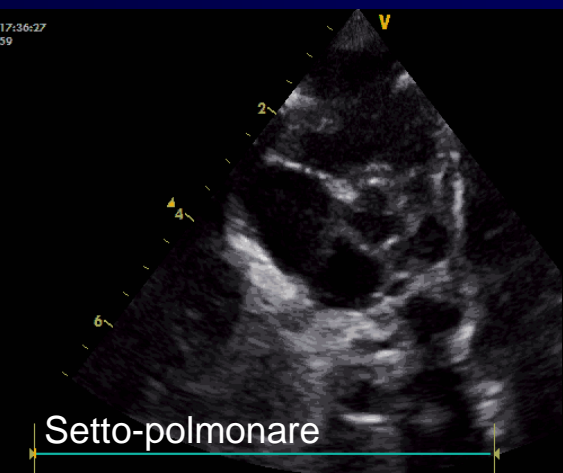
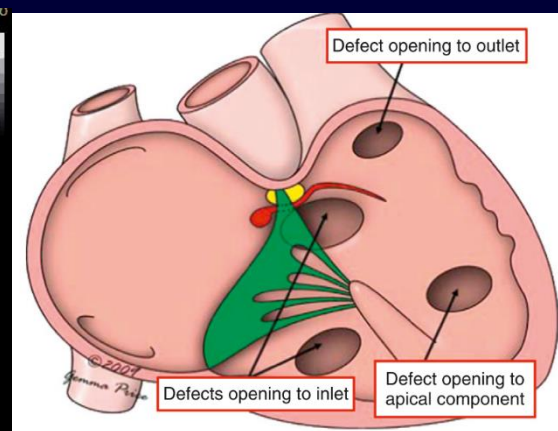
# Connessione atrioventricolare: studio valvola Tricuspidale



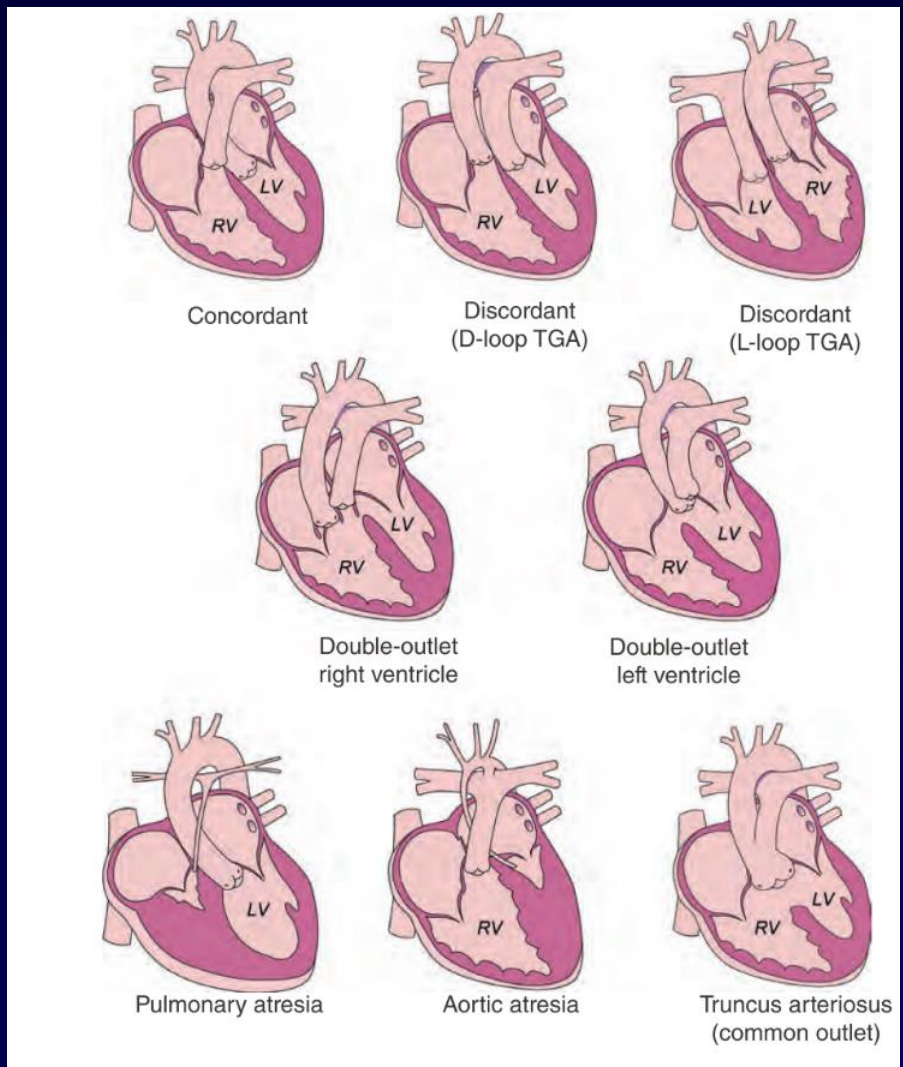
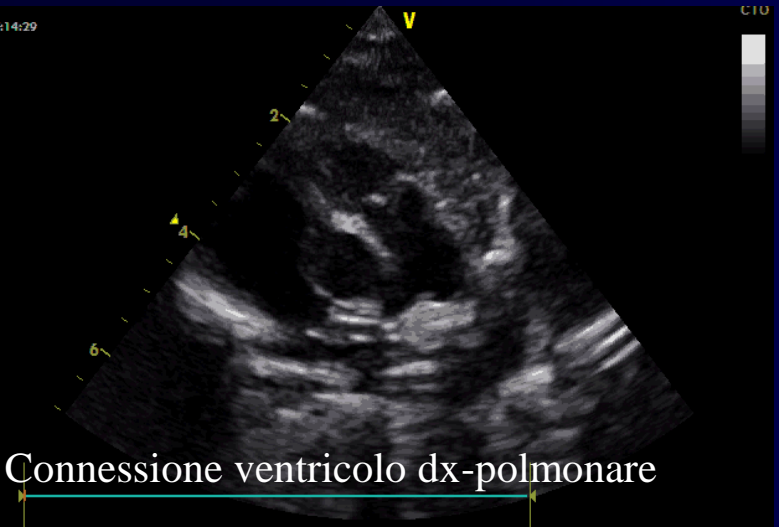
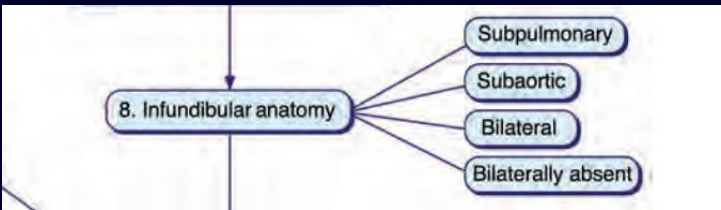
Apicale 4 camere



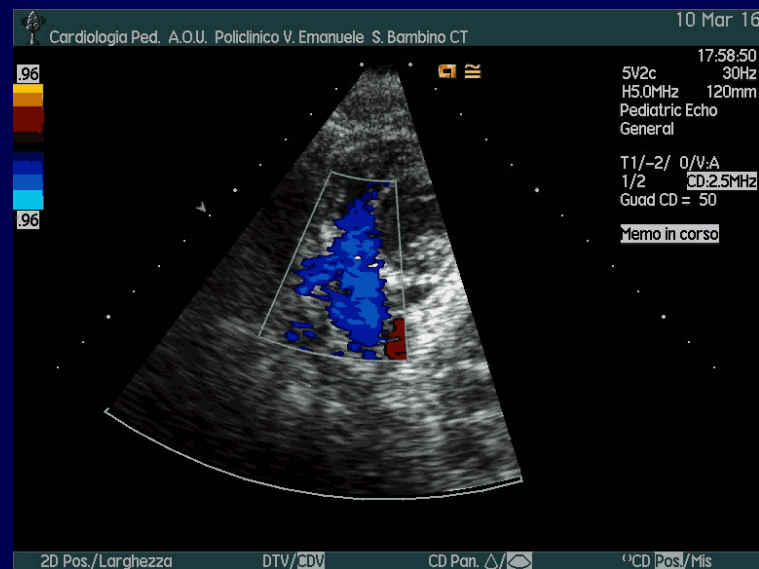
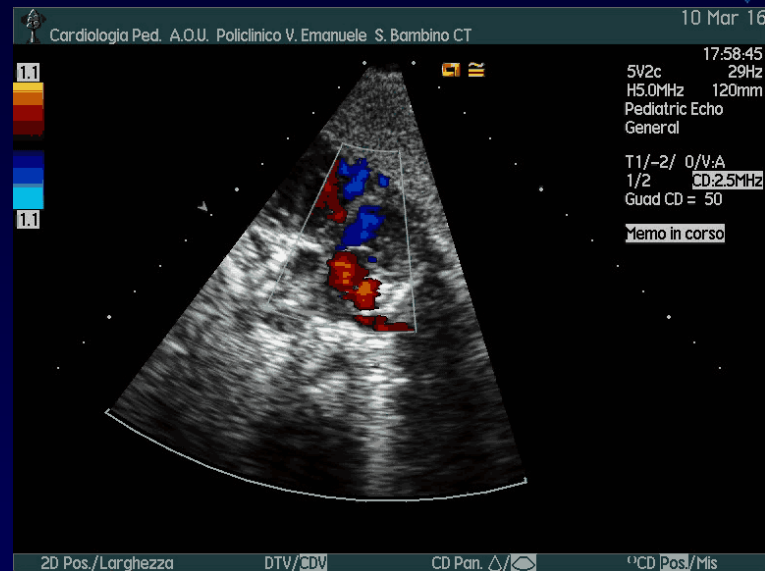
# Ventricoli studio setto ventricolare



