EMERGENCY PELVIC ULTRASOUND

The 2nd Cambridge Advanced Emergency Ultrasound Course

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Introduction

• Ultrasound is the primary imaging modality used to assess the pelvic anatomy and for pelvic pathology

• Goal-directed pelvic ultrasound (especially in pregnant women) is one of the core primary indications for emergency department ultrasound

• Pelvic scanning involves the use of both transabdominal ultrasound and transvaginal ultrasound

• Indications: Early Pregnancy Complications
  Ectopic Pregnancy
  Pelvic Pain (cyst torsion, rupture, haemorrhage)
  Acute Appendicitis
Objectives

• Scanning Technique

• Indications: Complications in the 1st Trimester of Pregnancy
  
  ▪ Ectopic Pregnancy
  
  ▪ Threatened, Inevitable, Missed Abortion
Technique

• 2 transducer types: Transabdominal & Transvaginal:
  • Multifrequency Curvilinear Transabdominal Probe with a frequency of 3.5 - 5 MHz
  • Multifrequency Transvaginal Probe with a frequency of 7 - 9 MHz

• Machine Pre-Set:
  • Select appropriate probe (TA vs TV)
  • Select the appropriate pre-set (Gynae or Obstetric)
Trans-Vaginal Probe
Scanning Technique

• The pelvic organs are routinely visualised by 2 approaches:
  — Transabdominal (TA)
  — Transvaginal (TV)

• Different advantages and limitations of both techniques mean that the pelvic examination frequently employs both to gain maximum information

• The standard examination should start with the trans-abdominal approach followed by the trans-vaginal if indicated. If the transabdominal scan is completely normal or a well defined abnormality is detected no further study is usually necessary

• Patient in a supine position with reverse Trendelenberg with transvaginal scanning
Transabdominal versus Transvaginal Scanning

• Complimentary Techniques

• The transabdominal approach offers a far wider Field of View allowing visualisation of the entire pelvis and abdomen offering a global overview

• The limitations of transabdominal ultrasound includes examining patients with empty urinary bladders, the examination of the obese patient, the evaluation of the retroverted uterus, and often less than optimal characterisation of adnexal masses

• Transvaginal sonography allows the use of higher frequency transducers producing much better resolution

• The limitation of transvaginal ultrasound is that the Field of View is limited
TA

TV
Scanning Technique

Transabdominal Pelvic Scanning

- Transabdominal pelvic scanning should be performed with a distended bladder which:
  - Provides an acoustic window
  - Displaces small bowel away from the pelvic viscera
  - Partially retroflexes the normally anterverted uterus to maintain the endometrial echo at a more perpendicular angle to the beam improving definition of the endometrium and any contents
  - Serves as a reference standard for evaluating cystic structures
Scanning Technique

- The uterus and adnexae should be imaged in both the **sagittal** and **transverse** planes.

- The long axis of the uterus is identified by the endometrial stripe and may require an oblique angulation to visualise the entire uterus and cervix.
Scanning Technique

• The adnexae may be imaged by scanning:
  
  — Directly over the adnexae

  — Obliquely from the contralateral side using the bladder as an acoustic window

  — Ovaries identified medial and iliac vessels
Scanning Technique

Transvaginal Pelvic Scanning

- Verbal / Written Consent
- Chaperone
- Infection Control / Protective Sheath (condom)
- Patient supine with knees slightly flexed in a slight reverse Tendelenburg position
- Transvaginal pelvic scanning should be performed with an empty bladder
- Standard Sagittal and Transverse images should be obtained
Scanning Technique

Transvaginal Pelvic Scanning

LONGITUDINAL SECTIONS

Anterior and posterior

Lateral

TRANSVERSE OR CORONAL SECTIONS

Anterior and posterior

Lateral
Scanning Technique

Transvaginal Pelvic Scanning: Image Orientation
IST TRIMESTER COMPLICATIONS

- Assessment in the 1st Trimester of Pregnancy
- Ectopic Pregnancy
- Threatened Abortion
ASSESSMENT IN THE 1ST TRIMESTER

Royal North Shore Hospital, Sydney

- 574 patients presenting with pain +/- bleeding in the first trimester of pregnancy 2006-2008
- 10% ectopic
- 75% discharged from the ED
- Mean time of 3 hours 20 minutes to formal scan in radiology
ASSESSMENT IN THE 1ST TRIMESTER

- Focused Emergency Ultrasound in the 1st Trimester of Pregnancy
  - Is there an intrauterine pregnancy?
  - Is there a viable intrauterine pregnancy?
ASSESSMENT IN THE 1ST TRIMESTER

