Evaluation of the fetal heart

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Fetal echocardiography

- Why
- When
- who

Indications

- Maternal
- Fetal
- Familial

Screening consideration

- Risk of CHD in live birth: ~0.8%
- Higher incidence in stillbirth
- Screening test risk

1. ≤ 1% of CHD: not indicated
2. 1 – 2% lower risk but reasonable to perform (single umbilical artery)
3. ≥ 2% : higher risk (CHD in the first degree relative)

Familial risk factors

History of CHD in siblings, parent, multiple relatives

- Recurrence risk with sibling/parent CHD: 2-5%
- Risk is general, typically non-lesion specific

i. Exceptions: LV obstructive lesions (8-10%), HLHS recurrence risk in sibling ~8%, BAV is highly heritable

Familial risk factors

- Maternal CHD carries higher risk (2×) than paternal CHD (3-7% versus 2-3%)
- Second degree relative: 1-2% risk of CHD
- Third degree relative: ≤ 1% risk of CHD

Mendelian disorders

- Familial autosomal dominant disorders with risk of cardiac phenotype (Marfan disease)
- Fetal deletion syndromes (22q11, Williams syndrome)

Maternal risk factors

Diabetes mellitus

- Pre-gestational diabetes: 3-5% risk of CHD

1. Higher risk for SV, heterotaxy, TA, d-loop TGA
2. Higher risk in poorly controlled pre-gestational DM

- Gestational DM in third trimester: no ↑ risk
- Poorly controlled DM: HCM in third trimester

Maternal risk factors

Maternal phenylketonuria

- Poorly treated: MR, microcephaly, growth retardation, CHD
- Phenylalanine levels > 15mg/dl:10-15× risk of CHD
- Phenylalanine levels < 6mg/dl: no increase in risk

Maternal risk factors

- Maternal autoimmune disease
- Anti-Ro/SSA or anti-La/SSB
- CHB

Maternal risk factors

Medication exposure

- Anticonvulsants: about 1.8% risk of CHD
- Lithium:

1. Old study: up to 8% risk of CHD and Ebstein anomaly
2. Newer prospective studies: minimal increase risk (1.1%) and no increased risk of EA

Maternal risk factors

Medication exposures

- ACE inhibitors: increased risk of CHD in first trimester (2.9%) (ASD,PDA)
- Selective serotonin reuptake inhibitors

1. Paroxetine may increase CHD (RVOT obst, PPHN)

Maternal risk factors

Medication exposures

- Retinoic acid: 8-20% risk of CHD (conotruncal defects, arch anomalies)
- Vit K antagonists (wafarin, coumadin)

1. Teratogenic in first trimester
2. Maybe increased risk of CHD beside other birth defects

Maternal risk factors

Medication exposures

- NSAID

1. In first trimester: small increase risk of CHD
2. Second to third trimester : ductal constriction
   - Usually mild and resolve with discontinuation
   - Severe ductal constriction: RV hypertension, RV dysfunction, post natal pulmonary hypertension

Maternal risk factors

Maternal infections

- Rubella (in first trimester)
  - Persistent PDA
  - Branch pulmonary artery stenosis/hypoplasia
- Other viruses (adenovirus, parovirus…)
  - Usually no increased risk of CHD
  - However may cause fetal pericarditis, myocarditis, CHB

Maternal risk factors

- Assisted reproduction technology
- CHD risk with IVF: 1.1-3.3% , non-specific
- Confounded by other factors (advanced maternal age, increased risk of twinning, unknown etiology of infertility)
- Reasonable to perform fetal echo

Fetal risk factors

- Suspicion of CHD on screening OB ultrasound (>40% CHD with abnormal 4-chamber view, >50% with addition of outflow tract views)
- Fetal cardiac arrhythmia
  - Bradycardia<110/min with CHB: 50% risk of CHD
  - Tachycardia >180/min: 1% risk of CHD
  - Irregular rhythm (PAC or PVC): 0.3% risk of CHD

Fetal risk factors

- Extracardiac malformation:
  - Omphalocele: 30% risk of CHD
  - CDH: 30% risk of CHD
  - GU anomalies: 23% risk of CHD
  - Duodenal atresia: 20% risk of CHD
- Genetic abnormalities: high risk of CHD ~30%

Fetal risk factors

Increased nuchal translucency:

- Transient subcutaneous posterior neck fluid collection 10-14 ws gestetion
- Normal: 95%ile 3mm, 99%ile 3.5mm
- Increased NT associated with aneuploidy and CHD
  - 3-3.5mm NT: 3% risk of CHD
  - >3.5mm NT:6% risk of CHD
  - >6mm NT: 24% risk of CHD

Fetal risk factors

- Single umbilical artery: 2-3% risk of CHD
- Absence of ductus venosus: 3% risk of CHD
  - Also may lead to volume overload/heart failure due to placental venous return via low resistance venous pathway through liver

Fetal risk factors

- Monochorionic monozygotic twins: 2-9% risk of CHD
- Twin-twin transfusion syndrome:
  - Recipient twin at risk for polyhydramnios, CHF, acquired RV outflow tract obstruction

Fetal risk factors

- Fetal hydrops: fluid accumulation > 2 of compartment, pleural, pericardial, skin, abd cavity, placenta
- ~80% of all cases of hydrops: non-immune
- 25% of non-immune hydrops are due to CHD or arrhythmia (increased hydrostatic pressure)

Fetal risk factors

- non-immune hydrops
  - AV valve regurgitation (Ebstein anomaly, CAVCD)
  - Pressure overload (biventricular outflow obstruction)
  - Decreased diastolic filling time (tachyarrhythmias)
  - Systolic dysfunction (cardiomyopathy, myocarditis)

Fetal Cardiovascular Assessment

- • Detailed assessment of cardiovascular anatomy by 2-D imaging
- • Assessment of blood flow within the heart, systemic and pulmonary veins, and great arteries
- • Assessment of ventricular (systolic & diastolic) function
- • Assessment of rhythm

Fetal Echocardiography

- **The Normal Anatomy**
- •Define fetal position including left & right
- •Defining Visceral-Atrial Situs
- •The 4 Chamber View
- •The Outlets, Great Arteries, Arches
- •3 Vessel View
- •Basic Rhythm and Function