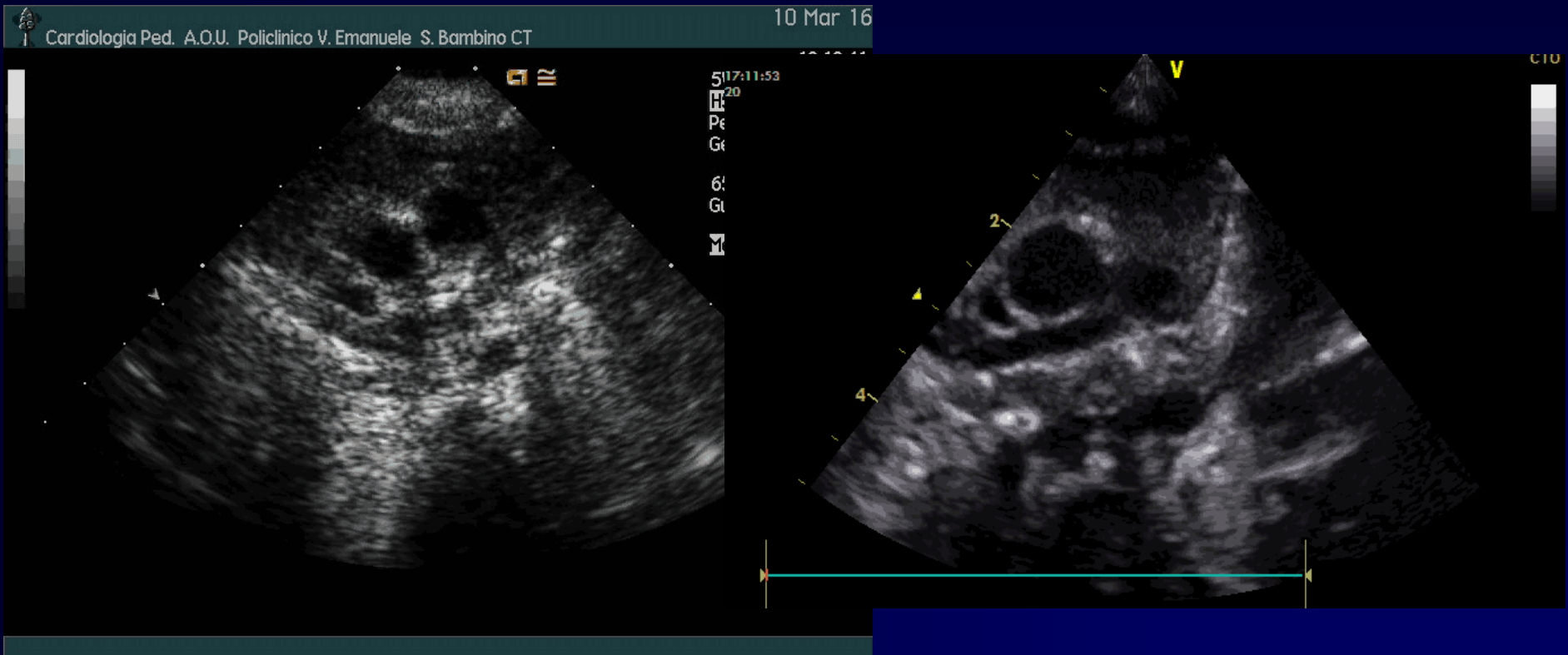
7. Ventriculo-arterial alignments (concordant, discordant [TGA], DORV, etc.)



