First Trimester Fetal Echocardiography

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Eastern Virginia Medical School
Fetal Echo In Early Gestation

• Definition
• Approach
• Efficacy
• Normal / Abnormal anatomy
## Chronology of Cardiac Development

<table>
<thead>
<tr>
<th>Feature</th>
<th>Weeks of development (from fertilization)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angiogenic clusters</td>
<td>Early 3</td>
</tr>
<tr>
<td>Formation of heart tubes</td>
<td>Early 3</td>
</tr>
<tr>
<td>Cardiac pumping</td>
<td>Early 3</td>
</tr>
<tr>
<td>Fusion of heart tubes</td>
<td>Early 3</td>
</tr>
<tr>
<td>Looping of heart tube</td>
<td>Mid 3</td>
</tr>
<tr>
<td>Appearance of intraventricular septum</td>
<td>Mid 3/late 3</td>
</tr>
<tr>
<td>Septum primum</td>
<td>End 3/early 4</td>
</tr>
<tr>
<td>Appearance of endocardial cushions</td>
<td>End 4</td>
</tr>
<tr>
<td>Conotruncal ridges</td>
<td>Late 4/early 5</td>
</tr>
<tr>
<td>Conotruncal septum</td>
<td>Early 5/mid 5</td>
</tr>
<tr>
<td>Septum secundum</td>
<td>Late 5/early 6</td>
</tr>
<tr>
<td>Fusion of endocardial cushions</td>
<td>Early 6</td>
</tr>
<tr>
<td>Obliteration of membranous septum</td>
<td>Mid 7/end 7</td>
</tr>
</tbody>
</table>


From Practical Guide To Fetal Echocardiography – Abuhamad, Chaoui – 2nd Edition
Early Fetal Echocardiography

- Detailed anatomic cardiac evaluation cannot be performed at less than 10 weeks gestation
Fetal Cardiac Size
Targeting a small organ

12 weeks: Chickpea

22 weeks: Olive

32 weeks: Almond

Modified from Fetal Heart Ultrasound how, why and when - Fredouille, Develay-Morice
Early Fetal Echocardiography

- First description of a fetal cardiac anomaly in early gestation occurred at 11 weeks in 1990

- First trimester screening resulted in increased attention to fetal anatomy in early gestation

Gembruch – Obstet Gynecol 1990
Early Fetal Echocardiography

• Several major malformations are evident in the 1st trimester:

• You won’t find what you are not looking for

1st Trimester US
• CRL
• Cardiac activity
• Adnexae
## NT and CHD

<table>
<thead>
<tr>
<th>Nuchal translucency</th>
<th>Prevalence CHD&lt;sup&gt;a&lt;/sup&gt;</th>
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<tbody>
<tr>
<td>&lt; 2.0 mm</td>
<td>1.9/1000&lt;sup&gt;b&lt;/sup&gt;</td>
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<tr>
<td>2.0–2.4 mm</td>
<td>4.8/1000&lt;sup&gt;b&lt;/sup&gt;</td>
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<tr>
<td>2.5–3.4 mm</td>
<td>6.0/1000&lt;sup&gt;b&lt;/sup&gt;</td>
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<tr>
<td>≥ 3.5 mm</td>
<td>23/1000&lt;sup&gt;b&lt;/sup&gt;</td>
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<sup>a</sup> Prevalence in study population 2.6/1000.

<sup>b</sup> Per 1000 pregnancies.

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Bahado-Singh AJOG 2005
Early Fetal Echocardiography

**Definition**

- Prior to 16 weeks’ gestation
- Prior to 15 weeks’ gestation
- NT Range: from 10+3 to 14 weeks’ gestation
Early Fetal Echocardiography

Approach to Examination

• Transvaginal
• Transabdominal
Early Fetal Echocardiography

Transvaginal

- Better resolution of probe
- Inconvenience to patients
- Limited probe range of motion
- Requires expertise
Early Fetal Echocardiography

Transvaginal

- Most optimal < 13 weeks
- Fetus in transverse lie
Early Fetal Echocardiography

Transvaginal
Early Fetal Echocardiography

Approach to Examination

• Targeted approach based upon:
  – Gestational age
  – Fetal lie and presentation
  – Maternal body habitus
Early Fetal Echocardiography

**Approach to Examination**

- Combined approach may be needed in some cases (suspected anomalies)
Early Fetal Echocardiography

**Indications (10-14 weeks)**

- Increased NT
- Reverse flow in Ductus Venosus
- Tricuspid / mitral regurgitation
- Abnormal cardiac axis*
- Other
Early Fetal Echocardiography

• Normal / Abnormal Anatomy
### Four Chamber View Visualization Rate (%)

<table>
<thead>
<tr>
<th>Authors</th>
<th>Year</th>
<th>10+0 - 10+6</th>
<th>11+0 - 11+6</th>
<th>12+0 - 12+6</th>
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<td><strong>80</strong></td>
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*most transvaginal*
Four Chamber View

From Practical Guide To Fetal Echocardiography – Abuhamad, Chaoui – 2nd Edition
Four Chamber View

From Practical Guide To Fetal Echocardiography – Abuhamad, Chaoui – 2nd Edition
Four Chamber View

13 wks

LV, RV, DAO, IVS, L, DAO, LV, RV
Four Chamber View

12 wks

TA

LV
RV
LA
RA

TV

LV
RV
LA
RA

From Practical Guide To Fetal Echocardiography – Abuhamad, Chaoui – 2nd Edition
Four Chamber View