Checklist in Four-Chamber view

- Size of the heart

- cardiomegaly

Checklist in Four-Chamber view

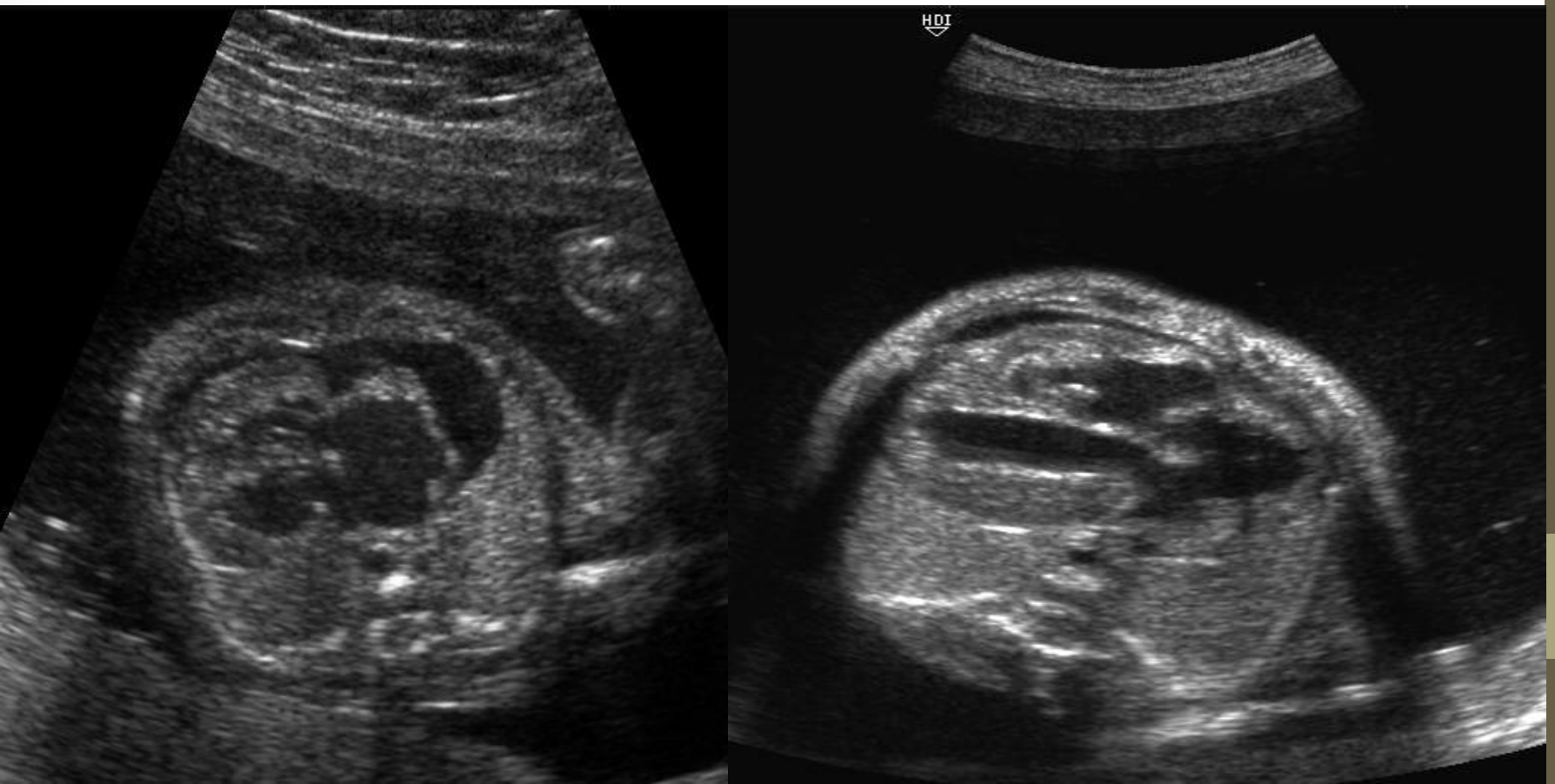
- Size of the heart
- Position of the heart

