PIPADOR REVISION

MRCOG Part 1 Revision Notes

ECG Changes in Pregnancy

PHYSIOLOGY • LECTURE 127

VISUAL EXAMINATION REVISION NOTES

2026 Edition

MRCOG PART 1 REVISION NOTES | PHYSIOLOGY

127 ECG Changes in Pregnancy

ECG fundamentals, physiological changes of pregnancy, pathological patterns, arrhythmias and electrolyte effects

PR 0.12–0.20 s	QRS < 0.12 s	QTc ≤ 460 ms	Axis −30° to +90°
3–5 small squares	< 3 small squares	Women (Bazett)	Normal range

■ KEY FACTS: Learning objectives

- Revise the electrophysiological basis of the ECG, normal intervals and the cardiac axis.
- List the normal ECG changes of pregnancy and explain their causes.
- Distinguish physiological changes from pathological findings (ischaemia, PE, arrhythmia, cardiomyopathy).
- Recognise ECG changes of electrolyte disturbance, including magnesium toxicity.
- Outline the management of arrhythmias in pregnancy.

127.1 ECG fundamentals

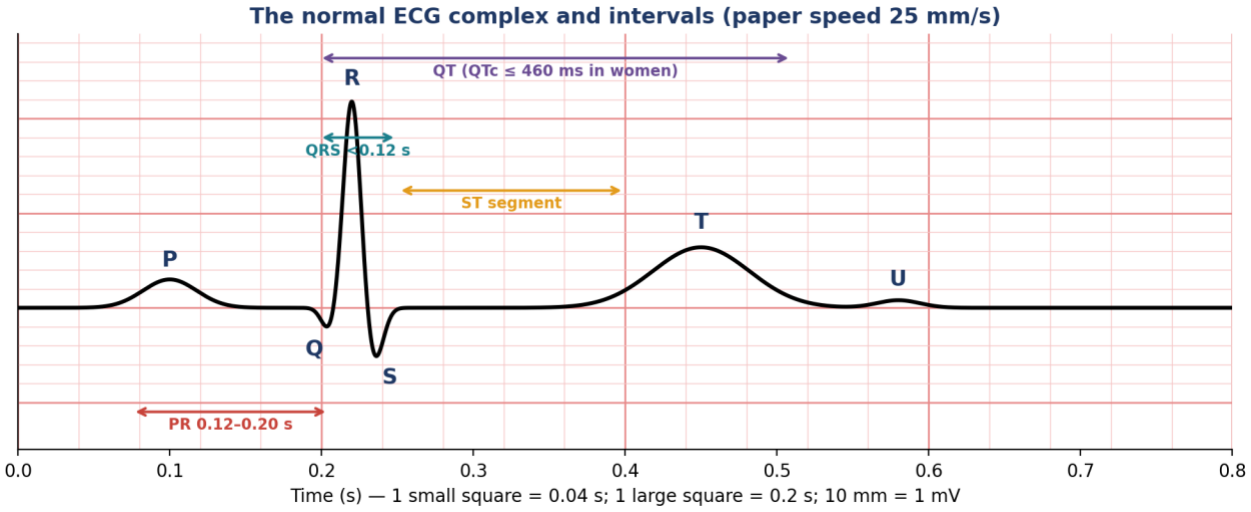


Figure 127.1 — The normal ECG complex with standard intervals

Component	Represents	Normal value	Key abnormalities
P wave	Atrial depolarisation (SA node → atria)	< 0.12 s; < 2.5 mm tall	P mitrale (bifid; LA enlargement, e.g. mitral stenosis); P pulmonale (peaked; RA enlargement)
PR interval	Atrial depolarisation + AV nodal delay	0.12–0.20 s (3–5 small squares)	Short: pre-excitation (WPW); long: 1st-degree AV block, hypermagnesaemia, β-blockers/digoxin
QRS complex	Ventricular depolarisation	< 0.12 s (< 3 small squares)	Wide: bundle branch block, ventricular rhythm, hyperkalaemia, TCA overdose
ST segment	Plateau phase (phase 2) — ventricles uniformly depolarised	Isoelectric	Elevation: STEMI, pericarditis; depression: ischaemia, digoxin, hypokalaemia
T wave	Ventricular repolarisation (phase 3)	Upright in I, II, V3–V6; may be inverted in III, aVR, V1	Peaked (hyperK⁺), flat (hypoK⁺), inverted (ischaemia, PE, cardiomyopathy)

