Level 13

Rhythm 101—the sinus rhythm

If you want to be able to diagnose rhythm problems, you'll first have to learn what constitutes a sinus rhythm (the healthy heart's normal rhythm). In sinus rhythm there's a regular sequence of P waves and QRS complexes.

Criteria for sinus rhythm

All of the following four criteria need to be met in order for sinus rhythm to be present: **(1)** P waves are positive in leads I and II; **(2)** every P wave is followed by a QRS complex; **(3)** the distance between each P wave and the following QRS is constant; and **(4)** the distance between the QRS complexes is constant. Let's check the example below for the presence of sinus rhythm.

Sinus rhythm is present if the following criteria are met:

1. P waves are positive in leads I and II ✓
2. Every P wave is followed by a QRS complex ✓
3. The distance between each P wave and the following QRS complex is constant ✓
4. The distance between the QRS complexes is constant ✓

↓

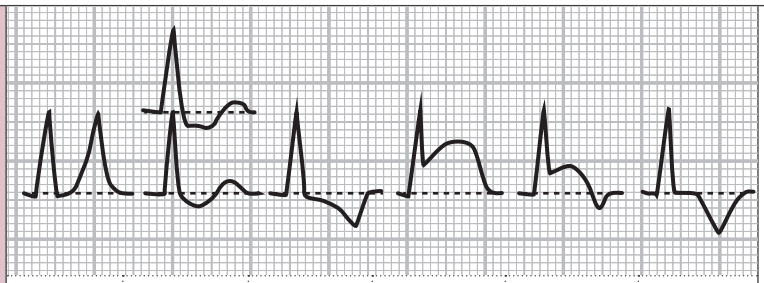
Sinus Rhythm

Note that apart from the limb leads, we also show you lead V1 here. This lead is located in close proximity to the right atrium and is therefore ideally suited for the assessment of atrial depolarization. The P wave is usually biphasic in lead V1, the initial positive deflection corresponds to right atrial depolarization, and the second (negative) part corresponds to left atrial depolarization.

We have now covered all the steps of the cookbook! You're almost done with the final level. You are now able to speak the ECG language. You understand the most important principles and are able to carry out a basic evaluation of the ECG. Great job!

Question	Answer	Diagnosis
1. Rhythm	Criteria for sinus rhythm: 1. Are the P waves positive in I and II? 2. Is there a QRS complex after each P wave? 3. Are the PR intervals constant? 4. Are the RR intervals constant?	sinus rhythm or no sinus rhythm?
2. Heart rate	Estimate heart rate: 300/number of large boxes between two QRS complexes	heart rate in beats per min
3. P waves	a) Large P-wave amplitude (>2.5 mm in II, III, or aVF)	right atrial enlargement
	b) Prolonged negative part of P wave in V1 (1 mm) and P wave with 2 peaks in II, P-wave duration >0.12 s	left atrial enlargement
4. PR interval	a) >0.2 s (if PR interval constant for all beats and each P wave is followed by a QRS complex)	I° AV block
	b) <0.12 s and QRS complex normal	LGL syndrome
	c) <0.12 s and visible delta wave	WPW syndrome
5. QRS axis	Determine the axis according to leads I, II, and aVF	normal axis left axis deviation right axis deviation northwest axis
6. QRS duration	a) ≥0.12 s (always think of WPW syndrome as a differential)	complete bundle branch block
	b) >0.1 s and <0.12 s with typical bundle branch block appearance (notching)	incomplete bundle branch block
7. Rotation	Rotation is defined according to the heart's transition zone. Normally the transition zone is located at V4, which means that right ventricular myocardium is located at V1–V3 and left ventricular myocardium is at V5–V6.	transition zone at V5–V6: clockwise rotation transition zone at V1–V3: counterclockwise rotation NOTE: don't evaluate rotation in the setting of myocardial infarction, WPW syndrome, or bundle branch block
8. QRS amplitude	a) QRS amplitude <0.5 mV in all standard leads	low voltage
	b) Positive criteria for left ventricular hypertrophy	left ventricular hypertrophy
	c) Positive criteria for right ventricular hypertrophy	right ventricular hypertrophy
9. QRS infarction signs	abnormal Q waves, QS waves, missing R-wave progression	myocardial infarction; localization according to affected leads

10. ST–T segment



	tall T wave	ST depression	ST depression	ST elevation		negative T	
QRS normal	→						hyperkalemia, vagotonia
QRS normal	→	→					probably ischemia (DD: digitalis)
QRS normal	→	→	→				nonspecific repolarization abnormality
QRS normal	→	→	→	→			acute ischemia, perimyocarditis, variant angina
QRS normal	→	→	→	→	→		STEMI/ perimyocarditis in resolution
QRS normal	→	→	→	→	→	→	STEMI subacute, NSTEMI, perimyocarditis
QRS with Q wave	→	→	→	→	→	→	STEMI acute, STEMI in resolution, STEMI subacute
QRS: left ventricular hypertrophy	→	→	→				left ventricular hypertrophy with abnormal repolarization
QRS: right ventricular hypertrophy, bundle branch block, or WPW syndrome	→	→	→				In these situations an ST-segment deviation is almost always present and cannot be interpreted in and of itself. It has to be left out in the ECG report

11. QT duration, T–U waves		
	a) QT shortening	hypercalcemia
	b) QT prolongation	hypocalcemia
	c) tall and peaked T wave	hyperkalemia
	d) U wave, ST depression, T-wave flattening, or a combination of these	hypokalemia