- Position of the heart /Shifting

Checklist in Four-Chamber view

- Size of the heart
- Position of the heart
- Heart axis 45° +- 15°

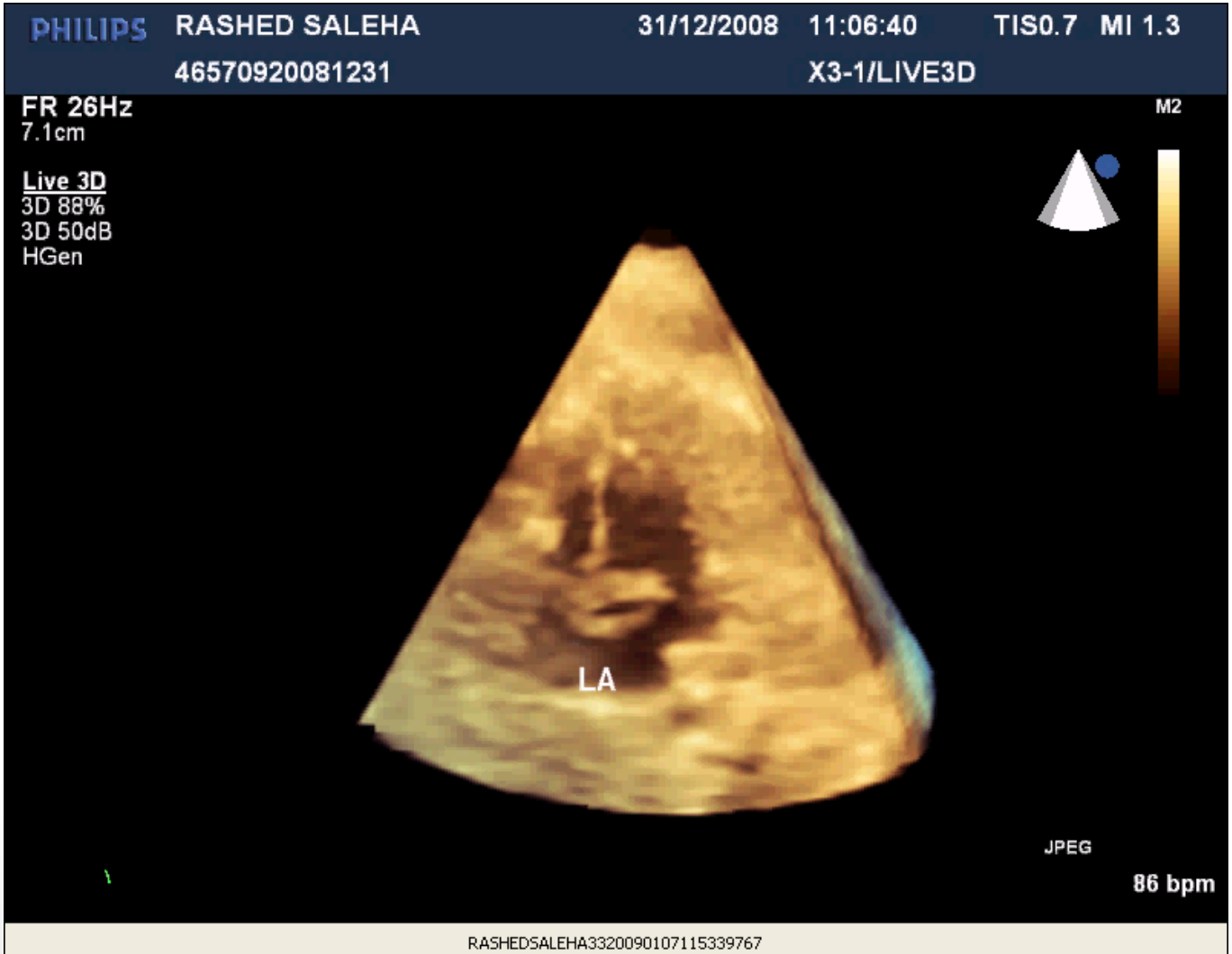
- Heart axis

