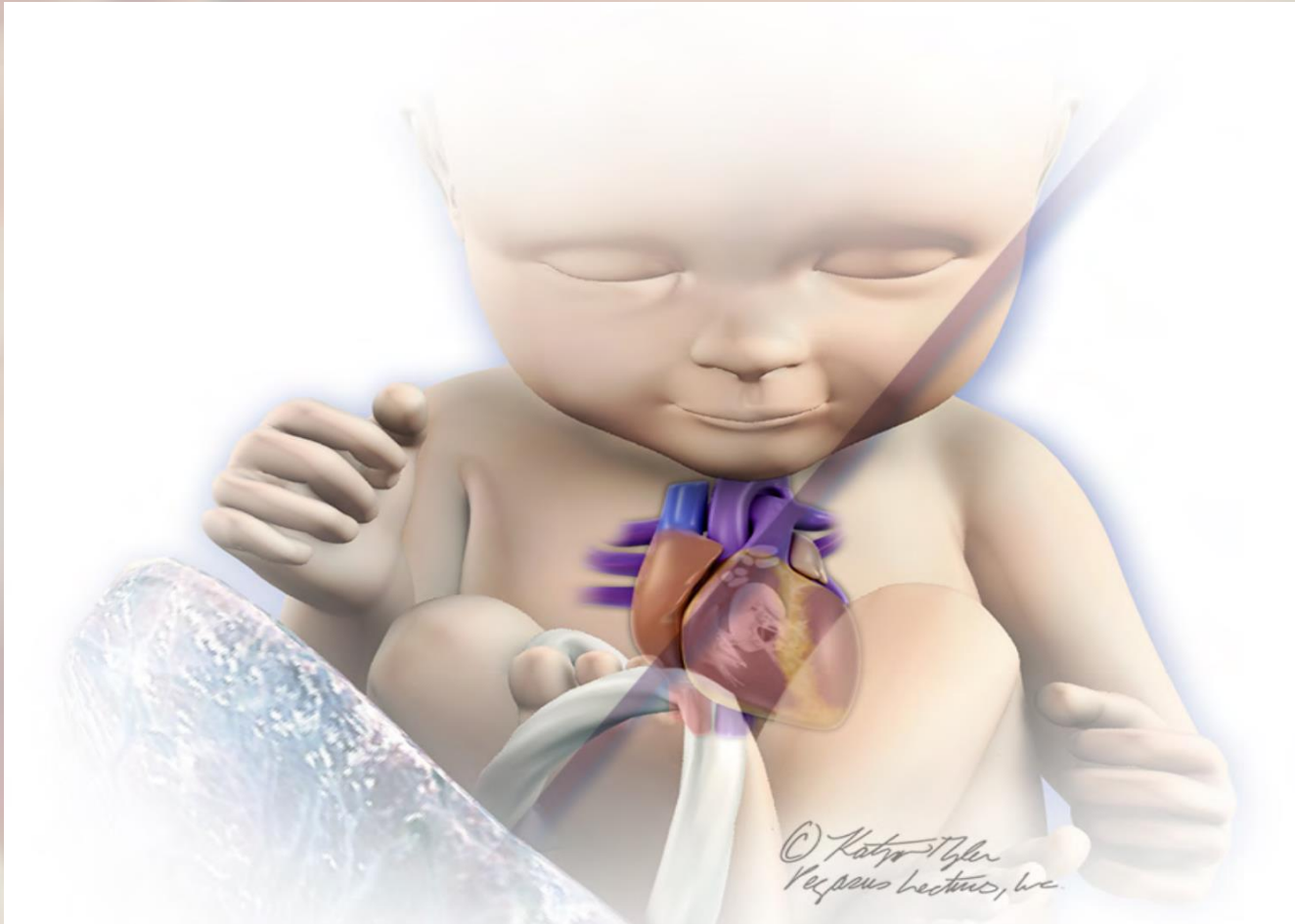


INDICATIONS FOR FETAL ECHOCARDIOGRAPHY



Dr. saeed bitarafan pediatric cardiologist

تشخیص بیماری قلبی در رحم در طول حدود ۵۵ سال
گذشته، از سال ۱۹۶۵ زمان اولین گزارش تشخیص یک
ضربان قلب جنینی توسط سونوگرافی تا کنون پیشرفت
چشمگیری داشته است . با پیشرفت تکنولوژی، آریتمی
های جنینی تشخیص داده شده ، تجسم آناتومی قلب
جنین امکان پذیر شده، و تشخیص بیماری قلبی مادرزادی
CHD ممکن شد.

نکات مهم:



❖ نتیجه یک اکو قلب جنین (سالم بودن - مشکل قابل درمان - مشکلات پیچیده)

❖ از نظر قانونی و بیمه ها فقط اکوی قلب جنین که توسط فوق تخصص قلب کودکان انجام شده مورد قبول است.

❖ عواقب قانونی برای متخصصین محترم زنان

Congenital heart disease is the **most common** severe congenital abnormality found among live Births.

development of the heart is an interaction of **genes, environment, and chance**, approximately **70% to 85%** of cases of congenital heart disease have multifactorial causes.

an overall incidence of CHD approaching 50 per 1,000 live births .

Congenital heart disease is **six** times more common than **chromosomal abnormalities** and **four** times more common than **neural tube defects**.

Improvements based on technical advances in the management and therapy of CHD has resulted in a shifting of the outcomes such that **adults living with CHD outnumber the number of children with CHD**.

در حال حاضر باتوجه به امکانات و مهارت اکوکاردیوگرافیست در بهترین شرایط تا **۹۵٪** دقت تشخیصی می توان بیماریهای قلبی مادر زادی را با اکو قلب جنین تشخیص داد .

با این حال ، در مطالعات جمعیتی اخیر ، میزان تشخیص پیش از تولد در ضایعات قلبی در عمل و در مناطق مختلف بسیار پایین و بسیار متغیر هستند ، حتی در بعضی گزارشات **۲۰٪ تا ۴۲٪** هم گزارش شده است .

این تفاوت قابل توجه احتمالاً به دلیل ترکیبی از عواملی از جمله :



❖ محدودیتهای فنی

❖ تجربه سونوگرافیست یا ارائه دهنده خدمات پزشکی

❖ محدودیتهای زمانی

❖ ویژگیهای خاص بیماران مانند ویوهای ضعیف در افراد چاق

است.

TIMING OF THE FETAL ECHOCARDIOGRAM



While **18 to 22 weeks** of gestation is generally considered to be optimal

However, it is important to keep in mind that fetal echocardiography at **18 to 22** weeks **may miss** cases in which disease is **progressive or occurs late in gestation**, for example:

Maternal diabetes-associated **ventricular hypertrophy**

This is especially true for **fetal arrhythmias**, which often do not manifest before **25 to 26 weeks** of gestation and, in some cases, only in the third trimester

INDICATIONS FOR FETAL ECHOCARDIOGRAPHY



بیانیہ علمی انجمن قلب آمریکا



**DIAGNOSIS AND TREATMENT OF FETAL
CARDIAC DISEASE A SCIENTIFIC
STATEMENT FROM THE AMERICAN HEART
ASSOCIATION (2014)**

most infants with congenital heart disease are born to women without high-risk indications for congenital heart disease.

Most women referred for detailed fetal echocardiographic study have been judged to be at risk according to factors defined as fetal, maternal, or familial risks

INDICATIONS WITH HIGHER RISK PROFILE (ESTIMATED **>2%** ABSOLUTE RISK)

-
- ❖ Maternal pregestational diabetes mellitus
 - ❖ Diabetes mellitus diagnosed in the first trimester
 - ❖ Maternal phenylketonuria (uncontrolled)
 - ❖ Maternal autoantibodies (SSA/SSB+)
 - ❖ Maternal medications
 - ACE inhibitors
 - Retinoic acid
 - NSAIDs in **third** trimester

- ❖ Maternal **first** trimester **rubella** infection
- ❖ Maternal infection with suspicion of fetal myocarditis
- ❖ **Assisted reproduction technology**
- ❖ CHD in first degree relative of fetus (maternal, paternal or sibling with CHD)
- ❖ First or second degree relative with disorder with Mendelian Inheritance with CHD association (**Noonan, Tuberous sclerosis**)
- ❖ Fetal cardiac abnormality suspected on obstetrical ultrasound

- ❖ Fetal extracardiac abnormality suspected on obstetrical ultrasound
- ❖ Fetal karyotype abnormality
- ❖ Fetal tachycardia(**> 180** bpm) or bradycardia (**< 110** bpm) , or frequent or persistent irregular heart rhythm
- ❖ Fetal increased NT **>95% (≥ 3 mm)**
- ❖ Monochorionic twinning
- ❖ Fetal hydrops or effusions

INDICATIONS WITH LOWER RISK PROFILE (ESTIMATED **>1% BUT <2%** ABSOLUTE RISK)

❖ Maternal medications

▪ Anticonvulsants

▪ Lithium

▪ Vitamin A

❖ SSRIs (only **paroxetine**)

❖ NSAIDs in **first/second** trimester

❖ CHD in second degree relative of fetus

❖ Fetal abnormality of the umbilical cord or placenta

❖ Fetal intra-abdominal venous anomaly

NOT INDICATED ($\leq 1\%$ RISK)

❖ Maternal gestational diabetes mellitus with HbA1c $< 6\%$

❖ Maternal medications

- SSRIs (other than paroxetine)
- Vitamin K agonists (Coumadin), although fetal survey is recommended

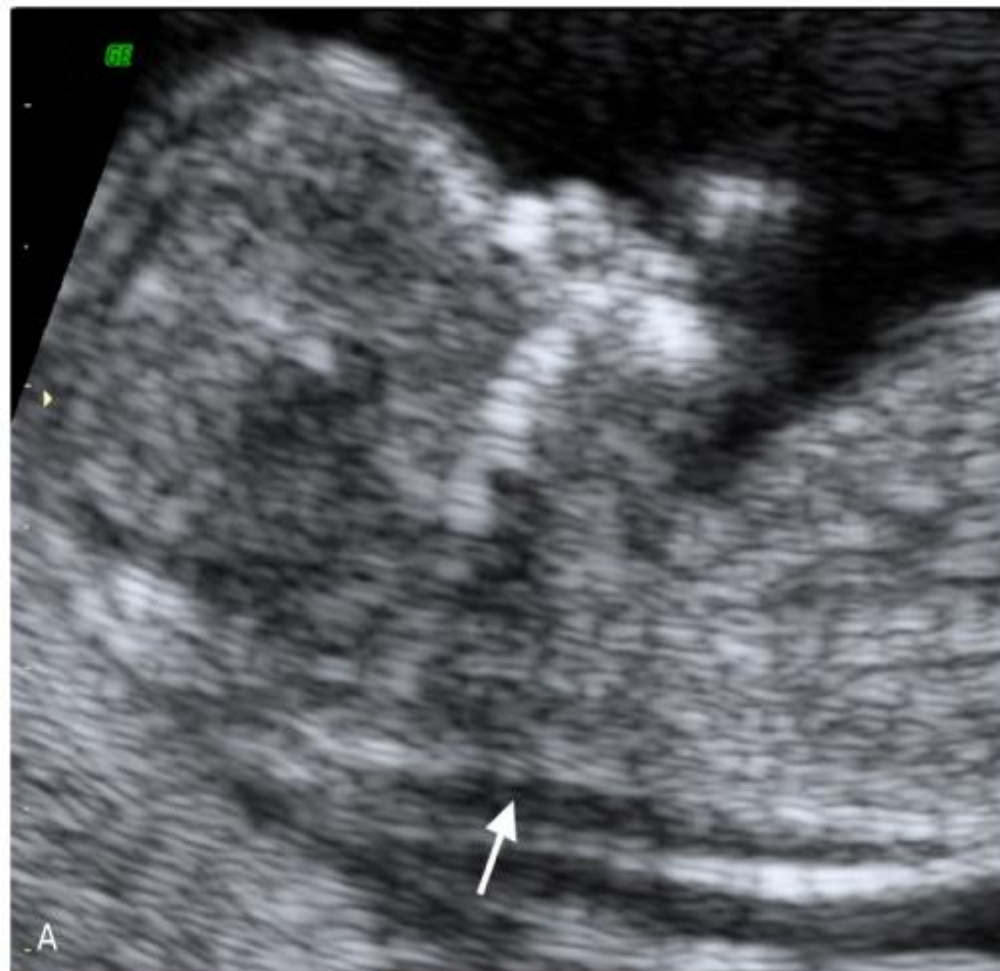
❖ Maternal infection other than rubella with seroconversion only