Component	Represents	Normal value	Key abnormalities
QT / QTc	Total ventricular depolarisation + repolarisation	QTc ≤ 450 ms (men), ≤ 460 ms (women); Bazett: QTc = QT ÷ √RR	Long: congenital LQTS, hypoK^+, hypoMg^{2+}, hypoCa^{2+}, drugs (e.g. erythromycin, ondansetron, methadone) → torsades de pointes
U wave	Late repolarisation (Purkinje)	Small, follows T	Prominent in hypokalaemia, bradycardia

■ KEY EQUATIONS

Paper speed 25 mm/s: 1 small square = **0.04 s**; 1 large square = **0.2 s**; 5 large squares = 1 s.

Calibration: 10 mm = 1 mV.

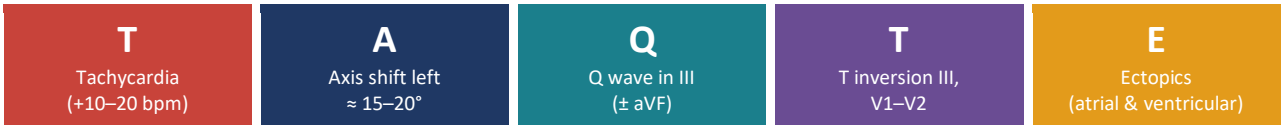
Heart rate = 300 ÷ number of large squares between R waves (regular rhythm) or number of QRS complexes in a 10-s strip × 6.

Normal axis −30° to +90°; left axis deviation < −30°; right axis deviation > +90°.

Leads and anatomical territories

Leads	Territory	Usual coronary artery
II, III, aVF	Inferior	Right coronary (≈ 80–90%) or circumflex
I, aVL, V5, V6	Lateral	Circumflex / diagonal branches of LAD
V1–V2	Septal	LAD (septal branches)
V3–V4	Anterior	LAD
V1–V3 (reciprocal ST depression)	Posterior	RCA / circumflex

127.2 Normal ECG changes in pregnancy



ECG changes in pregnancy arise from three main causes: (1) **mechanical** — elevation of the diaphragm alters the position of the heart (displaced upward and to the left, rotated anteriorly); (2) **haemodynamic** — ↑ heart rate and ↑ blood volume/chamber size; and (3) **autonomic and hormonal** influences on repolarisation.