- Assessment in 1st Trimester Pregnancy
  - **Gestational Sac:** location, size, shape, surrounding chorion
  - **Yolk Sac:** size, shape, location
  - **Emryo:** size, location, FH
  - **Other Cavity Contents:** blood, clot
  - Adnexal Mass
NORMAL SONOGRAPHIC APPEARANCES

• Gestational Sac

- A small intradecidual sac is usually visible by 5/40 by TVS

- The threshold level (the earliest we can expect to see a gestational sac is 4/40

- The discriminatory level (when we should always see a gestational sac is 5/40 +2) (Shapiro et al. Am J Obstet Gynaecol 1992)

- HCG levels at which a gestational sac should be seen are: 1500 (TV) and 6500 (TA)

- Differentiation between a gestational sac and a pseudogestational sac is difficult. It should not be relied upon to confirm an intrauterine pregnancy
NORMAL SONOGRAPHIC APPEARANCES

• **Double Decidual Sign**

  - Described by Nyberg et al (Radiology 1998) as a method of differentiating between an early intrauterine pregnancy and the decidual cast of an ectopic pregnancy

  - Sonographic visualisation of 2 echogenic rings:

    - Gestational sac and its echogenic outer layer of chorion

    - Echogenic endometrium
Double Decidual Sign
NORMAL SONOGRAPHIC APPEARANCES

- **Double Decidual Sign**
  - Although the presence of the Double Decidual Sign is indicative of an IUP it is not 100% sensitive and can be difficult to interpret

- **You should not use the Double Decidual Sign’ to confirm an intrauterine pregnancy**
NORMAL SONOGRAPHIC APPEARANCES

**Yolk Sac**

- First structure to be normally seen within the gestational sac and is the first true embryonic landmark

- Round echogenic ring about 5mm in diameter

- Using TA ultrasound it is usually first seen when the mean sac diameter of the gestational sac is 10-15mm and should always be seen when the mean sac diameter is $\geq$ 20mm

- Using TV ultrasound the yolk sac should be visible when the mean sac diameter is $\geq$8mm (5/40)

- **The identification of a yolk sac is the first definitive evidence of an IUP**
Yolk Sac
Yolk Sac
NORMAL SONOGRAPHIC APPEARANCES

- 10/40 loss of yolk sac, placenta seen
NORMAL SONOGRAPHIC APPEARANCES

- **Fetal Pole**
  - A fetal pole should be visualised by the time that the gestational sac reaches 16mm in diameter
  - After the fetal pole has reached 5mm cardiac activity should be detectable on TV ultrasound
Fetal Pole
Fetal Pole
NORMAL SONOGRAPHIC APPEARANCES

**FH Activity**

- Detection of fetal heart activity confirms live IUP

- Cardiac activity should be detectable on TV scanning when the fetal pole is $\geq 5$mm

- The heart rate should be measured using M-mode ultrasound as fetal bradycardia may represent impending fetal demise

- 5mm fetal pole: $\geq 100$ bpm / 5-9mm fetal pole $\geq 110$ bpm / 10-15mm fetal pole $\geq 120$ bpm
NORMAL SONOGRAPHIC APPEARANCES

- **Estimation of Gestational Age**
  - Gestational Sac Size
  - Crown-Rump Length
  - Biparietal Diameter
Crown Rump Length
### ULTRASOUND IN THE 1ST TRIMESTER

<table>
<thead>
<tr>
<th>FINDING</th>
<th>TV</th>
<th>TA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gestational Sac</td>
<td>4.5/40</td>
<td>5.0/40</td>
</tr>
<tr>
<td>Yolk Sac</td>
<td>5.0/40</td>
<td>5.5/40</td>
</tr>
<tr>
<td>Fetal Pole</td>
<td>5.5/40</td>
<td>6.0/40</td>
</tr>
<tr>
<td>FHM</td>
<td>6.0/40</td>
<td>6.5/40</td>
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</tbody>
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HCG levels at which a gestational sac should be seen are: 1500(TV) and 6500(TA)
## ULTRASOUND IN THE 1ST TRIMESTER

<table>
<thead>
<tr>
<th>US Finding Parameter</th>
<th>TA</th>
<th>TV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gestational Sac (HCG)</td>
<td>6500</td>
<td>1500</td>
</tr>
<tr>
<td>Yolk Sac (MSD)</td>
<td>20mm</td>
<td>8mm</td>
</tr>
<tr>
<td>Fetal Pole (MSD)</td>
<td>25mm</td>
<td>16mm</td>
</tr>
<tr>
<td>FHM (CRL)</td>
<td>9mm</td>
<td>5mm</td>
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ECTOPIC PREGNANCY

WHAT IS IT?