❖ Isolated CHD in a relative other than first or second degree



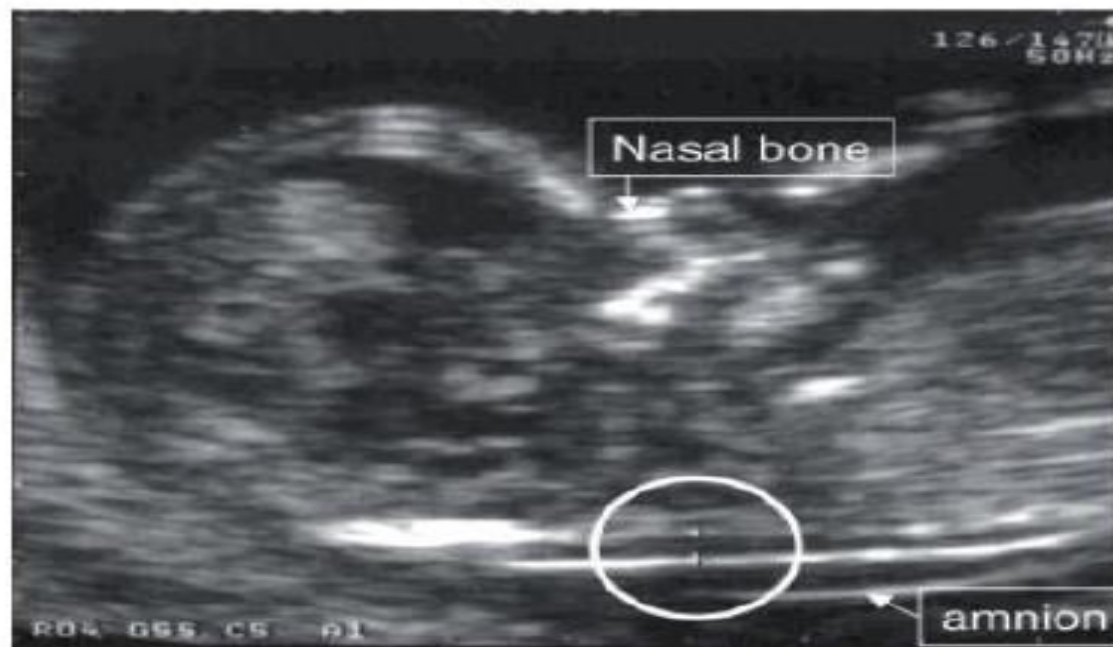
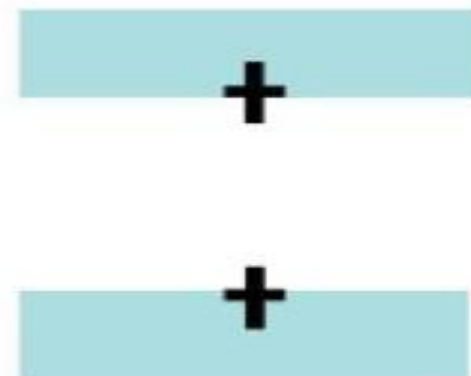
FETAL RISK FACTORS

INCREASED NUCHAL TRANSLUCENCY



INCREASED NUCHAL TRANSLUCENCY

NT is a fluid-filled appearance of the back of the fetal neck measured between 11 and 13 weeks 6 days of gestation. An NT measurement of ≥ 3.5 mm, which is $>95\%$ of expected, is associated with increased risk of CHD, both in the absence and presence of chromosomal abnormalities, and the risk of CHD increases with increasing NT size

A**B**

شکل ۴- نمای استاندارد برای اندازه گیری میزان ضخامت شفافیت گردنی: گرچه در این نما استخوان بینی دیده می شود ولی وجود استخوان بینی برای استاندارد بودن این نما الزامی نیست. شکل B محل استاندارد برای قرار دادن علامت برای اندازه گیری را نشان می دهد.



اکثر منابع ضخامت NT **بیشتر یا مساوی ۳** میلی متر و برخی
منابع دیگر، ضخامت **بیشتر یا مساوی ۲.۵** میلی متر را غیر
طبیعی می دانند.

EXTRACARDIAC BIRTH DEFECTS



Extracardiac defects are frequently associated with CHD, and both syndromic and nonsyndromic fetuses with CHD have an increased incidence of extracardiac defects

**TABLE
1.2****Associated Extracardiac Anomalies in Fetal Heart Defects
according to Organ System****Organ system****%**

Central nervous system

71.7

Genitourinary

Genital

25

Renal

75

Skeletal

52.3

Respiratory

38.1

Gastrointestinal

47.5

Craniofacial

35.7

TOTAL

53.6

Modified from Song MS, Hu A, Dyamenahalli U, et al. Extracardiac lesions and chromosomal abnormalities associated with major fetal heart defects: comparison of intrauterine, postnatal and postmortem diagnoses. Ultrasound Obstet Gynecol. 2009;33:552–559, with permission.

RISK OF HIGH OUTPUT FAILURE



Conditions which put the fetus at risk for high output cardiac failure should trigger a fetal echocardiogram. These include :

- 1 Monochorionic diamniotic twins with twin-to-twin transfusion syndrome (TTTS)
- 2 Fetal anemia
- 3 Chorioangioma.



MATERNAL RISK FACTORS

ASSISTED REPRODUCTION TECHNOLOGY

The use of assisted reproductive technologies has increased over the **past 2 decades**. In **2005**, an estimated **1%** of all live births in the United States were conceived with the use of in vitro fertilization .

There are conflicting reports on the direct association of the use of this technology and CHD malformations in offspring, with the more recent reports suggesting that the increased incidence of CHD in these pregnancies.

❖ may be attributable to the increased risk specifically for **multiple gestations**

❖ advanced **maternal age** on CHD risk

❖ the known increased risk associated with **monozygous twinning** (increased with in vitro fertilization)

❖ **unknown effect** of the underlying reason for subfertility in couples using in vitro fertilization/intracytoplasmic sperm injection, the direct causation from the technology remains unknown.

Nevertheless, the overall risk of CHD in infants conceived through in vitro fertilization seems to be slightly higher than that for reference populations with a risk of **1.1% to 3.3%**

The majority of defects identified are atrial and ventricular septal defects, which may be difficult to detect in fetal life and are of minor clinical significance in many cases.

Fetal echocardiogram is reasonable to perform in pregnancies of assisted reproductive technologies.

DIABETES MELLITUS

Diabetes is a common condition complicating pregnancy, affecting an estimated **3% to 10% of mothers**. Maternal diabetes is associated with an approximately **5-fold increase** in CHD compared to the normal population For those with pregestational diabetes.

The risk of CHD appears to increase with the **hemoglobin A1C** levels measured in the **first trimester**.

Pregestational DM (preconception metabolic control may affect risk) or DM identified in the first trimester:

Absolute Risk, live births % 3–5



Timing/Frequency of Evaluation : 18–22 wks Repeat evaluation in third trimester if **HbA1c >6%** may be considered

Gestational diabetes mellitus with HbA1c <6%:

Absolute Risk, live births % <1

If **HbA1c >6%**, fetal echocardiography in the third trimester may be considered to assess for ventricular hypertrophy

PHENYLKETONURIA

Maternal phenylketonuria (PKU) in which there is a serum phenylalanine level **>15 mg/dL** have a **10- to 15-fold** increase risk of CHD in the fetus . If maternal phenylalanine levels are **<6 mg/dL** before conception and during the **first trimester**, the risks of CHD are low .

However, if the level is **>10 mg/dL** a fetal echocardiogram is indicated

MATERNAL AUTOIMMUNE DISEASE

Complete heart block (CHB) occurs in **~4%** of pregnancies when maternal autoimmune antibodies are detected in an asymptomatic or symptomatic mother.

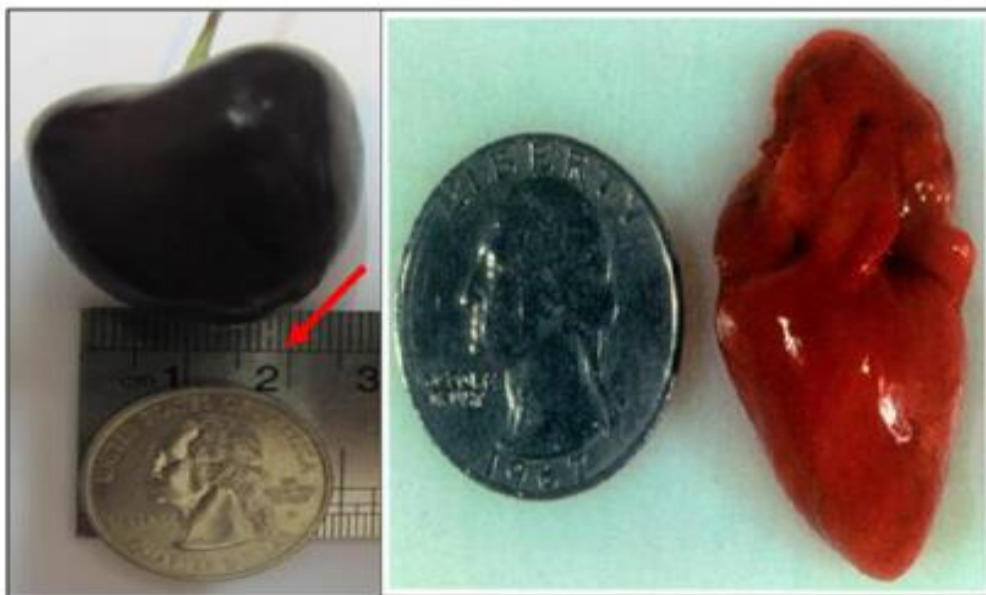
When the mother has **had a prior child with CHB**, the risk of CHB in the subsequent pregnancy is approximately **19%**.

