Assessing normal and abnormal pregnancy from 4-10 weeks

Monique Haak
Goals 4-10 week assessment by US

- Normal appearance gestational sac (GS), yolk sac (YS) and embryo
- Assessment of mean sac diameter (MSD) and CRL
- Viability criteria and terminology in non-viable pregnancy
- Recognition of ectopics, principles of pregnancy of unknown location (PUL)
- Role hCG and management of PUL
- Molar pregnancy
Conception and implantation
Embryo from 0-8 weeks

Source: The Virtual Human Embryo Project
Implantation -> gestational sac

1st evidence pregnancy on ultrasound; completely embedded blastocyst 14 d post conception

ISUOG's basic training curriculum  NEJM 2001;345/1400
Gestational sac

• Small, round fluid collection inside uterine cavity
• Normally positioned in mid-to upper uterine cavity
• Surrounded by a hyperechogenic rim
• Visible at approximately 4 weeks gestation
• Beware of difference in gestational age and embryo age
Location of gestational sac within upper half of uterus
4^0\ weeks - 2\ mm
Gestational sac measurement

Mean of 3 orthogonal planes
Growth in early pregnancy 1mm/day

5^4w mean ø3.9mm
6^4w mean ø18.8mm

Gestational sac diameter

ISUOG's basic training curriculum  Knez et al Best practice Reseach Clin O & G 2014;28:621-36
Yolk sac

- First structure identified within gestational sac
- Confirms intra uterine pregnancy, 100% PPV
- Spherical in shape
- Echogenic periphery
- Sonolucent center
- Attaches to embryo by vitelline duct
Yolk sac

- Imaged ~ 5 - 5.5 w
- Imaged when MSD ~ 5-6 mm
- Imaged 3-5 d prior to embryo
- Diameter peaks at 6 mm at 10 w, then decreases
- Usually not visible after first trimester
- Number of yolk sacs usually equals number of amnions
Yolk sac $5^0$ and $7^4$ weeks
Yolk sac in multiple pregnancy

Dichorionic diamniotic  Monochorionic diamniotic  Monochorionic monoamniotic
Amnion

- First seen ~ 5.5 w – small membranous structure continuous with the embryo
- Contains clear fluid
- Separates the embryo and amniotic space from the extraembryonic coelom
- Obliterates the coelomic cavity by 12-16 weeks
Amnion
Heartbeat use M-mode

Heartbeat visible from CRL > 2-4 mm
Rapid frequency ↑5-9 weeks
Use M-mode

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Crown Rump Length (CRL)

- ISUOG guideline
- Midline sagittal section of whole fetus
- Ideal orientation horizontally
- Magnification fill most of width of screen
- Fetus in neutral position
- Amniotic fluid between chin and chest
- Endpoints clearly defined

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ISUOG guideline 1st trim us scan UOG 2013;41:102-113
Embryo 6-8 weeks

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$9^4$ weeks
10 weeks
Practical rules early pregnancy

<table>
<thead>
<tr>
<th></th>
<th>Transvaginal ultrasound</th>
<th>Abdominal ultrasound</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Gestational age</td>
<td>Measurement</td>
</tr>
<tr>
<td>GS</td>
<td>4^0</td>
<td>2 mm</td>
</tr>
<tr>
<td>YS</td>
<td>5^0</td>
<td>2 mm</td>
</tr>
<tr>
<td>Heartbeat</td>
<td>5^4</td>
<td>70 bpm</td>
</tr>
<tr>
<td>CRL</td>
<td>5^3</td>
<td>3 mm</td>
</tr>
<tr>
<td>Movement</td>
<td>7^0</td>
<td></td>
</tr>
</tbody>
</table>

CRL in cm + 6,5 = GA in weeks
Pain & blood loss in early pregnancy

<table>
<thead>
<tr>
<th>Event</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain &amp; vaginal bleeding</td>
<td>1:5 pregnant women</td>
</tr>
<tr>
<td>Blood loss</td>
<td>50% continue into normal pregnancy</td>
</tr>
<tr>
<td>50 % remaining blood loss</td>
<td>Non viable, of which 10—15% ectopic pregnancy</td>
</tr>
</tbody>
</table>

Pain in early pregnancy late symptom!!