12 wks
Pulmonary Veins

12 wks

From Practical Guide To Fetal Echocardiography – Abuhamad, Chaoui – 2nd Edition
Four Chamber View

11 wks
Four Chamber View

12 wks
Abdominal Situs

12 wks
Abnormal Anatomy
Four Chamber View (EIF)

12 wks
Abdominal Situs

From Practical Guide To Fetal Echocardiography – Abuhamad, Chaoui – 2nd Edition
Heterotaxy Syndrome

14 wks

From Practical Guide To Fetal Echocardiography – Abuhamad, Chaoui – 2nd Edition
Ventricular Septal Defect

13 wks
Ventricular Septal Defect

13 wks
AV- Canal

From Practical Guide To Fetal Echocardiography – Abuhamad, Chaoui – 2nd Edition
AV- Canal

From Practical Guide To Fetal Echocardiography – Abuhamad, Chaoui – 2nd Edition
AV- Canal

From Practical Guide To Fetal Echocardiography – Abuhamad, Chaoui – 2nd Edition
Hypoplastic Left Heart Syndrome

12 wks
Hypoplastic Left Heart Syndrome

12 wks
Hypoplastic Left Heart Syndrome

12 wks

From Practical Guide To Fetal Echocardiography – Abuhamad, Chaoui – 2nd Edition
Hypoplastic Left Heart Syndrome

13 wks

From Practical Guide To Fetal Echocardiography – Abuhamad, Chaoui – 2nd Edition
Mitral Atresia

13 wks
Ebstein Anomaly

13 wks

GA=12w5d

From Practical Guide To Fetal Echocardiography – Abuhamad, Chaoui – 2nd Edition
Tricuspid Atresia

13 wks
Outflow Tracts
## Right Ventricular Outflow Visualization Rate (%)

<table>
<thead>
<tr>
<th>Authors</th>
<th>Year</th>
<th>10+0 - 10+6</th>
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*most transvaginal*
# Left Ventricular Outflow Visualization Rate (%)

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*most transvaginal*
## Outflow Tracts

**Visualization Rate of both (%)**

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<td><strong>22</strong></td>
<td><strong>40</strong></td>
<td><strong>66</strong></td>
<td><strong>84</strong></td>
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</table>
Left Ventricular Outflow

13 wks

LV, RV, Ao
Outflow Tracts

11 wks
Outflow Tracts

11 wks
Outflow Tracts

13 wks
Outflow Tracts

13 wks
Outflow Tracts

11 wks
Outflow Tracts

13 wks

Transverse Ductal Arch

Three Vessel Trachea
Ductal Arch

13 wks
Aortic & Ductal Arches

13 wks
Abnormal Anatomy
Coarctation of Aorta

13 wks
Coarctation Aorta

14 wks
Hypoplastic Left Heart Syndrome

12 wks
Tetralogy of Fallot

13 wks

A

RV

LV

VSD

AO

B

LV

RV

AO
Common Arterial Trunk

13 wks

From Practical Guide To Fetal Echocardiography – Abuhamad, Chaoui – 2nd Edition
Double Outlet RV

11 wks
Double Outlet RV

14 wks
Transposition of Great Arteries

14 wks

AO, SVC, RV, LV, PA, AO
Right Aortic Arch with Left Ductus Arteriosus

13 wks
Cardiac Axis

Normal

Abnormal (TOF)
Cardiac Axis

13 wks
Cardiac Axis

12 wks

From Practical Guide To Fetal Echocardiography – Abuhamad, Chaoui – 2nd Edition
## Cardiac Axis

<table>
<thead>
<tr>
<th>GA (wks)</th>
<th>N</th>
<th>Cardiac axis (°)</th>
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<tr>
<td>11+0 – 11+6</td>
<td>18</td>
<td>53 ± 5</td>
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<tr>
<td>12+0 – 12+6</td>
<td>40</td>
<td>48 ± 3</td>
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<tr>
<td>13+0 – 13+6</td>
<td>26</td>
<td>46 ± 3</td>
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<tr>
<td>14+0 – 14+6</td>
<td>16</td>
<td>44 ± 4</td>
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</table>

Normal Range: 30 – 60°

Source: Sinkovskaya – ISUOG 2009
Cardiac Axis

Gestational age, weeks

Mean
±0,95 Conf. Interval

Sinkovskaya – ISUOG 2009
Cardiac Axis

13 wks

TOF
Cardiac Axis

13 wks

HLHS
Cardiac Axis

12 wks

HLHS
## Complete Fetal Echocardiogram Success Rates (%)

<table>
<thead>
<tr>
<th>Authors</th>
<th>Year</th>
<th>Type</th>
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<td>Weiner et al</td>
<td>2002</td>
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<td>Huggon et al</td>
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<td>Yagel et al</td>
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<td>TV</td>
<td>95</td>
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</table>

*TV*– transvaginal; *TA* – transabdominal; *C* – combined
<table>
<thead>
<tr>
<th>Authors</th>
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<th>*CHD, n</th>
<th>Sensitivity, %</th>
<th>Specificity, %</th>
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<td>7</td>
<td>11</td>
<td>-</td>
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Early Fetal Echocardiography

Spectrum of CHD

• More complex abnormalities
• Higher association with aneuploidy
• Higher association with hydrops
Early Fetal Echocardiography

Advantages

• Early reassurance
• Early diagnosis
• Option for early termination
Early Fetal Echocardiography

**Disadvantages**

- Requires operator skills & high-end equipment
- May require combined TA & TV approach
- When normal, requires repeat echo in second trimester
- May have higher false + and false -