Other cardiovascular abnormalities related to maternal autoantibodies include **myocarditis, cardiomyopathy, endocardial fibroelastosis, ventricular arrhythmias, and dysplasia of the atrioventricular or semilunar valves .**

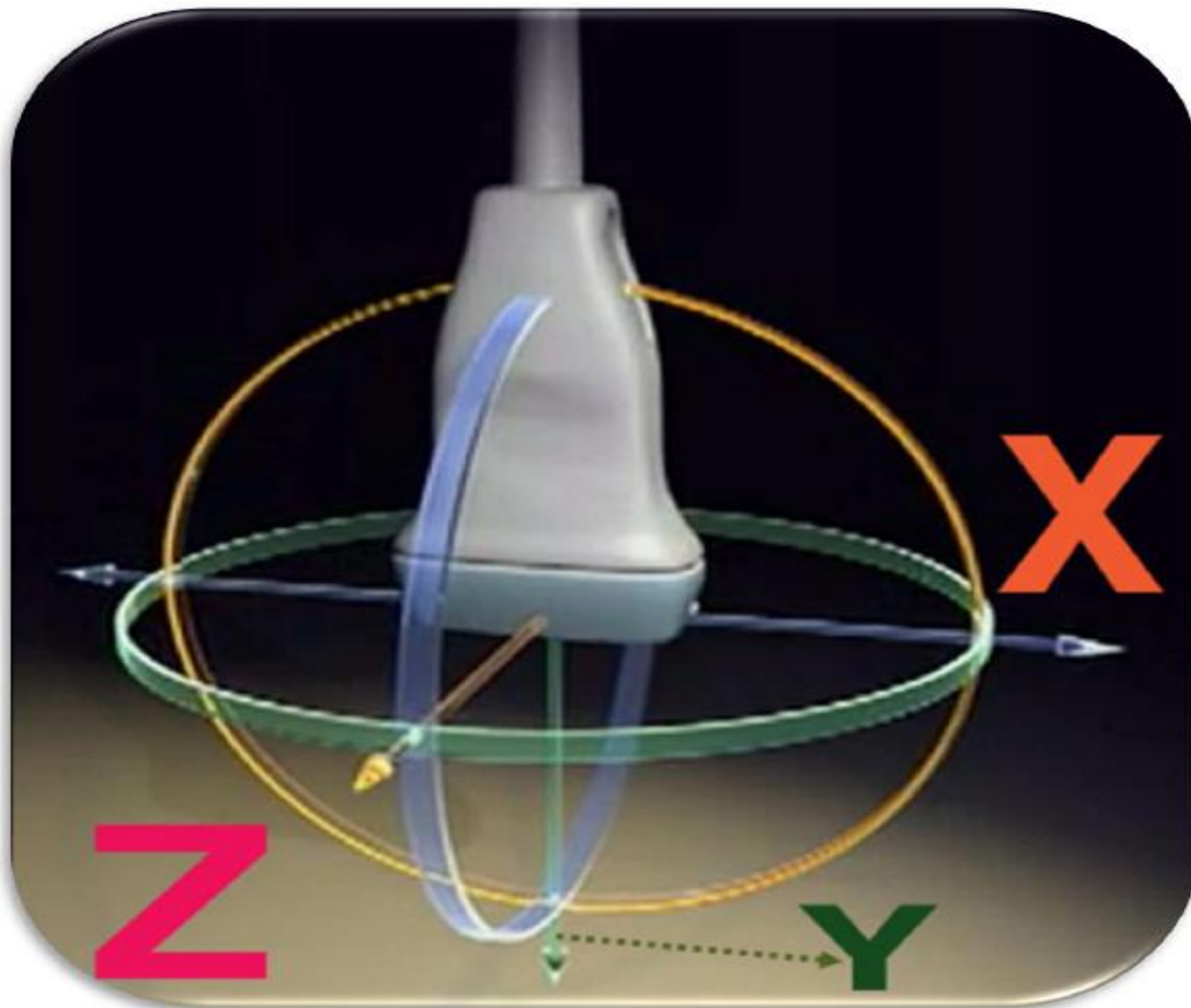
FAMILY HISTORY OF CONGENITAL HEART DISEASE

Overall, estimates of CHD when there is **maternal** heart disease are **5.7%**, **paternal** heart disease **2.2%**, and prior child with heart disease **~2% to 6%**

شکل ۷- اندازه قلب جنین در ۲۰ هفته‌گی در مقایسه با اندازه یک سکه ۲۵ سنتی (یک چهارم دلار) و مقایسه اندازه سکه با یک گیلان بر روی خط کش (عدد ۲، دو سانتی متر)

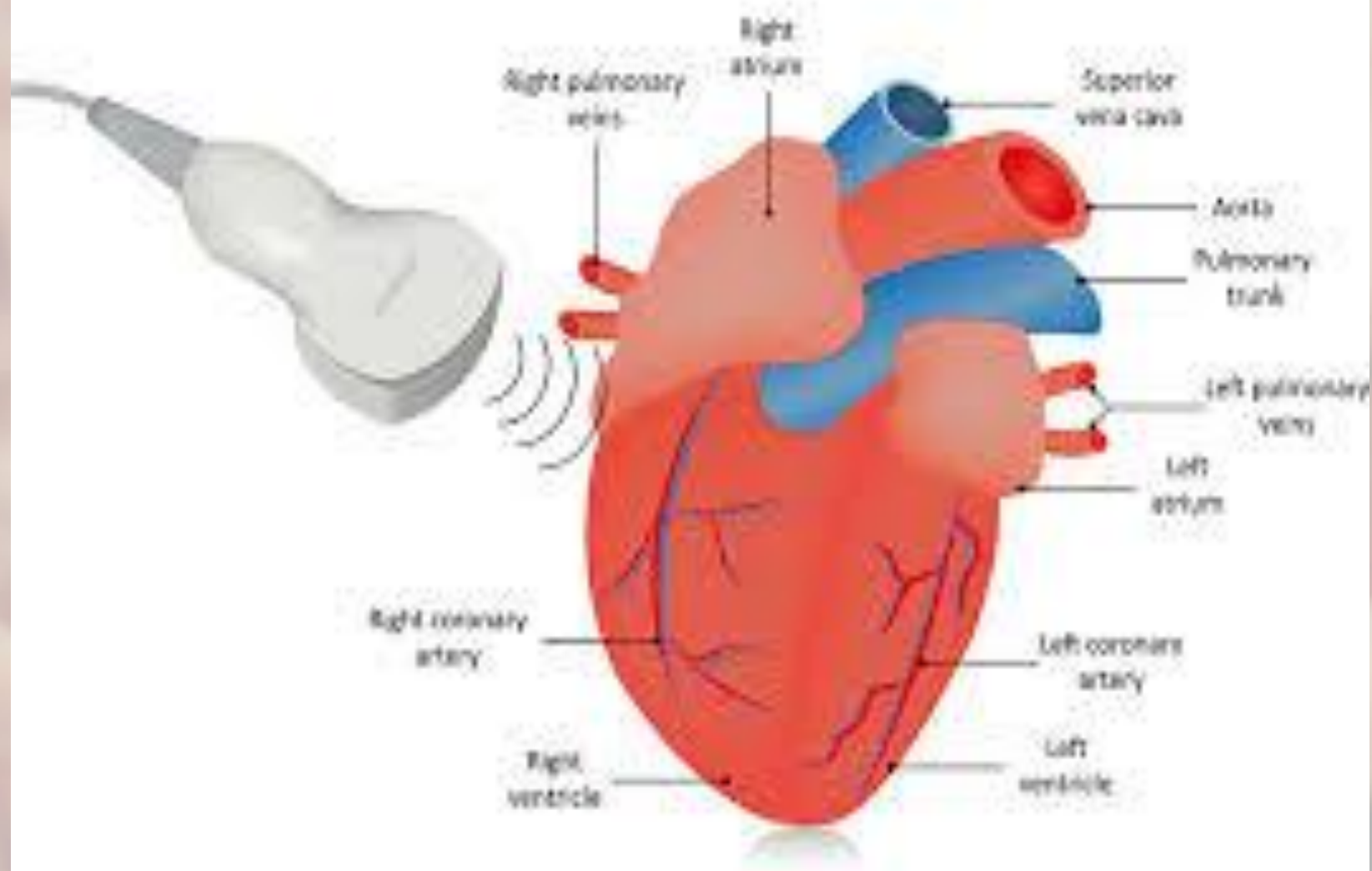


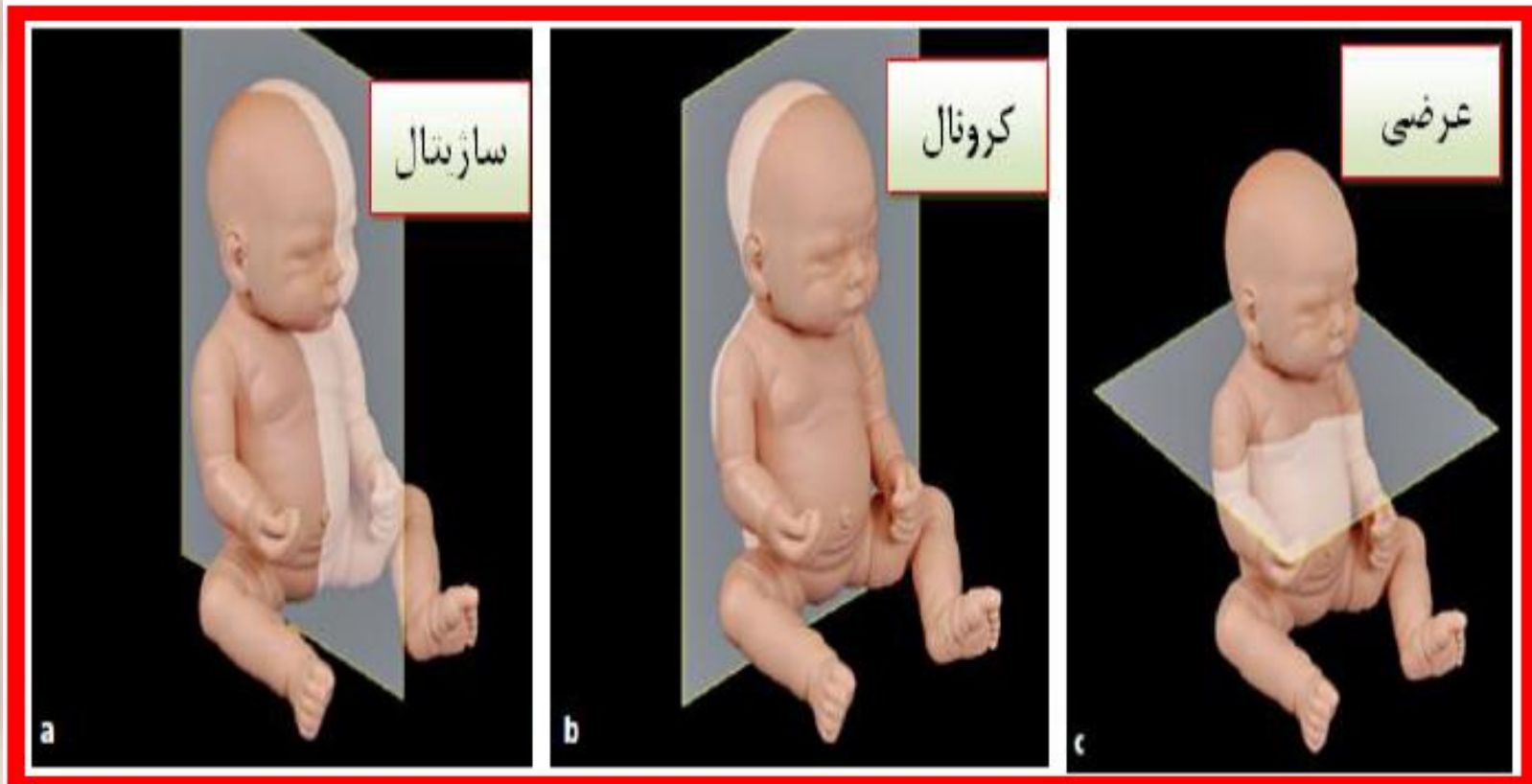
¹ - Unaccommodating fetal position



شکل ۲- سه محور X-Y-Z

Echocardiogram





شکل ۴- سطح برش در سه سطح:

- Sagittal
- Coronal
- Transverse

نمایش استاندارد اکوکاردیوگرافی جنین



STANDARD PLANES

Fetal echocardiography consists of a sequential segmental analysis of the cardiovascular structures . Evaluation in standard planes can be useful, including the

- (1) Four-chamber view
- (2) Left ventricular outflow tract (LVOT) view
- (3) Right ventricular outflow tract (RVOT) view
- (4) Three vessel and trachea view

(5) Bicaval view

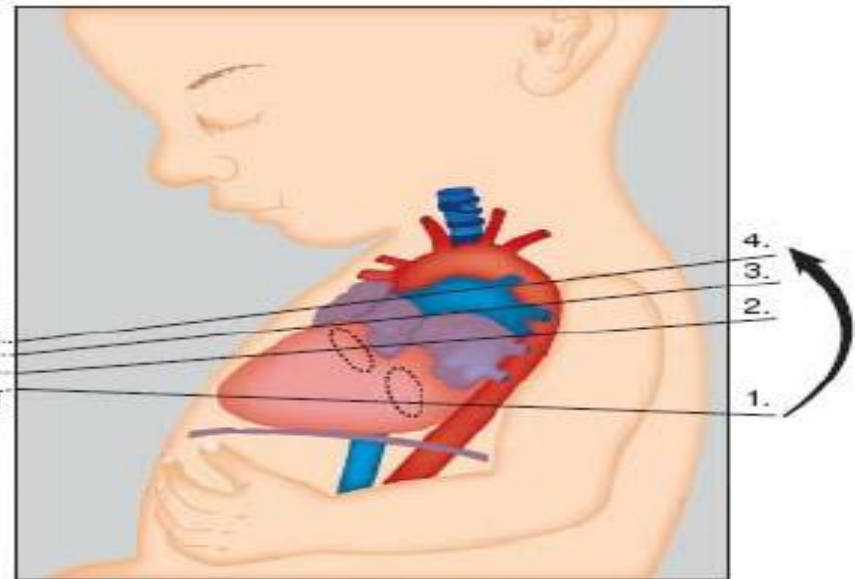
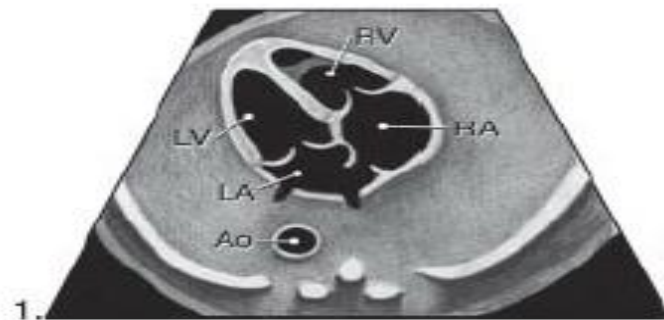
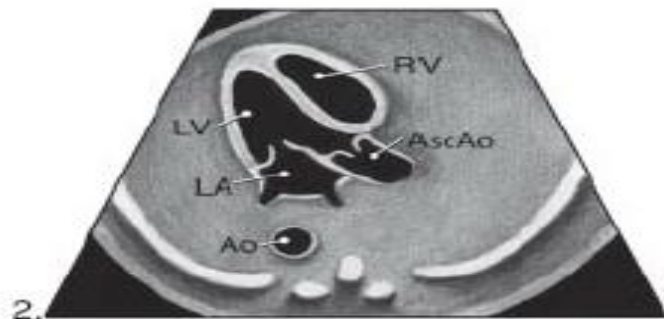
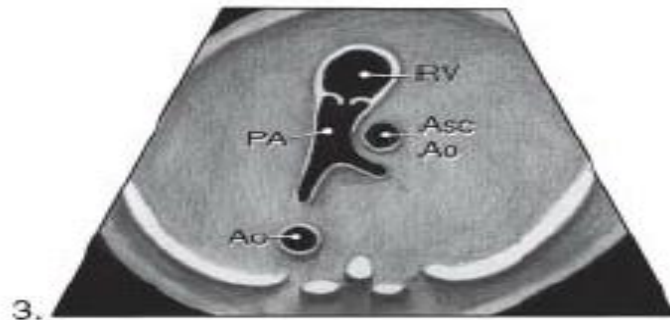
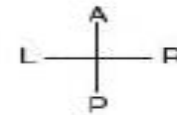
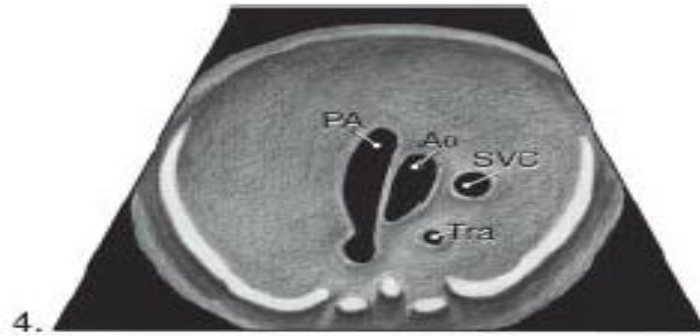
(6) Long axis of the aortic arch

(7) Long axis of the ductal arch

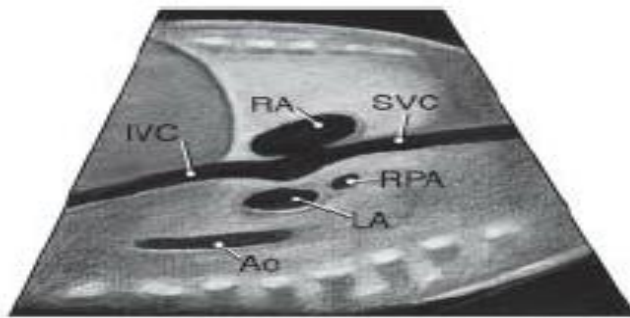
(8) A high short axis view of the great arteries

(9) A low short axis view of the ventricles.

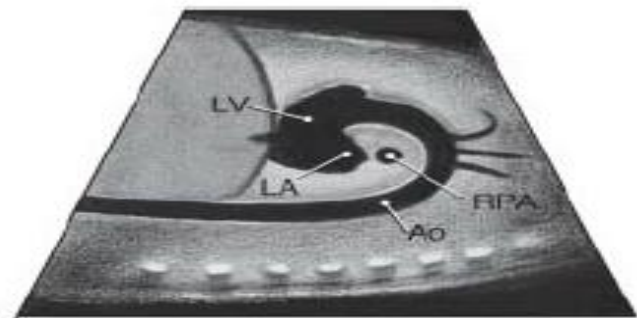
Color Doppler ultrasonography is required with the adjunctive use of pulsed Doppler ultrasonography as needed.



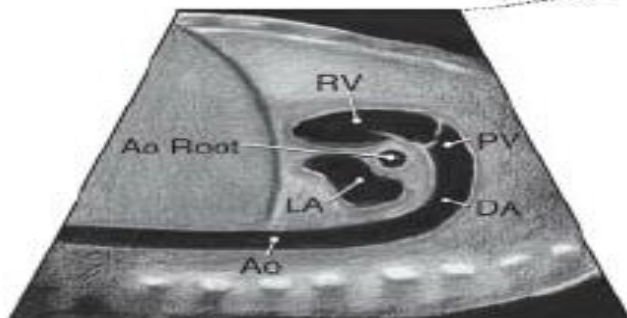
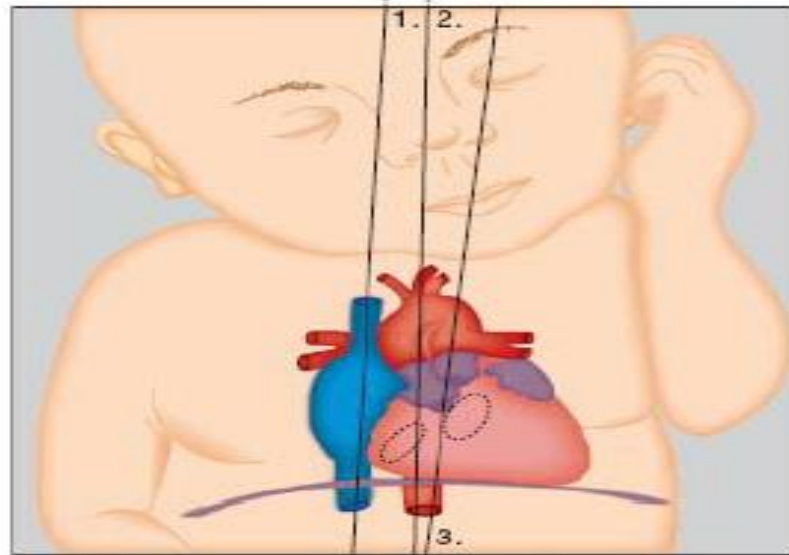
1. Four-chamber View
2. Left Ventricular Outflow Tract
3. Right Ventricular Outflow Tract
4. Three-vessel Trachea View