# Proiezione sottocostale

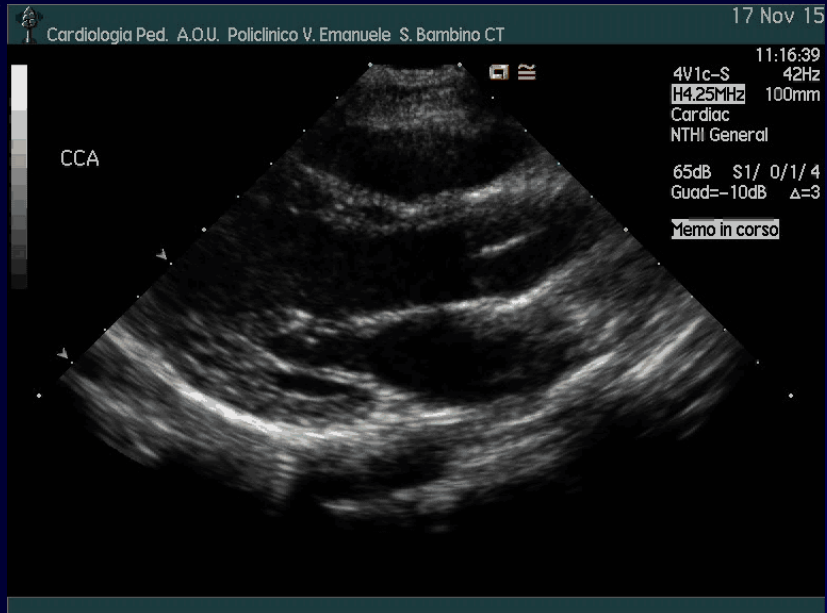


# Proiezione Soprasternale



CAP cava-aorta-polmonare

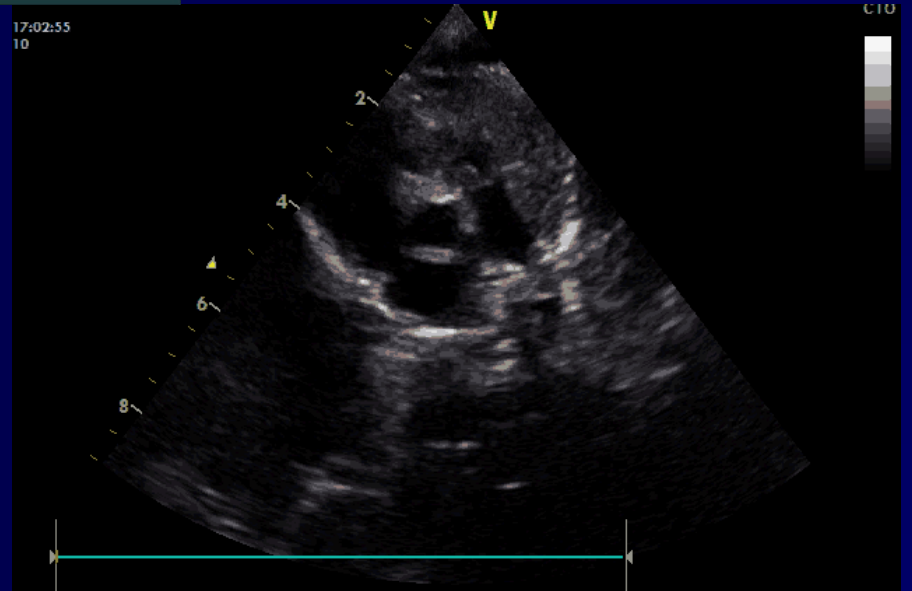
# Studio Valvola Semilunare Aorta



Parasternale asse lungo

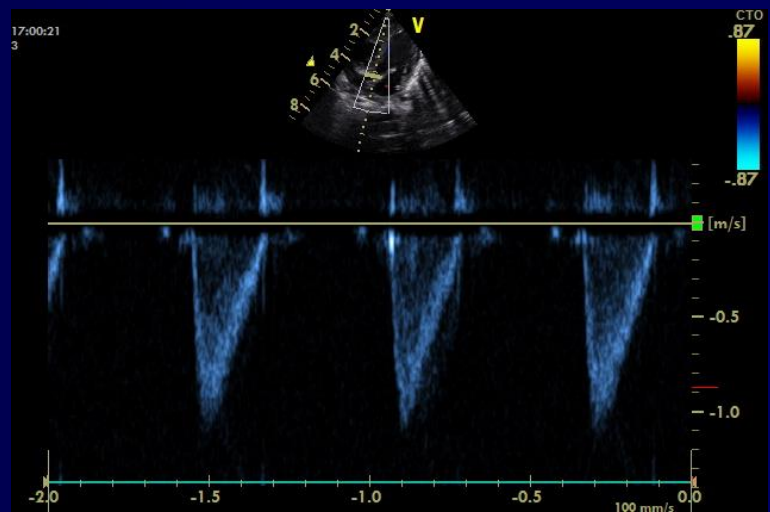
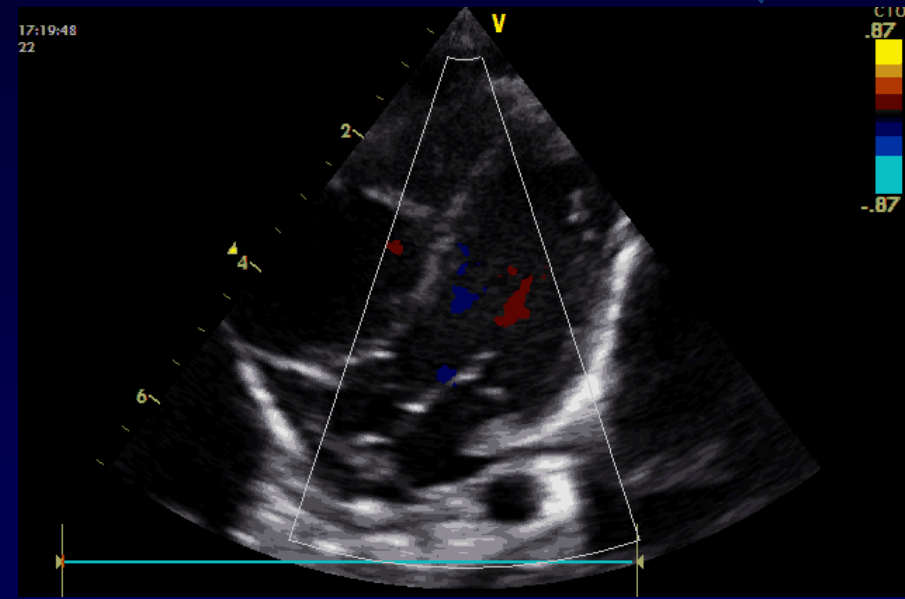
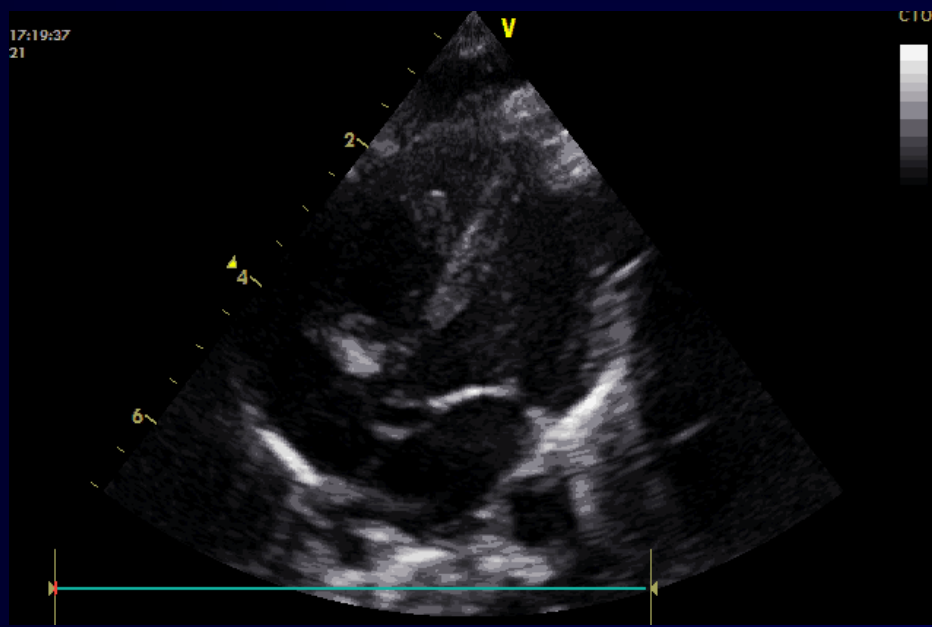


Parasternale asse corto



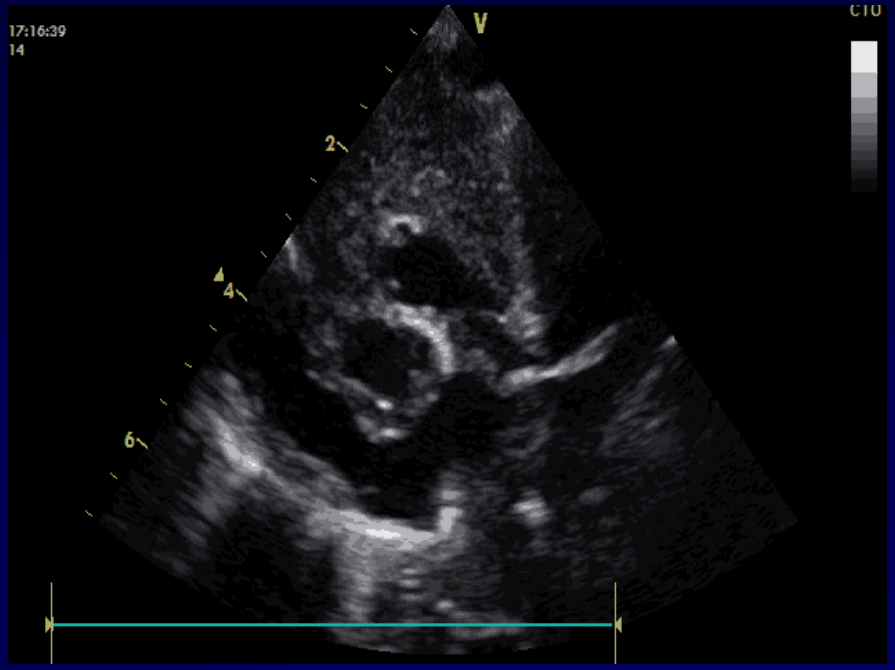
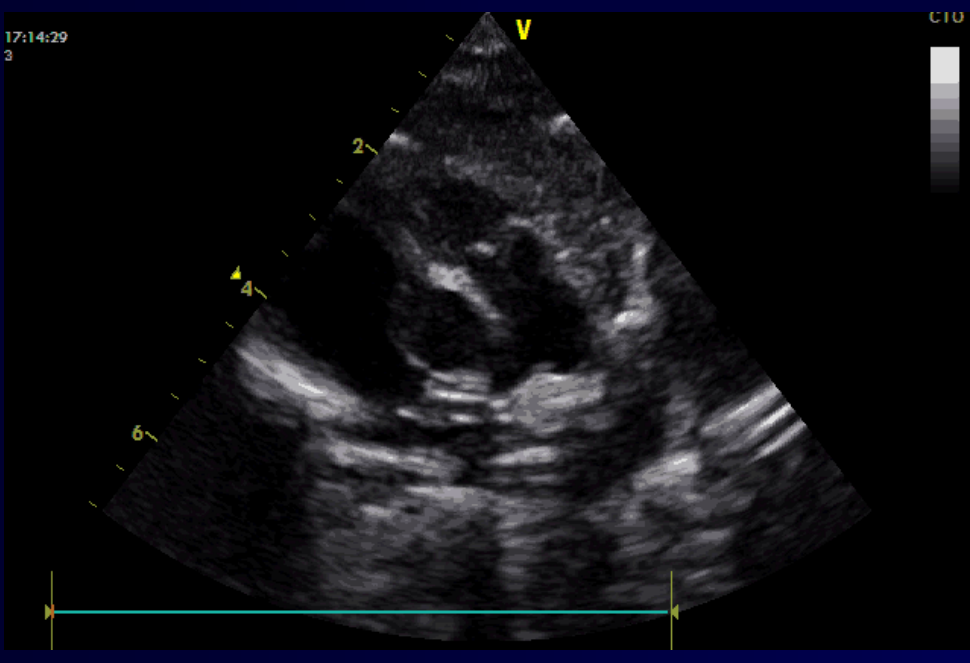