- Implantation of a fertilized ovum outside of the fundus or body of the uterine cavity

WHEN TO WORRY!

- Bleeding - 25% of pregnancies (1st Trimester)
- Pain
- Collapse
- Basically all the time!
CLINICAL FEATURES

- Classical Triad:
  - Pain, Bleeding, Adnexal Mass

- Present in <50% of ectopics

- +ve Predictive Value: 14%

- 50% Palpable Mass

- 50% PV Bleeding

- 20% Haemodynamically Unstable
ECTOPIC PREGNANCY

- 1.4% of all pregnancies and rising
- 12% of all maternal deaths
- Case fatality falling
  - from 3.5/1000 (1970s) to 1/1000
- 1/3 missed on initial ED presentation
TYPES

- Fallopian (95%)
  - Ampullary or isthmic
- Interstitial (2-4%) = intramural, cornual
- Cervical
- Ovarian
- Scar
- Abdominal
PELVIC ANATOMY
PELVIC ANATOMY

Diagram of the female reproductive system with labeled parts:
- Fallopian Tube
- Uterus
- Ovary
- Fundus
- Body
- Cervix
- Infundibulum
- Fimbria
- Ampulla
- Isthmus
- Interstitial
INCREASED RISK

PREVIOUS:
- Salpingitis or PID
- Tubal Surgery
- Ectopic Pregnancy
- IUCDs
- Advanced Maternal Age
- Infertility
- Ovulation Induction
- IVF
HETEROOTROPIC PREGNANCY

- Twin Pregnancy
  - One Intrauterine
  - One Ectopic
- Previously 1:30,000
- Now up to 1:7,000
- With fertility tretament may be up to 1:100
GOAL OF SONOGRAPHY

- In 1st Trimester Pregnancy the PRIMARY goal excluding an ectopic pregnancy is to identify an:

INTRAUTERINE PREGNANCY
GOAL OF SONOGRAPHY

In 1st Trimester Pregnancy the PRIMARY goal excluding an ectopic pregnancy is to identify an:

INTRAUTERINE PREGNANCY

Beware the risk of heterotrophic pregnancy in IVF patients
ULTRASOUND IN THE 1ST TRIMESTER

‘DISCRIMINATORY ZONE’

This is the hCG level above which an intrauterine pregnancy SHOULD be seen

- Depends of lab reference & equipment used

- For TV generally 1500-2000

- For TA generally 5000-6500

- Multiple gestations may have a hCG ≥ 2300 (TV) before u/s evidence
PREGNANCY OF UNKNOWN LOCATION

Empty uterus with a hCG below the discriminatory zone

- Early IUP that continues (1/3)
- Miscarriage (1/9)
- ‘Resolved’ Pregnancy (1/2)
  - Early IUP that fails
  - Early ectopic that fails
- Ectopic 14-28%
HCG

- Ectopics classically have low levels of hCG with a slow rate of rise

**BUT**

- 13% of ectopics will have normal doubling times (although will later plateau)
- 15% of normal pregnancies rise by less than 2/3 at 48 hours
• TA has limited but important role
  - TA will show large amounts of fluid
  - TV may miss an ectopic in a high position
  - May provide an alternative diagnosis

• Ovary usually sits adjacent to ampulla, which is the commonest site of an ectopic

• 85% of ectopics are on the same side as the corpus
NORMAL EARLY PREGNANCY SONOGRAPHIC APPEARANCES

- Gestational Sac
- Day 32-34 (41-42 on TA)
- Develops a ‘Double Decidual Sign’ (Decidua Vera & Decidua Capsularis)
- **BEWARE** ‘Pseudogestational Sac’ seen with ectopic pregnancies
PSEUDOGESTATIONAL SAC VS GESTATIONAL SAC

- Well defined double decidual sign is visible at about 5-6 weeks
- Less of an issue with TV scanning as other structures (yolk sac / fetal pole) are often visible by this time
- **IF ANY DOUBT - ECTOPIC UNTIL PROVEN OTHERWISE**
- Consider in clinical context
- Check hCG levels
- Re-scan
? Gestational Sac or Pseudo-Gestational Sac
Yolk Sac

3-Days Later
DEFINITE SIGNS OF AN INTRA-UTERINE PREGNANCY

- Yolk Sac
- Embryo

Reliable signs of early pregnancy UNLIKE trying to differentiate the ‘Double Decidual’ Sign from a Pseudo-Gestational Sac
YOLK SAC

- Round or oval in shape
- Thin, uniform, echogenic walls
- Seen at 5-6 weeks
- Should be seen when the mean sac diameter is \( \geq 8\text{mm} \) - often seen earlier
EMBRYO

