Ultrasound follow up, prediction of pregnancy loss and ectopic pregnancy

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Summary

• 1. How to get the diagnosis RIGHT
  – Miscarriage
  – Ectopic

• 2. How to manage expectations
US measurements and diagnosis of miscarriage
Ultrasound scanning in early pregnancy

- Localisation
- Accurate measurement of pregnancy structures
- Assessment of viability
How to measure an early pregnancy

Gestation sac

- MSD: Three orthogonal planes; two in sagittal plane, one in transverse. Largest sac diameters from inner borders of the sac.
- Location
- Regularity
- Sub-chorionic haematoma
Gestation sac

Fluid in cavity - pseudosac
Yolk sac

- Three orthogonal planes, from outer borders
CRL

- Greatest straight line length while caudal and cephalic cannot be distinguished
- CRL once sufficiently deflexed (9 weeks)
Fundamental issue:

A normal early pregnancy may be indistinguishable from an abnormal early pregnancy that has arrested its development.
Pregnancy of unknown viability
<table>
<thead>
<tr>
<th></th>
<th>First visible on TVS (days from LMP)</th>
<th>Growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gestation Sac</td>
<td>31 days (4+3 weeks)</td>
<td>1mm/day</td>
</tr>
<tr>
<td>YS</td>
<td>35 days (5 weeks)</td>
<td>Max at 10/40</td>
</tr>
<tr>
<td>Embryo</td>
<td>37 days (5+2 week)</td>
<td>0.7mm/day</td>
</tr>
<tr>
<td>Amnion</td>
<td>49 days (7 weeks)</td>
<td></td>
</tr>
</tbody>
</table>
Why you might not see what you expect to...

**Patient**
- Incorrect dates
  - Erratic cycles (PCO)
  - Recent pregnancy/ breastfeeding
  - Contraception
  - Ovulation to implantation interval
- Sonographic view
  - TA vs TV scan
  - BMI
  - Fibroids
  - Axial uterus

**External factors**
- Experience of sonographer
- Quality of machine
- Inter/Intra-observer variation
  - 14-18% 6-9 weeks

**Pregnancy**
- Miscarriage
- Genetic abnormality
- Location
**Aim for 100% specificity**

- Key question: “Is there a chance of viable pregnancy?”
  - A false positive diagnosis of miscarriage is much worse than a false negative diagnosis
    - False positive: Inadvertent ToP
    - False negative: raised hopes, delay in intervention

**First do no harm**
Evolution of criteria for the diagnosis of miscarriage

2006:
ACR – empty GS MSD >16mm, CRL >5mm and no FH
RCOG – empty GS MSD >20mm, CRL >6mm and no FH

2011 (Abdallah et al):
4.4% false positive rate if cut-off MSD ≥16mm
0.5% false positive rate if cut off MSD ≥20mm
8.3% false positive rate for cut-off CRL 5mm
MSD >25mm, CRL >7mm

2015 (Priesler et al):
Verified cut-offs proposed in 2011
Intervals between scans
Defining safe criteria to diagnose miscarriage: prospective observational multicentre study

Jessica Preisler,1 Julia Kopeika,2 Laure Ismail,1,3 Veluppillai Vathanan,4 Jessica Farren,1 Yazan Abdallah,1 Parijat Battacharjee,5 Caroline Van Holsbeke,6 Cecilia Bottomley,4 Deborah Gould,3 Susanne Johnson,7 Catriona Stalder,1 Ben Van Calster,8 Judith Hamilton,2, Dirk Timmerman,6,8 Tom Bourne1,6,8

To validate change in guidelines
Prospective multicentre study; 2845 women presenting with bleeding, pain, hyperemesis
  - Validated guidance on miscarriage diagnosis
  - Added evidence based guidance on repeat scans

*BMJ* 2015;351:h4579 doi:10.1136/bmj.h4579
Criteria that are specific for miscarriage

Initial scan
- Empty GS MSD >25mm.
- Embryo CRL 7mm with no FH

Initial scan beyond 70 days (10w from LMP)
- MSD >18mm with no embryo
- Embryo CRL 3mm with no FH

Repeat scan
- CRL < 7mm: rescan in 7 days shows no FH
- MSD <12mm and no embryo with or without a yolk sac: rescan 14 days shows no doubling of MSD
- MSD >12mm, no embryo with or without a yolk sac: rescan in 7 days shows no CRL with FH

Priesler et al BMJ 2015
If you or patient have any doubts....

RE-SCAN
<table>
<thead>
<tr>
<th>Findings suspicious for pregnancy failure</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Findings close to decision boundaries</strong></td>
</tr>
<tr>
<td>CRL &lt;7mm but no FH</td>
</tr>
<tr>
<td>MSD 16-24 mm but no embryo</td>
</tr>
<tr>
<td><strong>Size smaller or structures less</strong></td>
</tr>
<tr>
<td><strong>developed, than expected by dates</strong></td>
</tr>
<tr>
<td>No embryo at 6 weeks</td>
</tr>
<tr>
<td><strong>Discordant growth</strong></td>
</tr>
<tr>
<td>Empty amnion – amnion and YS but no</td>
</tr>
<tr>
<td>embryo</td>
</tr>
<tr>
<td>Enlarged YS &gt;7mm</td>
</tr>
<tr>
<td>Small GS wrt embryo (&lt;5mm difference</td>
</tr>
<tr>
<td>between MSD and CRL)</td>
</tr>
<tr>
<td>Discordant twins</td>
</tr>
<tr>
<td><strong>Growth slower than expected</strong></td>
</tr>
<tr>
<td>GS&lt; 1mm/day, CRL &lt; 0.7mm/day</td>
</tr>
<tr>
<td><strong>Other features</strong></td>
</tr>
<tr>
<td>Irregular sac</td>
</tr>
<tr>
<td>Sac low in cavity</td>
</tr>
<tr>
<td>Sub-chorionic haematoma</td>
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<tr>
<td>(Fetal bradycardia)</td>
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Ectopic pregnancy
Ectopic pregnancy

