ECG Interpretation: Review and Common Mistakes

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Objectives:

- Identify ECG interpretation basic concept
- Identify patterns of injury with myocardial ischemia and infarction
- Explain the common errors practitioners make with ECG interpretation
- Interpret ECGs when given a computer-generated interpretation to evaluate for errors
- Explain the importance of using the ECG as an adjunct to patient evaluation and care, not relying solely on findings to treat patients

The components of the conduction system and their vascular supply



anterior and posterior septal branches.

ANTERIOR FASCICLE

Activates the anterior wall. Supplied by septal branches of LAD. Very sensitive to ischemia.

ECG: Back to Basics

- Normal Sinus Rhythm
 - Rate 60-100 bpm
 - P waves: Present
 - PR Interval: Normal and consistent (0.12-0.2 sec)
 - QRS: Regular



Common Atypical Rhythms

- Supraventricular tachycardia/Paroxysmal SVT
 - Rate 140-220 bpm
 - P waves: Present but potentially hidden with rapid rate
 - PR Interval: Consistent but may be hidden with rapid rate
 - QRS: Narrow, regular, and fast



Premature Contractions

PAC

• P:QRS 1:1

- Extra atrial contractions
- Occur at any time and rate
- The P waves look different from normal P waves

PVC

- Can occur at any time and with any rate
- Different QRS morphology
- T waves in opposite direction
- Usually followed by a compensatory pause





Atrial Fibrillation

- Irregularly irregular rhythm, most common sustained dysrhythmia
 - Rate: Atrial rate: ~350 Ventricular rate: Slow to rapid
 - Rhythm: Irregular
 - P waves: Absent
 - QRS: < 0.12 seconds



First Degree Heart Blocks

- Rate: Normal
- Rhythm: Normal (relatively)
- P waves: Present
- PR Interval: >0.20 seconds
- P:QRS: 1:1



Second Degree Heart Block

Type 1 (Wenkebach)

- Rate: 60-100 bpm
- Rhythm: Regular to slightly irregular
- P Waves: Present
- PR Interval: Lengthens until a QRS is dropped
- P:QRS: 1-1.5:1

Type 2

- Rate: < 60 bpm
- Rhythm: Regular
- P Waves: Present with extra P waves not conducting QRS
- PR Interval: Fixed and long
- P:QRS: 1.5-2:1



Third Degree Heart Block

- Rate: < 60 bpm
- Rhythm: Regular to Irregular
- P waves: Present, non-conducting
- PR Interval: Nonexistent
- QRS: Widened
- P-P distance is typically the same, though may be lost in a QRS
- R-R distance is typically the same throughout



Consider BBB when QRS > 100 milliseconds

	V1	V6
LBBB	QRS negative	QRS positive
	Wide QS wave	Tall R wave with no septal Q wave
RBBB	rSR'	qRS (slurred S in Lead I)

Left bundle branch block characteristics



Right bundle branch block characteristics





modified: excessively discordant ST-segment elevation (> 25% of the depth of the preceding S wave)



Ventricular Tachycardia

- Fast, wide complex rhythm
- May be pulseless or with a pulse
- Considered Ventricular Tachycardia if 3 or more consecutive PVCs
- Rate: ~100-250 bpm
- Rhythm: Regular
- P waves: May or may not be visible
- QRS: Wide (> 0.12 sec)



Ventricular Fibrillation

- Rate: ~300 bpm
- Rhythm: Irregular
- P waves: Absent
- PR Interval: Not calculated
- QRS: Not calculated



Prolonged QTi

- QTc > 500 ms (normal QTi < 460 ms)
- Primary causes
 - Genetic (LQT 1, 2, 3, Romano-Ward syndrome)
- Acquired causes
 - Medications (antibiotics, antifungals, antipsychotics, antidepressants) <u>www.qtdrugs.org</u>
 - Electrolyte abnormalities (hypokalemia)
- Risk for VT, VF, and R on T phenomenon (PVC falls at peak of T wave, may precipitate VT, VF)
- Brugada syndrome
 - Association of characteristic ECG pattern w/ risk of ventricular tachyarrhythmias

