Sonography in the First Trimester

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Basic Embryology

1mm Sac

Embryonic Timeline

- Ovulation: Day 14-16
- Fertilization: Day 14-16
- Zygote to Morula: Day 16-18
- Morula to Blastocyst: Day 18-19
- Implantation: Day 19-20

Week 3

Yolk Sac Formation: 4w1d

Goals for a 1st Trimester Scan

- Visualization and localization of the gestational sac
- Determination of viability
- Determination of the # of embryos & viability
- Estimation of gestational age
- Determination of any detectable anomalies

Embryology Terms

- Gamete --------- Before fertilization
- Zygote --------- After fertilization
- Morula --------- 16-32 Cells (18 Days)
- Blastocyst -------- 20 Days
- Embryonic Disc --- 28 Days
- Ultrasound Detection --- 31 Days
- Earliest Heart Beat ------ 36 Days
Earliest Definite Ultrasound Visualization: 31 days

Pre-embryonic (embryonic disc stage 4w4d or 32 days)

"Double Sac" Sign

4 WEEK GESTATION

DECIDUA CAPSULARIS
DECIDUA BASALIS
DECIDUA PARIELALIS
ENDOMETRIAL CAVITY
MYOMETRIUM OF UTERUS
GESTATIONAL SAC
CERVIX

"Double Sac" Sign

Video Clip
Estimation of Gestational Age from the MSD (mean sac diameter)

Age in Days (by LMP) = \( \frac{(L+W+H)}{3} + 30 \)

5 weeks by LMP

5w0d by LMP

Width (from trv image) = 6
6+6+4 divided by 3 = 5.3, +30 = 35.3d or 5w

5 weeks 6 days by LMP

Width 15mm MSD 13 = 43d =6w1d

Human Chorionic Gonadotropin

- Made by trophoblastic cells
- Detectable after implantation
- Doubling time every 2-3 days
- Correlates well with embryonic and sac size
- Level maximizes at about 8 weeks
- Max level is about 50,000 -100,000 IU/L
- Declines after 10-12 weeks

Beta Chorionic Gonadotropin Levels

<table>
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<tr>
<th>MSD</th>
<th>Age (weeks)</th>
<th>HCG Level</th>
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<tbody>
<tr>
<td>2mm</td>
<td>5.0</td>
<td>1,164</td>
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<tr>
<td>5mm</td>
<td>5.4</td>
<td>1,932</td>
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<td>10mm</td>
<td>6.0</td>
<td>4,478</td>
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<tr>
<td>15mm</td>
<td>6.6</td>
<td>10,379</td>
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<td>20mm</td>
<td>7.3</td>
<td>24,060</td>
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Embryonic Timeline

- Week 6: Heartbeat will be detectable during this week. This is the neural tube stage.
- Weeks 6-10: Essentially all of the tissues and organs of the embryo will form during this period.
- Week 11: All of the organs are present and all but a portion of the bowel and the external genitalia are in their final positions.
- Week 12: The bowel will reenter the fetal abdomen.

CRL and Gestational Age

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<th>CRL (mm)</th>
<th>Gest. Age (weeks)</th>
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<tbody>
<tr>
<td>2</td>
<td>5.7</td>
</tr>
<tr>
<td>4</td>
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<td>17.9</td>
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</tbody>
</table>

Hadlock et al, Radiology 18: 501, 1992

Yolk sac and the Early Embryo
Embryonic Period 8w

CRL = 18mm 8w3d

Fluid?

Oblique Scanning Plane

Don't include the yolk sac in the CRL

Be aware of fetal position
After 13 weeks use BPD, HC, AC, and FL

Skeletal Development

Manipulation of Transducer for CRL

Video Clip
Indications for a First Trimester Scan
- Vaginal bleeding
- Size and date discrepancy
- No heart tones
- Pelvic pain
- Accurate dating for future C-section
- History of an anomaly
- Trauma

Significance of the Yolk Sac
- Earliest landmark in the early gestational sac
- Identifies an IUP
- Helps to locate the embryo and heart beat
- Should be round and “cystic” 3-6mm
- 1 yolk sac per embryo, can help identify monoamniotic twins
- Should disappear by 12 weeks
Vaginal Bleeding (1st Trimester)

- Implantation Bleed
- Abortion
- Subchorionic Hemorrhage
- Placental Previa
- Ectopic Pregnancy
- Blighted Ovum

Implantation Bleed

- Most common cause of 1st trimester vaginal bleeding
- Generally not significant
- Sonolucent area between the chorion and uterus (near the internal os)

Subchorionic Bleeds

- Can be behind the placenta
- Can be behind the chorion laeae
- Can be behind the chorionic plate of the placenta
- Prognosis depends upon the cause and how much of the placenta is involved: >1/3 prognosis worsens
Vaginal Bleeding: 1st Trimester
- Implantation Bleed
- Subchorionic Hemorrhage
- Blighted Ovum
- Placental Previa
- Ectopic Pregnancy
- Abortion

1/4 of placenta is separated from uterus

Blighted Ovum: Arrested or absent development of the embryonic pole (trophoblasts develop)
No embryo or Yolk Sac