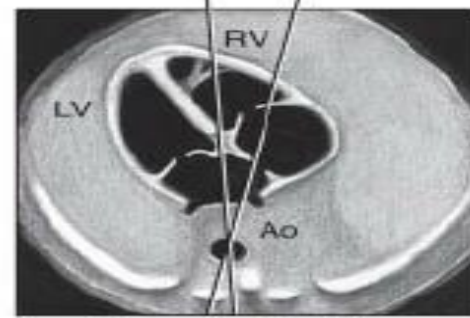
1. Bicaval View



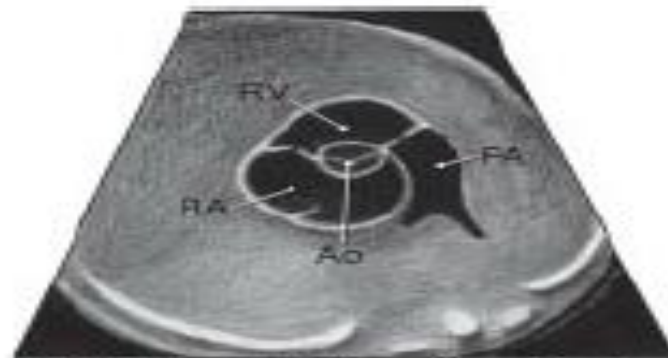
2. Aortic Arch View



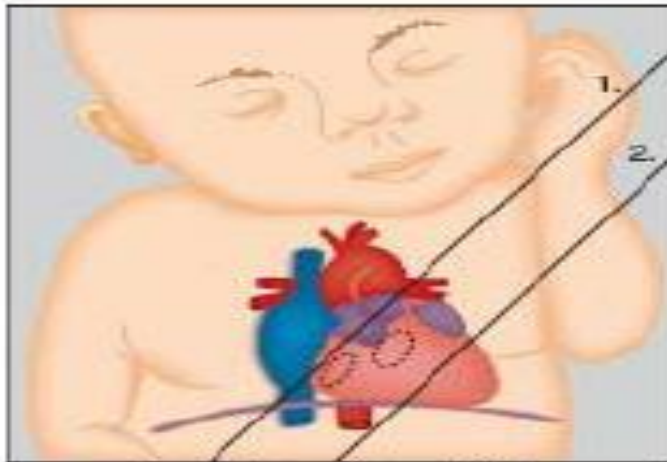
3. Ductal Arch View



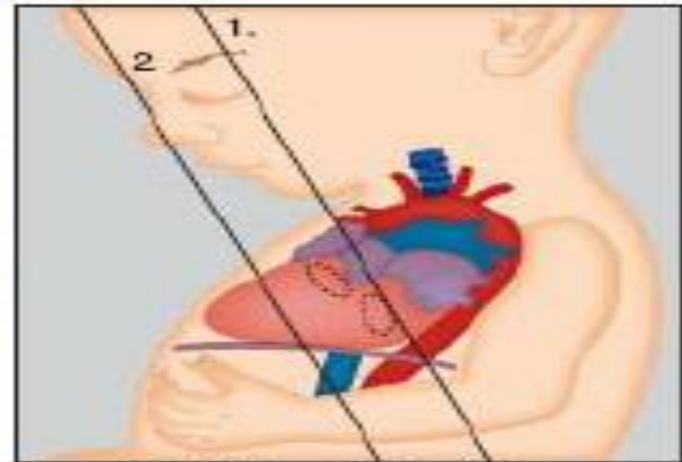
Four-chamber View



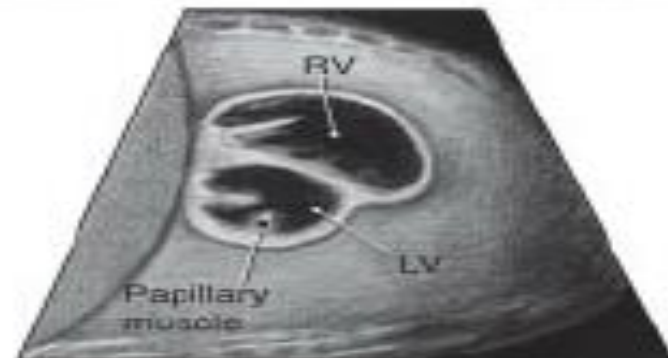
1. High Short Axis View - Great Arteries



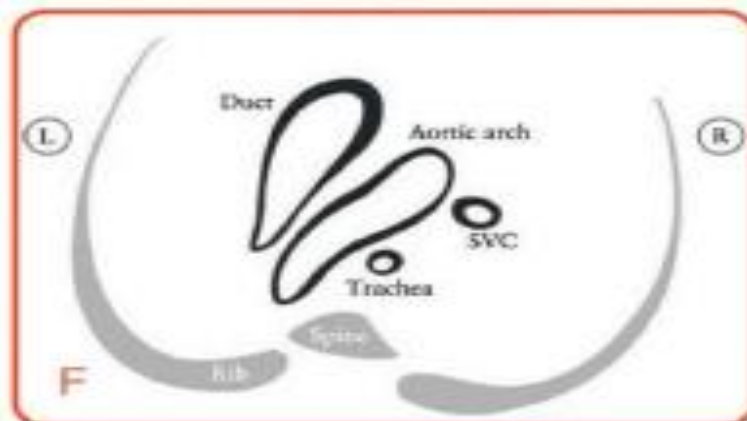
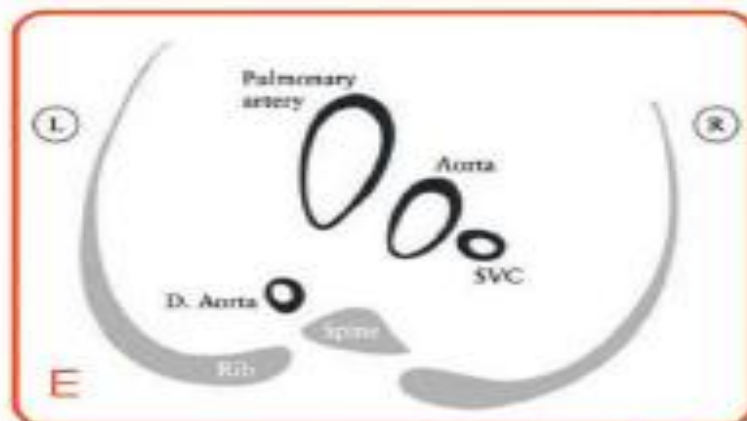
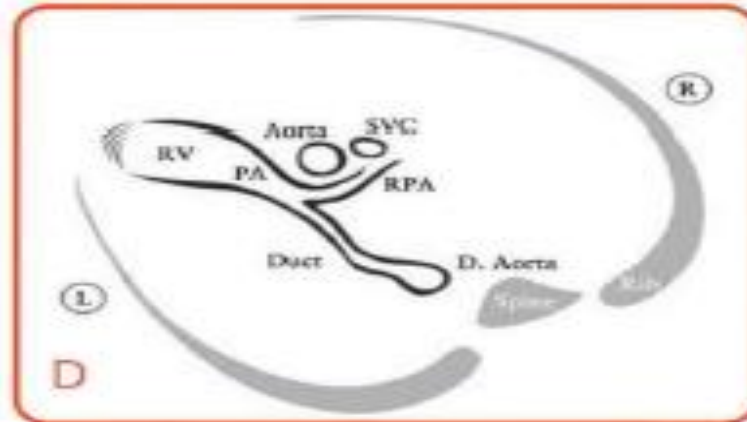
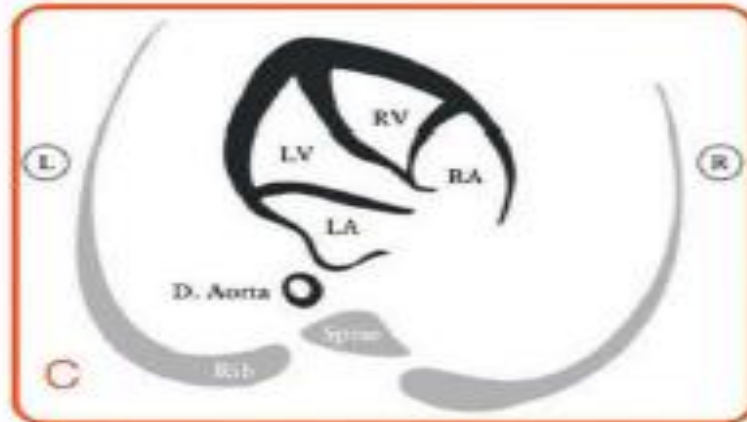
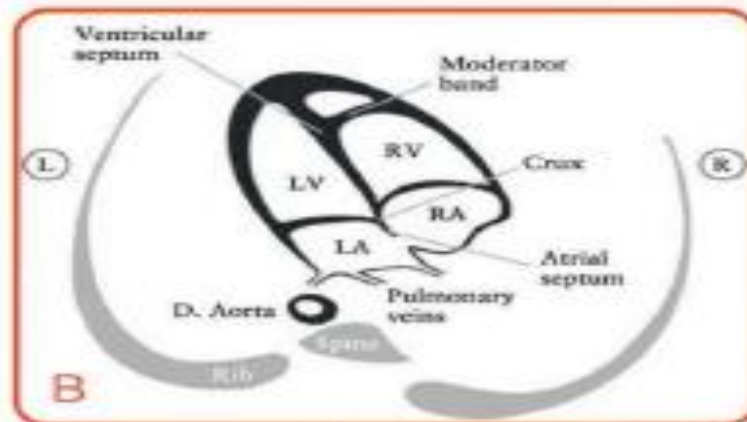
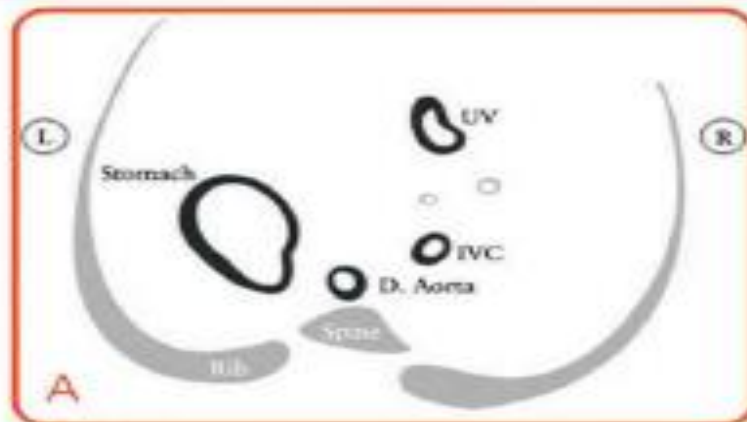
Fetal Heart - Coronal View