# Studio Valvola Semilunare Aorta



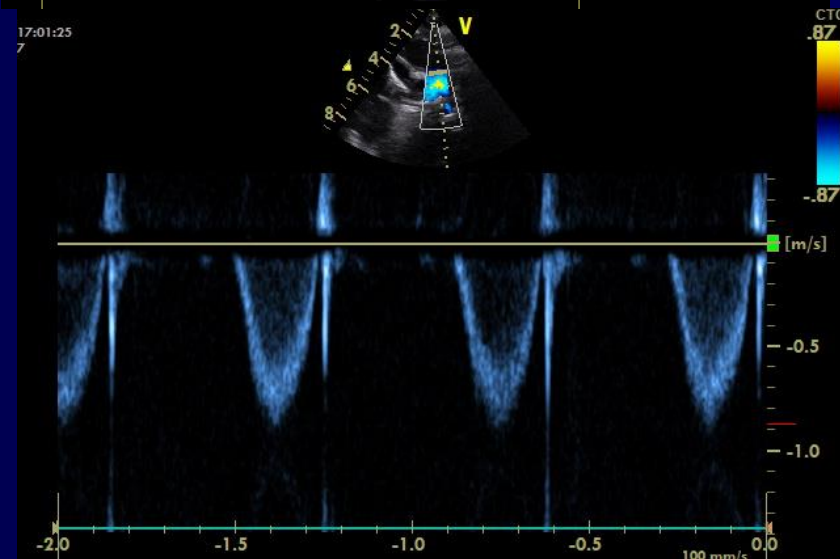
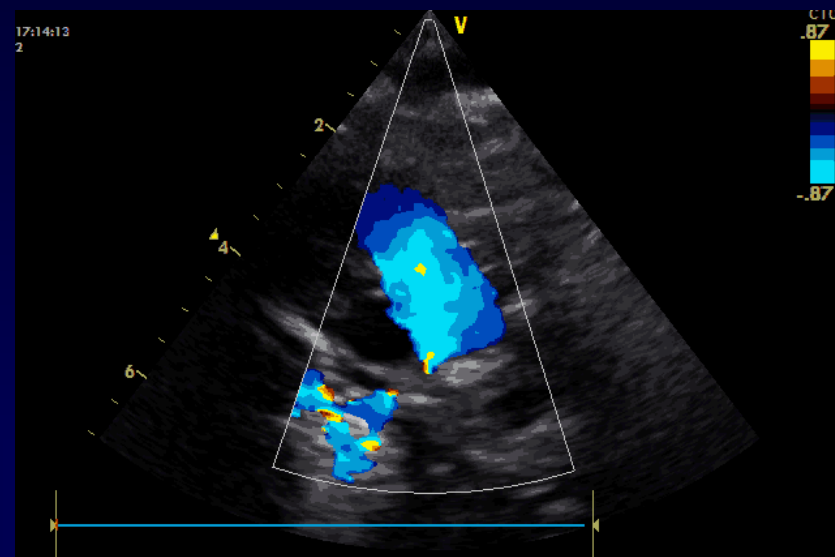
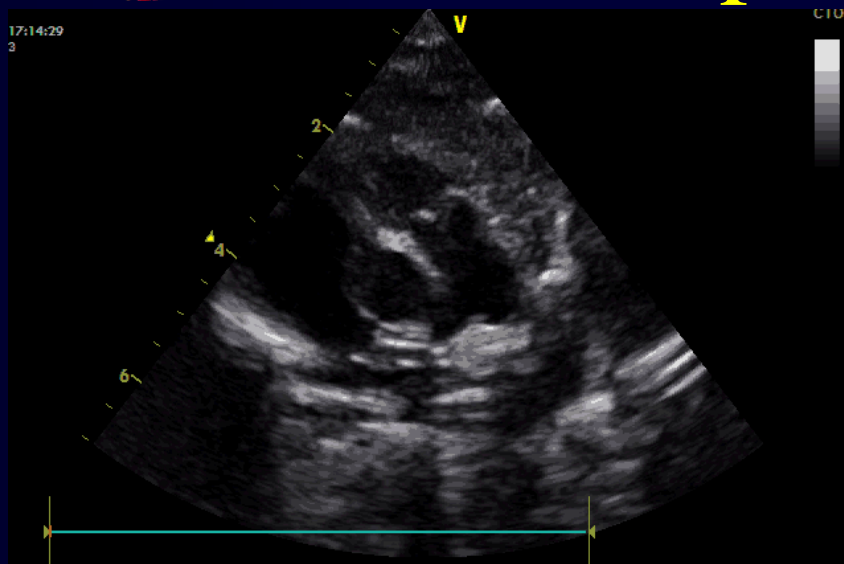
Proiezione apicale 5 camere

# Studio della valvola semilunari polmonare



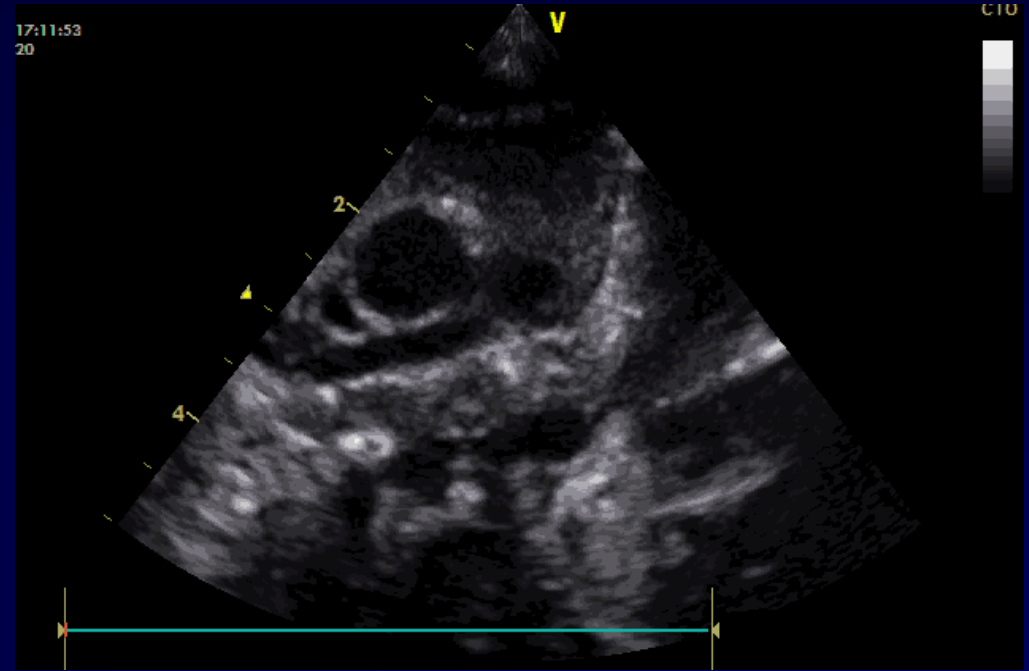
Parasternale asse corto

# Studio della valvola semilunare polmonare



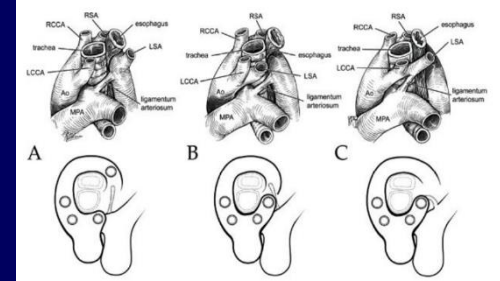
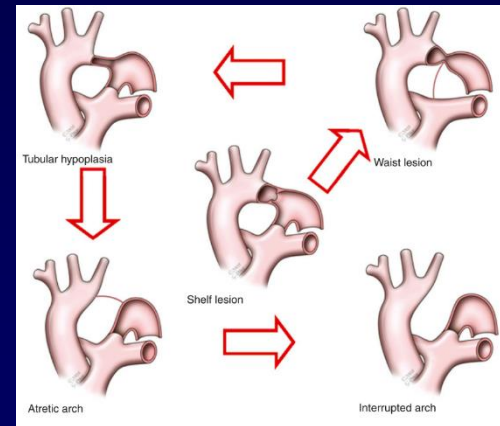
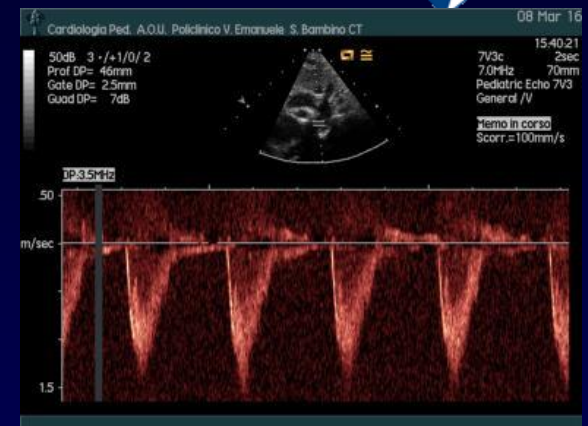
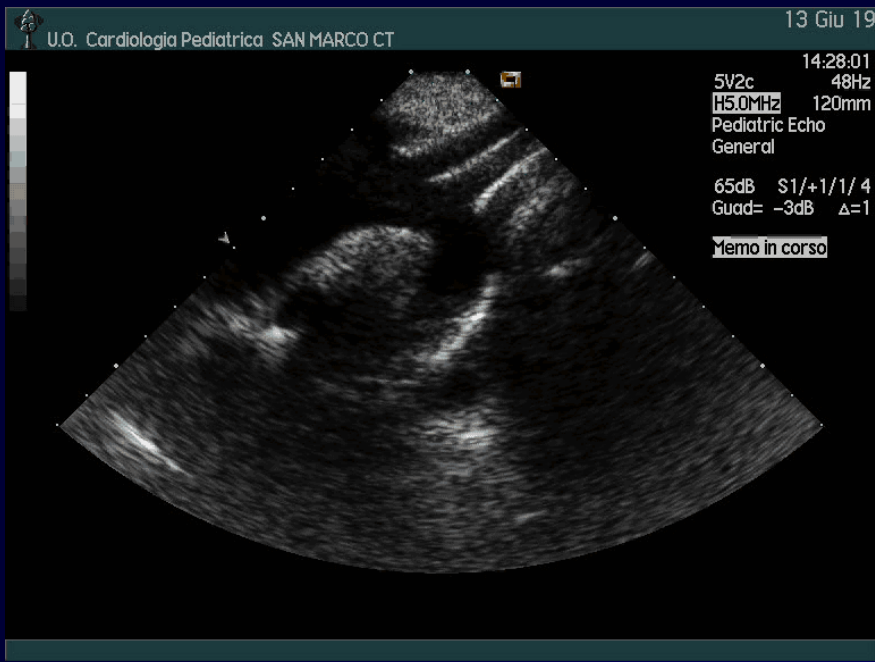
# Arteria Polmonare e rami