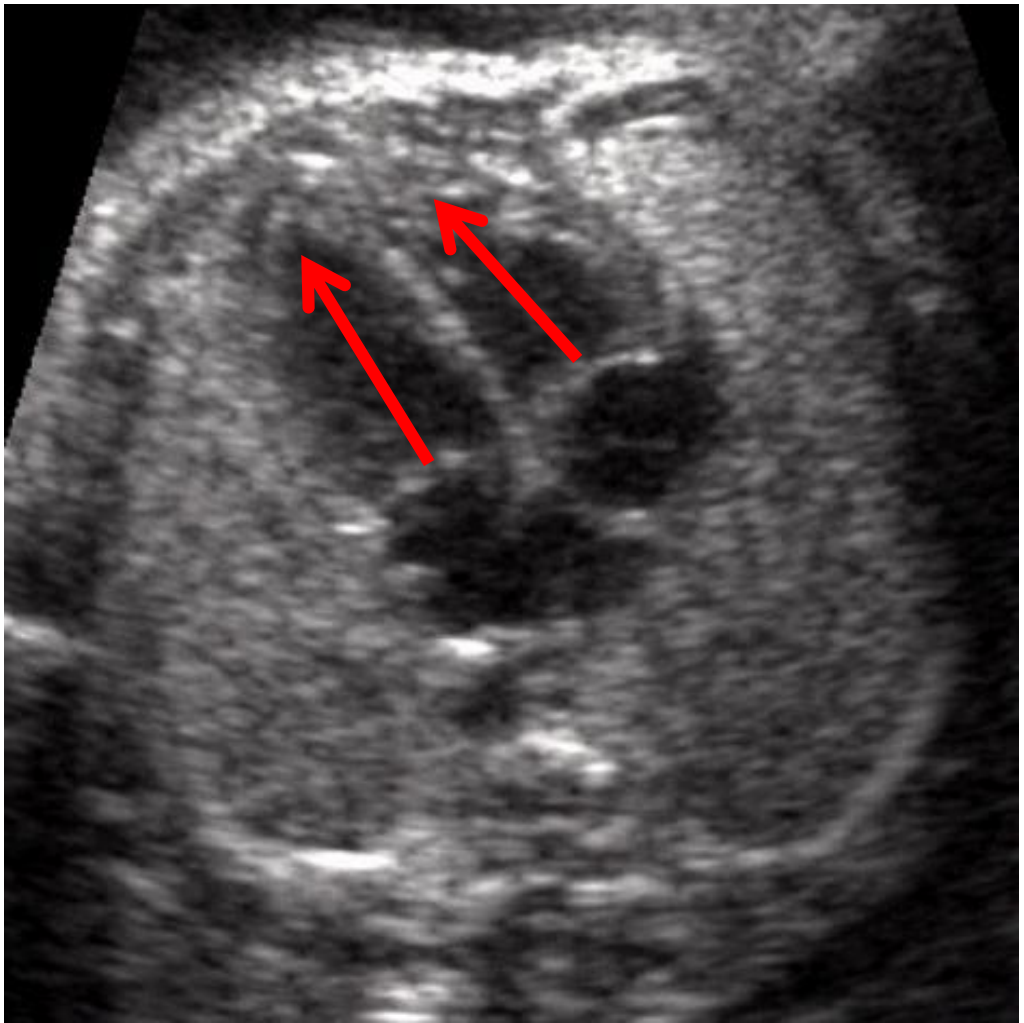


Checklist in Four-Chamber view

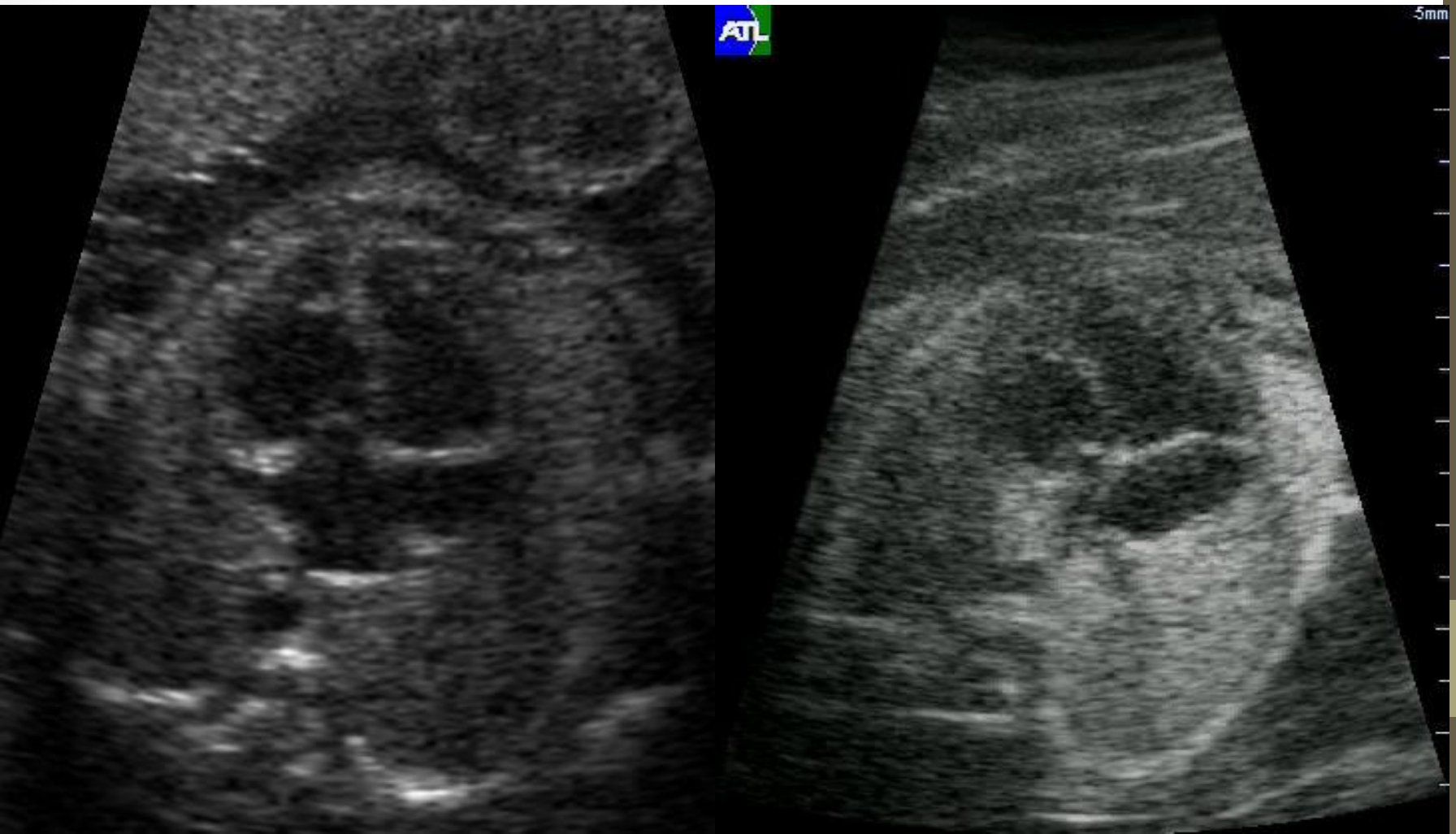
- Size of the heart
- Position of the heart
- Heart axis 45° +- 15°
- Rhythm
- contractility
- Pericardial effusion