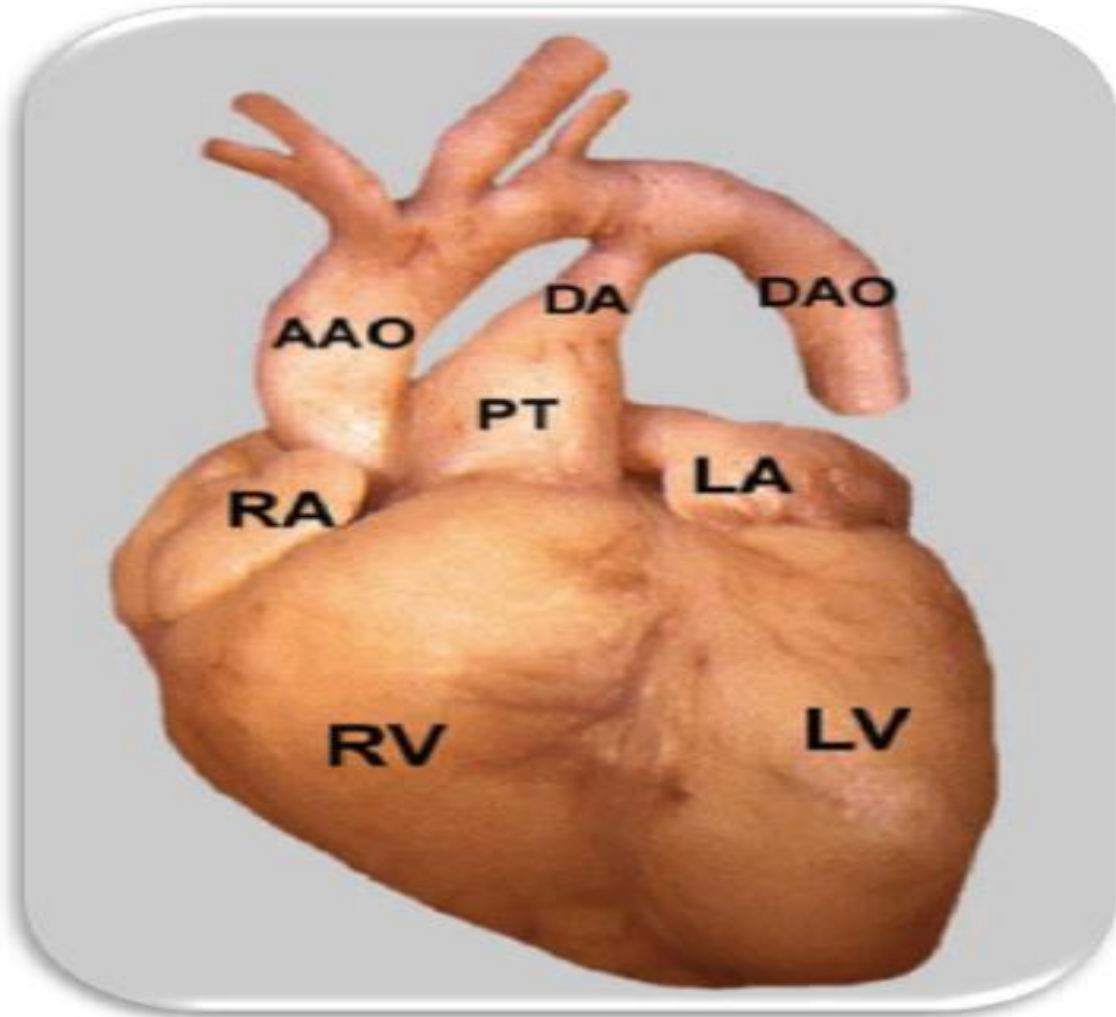


Fetal Heart - Sagittal View



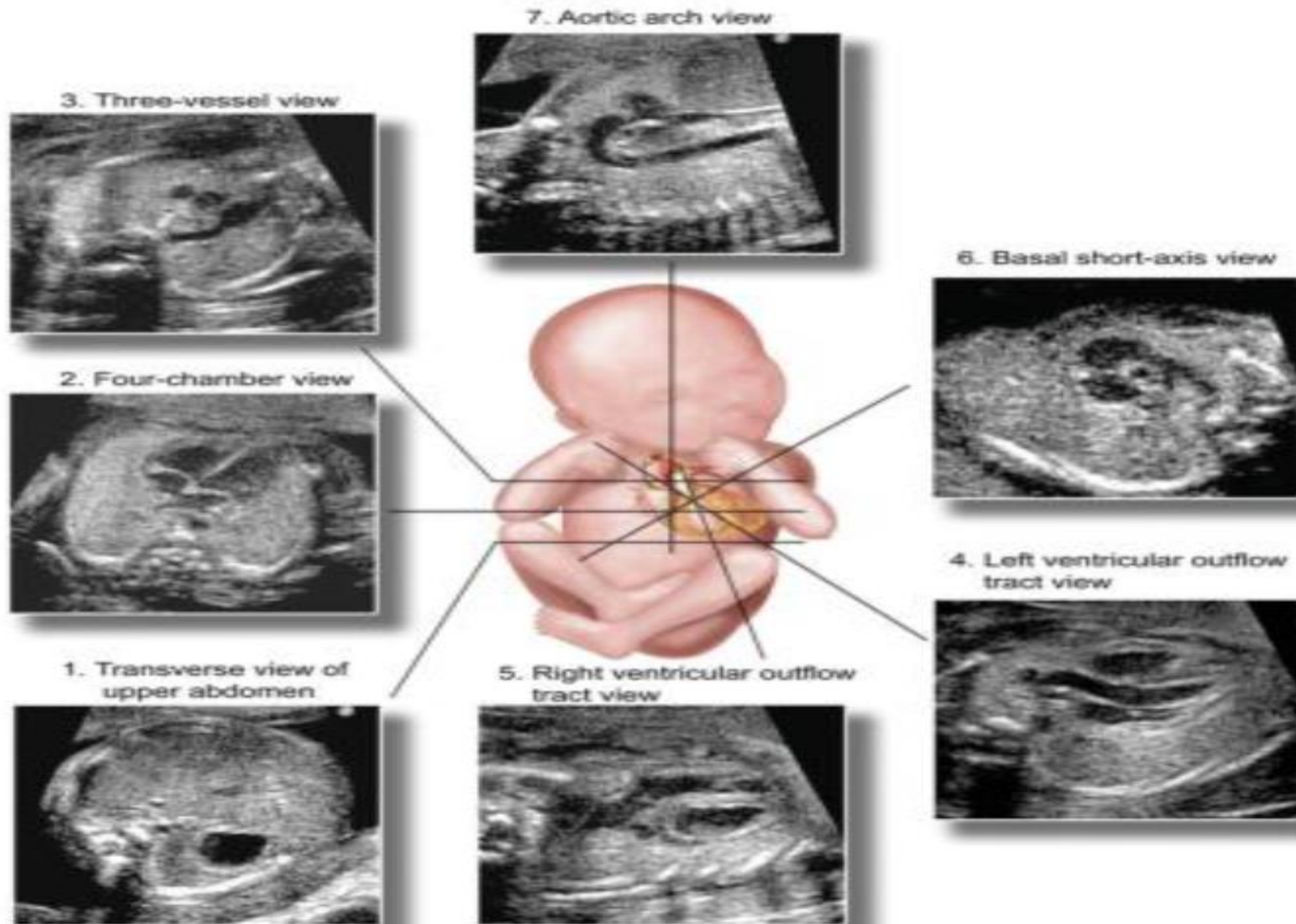
2. Low Short Axis View - Ventricles





شكل ٩١ -

Aortic arch و Ductal arch



شکل ۱۰۵- هفت نمای اصلی در بررسی قلب جنین و سطح برش ها آن ها

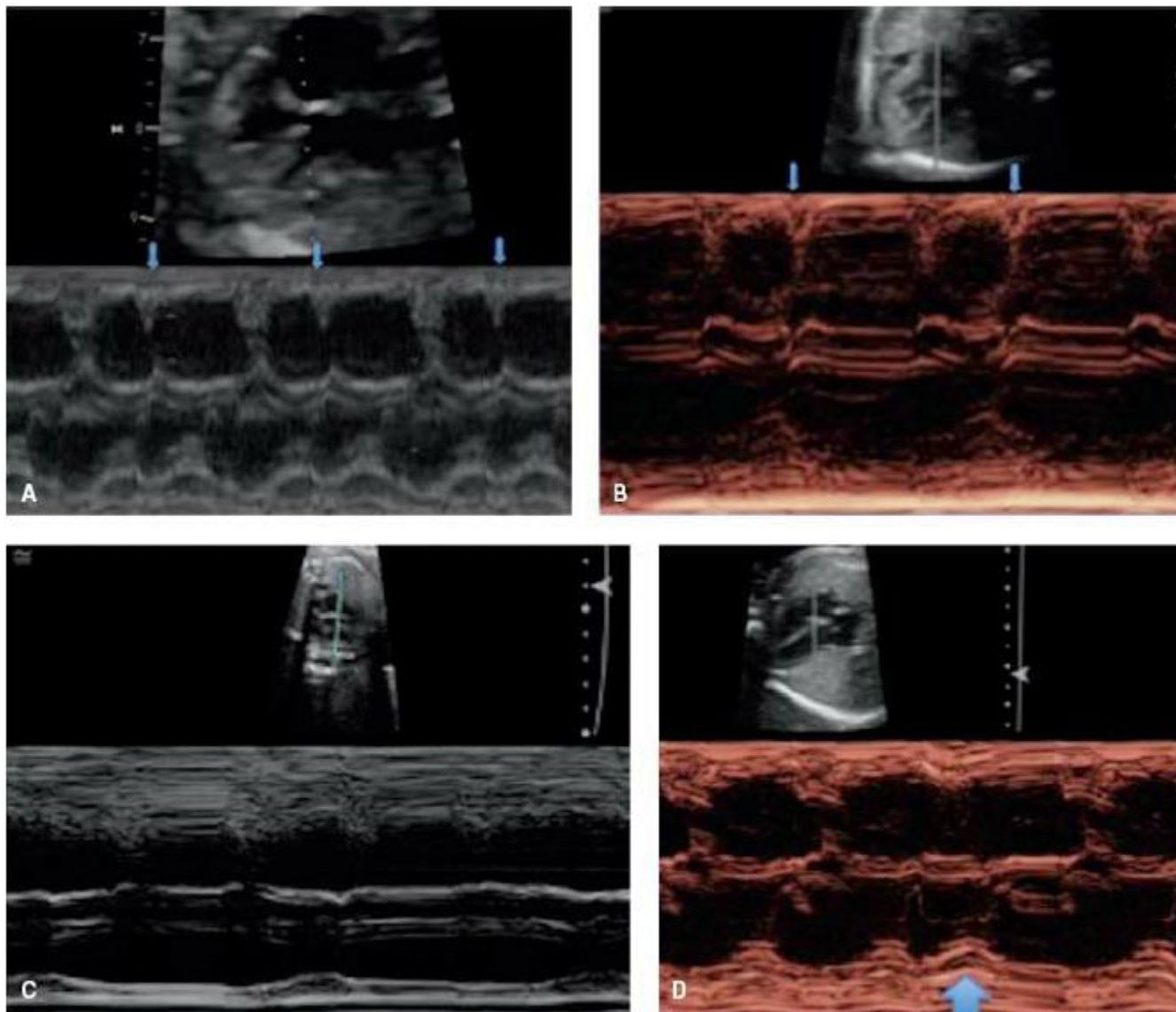
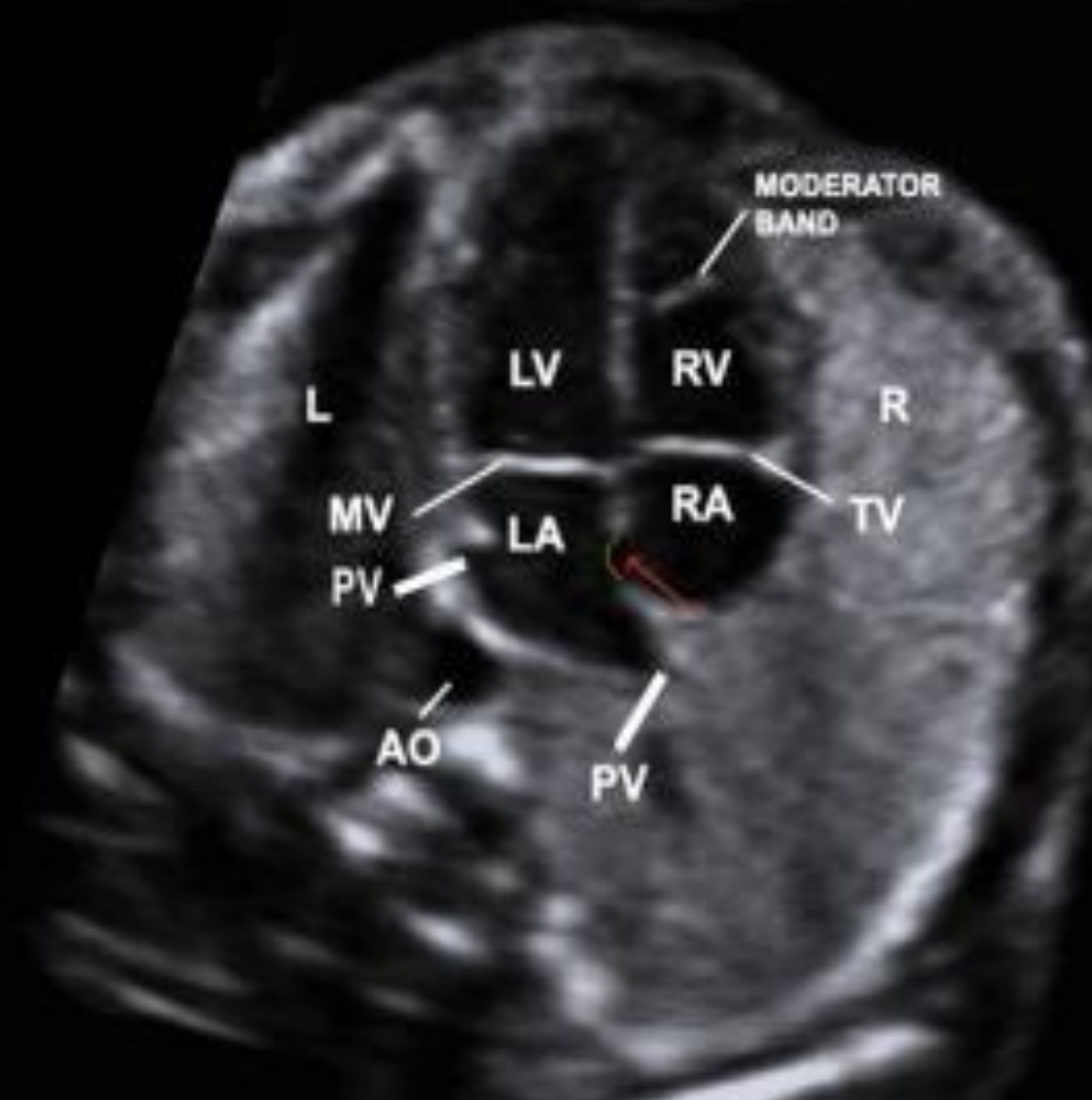
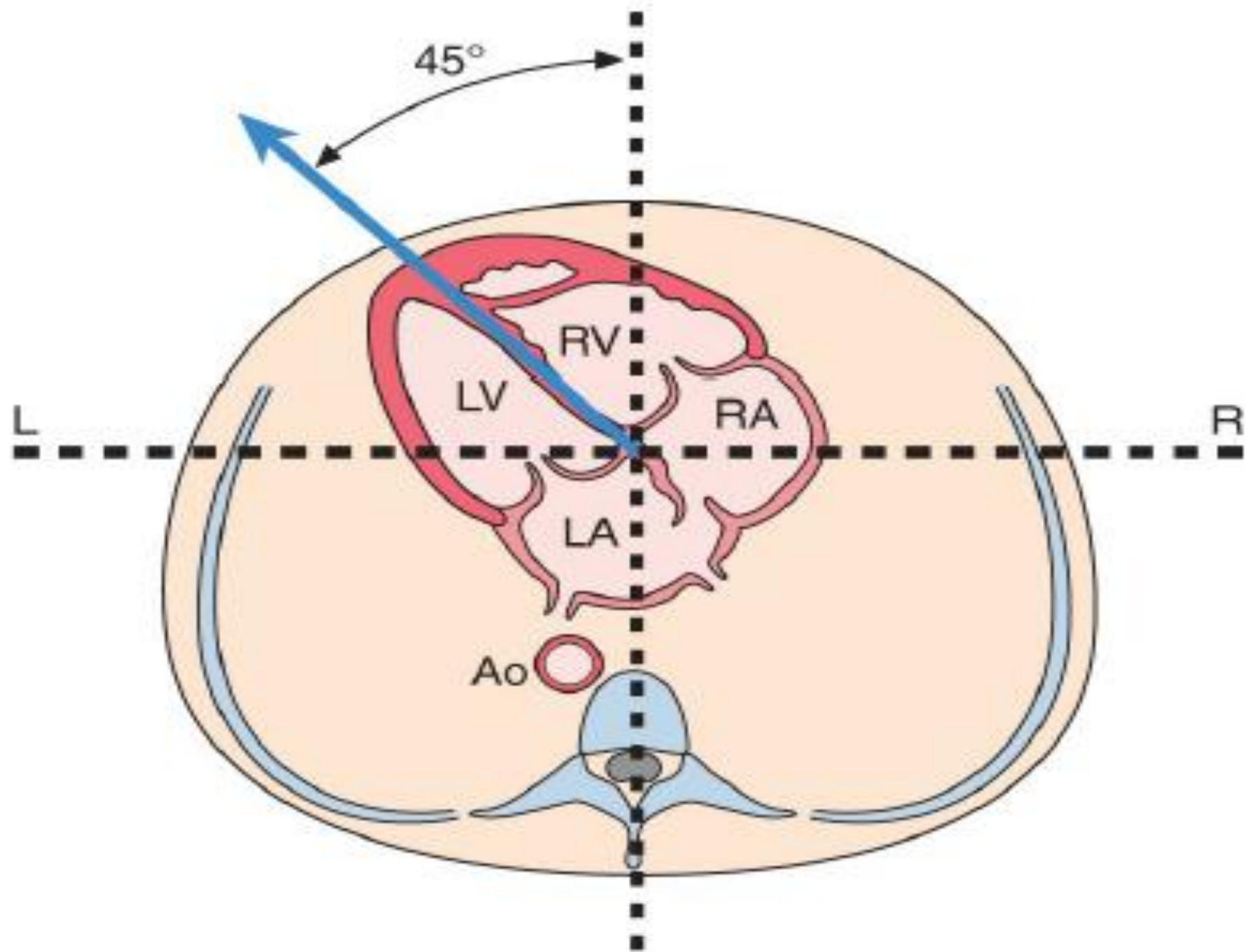