Parasternale asse  
corto cranializzata



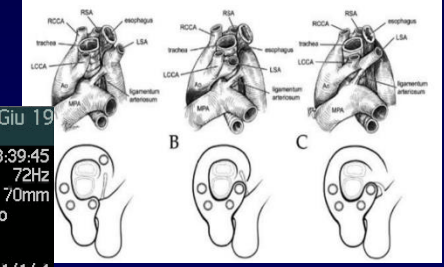
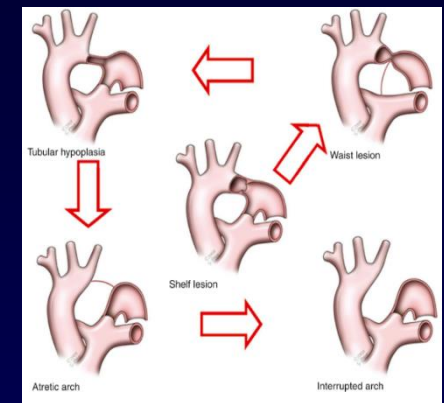
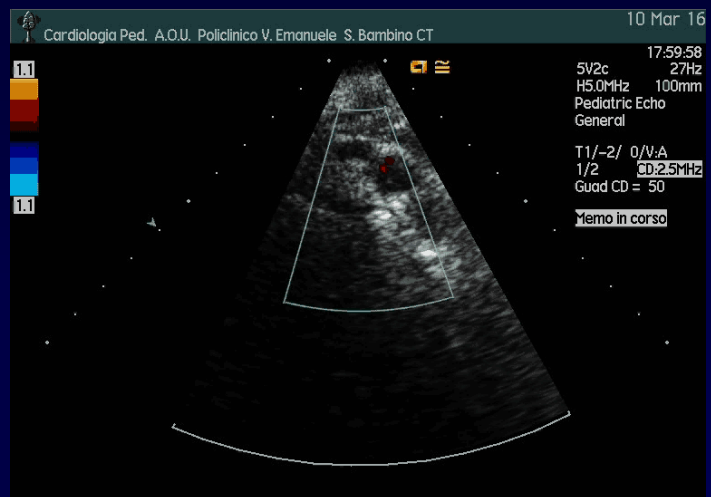
Rami polmonari

# Aorta Arco

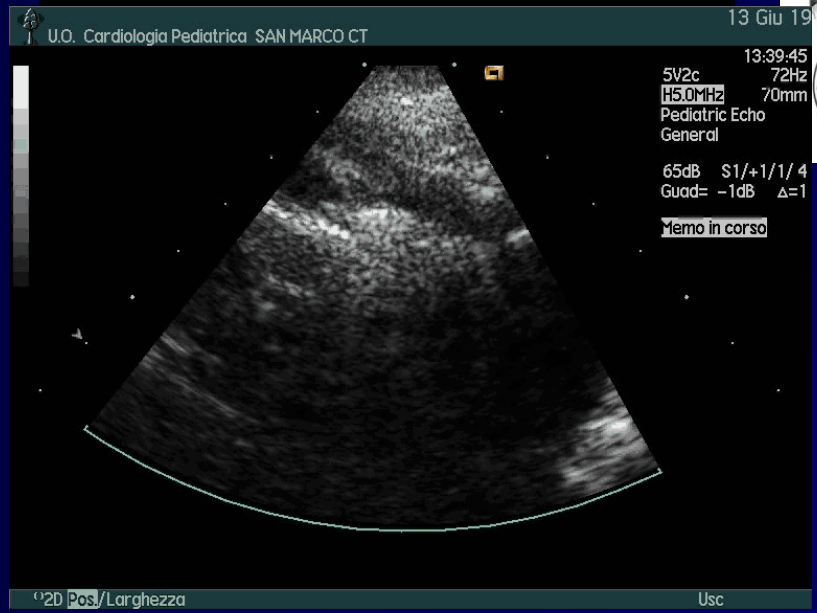




# Aorta Arco

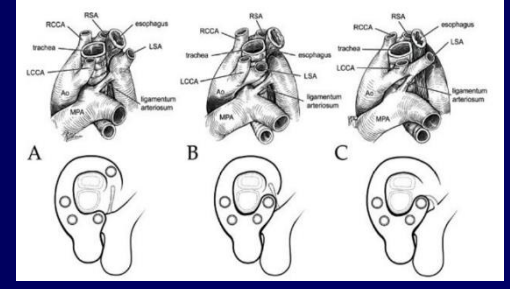
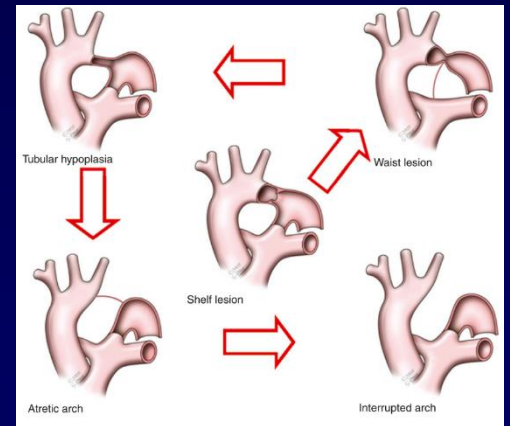
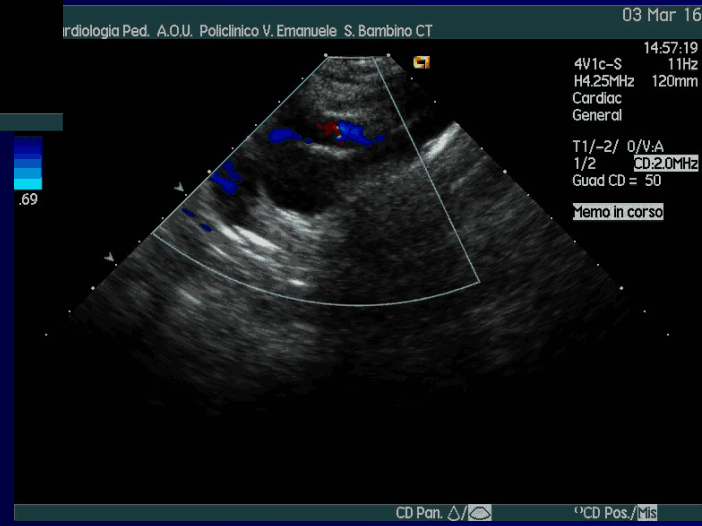
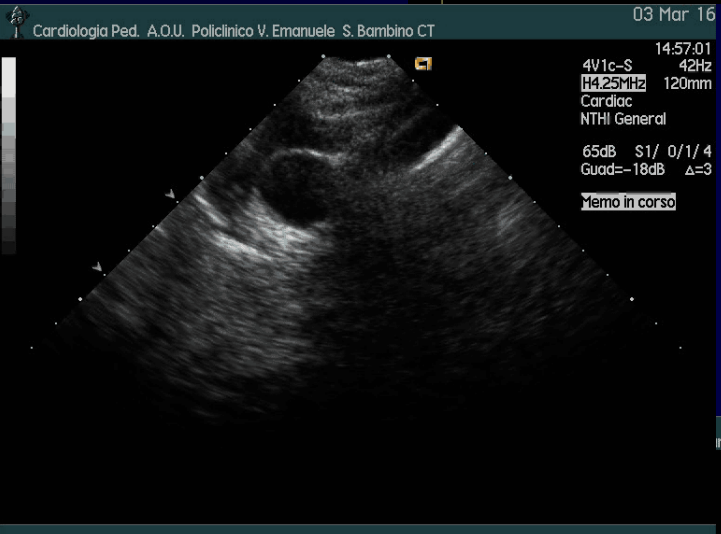
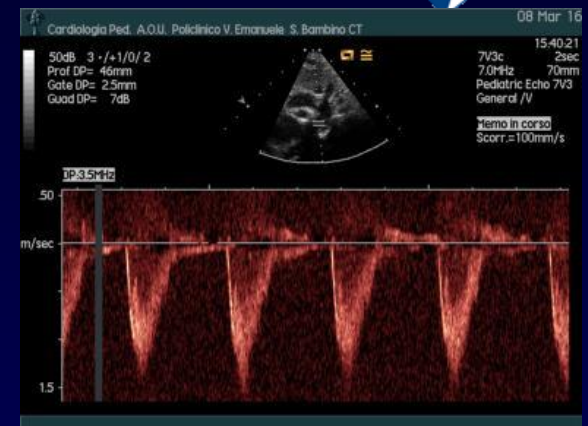
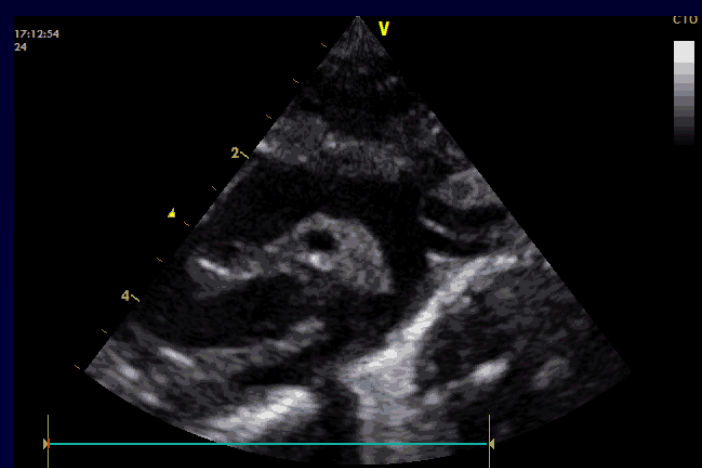