Obstetric cause:
- Miscarriage, ectopic, haemorrhage ruptured corpus luteum cyst, ovarian torsion

Non-obstetric cause:
- Cystitis, appendicitis, ureteric stones, constipation

Knez et al Best Practice Res Clin O & G 2014;28:621-636
## Terminology early pregnancy events 1

<table>
<thead>
<tr>
<th>Terminology</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viable</td>
<td>Results in liveborn baby</td>
</tr>
<tr>
<td>Nonviable</td>
<td>Cannot result in liveborn baby (failed intrauterine pregnancy, ectopic pregnancy)</td>
</tr>
<tr>
<td>Intrauterine pregnancy uncertain viability</td>
<td>TV ultrasound - intrauterine GS, no heartbeat</td>
</tr>
<tr>
<td>Empty sac</td>
<td>GS: absent structures, minimal debris, no heartbeat</td>
</tr>
<tr>
<td>Human chorionic gonadotropin</td>
<td>Positive serum pregnancy test serum hCG &gt; 5 IU/mL</td>
</tr>
<tr>
<td>Terminology</td>
<td>Ultrasound findings</td>
</tr>
<tr>
<td>------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Fetal loss</td>
<td>Previous CRL and heartbeat followed by loss of heartbeat</td>
</tr>
<tr>
<td>Delayed miscarriage/early pregnancy loss</td>
<td>US intrauterine pregnancy: reproducible loss heart activity, failure increase CRL over 1 w or persisting empty sac at &lt; 12 w</td>
</tr>
<tr>
<td>Ectopic pregnancy</td>
<td>+ blood/urine hCG, gestational sac outside uterus</td>
</tr>
<tr>
<td>Heterotopic pregnancy</td>
<td>Intrauterine + ectopic pregnancy</td>
</tr>
<tr>
<td>Pregnancy of unknown location (PUL)</td>
<td>No identifiable pregnancy on US with + blood/urine hCG</td>
</tr>
</tbody>
</table>

Farquharson et al Human Reproduction 2005;20:3008-3011
## Guideline TV US intrauterine pregnancy failure and uncertain viability

<table>
<thead>
<tr>
<th>Diagnostic for pregnancy failure</th>
<th>Suspicious / not diagnostic pregnancy failure</th>
</tr>
</thead>
<tbody>
<tr>
<td>CRL ≥ 7 mm no heartbeat</td>
<td>CRL &lt; 7mm no heartbeat</td>
</tr>
<tr>
<td>Mean GS Ø 25 mm no embryo</td>
<td>Mean GS Ø 16-24 mm no embryo</td>
</tr>
<tr>
<td>Absence embryo with heartbeat ≥ 2 wk after scan GS without YS</td>
<td>Absence embryo with heartbeat ≥ 7-13days after scan GS without YS</td>
</tr>
<tr>
<td>Absence embryo with heartbeat ≥ 11 days after scan GS with YS</td>
<td>Absence embryo with heartbeat 7-10 days after scan GS with YS</td>
</tr>
<tr>
<td>If viability in doubt rescan after 1 week</td>
<td>Absence embryo ≥ 6 wks after LMP</td>
</tr>
<tr>
<td>Empty amnion adjacent to YS no embryo</td>
<td>Enlarged YS &gt; 7mm</td>
</tr>
<tr>
<td>Doubilet et al NEJM 2013;369:1443-51</td>
<td>Small GS in relation to size of embryo (&lt; 5 mm difference between mean GS Ø and CRL</td>
</tr>
</tbody>
</table>
Early pregnancy: Vitality

Normal

Abnormal
Uncertain viability $6^2$ weeks

GS and YS, no heartbeat
Repeat scan 1 week
Gestational sac: failing pregnancy
Twin pregnancy with vanishing twin

Evron et al Fertil Steril 2015;103:1209-14
Haematomata
Miscarriage

8 weeks no heartbeat
Ectopic pregnancy

Figure 46-9 Sites of ectopic pregnancy.

Copyright © 2004 Lippincott Williams & Wilkins.

