

Normal ECG Interpretation

Concise, exam-oriented handout for MBBS Final Year

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1. Introduction to ECG Basics

What is an ECG? Recording of the heart's electrical activity—essential for rhythm analysis, ischemia/MI, electrolyte disorders & structural clues.

Standard 12-lead ECG: Limb leads I, II, III, aVR, aVL, aVF; precordial leads V1–V6.

Paper & Calibration - At a Glance

Setting	Value	Remember
Paper speed	25 mm/s	1 small box = 0.04 s; 1 large box = 0.20 s
Amplitude	10 mm/mV	1 small box = 0.1 mV
Calibration mark	10 mm high	Check standardization before reading

2. Understanding the ECG Waves and Intervals

Component	Normal	Notes
P wave	Duration < 120 ms; amplitude < 2.5 mm (Lead II)	Atrial depolarization
PR interval	120–200 ms	AV nodal conduction
QRS complex	< 120 ms	Ventricular depolarization; narrow & sharp
QTc	< 440 ms (men), < 460 ms (women)	>500 ms high risk (torsades)
ST segment	Isoelectric	Elevation/depression → ischemia/injury
T wave	Upright in I, II, V3–V6; inverted in aVR	V1 may vary

3. Normal Heart Rate and Rhythm

Rate calculation: 300-150-100-75-60-50 (large-box method) or QRS count × 6 on a 10-s strip.

Rhythm	Definition / Features
Normal Sinus Rhythm	Each QRS preceded by similar P; constant PR; rate 60–100 bpm; normal axis.
Sinus brady/tachy	<60 or >100 bpm with otherwise sinus features (consider clinical context).

4. Axis Determination

Look at	Finding	Axis
Lead I & aVF	Both positive	Normal ($\approx -30^\circ$ to $+90^\circ$)
Lead I +, aVF -	Check lead II (+: normal, -: left axis)	Borderline vs Left axis
Lead I -, aVF +	Right axis deviation	$> +90^\circ$
Both negative	Extreme axis (NW axis)	$\approx -90^\circ$ to -180°

5. Recognizing Abnormal Signs (Exam-Oriented)

- P waves: P pulmonale (peaked in II) → RAE; P mitrale (bifid in II/broad in V1) → LAE.
- PR: >200 ms = 1° AV block; short PR + delta wave → WPW.
- QRS: ≥ 120 ms = BBB/ventricular origin; pathologic Q waves suggest prior MI.
- ST/T: ST \uparrow/\downarrow or T inversion → ischemia; tall peaked T → hyperkalemia; U waves → hypokalemia.
- QTc: >500 ms high risk torsades—review drugs/electrolytes.

6. Practical Steps to Read an ECG

- Confirm patient & calibration (25 mm/s; 10 mm/mV).
- Rate → Rhythm → Axis → Intervals (PR, QRS, QTc) → P/QRS/ST/T review by territories.
- Check R-wave progression: transition V3-V4; tall R V5-V6.
- Look for ischemia patterns: inferior (II, III, aVF); anterior (V1-V4); lateral (I, aVL, V5-V6).

Appendix A — ECG Normal Ranges (Quick Reference)

Item	Normal Range	Notes
Heart rate (adult)	60-100 bpm	Athletes can be lower
PR interval	120-200 ms	
QRS duration	< 120 ms	
QTc (Bazett)	< 440 ms (m), < 460 ms (f)	>500 ms high risk
P wave	Duration <120 ms; Amp <2.5 mm	Lead II values
Axis	-30° to $+90^\circ$	Use I/aVF (\pm lead II)
R progression	Transition by V3-V4	

Appendix B — Axis Quadrant Mini-Card

Lead I	aVF	Axis Zone	Mnemonic
+	+	Normal (-30° to $+90^{\circ}$)	Both thumbs up = normal
+	-	Left axis (consider LVH, LAFB)	Left up, aVF down
-	+	Right axis (RVH, LPFB)	Right up, I down
-	-	Extreme/NW axis	Both down