Growth will fall off
HCG will level off
Sac may move toward Cx

Trophoblastic ring may become irregular and thin < 2mm

Vaginal Bleeding: 1st Trimester
- Implantation Bleed
- Abortion
- Subchorionic Hemorrhage
- Placental Previa
- Ectopic Pregnancy
- Blighted Ovum

Placenta Previa
12w2d
Vaginal Bleeding: 1st Trimester

- Implantation Bleed
- Abortion
- Subchorionic Hemorrhage
- Placental Previa
- Ectopic Pregnancy
- Blighted Ovum

Glossary of 1st Trimester Terms

- Abortion: Premature expulsion of the gestation from the uterus
- Incomplete Abortion: The expulsion of only a portion of the gestational products from the uterus

Findings for Embryonic Demise

Old Criteria

- The Findings Below Depend upon Body Habitus and Type of Transducer, Endovag or transabdominal
- No Sac Growth on Serial Exams
- No Cardiac Pulsations in a 5mm Embryo
- No Embryo Seen in a Sac 25mm MSD
- No Yolk Sac Seen in a 20mm MSD Sac
- Trophoblastic Ring is not intact

Findings for Embryonic Demise

- No Sac Growth on Serial Exams
- A 7-10 day interval between scans is recommended
- Give the embryo a chance
- EV scanning is always best
- Abdallah et al US Obstet & Gynecol 2011
The Gestational Sac Grows about 1mm/Day
1 Week Should Give a Statistically Significant Increase in MSD

Jan 4
MSD = 3mm

Jan 11
MSD = 10mm

Findings for Embryonic Demise
- Slow Cardiac Pulsations in a 5 (now 7) mm Embryo in an endovaginal ultrasound examination

Findings for Embryonic Demise
- No Cardiac Pulsations in a 9mm Embryo in a transabdominal ultrasound examination

Reading an M-Mode
- Heart rate only 60 bpm
- Heart rate 160 bpm

Embryonic Demise
- No Cardiac Pulsations in a 9mm Embryo in a transabdominal ultrasound examination

M-Mode No Heart-beat
Findings for Embryonic Demise

- No Embryo Seen in a Sac 18 (now 25) mm MSD in an endovaginal ultrasound examination
Findings for Embryonic Demise

- No embryo seen in a sac 25mm MSD in a transabdominal or EV ultrasound examination
- Was 20mm

Findings for Embryonic Demise

- No yolk sac seen in a 10mm MSD gestational sac with endovaginal scanning

Findings for Embryonic Demise

- No yolk sac seen in a 20mm MSD gestational sac with transabdominal scanning

New Criteria for Embryonic Demise

- No sac growth on serial exams
- No cardiac pulsations in a 7mm embryo*
- No cardiac pulsations in a 9mm embryo**
- No embryo seen in a sac 25mm MSD*
- No embryo seen in a sac 25mm MSD**
- No yolk sac seen in a 10mm MSD sac*
- No yolk sac seen in a 20mm MSD sac**

* endovaginal scanning
** transabdominal scan

Small for Dates

- Normal pregnancy / Wrong dates
- Anembryonic pregnancy (blighted ovum)
- Ectopic pregnancy
- Fetal demise
- Oligohydramnios
- Intrauterine Growth Retardation (IUGR)

Anembryonic Pregnancy

- Oligohydramnios

Ectopic Pregnancy

Embryonic Demise
Ectopic Pregnancy

- 95% occur in the tube
- 5% are interstitial and are the most dangerous
- Cornual and cervical ectopics are increasing
- In vitro procedures increase the chance of ectopic pregnancy
- Heterotopic: IUP plus an ectopic

Ruptured Ectopic

- Bladder
- Uterus
- Blood

Cervical Ectopic Pregnancy

- Liver
- Bowel
- Right Kidney

Ectopic Pregnancy in Right Cornu

- RC
- Sac

Live Ectopic Pregnancy in Right Fallopian Tube

- Cervix
- Fundus
- Yolk Sac
- Embryo

Transabdominal scans

Endovaginal scans
Molar Pregnancy

- Large for Dates
- Vaginal Bleeding
- Very High HCG
- May be a live embryo
- 1 in 1200 pregnancies in the USA
- Risk is 20-40 fold higher if patient had a previous molar pregnancy (1 in 30-60)
There may or may not be a sac.

Theca Lutein Cysts

The arrow heads point to the major portion of the mole. The white arrows point to echogenic invasive villi that extent almost to the serosal surface of the uterus (black arrows).

Partial Mole at 12 weeks - Top, 14 weeks - Bottom

Video Clip

Large for Dates
- Normal Pregnancy / Wrong Dates
- Molar Pregnancy
- Gestation with Mass / Masses
- Multiple Gestation
Bicornuate Uterus

Hydatidiform Mole
Theca Lutien Cysts

Early Pregnancy with a Mass

Multiple Gestation

Video Clip

Triplets
Anomalies: Detectable in the 1st Trimester (Endovaginal Scanning is Best)

- Anencephaly
- Acrania
- Cystic hygroma
- Hydrops
- Conjoined twins
- Large omphalocele
- Severe gastroschisis
- Thanatophoric dwarf

Normal Head at 12 Weeks

Video Clip

Acrania at 10w2d

Normal Nuchal Translucency 10w6d

2mm
Normal Herniation of the Gut into the Base of the Cord at 11w2d

Omphalocoele 12w4d

Questions?