



PIPADOR REVISION

MRCOG Part 1 Revision Notes

Ultrasound of the Abdomen and Pelvis

ANATOMY • LECTURE 37

VISUAL EXAMINATION REVISION NOTES

2026 Edition

MRCOG Part 1 Revision Notes

Lecture 37: Ultrasound of the Abdomen and Pelvis

Anatomy • Visual revision edition

COLOUR CODE USED THROUGHOUT THESE NOTES

PHYSICS	DOPPLER	OBSTETRIC	GYNAECOLOGICAL	SAFETY / LIMITS
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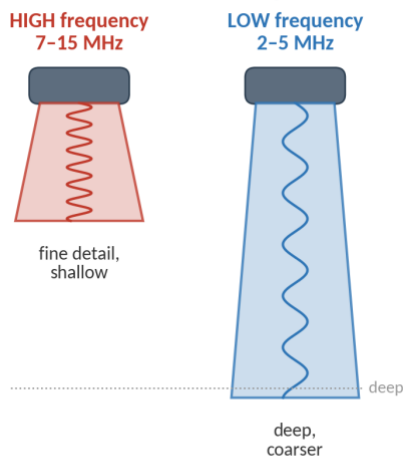
LEARNING OBJECTIVES — tick off as you go

- ☐ Explain how ultrasound images are made and the frequency trade-off.
- ☐ Describe Doppler modes and the key obstetric waveforms and indices.
- ☐ State safety principles (thermal and mechanical indices, ALARA).
- ☐ Describe first-trimester milestones, dating, screening and the anomaly scan.
- ☐ Apply ultrasound to the endometrium, fibroids, adnexal masses, PCOS, endometriosis and ectopic pregnancy.

1 Physical Principles

IN ONE LINE: Sound above 20 kHz (medical: 2–20 MHz) from a piezoelectric crystal; echoes from tissue interfaces build the image — the pulse–echo principle.

The trade-off: resolution vs penetration



Transvaginal probe = high frequency, close to the organ.
Abdominal probe = low frequency, reaches further.

Echogenicity: the grey scale

	ANECHOIC fluid: urine, amniotic fluid, simple cyst	posterior ENHANCEMENT
	HYPOECHOIC many fibroids, lymph nodes	
	ISOECHOIC same as surrounding tissue	
	HYPERECHOIC fat, fibrous tissue, dermoid	
	VERY BRIGHT bone, calcium, gas	posterior SHADOW

Echoes arise where **ACOUSTIC IMPEDANCE** changes — bigger mismatch, brighter echo.

Figure 1. Frequency trade-off and the grey scale.

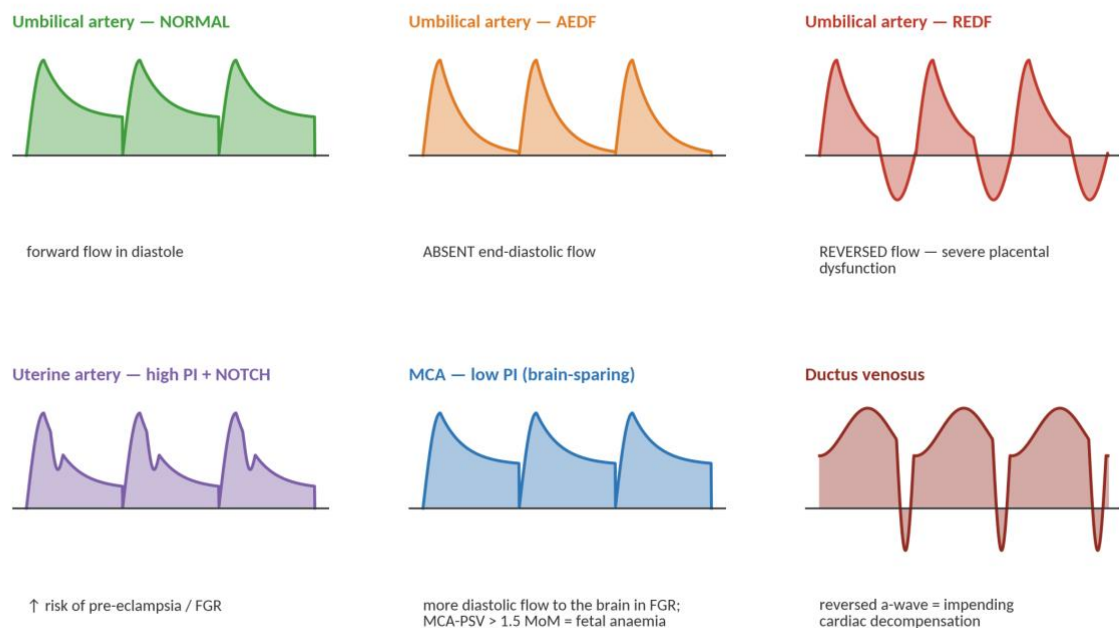
Mode	Use
A-mode	Amplitude spikes — essentially obsolete
B-mode	2D grey-scale image — the workhorse
M-mode	One line over time — fetal heart rate and motion
Doppler	Frequency shift from moving blood — speed and direction
3D / 4D	Volume rendering (face, heart); 4D = real-time 3D