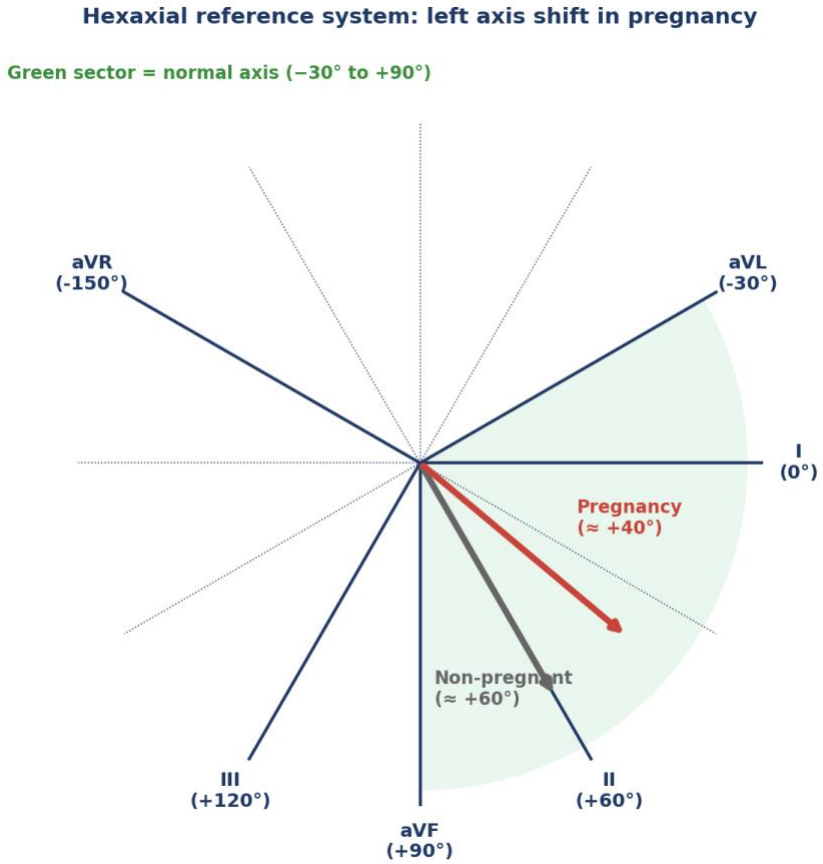


Figure 127.2 — Leftward shift of the QRS axis in pregnancy

Physiological change	Detail	Explanation
Sinus tachycardia	HR ↑ by 10–20 bpm, maximal in the 3rd trimester	↑ Sympathetic tone, ↑ CO requirement; resting HR > 100 bpm warrants assessment
Left axis shift	QRS axis shifts ≈ 15–20° to the left (usually stays within normal range)	Elevated diaphragm displaces/rotates the heart
Q wave in lead III (± aVF)	Small Q wave	Positional; varies with respiration (decreases with deep inspiration)
T-wave inversion in lead III (± aVF)	Inverted or flattened T	Positional
T-wave inversion in V1–V2 (occasionally V3)	Common benign finding	Positional / altered repolarisation
ST depression / T flattening	Minor non-specific changes, especially in left lateral leads; can appear during caesarean section and labour	Altered repolarisation; usually not ischaemic
Atrial and ventricular ectopics	Increased frequency	↑ Catecholamine sensitivity, ↑ chamber stretch, hormonal effects
PR and QT intervals	PR may shorten slightly; absolute QT shortens with ↑ HR (QTc essentially unchanged or minimally prolonged)	Rate-related
QRS voltage	May alter slightly with position/chamber size	Not diagnostic of hypertrophy

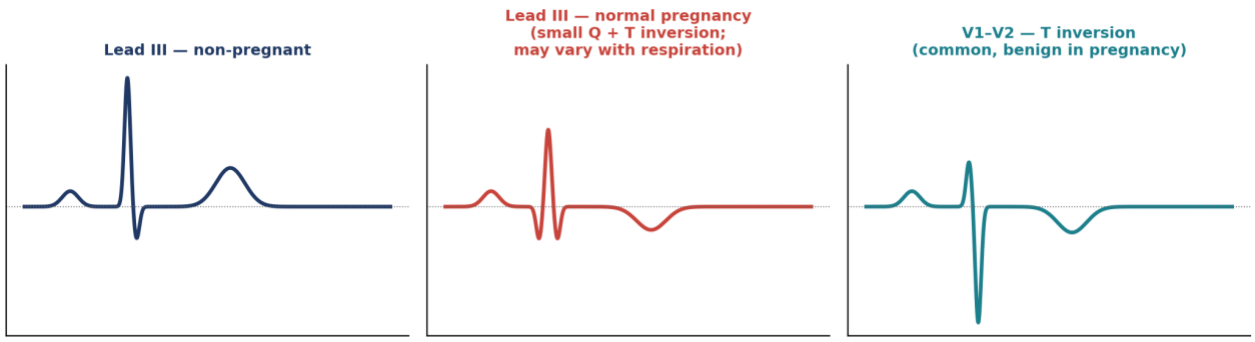


Figure 127.3 — Typical benign appearances: small Q and inverted T in lead III; T inversion in V1–V2

■ EXAM TIP

- A common SBA: 'Which ECG finding is normal at 34 weeks?' → **Q wave and T inversion in lead III**, **left axis shift**, **sinus tachycardia**, **ectopic beats**, **T inversion in V1–V2**.
- **Not normal**: ST elevation, new LBBB, pathological Q waves in multiple leads, AF, sustained arrhythmia, QTc > 460–470 ms, T inversion in lateral leads (V4–V6) with symptoms, high-grade AV block.