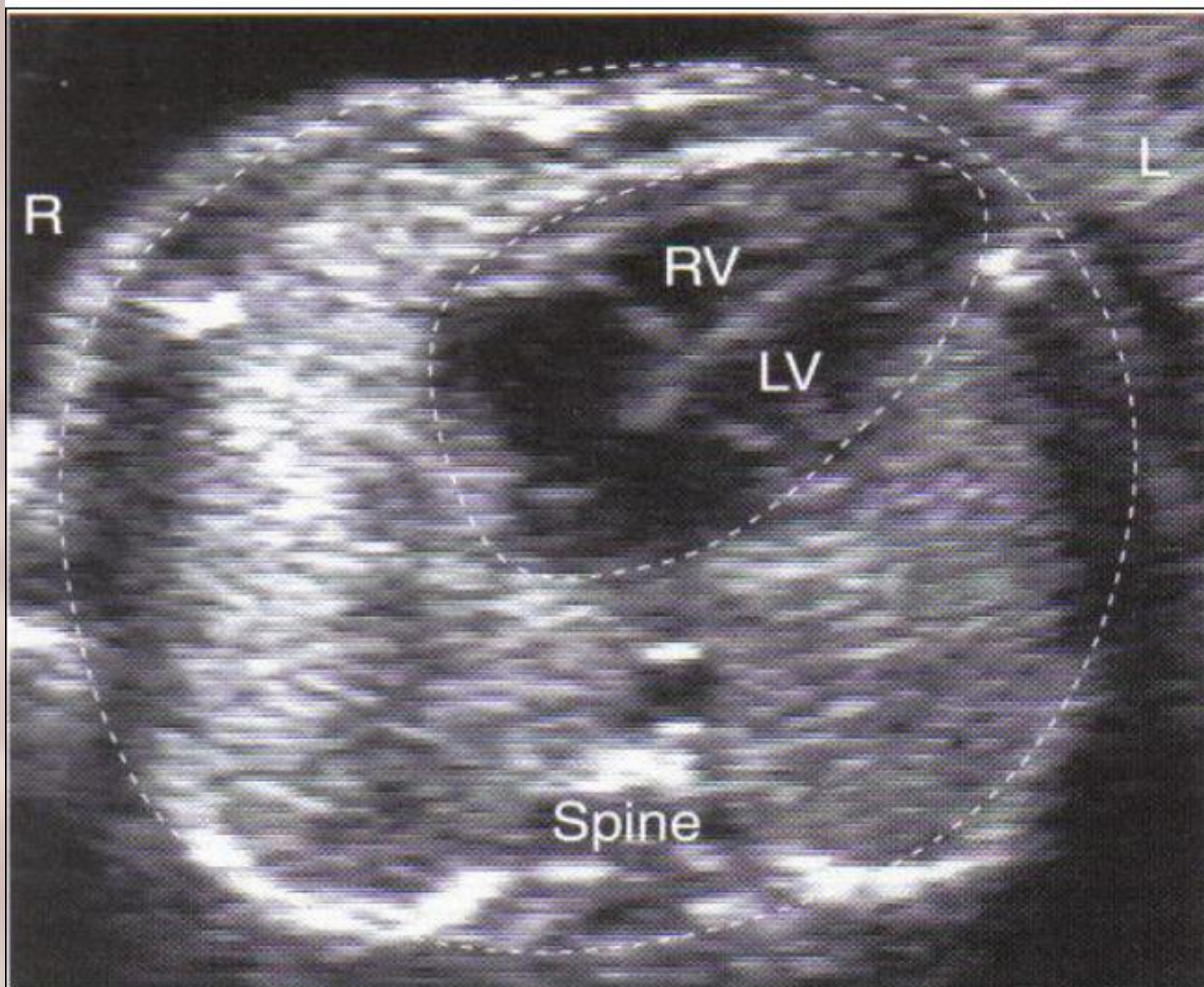
Figure 5.33 Premature atrial contractions (*small arrows*) which are conducted in **A** and blocked in **B** resulting in ventricular bradycardia. **C**: CAVB with no correlation between faster atrial and much slower ventricular events. **D**: PVC (*thick arrow*) does not disturb the regular atrial rhythm.