Arco-aortico- sinistro-posto



Biforcazione del primo vaso arterioso

# Aorta Arco



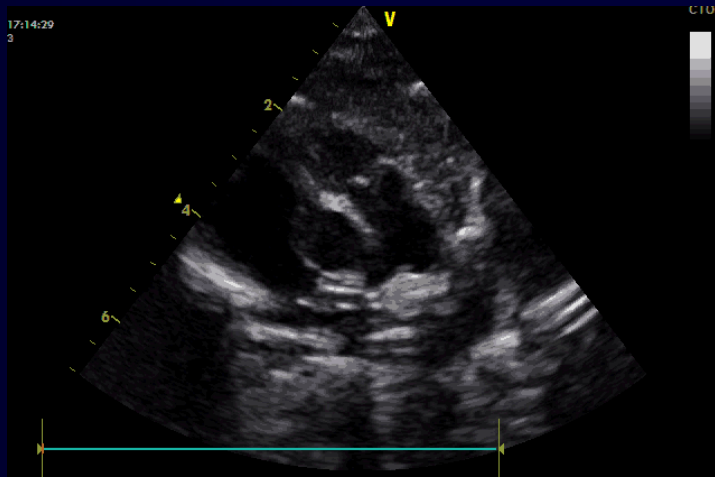
Arco-aortico- destro-posto

# Sottocostale valutazione Aorta

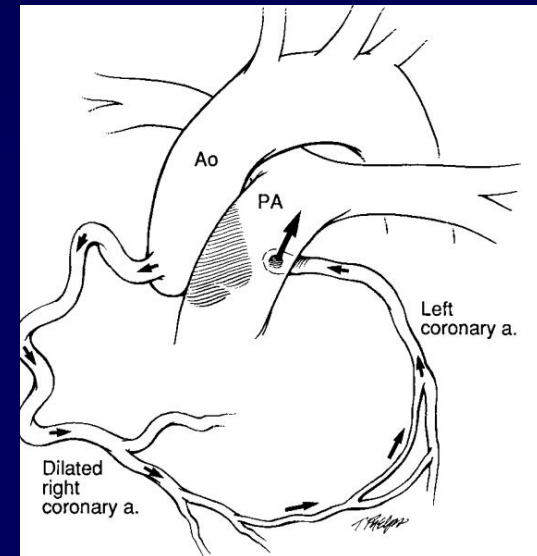
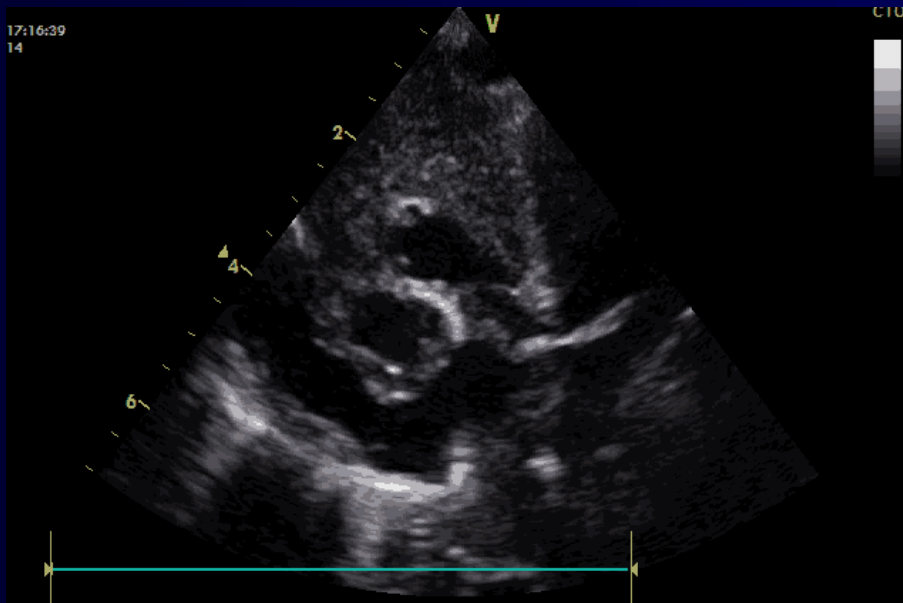
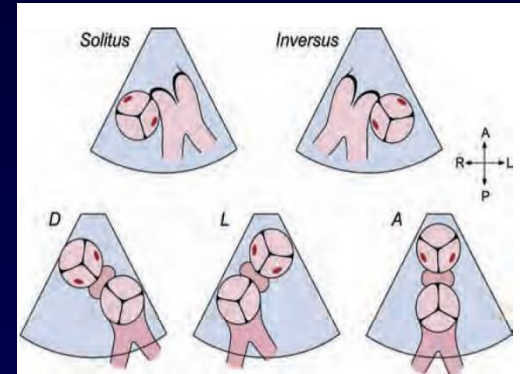




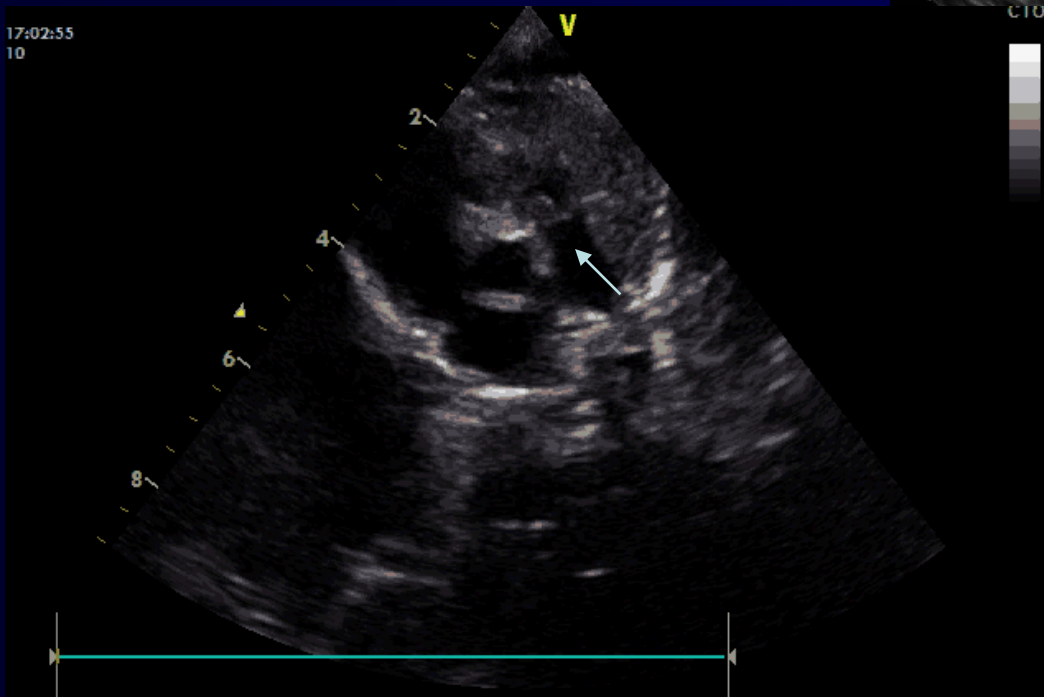
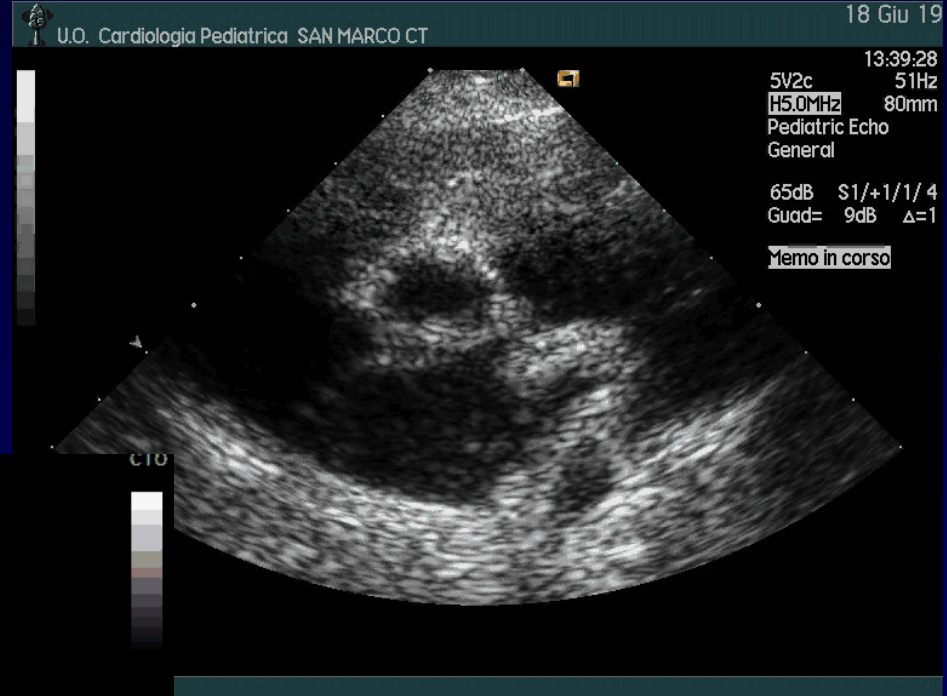
# Studio origine delle arterie coronarie