- Tubal 90%
- Scar ectopic 6%
- Interstitial 2-4%
- Ovarian 1%
- Cervix 0.15%
- Broad ligament
- Cornual
- Abdominal 0.1-0.7%

Non tubal EP account for 20% of mortalities connected to all ectopic pregnancies

Heterotopic pregnancy 1/7000 pregnancies (1/100 post IVF)
Sonographic criteria for different types of tubal ectopic pregnancy

<table>
<thead>
<tr>
<th>Sonographic criteria</th>
<th>% of ectopics seen on US</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inhomogenous adnexal mass ('blob' sign')</td>
<td>60%</td>
</tr>
<tr>
<td>Empty extrauterine gestation sac ('bagel sign')</td>
<td>20%</td>
</tr>
<tr>
<td>Extrauterine gestation sac +/- yolk sac +/- fetal pole +/- fetal cardiac activity</td>
<td>20%</td>
</tr>
</tbody>
</table>

Interstitial pregnancy
Interstitial pregnancy

- Pregnancy high in fundus, towards edge of uterus
- Endometrial stripe connecting to pregnancy site
- Thin myometrial mantle of < 5mm around the GS

- Interstitial pregnancy and cornual pregnancy are 2 separate entities:
  - **Interstitial pregnancy** – GS in the muscular part of the tube that penetrates the uterine wall
  - **Cornual pregnancy** – GS in a rudimentary horn of a unicornuate uterus, cornu of a bicornuate or septate uterus
Caesarean scar ectopic

- Incidence increasing. 1:2000 of all pregnancies, 6% of EP
- Prompt diagnosis is crucial – uterine rupture, haemorrhage, bladder invasion
- **Sonographic criteria**
  - Empty uterus, empty cervix
  - GS in the anterior wall of the lower segment of the uterus
  - Thin or no myometrium between bladder and gestation sac
  - Doppler flow
  - Discontinuity in uterine wall on sagittal view
Cervical ectopic

Sonographic criteria

- GS in the cervical tissue not the cervical canal
- Decidual ring, vascularity
- To differentiate from a GS in the cervical canal (inevitable miscarriage):
  - **Sliding sign** – when pressure is applied to cervix with TV probe, a GS in the cervical canal will slide but a cervical EP does not move
Heterotopic pregnancy

- **Incidence:**
- 1:7,000 natural conceptions
- 1-3:100 assisted conception
- Laparoscopy and salpingectomy
Ectopic pregnancy: Diagnostic pitfalls

- Intrauterine fluid collection – pseudosac
- “Incomplete miscarriage” with blood in uterus may not be a miscarriage - exclude an EP (unless IUP seen previously)
- “Complete miscarriage” is a PUL and possible EP (unless IUP seen previously)
- IUP does not exclude EP (heterotopic)
- Low GS may be scar EP
- Sac in the cervix may be a cervical EP rather than an inevitable miscarriage
A triple layer endometrium with a positive PT is likely to be an ectopic pregnancy - beware
Managing expectations and psychological considerations
The issue of early testing...

- Very early presentations due to ovulation apps, home ovulation tests, sensitive home pregnancy tests - Inconclusive scans and uncertainty
  - PUV and PUL

When should we do the first scan?
- Day 35 (5 weeks) – PUV rate 60%
- Day 42 (6 weeks) – PUV rate 29%
- If no clinical symptoms, USS to look for viability on Day 49 (7 weeks)
Managing patient expectations

- Accurate prediction of pregnancy viability by means of a simple scoring system.
  - Bottomley C¹, Van Belle V, Kirk E, Van Huffel S, Timmerman D, Bourne T.

Managing patient expectations: Scoring systems (Bottomley et al)

- Maternal age
- Bleeding score
- Mean gestational sac size
- Fetal heart beat
- Mean yolk sac diameter
- Mean gestational sac size +/- fetal heart beat
  - Estimated chance of a viable pregnancy

*Human Reproduction*, Bottomley et al, Volume 28, Issue 1, 1 January 2013, Pages 68–76,
• Women offered information of potential pregnancy outcome based on a predictive model found it useful to manage their expectation and anxiety

• Reassurance is difficult
The psychological impact....

BMJ Open

Mental health

Post-traumatic stress, anxiety and depression following miscarriage or ectopic pregnancy: a prospective cohort study

Jessica Farren¹, Maria Jalbrant², Lieveke Ameye³, Karen Joash¹, Nicola Mitchell-Jones⁴, Sophie Tapp⁵, Dirk Timmerman⁵, Tom Bourne¹⁵,⁶

Author Affiliations
In the future

- Criteria for IVF
- Criteria for 3-D USS
- AI
- Non-USS markers to predict miscarriage
Conclusion

• Always err on side of caution in diagnosis of miscarriage: if in doubt, re-scan
• Manage expectations – informally or formally (predictive models)
• High index of suspicion in the dx of EP
• Consider the psychological sequelae of pregnancy loss
- My thanks to
- Jessica Farren
- Shabnam Bobdiwalla