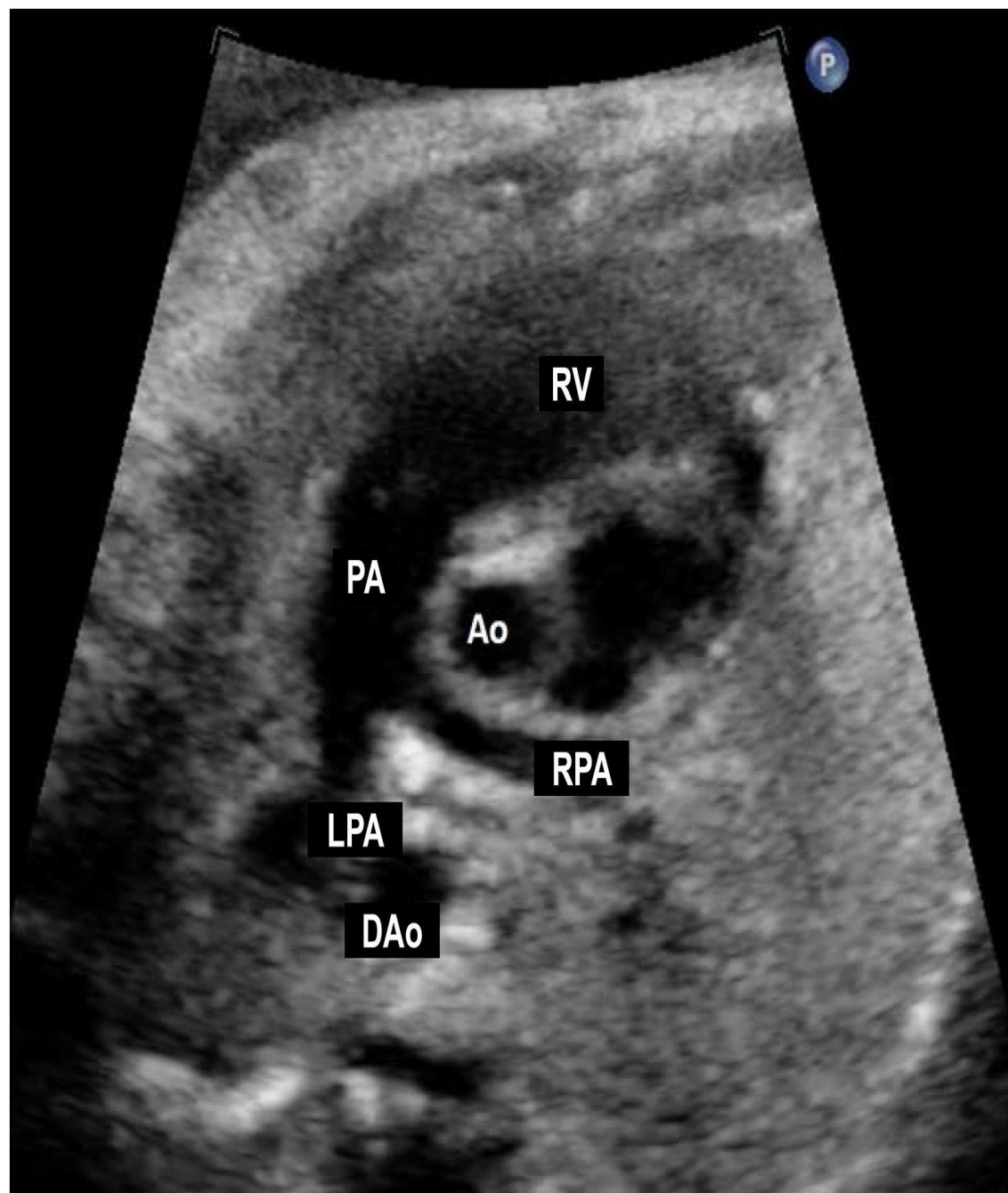


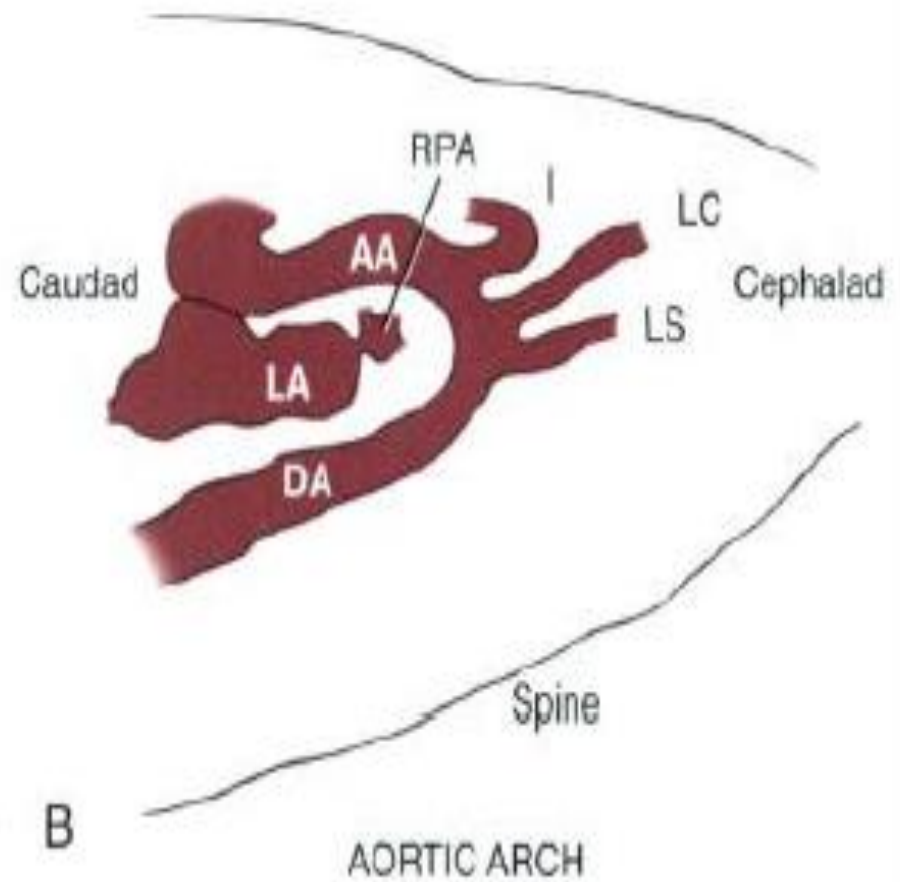
MODERATOR
BAND

L LV RV R
MV LA RA TV
PV AO PV

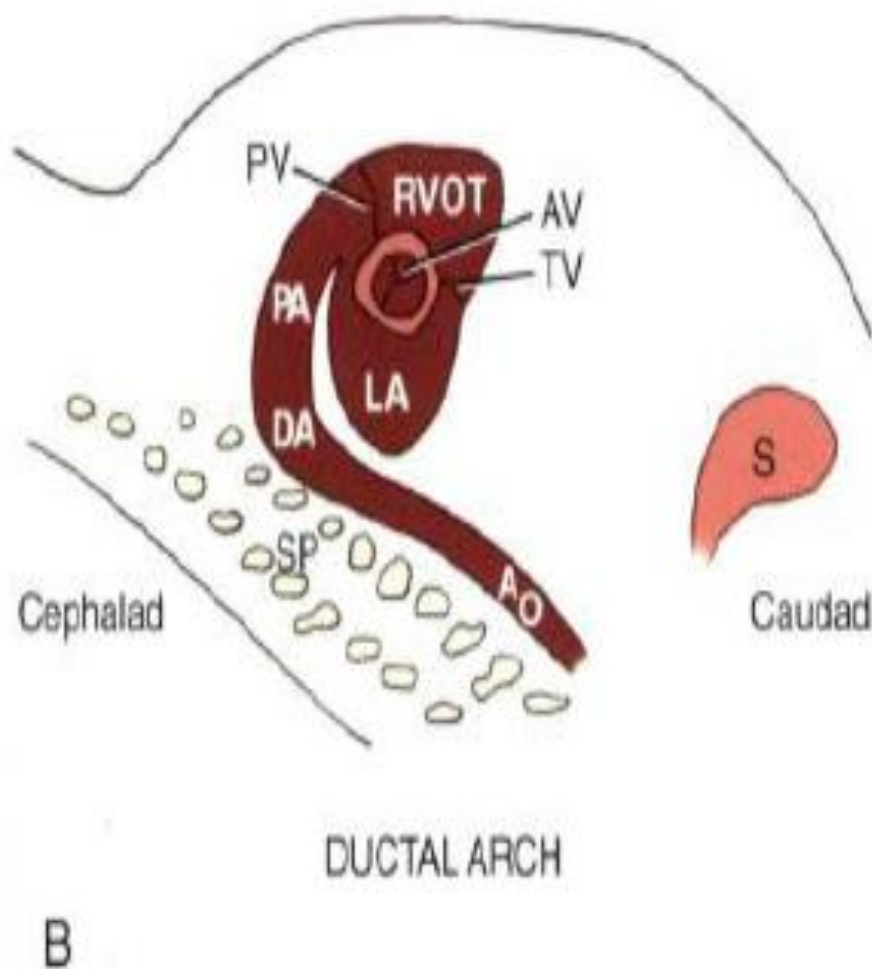






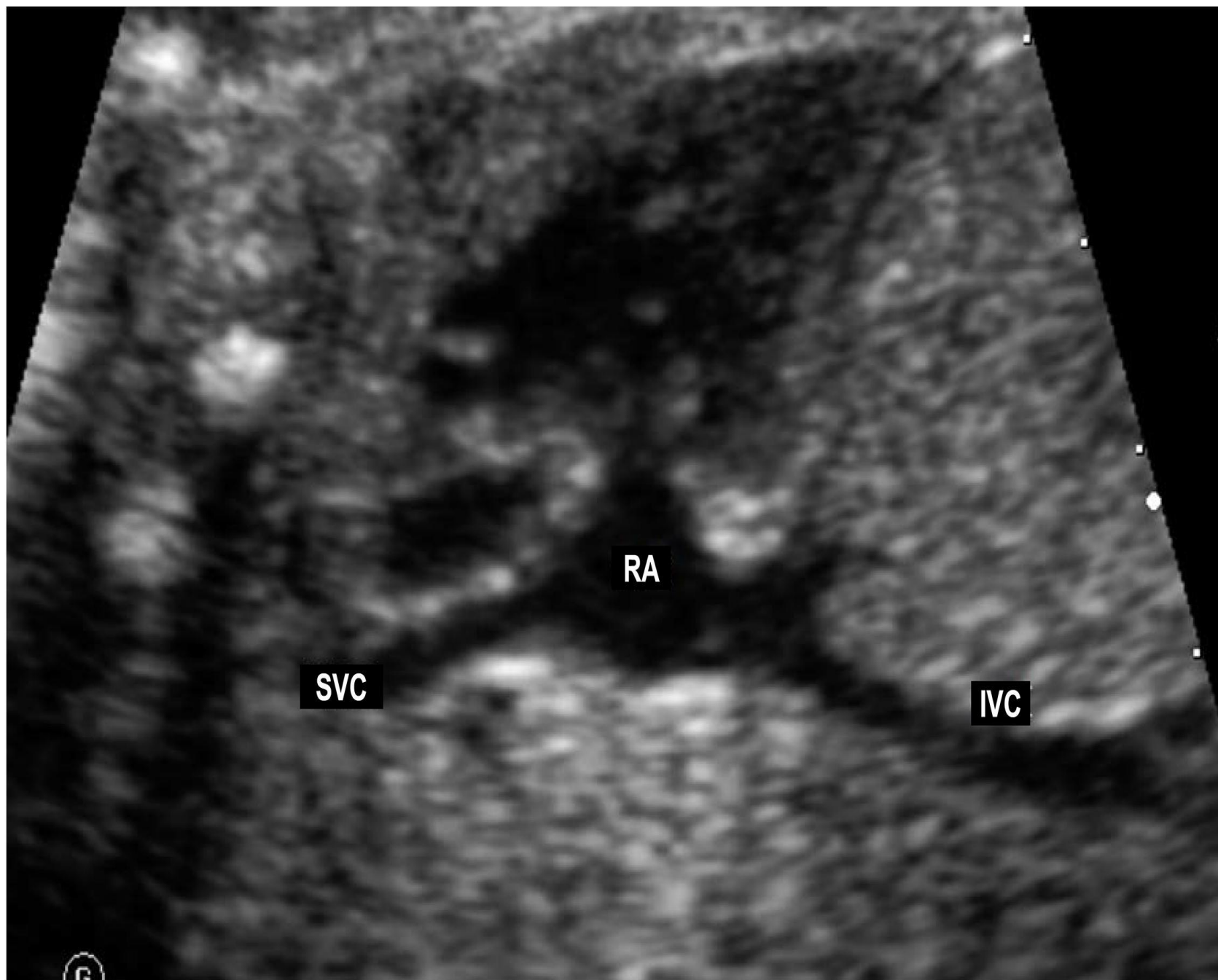


شکل ۹۴- کمان آئورت (aortic arch)



شکل ۹۳- کمان مجرا (ductal arch)





از حسن توجه شما بسیار سپاسگزارم