- Seen as a thickening on the edge of the yolk sac
- Cardiac activity seen at approximately 5.5 - 6 weeks
  - CRL ≥5mm
SONOGRAPHIC FEATURES OF AN ECTOPIC PREGNANCY

Accuracy

- Absent IUP 5%
- Any free fluid (no IUP) 50%
- Moderate - Large free fluid (no IUP) 60 - 85%
- Adnexal Mass (no IUP) 75%
- Ectopic Pregnancy Visualised 100%
- Adnexal Mass + Free Fluid + no IUP 97%

In one reported series 34% of pregnancies had no adnexal mass or free fluid
ABSENT IUP

- Endometrial thickening without gestational sac
- Ectopic, early pregnancy or failed pregnancy
- Interpret in clinical context with quantatative hCG and other sonographic features

*Must have follow up of some form*
Absent IUP: Not Ectopic
Absent IUP: Ectopic
FREE FLUID

- Pouch of Douglas
- Uterine-Vesico Pouch
- Morison’s Pouch
- Spleno-Renal Recess

N.B. Pelvic free fluid can occur in up to 20% of normal pregnancies

Larger amounts and more echogenic (blood) are more suggestive of ectopic
Free Fluid: Ectopic
Free Fluid: Not Ectopic
ADNEXAL MASS

- Heterogenous round or oval mass adjacent to the uterus
- May be hyper-, hypo-, or of mixed echogenicity
- May have a cystic component
ADNEXAL MASS

- Corpus Luteum
- Intestinal Loop
- Pyosalpinx
- Para-Ovarian Cyst
- Appendicitis
Adnexal Mass: Ectopic
Adnexal Mass: Not Ectopic
(Ruptured Corpus Luteum)
EXTRA-UTERINE GESTATION

- Definitive sign of Ectopic Pregnancy
Ectopic Pregnancy
Extra-Uterine Gestation
MISCARRIAGE

- Ultrasound plays the primary role in the first trimester of pregnancy in identifying pregnancies that have failed or are at an increased risk of failing.
- The single most important feature for the confirmation of fetal life is the identification of cardiac activity.
RISK FACTORS FOR EARLY PREGNANCY FAILURE

- Early Gestation: <6/40 - 20%  >8/40 - 2%
- Small gestational sac size >80% miscarriage rate
- ? yolk sac size
- Identification of intrauterine blood & clot (subchorionic haemorrhage)
- Menstrual age, past history, uterine malformation
**Subchorionic Haemorrhage**

- Most common cause of vaginal bleeding in patients with intrauterine gestations

- Appears as a hypoechoic or anechoic crescent adjacent to the rim of the gestational sac and represents bleeding at the placental margin

- The overall rate of miscarriage with an identified subchorionic haemorrhage is approximately 9% and increases with maternal age and the size of the haematoma
Subchorionic Haemorrhage
Blighted Ovum with low lying Gestational Sac
ESTABLISHING THE DEATH OF AN EMBRYO

- Re-scan in 7-10 days if:
  - CRL < 6mm with no FH activity (TV)
  - Empty Gestational Sac <20mm
FIRST TRIMESTER ASSESSMENT

**SUMMARY**

The role of the emergency physician is to:

- Confirm/Exclude an ectopic pregnancy
- Confirm an IUP (identification of an intrauterine gestational sac with yolk sac)
- Confirm a live IUP (detection of FHM)
Early Pregnancy Ultrasound Findings

Ongoing pregnancy confirmed? (FH seen)

Yes

Confirmed or suspected extra-uterine pregnancy
Free fluid in pelvis / abdo

No

Adnexal Mass?

Yes

Empty Gestational Sac
Mean diameter < 20mm

No

? Ectopic

No

Irregular contents in cavity, no identifiable fetal pole or intact gestational sac

No

Empty Uterus
(Complete midline echo)

? Incomplete Abortion

No

? Complete Abortion
?Ectopic

Yes

Re-scan in ~10 days to assess viability

CRL < 6mm
No FH

Gestation sac containing yolk sac
(no fetal pole)

CRL 6mm or greater (TV)
No FH

No

Missed Abortion

Refer O&G

NB: Diagnosis may need confirmation by serial BHCGs and repeat scan

Refer O&G

No

CRL < 6mm
No FH

Gestation sac containing yolk sac
(no fetal pole)

Empty Gestational Sac
Mean diameter < 20mm

Empty Uterus
(Complete midline echo)

Irregular contents in cavity, no identifiable fetal pole or intact gestational sac

Yes

Refer back to LMO

No

No

No

No
QUESTIONS?