Chest Leads Relating the Cardiac Injury



FIGURE 3.12

ECG Leads



Schematic overview of the coronary arteries and their relation to the ECG leads



RCA = Right coronary artery PDA = Posterior descending artery

LMCA = Left main coronary artery LAD = Left anterior descending artery D = Diagonal branches (D1, D2) Septals = Septal branches LCx = left circumflex artery OB = Obtuse marginals (OB1, OB2, OB3) LPD = Left posterior descending artery

RCA: supplies the RV and the inferior portion of the LV, the AV node and the conal branch supplies the SA node

LAD: supplies the anterior portion of the LV, the interventricular septum, and the perforating branches supply the bundle branches

LCx: supplies the lateral wall of the LV, less commonly supplies the SA and/or AV node





Primary (injury – ST segment elevation)	Reciprocal* (ST segment depression)
Anterior (V1-V4)	Inferior (II, III, aVF)
Lateral (I, aVL, V5-V6)	Inferior (II, III, aVF)
Inferior (II, III, aVF)	Lateral (I, aVL, V5-V6)
Posterior	Anterior (V1-V4)

Common Mistakes Providers Make in ECG Interpretation

- Following the computer read
- Treating the monitor, and not the patient

Computer Interpretations (2)

Advantages

- Reduction of reading time for providers by 24-28%
 - Heart rate
 - QRS axis
 - Duration of the PR and QRS intervals
- Most accurate for sinus rhythm and normal waveform

Disadvantages

- Misdiagnosis of:
 - Atrial fibrillation
 - Pacemaker rhythms
 - Lead reversals
 - Myocardial infarction
- Least accurate for abnormalities in rhythm, conduction, and wave form
- Makes all interpretations from measurements of leads I and II, using the equilateral triangle equation of Einthoven, calculating the other 4 limb leads

Case 1 Read: AF with PVC or aberrantly conduction. Left axis deviation.



Case 2: Read: Sinus Tachycardia with PACs with aberrant conduction. Right axis deviation



Case 3: Sinus rhythm. Left axis deviation. Prolonged QT.









Case 6: Read: Idioventricular rhythm, rate 37 bpm. Inferior infarct.



Case 7: Read: Sinus rhythm. Right axis deviation. Non-specific ST and T wave abnormality.



Case 8: Read: Polymorphic VT suggestive of torsades de pointes



Repeated ECG with leads appropriately placed and tremor removed.



References

- Knecktel, M. EKGs for the Nurse Practitioner and Physician Assistant, 2nd edition. Pringer Publishing Company. New York, NY. 2017
- Roberts, D. Mastering the 12 Lead EKG. Red Rock Publishing. Jackson, TN 2018
- Guglin, M, Thatai, D. Common errors in computer electrocardiogram interpretation. International Journal of Cardiology 2006; 106: 232-237.
- Hurst. J. Electrocardiographic Crochets or Common Errors Made in the Interpretation of the Electrocardiogram. *Clinical Cardiology* 1998 (21): 211-216.
- Cairns, A, Bond, R, Finlay, D, Breen, C, Guldenring, D, Gaffney, R, Gallagher, A, Peace, A, Henn, P. A computer-human interaction model to improve the diagnostic accuracy an clinical decision-making during 12-lead electrocardiogram interpretation. *Journal of Biomedical Informatics* 2016 (64): 93-107.
- Smulyan, H. The Computerized ECG: Friend and Foe. The American Journal of Medicine 2018.
- Mirijello, A, Fuorlo, M, Addolorato, G, Landolfi, R. 'Doctor, treat your patient, not your monitor!' Tremor-induced ECG artefacts mimicking torsades de pointes. BMJ Case Reports 2014. DOI: 10.1136/bcr-2014-204735. Accessed September 18, 2018