Probe	Frequency	Use
Curvilinear abdominal	2–5 MHz	Transabdominal obstetric/gynae, kidneys, abdomen
Transvaginal	5–9 MHz	Early pregnancy, endometrium, fibroids, adnexa
Linear	7–15 MHz	Breast, thyroid, vessels
Phased array	2–5 MHz	Heart; small acoustic windows

2 Doppler

- **Continuous-wave** (high velocities, no depth) • **pulsed-wave** (sampled at a chosen depth) • **colour** (direction: **BART** — **B**lue **A**way, **R**ed **T**owards) • **power** (amplitude only; sensitive to slow flow).

Obstetric Doppler waveforms (schematic)



RI = (PSV - EDV) / PSV • PI = (PSV - EDV) / mean velocity • CPR = MCA-PI / UA-PI (low = compromise)

Figure 2. Waveforms you must recognise.

Vessel	What it tells you
Umbilical artery	Main FGR surveillance tool — AEDF / REDF = severe placental dysfunction
Uterine artery	High PI ± early diastolic notch (around 20–24 weeks) → risk of pre-eclampsia / FGR
Middle cerebral artery	PSV > 1.5 MoM → fetal anaemia (red-cell alloimmunisation); low PI → brain-sparing in FGR
Ductus venosus	Absent/reversed a-wave in severe FGR → impending cardiac decompensation
Cerebro-placental ratio	MCA-PI ÷ UA-PI — low = compromise

3 Safety

TWO THEORETICAL HARMS

- **Thermal** — tissue heating: **Thermal Index** (TIS soft tissue, TIB bone, TIC cranial)
- **Mechanical** — cavitation: **Mechanical Index**
- No proven fetal harm at diagnostic output

ALARA

- As Low As Reasonably Achievable — lowest output, shortest time
- **Pulsed Doppler** deposits the most energy — avoid routine use in the first trimester
- Keep the TI low, especially over the embryo and bone

4 Obstetric Ultrasound

Early pregnancy ultrasound milestones (transvaginal, approximate)

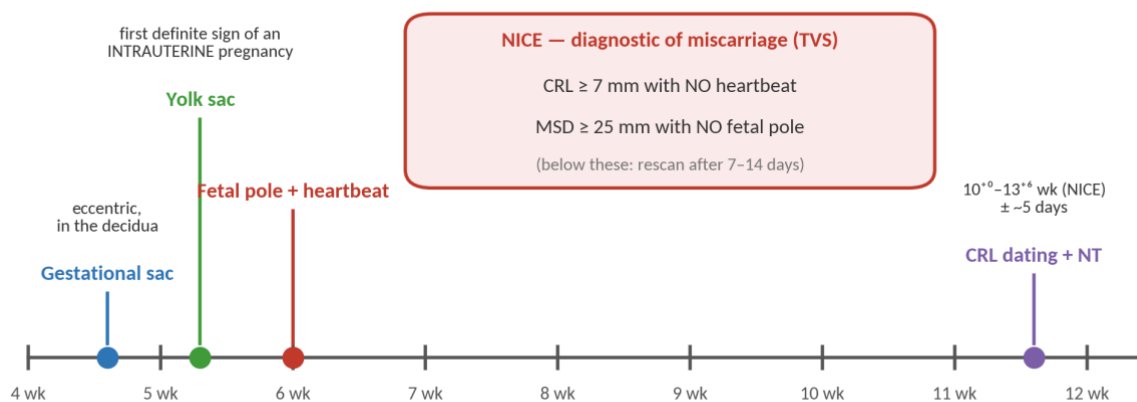


Figure 3. First-trimester milestones.