Foramen ovale

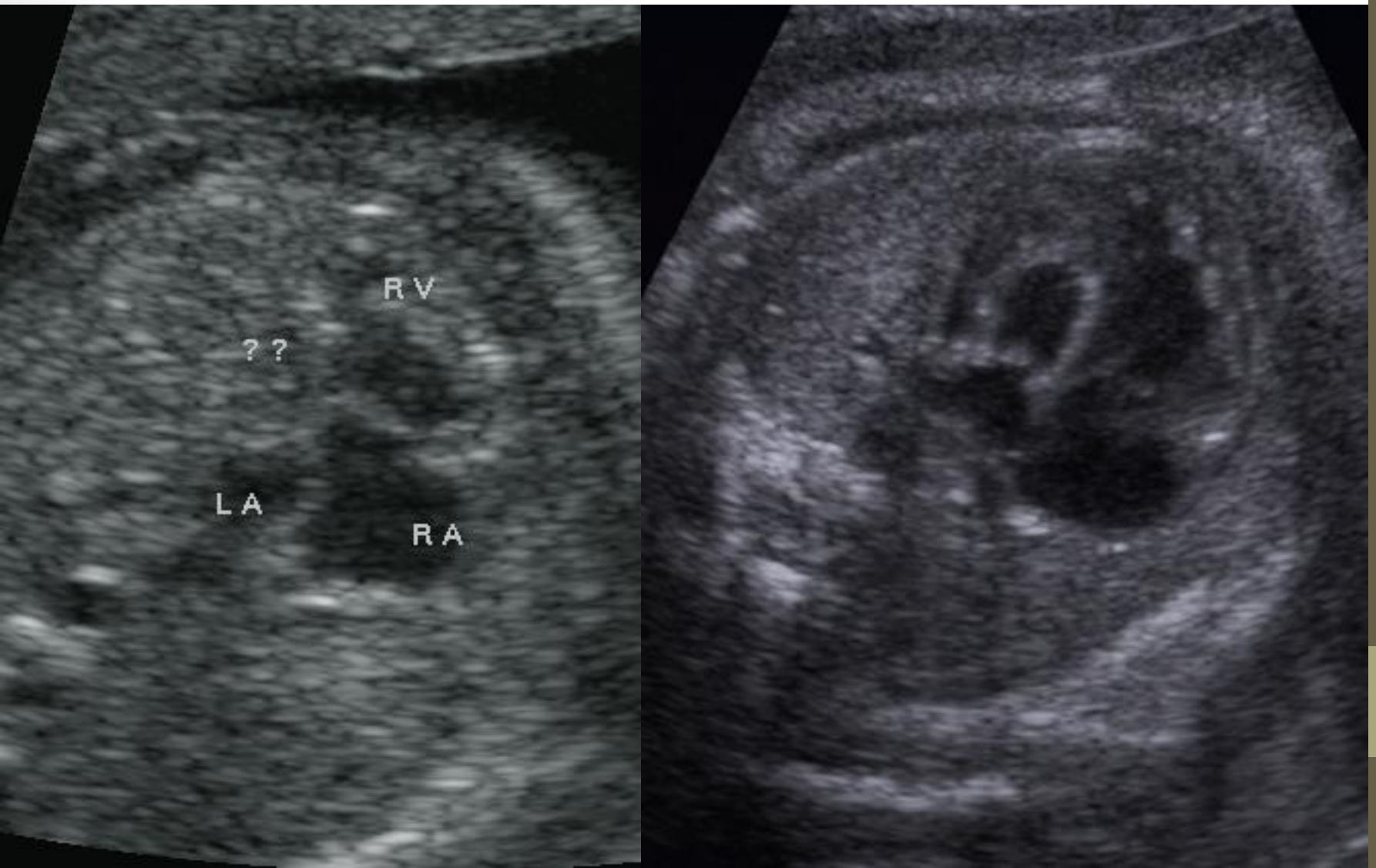




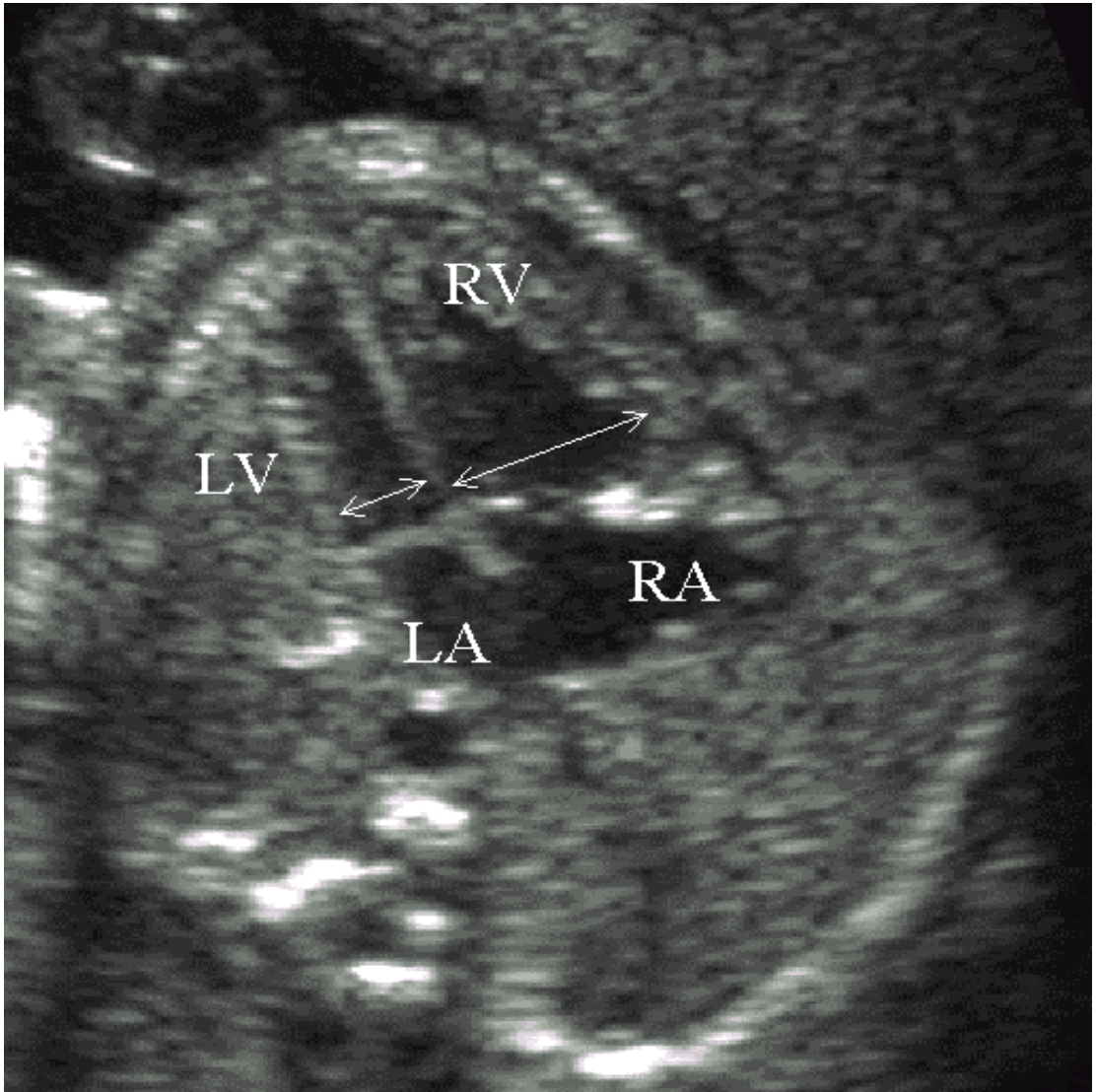
Atrioventricular discordance in corrected TGA