127.3 Physiological vs pathological — interpreting the pregnant ECG

Finding	Likely physiological	Think pathology
Heart rate	80–100 bpm at rest	> 100–110 bpm persistently: haemorrhage, sepsis, PE, anaemia, thyrotoxicosis, cardiomyopathy, SVT
Axis	Mild left shift within normal range	Marked LAD (< −30°: left anterior fascicular block) or new RAD (acute RV strain — PE)
Lead III	Isolated Q + T inversion (varies with respiration)	Q waves and ST elevation in II, III, aVF (inferior MI)
Right precordial T waves	T inversion V1–V2 (± V3)	T inversion V1–V4 with RBBB/RAD + tachycardia: PE; arrhythmogenic RV cardiomyopathy
ST segment	Minor depression in labour/at CS	ST elevation; dynamic ST depression with chest pain (SCAD, ischaemia)
Rhythm	Ectopics, sinus arrhythmia	AF/flutter (consider mitral stenosis, thyrotoxicosis), SVT, VT
QTc	≤ 460 ms	> 460–470 ms: congenital LQTS (↑ risk postpartum), drugs, hypokalaemia/hypomagnesaemia (hyperemesis)

Pulmonary embolism

- **Sinus tachycardia** is the most common ECG finding; the ECG may be normal.
- Features of RV strain: T inversion V1–V4, right axis deviation, RBBB, P pulmonale; the classic **S1Q3T3** pattern is uncommon and **overlaps with normal pregnancy** (Q3/T3).
- An ECG (and CXR) helps to exclude other causes but **cannot exclude PE** — follow RCOG Green-top Guideline 37b: start LMWH unless contraindicated, then CTPA or V/Q scanning (compression duplex first if leg symptoms).

Ischaemia and myocardial infarction

- Pregnancy increases MI risk ≈ 3–4-fold; **spontaneous coronary artery dissection (SCAD)** is the leading cause of pregnancy-associated MI, especially late pregnancy and early postpartum.
- Use **high-sensitivity troponin** (not elevated by normal pregnancy or uncomplicated labour; may rise mildly in pre-eclampsia).
- Do not attribute ST changes with chest pain to pregnancy — urgent cardiology involvement.

Peripartum cardiomyopathy and other structural disease

- ECG is abnormal in most women with PPCM but non-specific: sinus tachycardia, T-wave inversion, LBBB, low voltage, arrhythmias. **BNP/NT-proBNP** and **echocardiography** confirm.

- Mitral stenosis: P mitrale, AF, right axis deviation (pulmonary hypertension). Hypertrophic cardiomyopathy: LVH with deep T inversion, pathological Q waves.

127.4 Arrhythmias in pregnancy

Arrhythmia	Notes	Management principles
Ectopic beats	Very common, benign	Reassurance; check K^+, Mg^{2+}, thyroid function; avoid caffeine
SVT (AVNRT/AVRT)	Most common sustained arrhythmia in pregnancy; may present for the first time	Vagal manoeuvres (modified Valsalva) → IV adenosine (safe; short half-life) → β-blocker (metoprolol); DC cardioversion is safe in any trimester
AF / atrial flutter	Uncommon — suggests structural disease (MS), thyrotoxicosis, electrolyte disturbance	Rate control (β-blocker, digoxin); anticoagulation with LMWH (warfarin teratogenic; DOACs avoided); DC cardioversion if unstable
Ventricular tachycardia	Rare; consider cardiomyopathy (including PPCM), congenital heart disease, LQTS	Immediate DC cardioversion if unstable; β-blockers; ICD where indicated
Bradycardia / heart block	Congenital complete heart block usually well tolerated	Temporary pacing in labour if symptomatic

■ CLINICAL CORRELATION

- **Fetal** note: **congenital complete heart block** results from maternal **anti-Ro/SSA and anti-La/SSB** antibodies (SLE/Sjögren's) damaging the fetal conduction system — screen with fetal echocardiography/PR-interval surveillance from ≈ 16–26 weeks.
- Amiodarone is generally avoided (fetal hypothyroidism, goitre, growth restriction) unless other treatments fail.