Coronaria Destra

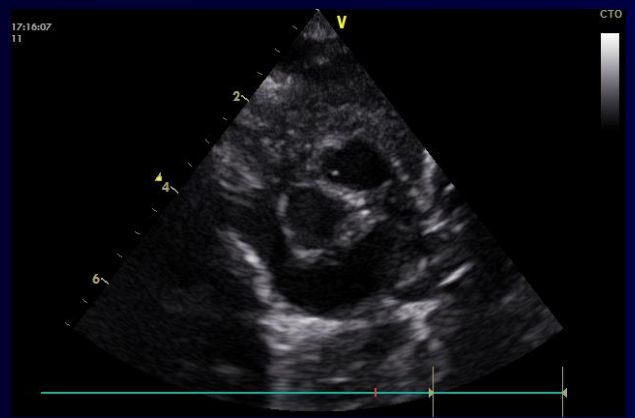
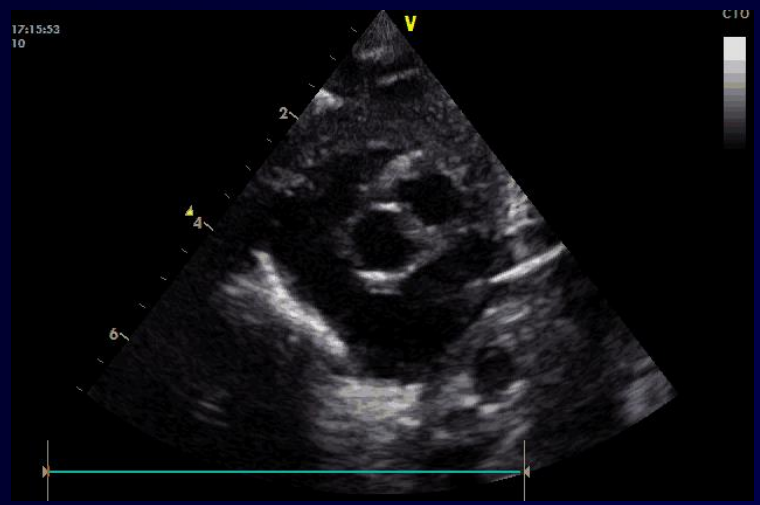


# Studio origine delle Arterie Coronarie

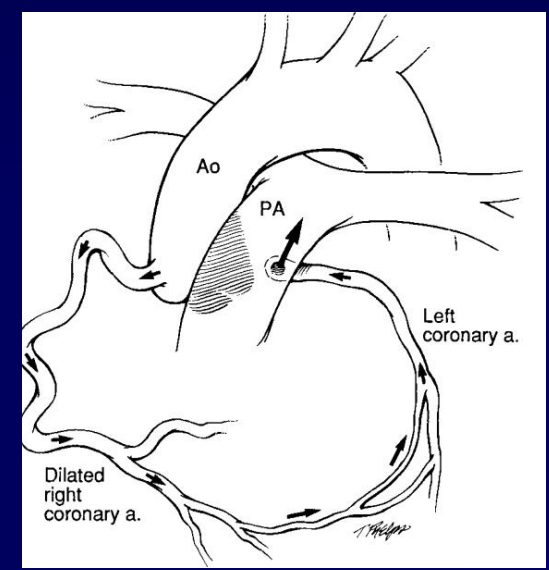
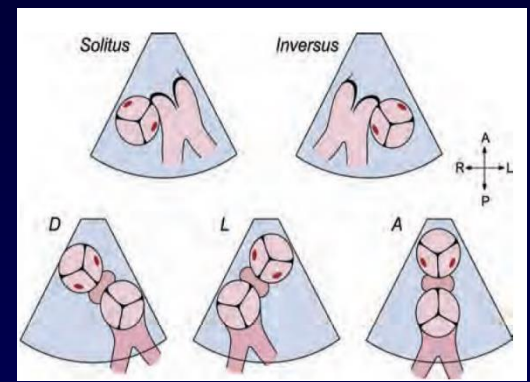


Coronaria sinistra

# Studio origine delle arterie coronarie



Coronaria sinistra



# Elenco di ciò che è possibile vedere nelle singole proiezioni

## Structures viewed from subxiphoid (subcostal) views

Inferior vena cava  
 Hepatic veins  
 Abdominal aorta  
 Diaphragm  
 Superior vena cava  
 Left atrium  
 Right atrium  
 Atrial septum  
 Coronary sinus  
 Pulmonary veins  
 Mitral valve  
 Tricuspid valve  
 Left ventricle  
 Right ventricle  
 Ventricular septum  
 Left ventricular papillary muscles  
 Aortic valve  
 Pulmonary valve  
 Ascending aorta  
 Coronary arteries  
 Main and branch pulmonary arteries  
 Pericardium

## Structures viewed from apical views

Inferior vena cava  
 Left atrium  
 Right atrium  
 Atrial septum  
 Coronary sinus  
 Selected pulmonary veins  
 Mitral valve  
 Tricuspid valve  
 Left ventricle  
 Right ventricle  
 Ventricular septum  
 Left ventricular papillary muscles  
 Aortic valve  
 Pulmonary valve  
 Ascending aorta  
 Main and branch pulmonary arteries

## Structures viewed from left parasternal views

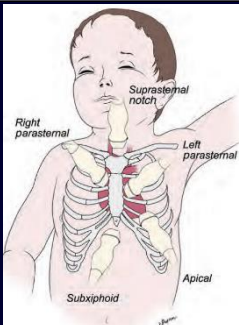
Inferior vena cava  
 Superior vena cava  
 Left atrium  
 Right atrium  
 Atrial septum  
 Coronary sinus  
 Pulmonary veins  
 Mitral valve  
 Tricuspid valve  
 Left ventricle  
 Right ventricle  
 Ventricular septum  
 Left ventricular papillary muscles  
 Aortic valve  
 Pulmonary valve  
 Ascending aorta  
 Coronary arteries  
 Main and branch pulmonary arteries  
 Pericardium

## Structures viewed from suprasternal notch views

Superior vena cava  
 Left atrium  
 Pulmonary veins  
 Ascending aorta  
 Superior thoracic aorta  
 Main and branch pulmonary arteries  
 Aortic arch  
 Proximal brachiocephalic arteries  
 Left innominate vein

## Structures viewed from right parasternal views

Inferior vena cava  
 Superior vena cava  
 Right atrium  
 Atrial septum  
 Right pulmonary veins  
 Ascending aorta  
 Right pulmonary artery



## 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

**Table 5** Recommended measurements of cardiovascular structures

Measurement	Timing	View(s)
Tricuspid valve annulus	Diastole	Apical 4-chamber
Pulmonary valve annulus	Systole	PSAX/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-chamber
Aortic valve annulus	Systole	PLAX
Aortic root	Systole	PLAX
Ascending aorta	Systole	PLAX
Transverse aortic arch	Systole	SSN
Aortic isthmus	Systole	SSN

*PLAX*, Parasternal long-axis; *PSAX*, parasternal short-axis; *SSN*, suprasternal notch.

# Valori Normali di Riferimento

Table 1 Normal M mode echocardiographic values for neonates with mean body weight between 2000 g and 4000 g

BW (kg)	RVAWd (mm)	RVDD (mm)	IVSd (mm)	IVSs (mm)	LVEDD (mm)	LVESD (mm)	LVPWd (mm)	LVPWs (mm)	PAD (mm)	AoD (mm)	LAD (mm)
2.0	1.3	4.0	2.1	2.4	15.0	9.7	1.9	2.8	6.2	6.9	8.3
	<b>2.4</b>	<b>8.4</b>	<b>3.5</b>	<b>4.4</b>	<b>17.1</b>	<b>11.0</b>	<b>2.7</b>	<b>4.5</b>	<b>9.3</b>	<b>8.2</b>	<b>11.5</b>
	3.5	12.8	4.7	6.4	19.2	12.3	3.5	6.2	12.4	9.5	14.7
2.5	1.4	4.0	2.1	2.4	15.0	9.2	2.2	2.9	6.8	7.4	8.5
	<b>2.5</b>	<b>8.4</b>	<b>3.5</b>	<b>5.0</b>	<b>18.1</b>	<b>11.7</b>	<b>3.2</b>	<b>5.0</b>	<b>11.0</b>	<b>8.8</b>	<b>12.1</b>
	3.6	12.8	4.7	7.6	21.1	14.2	4.2	7.1	15.2	10.2	15.6
3.0	1.4	4.1	2.3	2.5	15.1	9.2	2.4	3.1	7.0	7.5	9.4
	<b>2.5</b>	<b>8.5</b>	<b>3.6</b>	<b>5.1</b>	<b>18.2</b>	<b>11.7</b>	<b>3.5</b>	<b>5.1</b>	<b>11.0</b>	<b>9.1</b>	<b>12.6</b>
	3.6	12.9	4.9	7.7	21.3	14.2	4.6	7.1	15.0	10.7	15.8
3.5	1.5	4.1	2.3	2.5	15.4	9.5	2.5	3.3	8.0	7.5	10.2
	<b>2.6</b>	<b>8.6</b>	<b>3.7</b>	<b>5.3</b>	<b>18.8</b>	<b>11.9</b>	<b>3.6</b>	<b>5.4</b>	<b>11.2</b>	<b>9.3</b>	<b>13.2</b>
	3.7	13.1	5.1	8.1	22.2	14.3	4.7	7.5	14.4	11.1	16.2
4.0	1.5	4.1	2.4	2.6	16.5	10.2	2.6	3.5	9.3	7.6	10.5
	<b>2.6</b>	<b>8.6</b>	<b>3.8</b>	<b>5.4</b>	<b>19.9</b>	<b>12.7</b>	<b>3.7</b>	<b>5.7</b>	<b>12.5</b>	<b>9.6</b>	<b>13.7</b>
	3.7	13.1	5.2	8.2	23.3	15.2	4.8	7.9	15.7	11.6	16.9

The mean value is bold; the value above is mean - 2 SD, the value below is mean + 2 SD.