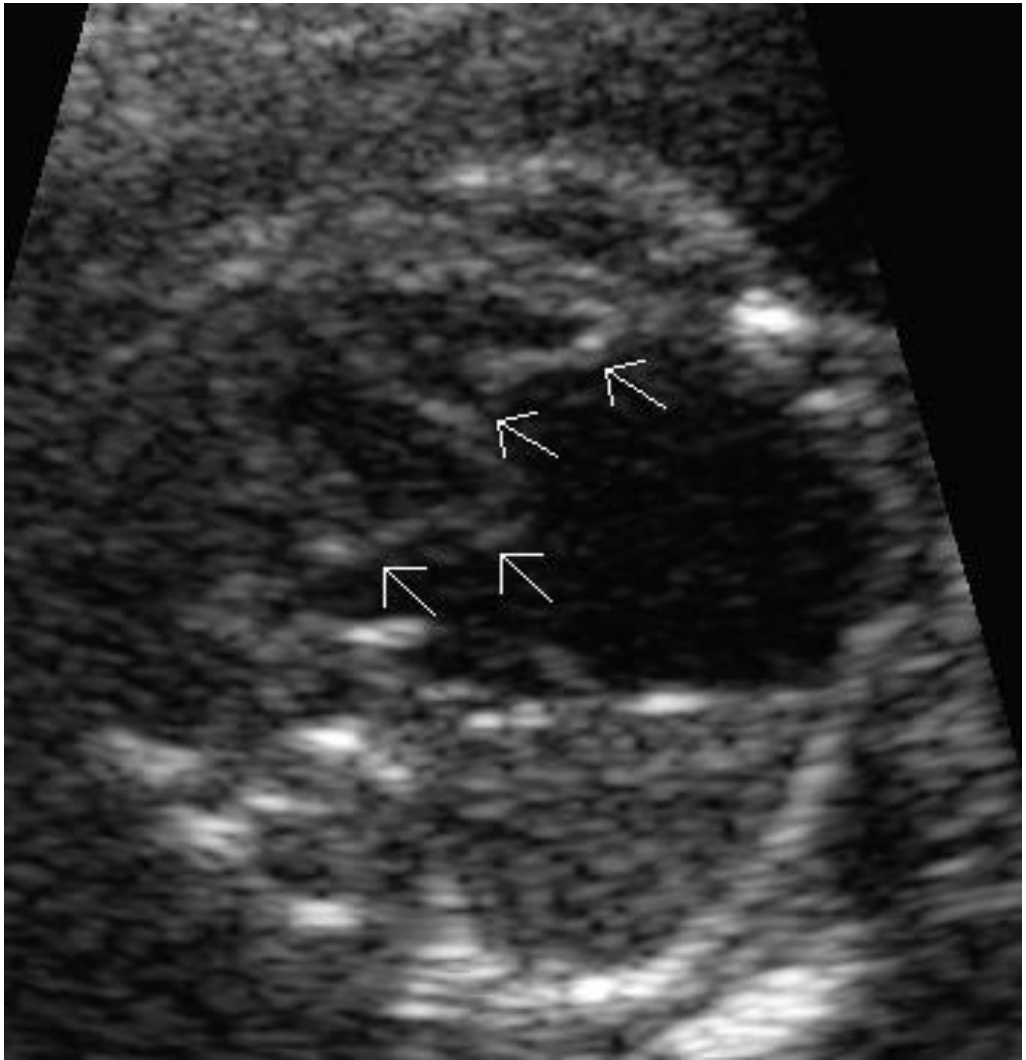
Left ventricle



Aortic coarctation



Ebstein anomaly

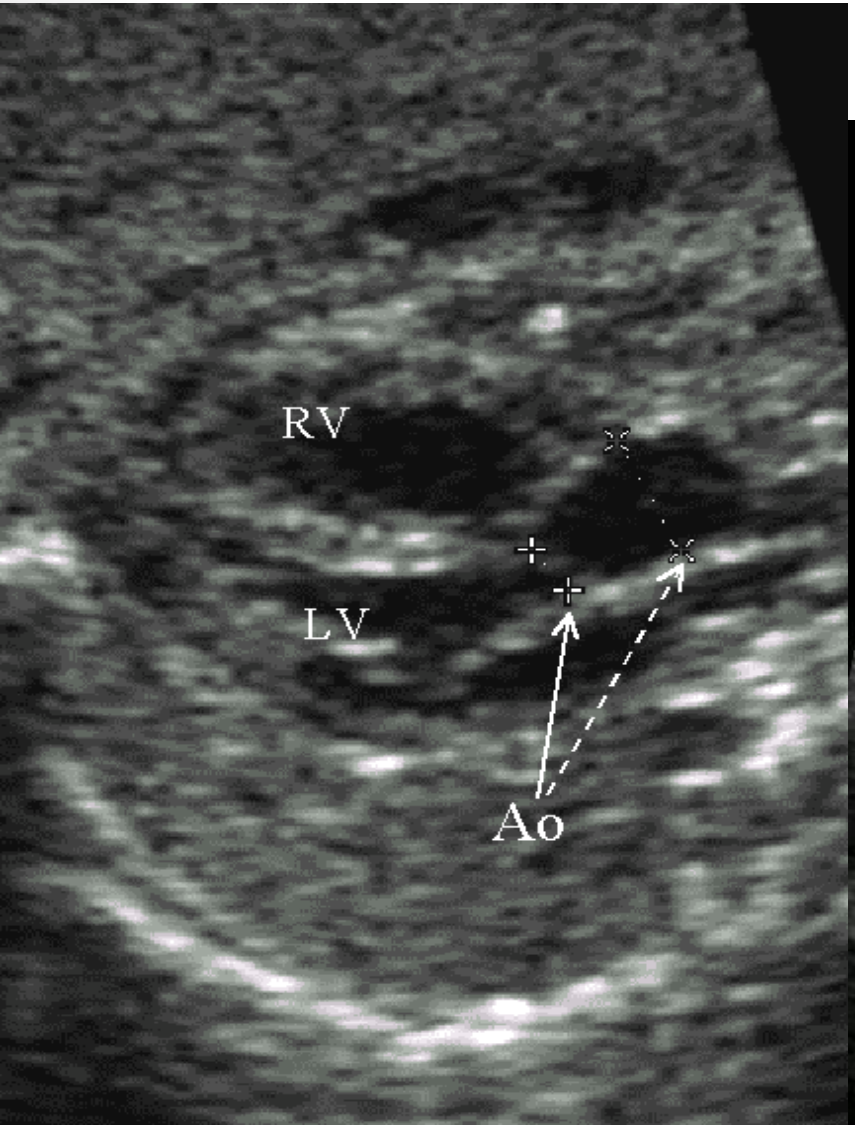


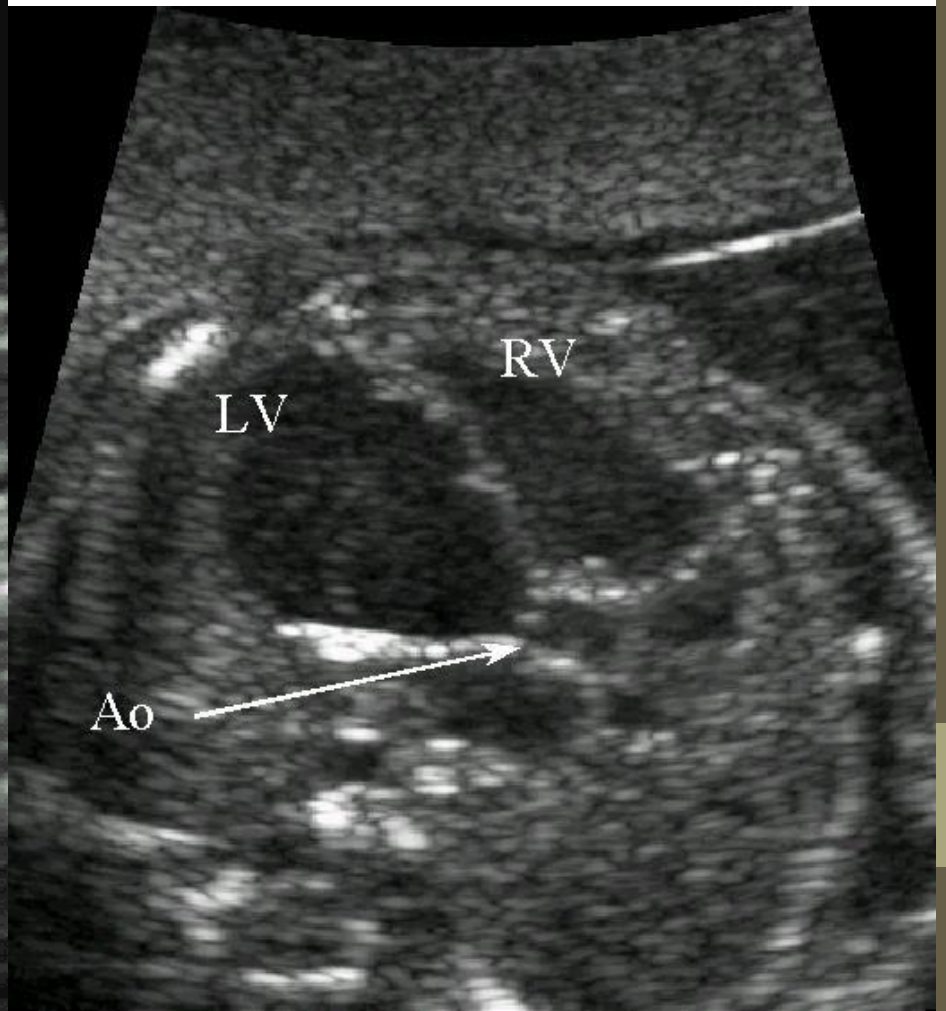
AVSD

Five-Chamber-View
Connection of the aorta with the LV