Scan	Key points
Dating (10^{+0}–13^{+6} wk)	CRL — the most accurate dating ($\pm \sim 5$ days); use head circumference if CRL is above 84 mm
Combined test (11^{+0}–13^{+6} wk)	Age + NT + PAPP-A (low in T21) + free β -hCG (high in T21) $\rightarrow$ risk of trisomy 21, 18, 13. NT ≥ 3.5 mm $\rightarrow$ offer further assessment (also linked to heart defects)
Anomaly scan (18^{+0}–20^{+6} wk)	Head (ventricles, cavum, cerebellum), face (lips), spine, heart (4-chamber, outflow tracts, 3-vessel-trachea), abdomen (stomach, kidneys, bladder, cord insertion), limbs, placenta, liquor
Growth	HC, AC, FL on customised charts — AC is most affected by growth restriction. SGA < 10 th centile; FGR = pathological smallness (abnormal Doppler or falling growth)

Amniotic fluid: deepest vertical pocket (DVP) and amniotic fluid index (AFI)

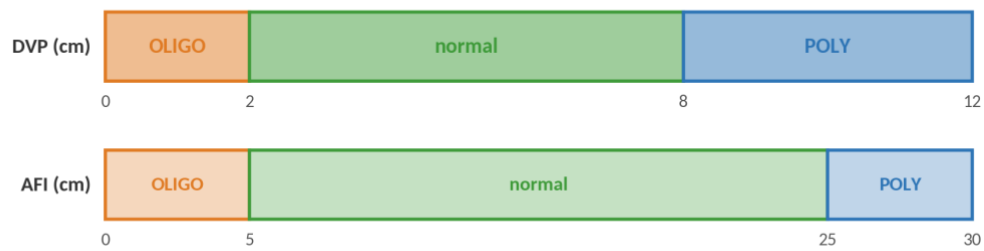


Figure 4. Amniotic fluid thresholds.

5 Gynaecological Ultrasound

- **Transvaginal** with an **empty** bladder (transabdominal needs a full one). Assess uterus, endometrium, ovaries, adnexa and the **pouch of Douglas**.

Target	Key points
Endometrium	Premenopausal ~4–14 mm by phase; triple-line in the late follicular phase. Postmenopausal bleeding: < 4 mm reassuring, ≥ 4 mm → further investigation
Fibroids	Well-defined hypoechoic/heterogeneous masses; FIGO 0–8; calcification shadows; red degeneration in pregnancy
PCOS	≥ 20 follicles (2–9 mm) per ovary or volume ≥ 10 mL (2023 international guideline)
Endometriosis	Endometrioma ('ground-glass'), deep nodules, kissing ovaries, negative sliding sign in the pouch of Douglas
Ectopic pregnancy	Empty uterus + positive test; adnexal mass separate from the ovary ('bagel' / tubal ring); free fluid. Pseudosac is central; a true sac sits eccentrically in the decidua

IOTA B-rules (benign)	IOTA M-rules (malignant)
B1 unilocular cyst	M1 irregular solid tumour
B2 solid part < 7 mm	M2 ascites
B3 acoustic shadows	M3 ≥ 4 papillary projections
B4 smooth multilocular < 100 mm	M4 irregular multilocular-solid ≥ 100 mm
B5 no flow (colour score 1)	M5 very strong flow (colour score 4)

Only B-rules → benign; only M-rules → malignant; both or neither → inconclusive (ADNEX model / specialist scan). In the UK, **IOTA** is advised for **premenopausal** masses (RCOG GTG 62) and the **RMI** for **postmenopausal** women.