127.5 Electrolyte disturbances and drug effects

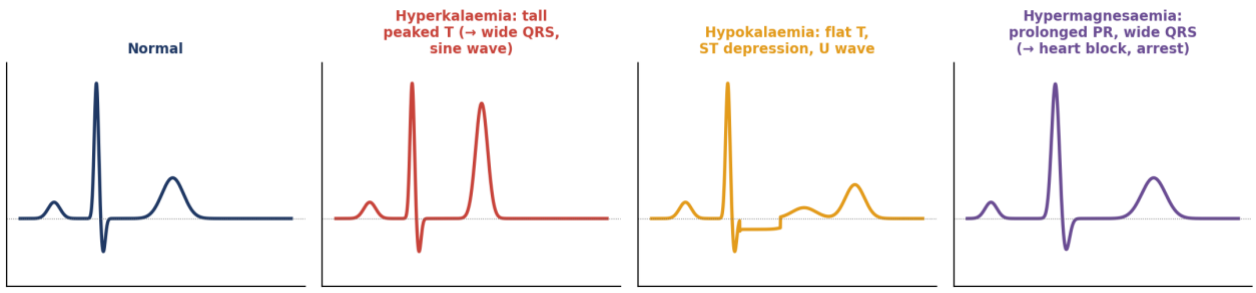


Figure 127.4 — ECG patterns of potassium and magnesium disturbance (schematic)

Disturbance	ECG changes	Obstetric context
Hyperkalaemia	Tall, peaked T waves → PR prolongation, flattened P → wide QRS → sine wave → VF/asystole	AKI (HELLP, haemorrhage, sepsis), massive transfusion of stored blood
Hypokalaemia	Flat T, ST depression, prominent U waves, long QT(U)	Hyperemesis gravidarum, β-agonists (salbutamol tocolysis), diuretics
Hypocalcaemia	Prolonged QT (ST segment)	Massive transfusion (citrate), hypoparathyroidism, $MgSO_4$ therapy
Hypercalcaemia	Short QT	Primary hyperparathyroidism (rare in pregnancy)
Hypomagnesaemia	Long QT, torsades de pointes	Hyperemesis, malnutrition, diuretics
Hypermagnesaemia	Prolonged PR, widened QRS, AV block, bradycardia → cardiac arrest	$MgSO_4$ for eclampsia prophylaxis/treatment or fetal neuroprotection, especially with oliguria/renal impairment

Serum Mg^{2+} (mmol/L)	Clinical effect
0.7–1.0	Normal range
2.0–4.0	Therapeutic range for eclampsia prophylaxis
> 4–5	Loss of patellar (deep tendon) reflexes — monitor reflexes hourly
> 6–7.5	Respiratory depression/paralysis (monitor RR, SpO_2)
> 7.5–12	ECG changes, AV block
> 12	Cardiac arrest

■ **RED FLAGS**

- **Antidote for magnesium toxicity: 10 mL of 10% calcium gluconate IV over 10 minutes** (and stop the infusion).
- Standard regimen (Collaborative Eclampsia Trial / NICE NG133): 4 g IV loading over 5–15 minutes, then 1 g/h for 24 hours; recurrent seizure: further 2–4 g over 5 minutes.
- Monitor urine output, reflexes, respiratory rate and SpO_2; check serum Mg^{2+} if oliguric or signs of toxicity.

Other drugs relevant to obstetrics

- **QT-prolonging**: ondansetron (hyperemesis), erythromycin/macrolides, methadone and some antipsychotics — use with caution in congenital LQTS.
- **Oxytocin**: tachycardia and transient ST depression with rapid bolus; avoid large undiluted boluses in cardiac disease.
- **β_2-agonists (terbutaline, salbutamol)**: sinus tachycardia, hypokalaemia, ischaemic changes.
- **Local anaesthetic systemic toxicity** (e.g. bupivacaine): bradyarrhythmias, wide QRS, VT/VF — treat with **Intralipid 20%**.

127.6 Quick-revision checklist

■ **MNEMONIC / MEMORY AID**

'Normal pregnancy ECG = TAQ-TE': **T**achycardia, **A**xis shift to the left, **Q** wave in III, **T** inversion in III and V1–V2, **E**ctopics.

Magnesium toxicity sequence — 'Reflexes, Respiration, Rhythm' (≈ 5 → 7 → 12 mmol/L).