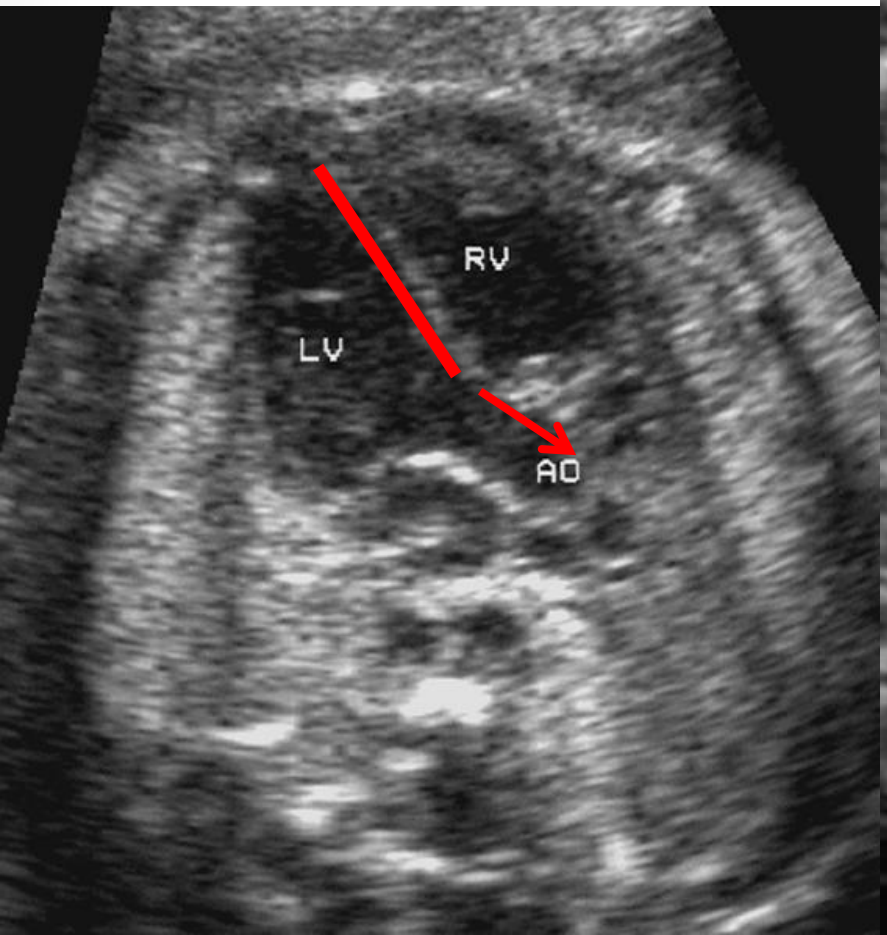

GE

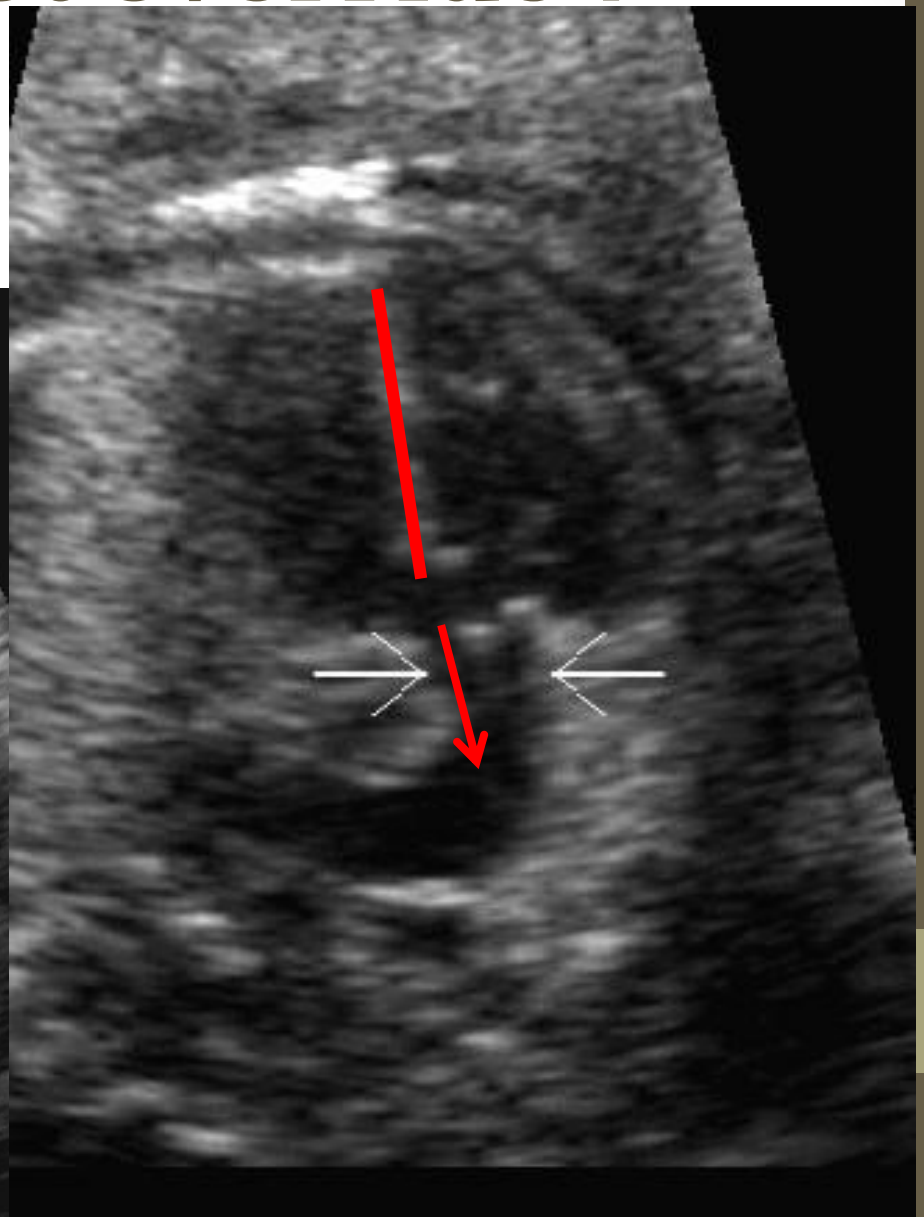
Size of the ascending aorta





Override or not override ?

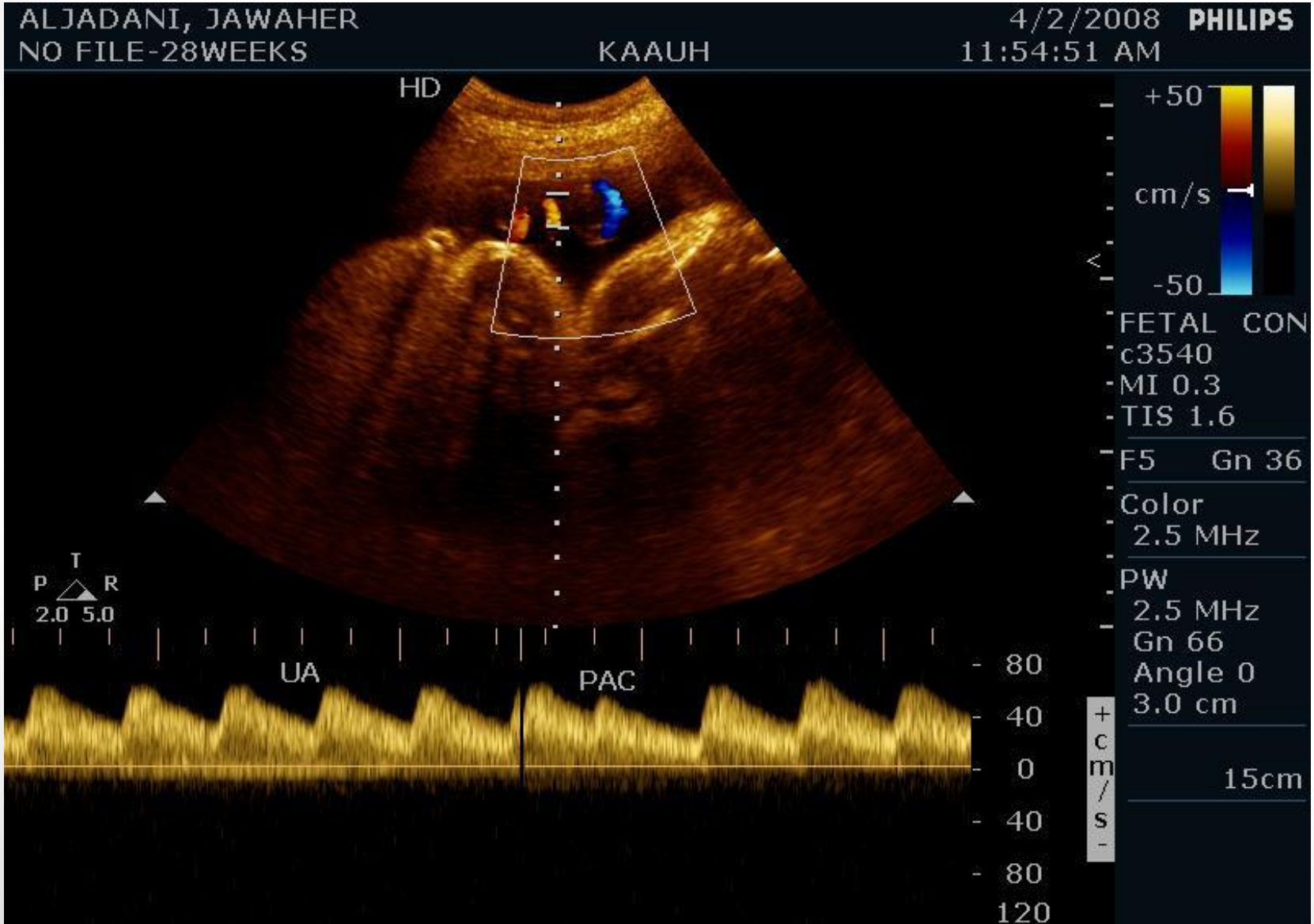




Spectral Doppler Assessment

- • IVC/SVC
- • Pulmonary veins
- • Foramen Ovale
- • Mitral and Tricuspid valve flows
- • Ventricular outflows/great arteries
- • Ductus venosus
- • Ductus arteriosus
- • Umbilical artery
- • Umbilical vein

Blocked PAC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