AoD, aortic diameter; BW, body weight; IVSd, thickness of interventricular septum at end diastole; IVSs, thickness of interventricular septum at end systole; LAD, left atrial dimension; LVEDD, left ventricular end diastolic dimension; LVESD, left ventricular end systolic dimension; LVPWd, left ventricular posterior wall thickness at end diastole; LVPWs, left ventricular posterior wall thickness at end systole; PAD, pulmonary artery diameter; RVAWd, right ventricular anterior wall thickness at end diastole; RVDD, right ventricular end diastolic dimension.

*Heart* 2000;**83**:667-672

**Table 1** Patient demographics Journal of the American Society of Echocardiography May 2012

Variable	Controls (n = 44)	Patients with PHT (n = 41)	P
Age (y)	7.7 ± 4.1	7.9 ± 5.6	.82
Height (cm)	126.1 ± 23.7	117.6 ± 34.2	.20
Weight (kg)	31.1 ± 16.5	26 ± 17.5	.14
Heart rate (beats/min)	97 ± 28	105 ± 23	.43

**Table 2** Conventional echocardiographic measures

Variable	Controls (n = 44)	Patients with PHT (n = 41)	P
RA area	9.6 ± 2.5	12.4 ± 6.2	.02
LA diameter	9.2 ± 2.8	7.6 ± 3.7	.044
TV diameter	2.15 ± 0.48	2.57 ± 0.75	.005
PV diameter	1.85 ± 0.36	2.06 ± 0.65	.10
Right PA	1.1 ± 0.3	1.3 ± 0.5	.002
Left PA	1.1 ± 0.3	1.4 ± 0.5	.002
RVIDd (cm)	1.83 ± 0.72	2.73 ± 1.29	.0002
RVIDs (cm)	1.5 ± 0.52	3.6 ± 6.5	.002
TR velocity (m/sec)	2 ± 0.4	4.5 ± 1	<.0001
PA acceleration (msec)	119.7 ± 31.8	65.3 ± 22.7	<.0001
MV diameter	2.10 ± 0.45	1.83 ± 0.59	.03
LVEId	1 ± 0	1.6 ± 0.5	<.0001
LVEIs	1.1 ± 0.1	2.1 ± 0.8	<.0001
TAPSE (cm)	1.9 ± 0.2	1.4 ± 0.3	<.0001
EF (%)	58.7 ± 12.6	66.3 ± 16.6	.10

LA, Left atrial; LVEId, LVEI in diastole; LVEIs, LVEI in systole; MV, mitral valve; PA, pulmonary artery; PV, pulmonary valve; RA, right atrial; RVIDd, diastolic RV inner diameter; RVIDs, systolic RV inner diameter; TV, tricuspid valve.  
Data are expressed as mean ± SD.

Tabella I. Valori normali indicizzati per BSA calcolati all'ecocardiogramma. Le misure dei diametri ventricolari sinistro destro sono relativi alla sezione parasternale asse lungo in telediastole. I diametri delle valvole aorta o polmonaresono misurati a livello dell'anulus. Tutti i valori sono espressi in millimetri

BSA	Polmonare		Aorta		Ventricolo sn		Ventricolo dx	
	Media	Dev St	Media	Dev St	Media	Dev St	Media	Dev St
25	8.40	1.10	7.20	1.00	20.00	3.60	8.70	4.50
30	9.30	1.15	8.10	1.00	22.90	4.90	8.70	4.50
35	10.10	1.20	8.80	1.00	23.60	4.60	8.80	4.50
40	10.70	1.15	9.50	1.00	26.00	5.00	8.90	4.50
45	11.30	1.15	10.10	1.00	27.10	5.05	9.00	4.50
50	11.90	1.20	10.60	1.00	29.00	5.60	9.30	4.50
60	12.80	1.20	11.40	1.05	31.60	5.60	9.60	4.40
70	13.50	1.15	12.20	1.00	33.90	6.50	10.10	4.40
80	14.20	1.20	12.80	1.00	35.80	6.20	10.50	4.70
90	14.80	1.15	13.40	1.00	37.10	6.10	11.00	4.60
100	15.30	1.15	13.90	1.00	38.50	6.80	11.20	4.80
120	16.20	1.20	14.80	1.00	41.70	6.20	12.4	4.80
140	17.00	1.15	15.60	1.00	43.30	6.00	14.00	5.00
160	17.60	1.15	16.20	1.00	45.8	6.05	16.00	5.05
180	18.20	1.15	16.80	1.00	47.00	8.00	16.70	5.50
200	18.7	1.15	17.30	1.00	53.40	8.00	17.50	6.00

**A = appropriata; M= potrebbe essere appropriata;  
R= raramente appropriata**

**ECG Findings**

9.	PACs in the prenatal or neonatal period	R (3)
10.	PACs after the neonatal period	R (3)
11.	Supraventricular tachycardia	A (7)
12.	PVCs in the prenatal or neonatal period	M (6)
13.	PVCs after the neonatal period	M (6)
14.	Ventricular tachycardia	A (9)
15.	Sinus bradycardia	R (2)
16.	Sinus arrhythmia	R (1)

**TABLE 6 Prior Test Results**

Indication	Appropriate Use Rating
49. Known channelopathy	M (4)
50. Genotype positive for cardiomyopathy	A (9)
51. Abnormal chest X-ray findings suggestive of cardiovascular disease	A (9)
52. Abnormal ECG without symptoms	A (7)
53. Desaturation based on pulse oximetry	A (9)
54. Previously normal echocardiogram with no change in cardiovascular status or family history	R (1)
55. Previously normal echocardiogram with a change in cardiovascular status and/or a new family history suggestive of heritable heart disease	A (7)
56. Elevated anti-streptolysin O titers without suspicion for rheumatic fever	R (3)
57. Chromosomal abnormality known to be associated with cardiovascular disease	A (9)
58. Chromosomal abnormality with undefined risk for cardiovascular disease	M (5)
59. Positive blood cultures suggestive of infective endocarditis	A (9)
60. Abnormal cardiac biomarkers	A (9)
61. Abnormal barium swallow or bronchoscopy suggesting vascular ring	A (7)

**TABLE 8 Family History of Cardiovascular Disease in Patients Without Signs or Symptoms and Without Confirmed Cardiac Diagnosis**

Indication	Appropriate Use Rating
89. Unexplained sudden death before the age of 50 years	M (6)
90. Premature coronary artery disease before the age of 50 years	R (2)
91. Channelopathy	R (3)
92. Hypertrophic cardiomyopathy	A (9)
93. Non-ischemic dilated cardiomyopathy	A (9)
94. Other cardiomyopathies	A (8)
95. Unspecified cardiovascular disease	R (3)
96. Disease at high risk for cardiovascular involvement, including but not limited to diabetes, systemic hypertension, obesity, stroke, and peripheral vascular disease	R (2)
97. Genetic disorder at high risk for cardiovascular involvement	A (7)
98. Marfan or Loeys Dietz syndrome	A (7)
99. Connective tissue disorder other than Marfan or Loeys Dietz syndrome	M (6)
100. Congenital left-sided heart lesion, including but not limited to mitral stenosis, left ventricular outflow tract obstruction, bicuspid aortic valve, aortic coarctation, and/or hypoplastic left heart syndrome	M (6)
101. Congenital heart disease other than the congenital left-sided heart lesions	M (5)
102. Idiopathic pulmonary arterial hypertension	M (5)
103. Heritable pulmonary arterial hypertension	A (8)
104. Pulmonary arterial hypertension other than idiopathic and heritable	R (3)
105. Consanguinity	R (3)

**TABLE 9 Outpatient Neonates Without Post-Natal Cardiology Evaluation**

Indication	Appropriate Use Rating
106. Suspected cardiovascular abnormality on fetal echocardiogram	A (9)
107. Isolated echogenic focus on fetal ultrasound	R (2)
108. Maternal infection during pregnancy or delivery with potential fetal/neonatal cardiac sequelae	A (7)
109. Maternal diabetes with no prior fetal echocardiogram	M (6)
110. Maternal diabetes with a normal fetal echocardiogram	M (4)
111. Maternal phenylketonuria	A (7)
112. Maternal autoimmune disorder	M (5)
113. Maternal teratogen exposure	M (6)

**ACC/AAP/AHA/ASE/HRS/  
SCAI/SCCT/SCMR/SOPE  
2014 Appropriate Use Criteria for  
Initial Transthoracic Echocardiography  
in Outpatient Pediatric Cardiology**





# FOCUS SULL' ECOCARDIOGRAFIA IN ETÀ PEDIATRICA Percorso Sequenziale



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