6 FAST, Limitations and Newer Techniques

FAST scan — four windows

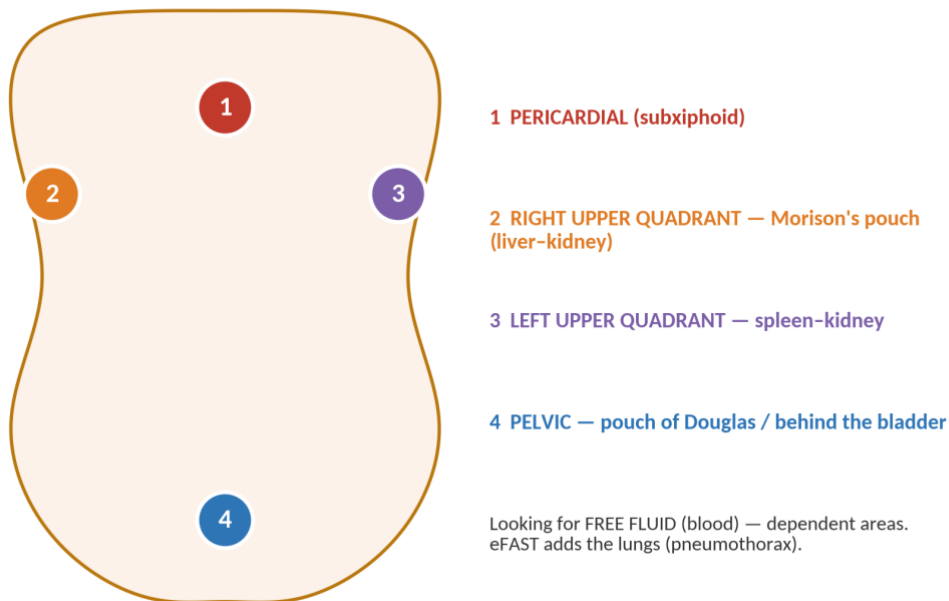


Figure 5. The four FAST windows.

LIMITATIONS

- **Operator-dependent**
- Blocked by **gas** and **bone** (shadowing)
- Poorer images with **obesity**
- Real-time — only stills/clips stored

NEWER TECHNIQUES

- **Saline infusion sonography** — polyps, submucous fibroids
- **3D/4D** — clefts, uterine anomalies, heart
- **Contrast** (microbubbles), **elastography**, point-of-care scanning

★ PEARL

First-trimester CRL is the most accurate dating measurement.

The old hCG 'discriminatory zone' (1500 IU/L, some units up to 3500) is unreliable on its own — current practice (NICE) combines **transvaginal scan with serial hCG**, and never interrupts a pregnancy of unknown location on one hCG value.

Use **pulsed Doppler sparingly** in the first trimester (highest energy output).

7 MRCOG Exam Pearls — Last-Minute Page

Numbers to know

2–20 MHz Diagnostic range	± 5 days CRL dating accuracy	≥ 7 mm CRL, no FH → miscarriage	≥ 25 mm MSD, no pole → miscarriage
≥ 3.5 mm NT — offer more testing	1.5 MoM MCA-PSV — anaemia	< 2 / > 8 cm DVP oligo / poly	< 4 mm PMB endometrium reassuring

HIGH-YIELD CHECKLIST

- ☐ Higher frequency = better resolution, less penetration.
- ☐ Fluid anechoic with enhancement; bone/gas bright with shadow.
- ☐ BART; power Doppler for slow flow; pulsed Doppler highest output.
- ☐ Thermal Index and Mechanical Index; ALARA.
- ☐ Yolk sac = first proof of an intrauterine pregnancy.
- ☐ Miscarriage (TVS): CRL ≥ 7 mm no FH, or MSD ≥ 25 mm no pole.
- ☐ CRL dating 10^{+0} – 13^{+6} ; HC if CRL > 84 mm.
- ☐ Combined test: NT, PAPP-A (low in T21), free β -hCG (high).
- ☐ UA AEDF/REDF; uterine notch; MCA-PSV > 1.5 MoM; DV a-wave.
- ☐ DVP < 2 / > 8 cm; AFI < 5 / > 25 cm.
- ☐ PMB endometrium ≥ 4 mm $\rightarrow$ investigate.
- ☐ IOTA simple rules (premenopausal); RMI (postmenopausal).

Quick-fire self-test — cover the right-hand column

Question	Answer
What does a higher frequency probe gain and lose?	Gains resolution, loses penetration
Appearance behind a simple cyst?	Posterior acoustic enhancement
Colour convention in colour Doppler?	BART — Blue Away, Red Towards
First definite sign of an intrauterine pregnancy?	Yolk sac
Most accurate dating measurement?	First-trimester CRL
CRL with no heartbeat that confirms miscarriage?	≥ 7 mm
Doppler sign of fetal anaemia?	MCA-PSV > 1.5 MoM
Most ominous umbilical artery finding?	Reversed end-diastolic flow
DVP defining polyhydramnios?	> 8 cm
IOTA: unilocular cyst is a B- or M-rule?	B-rule (B1)
Where is Morison's pouch?	Between the liver and right kidney

8 References

- NICE NG126. Ectopic pregnancy and miscarriage: diagnosis and initial management. 2019 (updated 2023).
- NICE NG201. Antenatal care. 2021.
- NHS Fetal Anomaly Screening Programme handbook.
- RCOG Green-top Guideline No. 62. Management of Suspected Ovarian Masses in Premenopausal Women. 2011.
- RCOG Green-top Guideline No. 31. The Investigation and Management of the Small-for-Gestational-Age Fetus. 2013.