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Early pregnancy: normal values of hCG
Early pregnancy: normal values of hCG

Gestational sac visible at 1800 MIU/ml

hCG (intact + \( \beta \)-subunits)
Ectopic right fallopian tube

LMP 8 weeks
Interstitial pregnancy

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## Ectopic management

<table>
<thead>
<tr>
<th>Day 1 5(^1)w</th>
<th>Abdominal pain minimal bloodloss Empty uterus L and R ovary normal</th>
<th>hCG 1349 IU/L Return in 2 days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day 3 5(^3)w</td>
<td>Empty uterus Next to L ovary ectopic mass 3.4 x 1.4 cm</td>
<td>hCG 1890IU/L</td>
</tr>
</tbody>
</table>

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Cervical ectopic pregnancy
Gestational sac in lower segment in cervical canal
Gestational sac in lower segment - in cs scar
Heterotopic pregnancy

Prevalence heterotopic pregnancy
Spontaneous pregnancy 1:30,000
ART pregnancy 1:100-500

ISUOG's basic training curriculum
Maruotti & Russo Fert Ster 2010;94:e49
# Management Protocol – Pregnancy Unknown Location (PUL)

<table>
<thead>
<tr>
<th>Progesterone (nmol/L)</th>
<th>β-hCG (IU/L)</th>
<th>Likely diagnosis</th>
<th>Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 20</td>
<td>&gt;25</td>
<td>Spontaneous resolving pregnancy</td>
<td>Check urine or serum β-hCG in 7 days</td>
</tr>
<tr>
<td>20-60</td>
<td>&gt;25</td>
<td>Unviable or ectopic pregnancy with moderate risk requiring intervention</td>
<td>Check serum β-hCG in 2 days</td>
</tr>
<tr>
<td>&gt;60</td>
<td>&lt;1500</td>
<td>Normal intrauterine pregnancy</td>
<td>Repeat scan when β-hCG expected &gt; 1000</td>
</tr>
<tr>
<td>&gt;60</td>
<td>&gt;1500</td>
<td>Ectopic pregnancy with high risk requiring intervention</td>
<td>Repeat scan same day by senior examiner</td>
</tr>
</tbody>
</table>
Hydatiforme mole

ISUOG's basic training curriculum
Hydatiforme mole

Complete
Prevalence 1:1500-2000
46, XX only paternal
Persisting throphoblast 15%

Partial
Prevalence 1:700
69 XXX of 69 XXY (triploidy), paternal and maternal 2%

HCG 330,000 IU/L
Hydatiform mole in twin pregnancy

- Blood loss and abdominal pain 8 weeks
- US dichorionic twin pregnancy of which 1 mola
- hCG 439.467 IU/l
- Counseling: miscarriage, hypertension, preeclampsia, thyroid disease, persistent trophoblast disease, lung metastases

Prevalence 1:10000-100.000
Accuracy of US diagnosis

Histology:
- CHM: 95%
- PHM: 20%

Histology:
- non molar failed pregnancy
Conclusion

• Aware of normal appearance and assessment GS, YS & embryo from 4 weeks gestational age onwards
• Criteria and terminology of viable and nonviable pregnancy
• In doubt about viable intrauterine pregnancy: repeat scan 1 w
• Scan uterus and ovaries to recognize ectopics
• Management of PUL and role hCG and progesteron
• Molar pregnancy appearance and pitfalls
• In doubt of location of pregnancy: repeat scan within 2 days
### Complete MOLA

- **Karyotype**: 46, XX (85%) or 46 XY (15%): all chromosomes are paternal.

- **Mechanism**: Androgenesis: 23, X sperm fertilizes an egg that is maternal inactivated, meaning that the egg has no active maternal chromosomes or an empty egg (no maternal chromosomes). The egg upon fertilization, duplicates the paternal chromosomes leading to 46, XX (**A**).

- In regards to 46, XY moles, the maternal inactive egg is fertilization by two sperm with one carrying the X and the other carrying the Y gene (**B**).

- **Hydropische zwelling van alle vlokken; geen embryonale structuren.**

- **1:2000 zwangerschappen**

- **Persisteren 15%**

### Partieele MOLA

- **Karyotype 69, XXX or 69, XXY**: Two sperm either 23, X or 23, Y fertilized the ovum leading to triploidy (**C**) (chromosomen zijn zowel paternaal als maternaal).

- hydropische zwelling van een gedeelte van de vlokken; embryonale structuren kunnen aanwezig zijn.

- **1: 20 000 zwangerschappen**

- **Persisteren 2%**

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![Diagram](image.png)