Brigham and Women's Hospital
Founding Member, Mass General Brigham

Can't-Miss ECG Cases for Hospitalists

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Harvard Medical School

No Disclosures

Case 1

A 67-year-old woman with a history of CAD s/p CABG presents after the development of acute chest pressure and lightheadedness. On presentation to the emergency room, her HR is 50 bpm and her blood pressure is 84/57 mmHg. Her extremities are cool. An ECG is obtained. What is the most important finding?

1. Anterior Non-ST-elevation MI
2. Anterior ST-elevation MI
3. Inferior ST-elevation MI
4. Inferior-Posterior ST-elevation MI

Nathanson LA et al. http://ecg.bidmc.harvard.edu

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Case 2

A 60-year-old female presents with nausea, epigastric discomfort, and chest pressure that started about 45 minutes ago. An ECG is obtained. Administering which of the following medications should be avoided in the emergency room?

1. Aspirin
2. Heparin
3. Morphine
4. Nitroglycerin

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A 60-year-old female presents with nausea, epigastric discomfort, and chest pressure that started about 45 minutes ago. An ECG is obtained. Administering which of the following medications should be avoided in the emergency room?
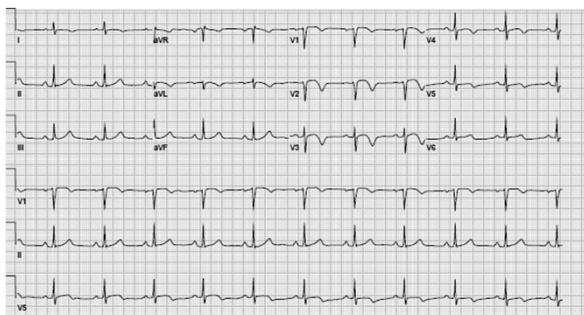
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Slide 13:

TABLE I Association Between Location of Culprit Lesion and Presence of ST-Segment Ratio in Leads III and II of >1 and ST-Segment Elevation in V_1

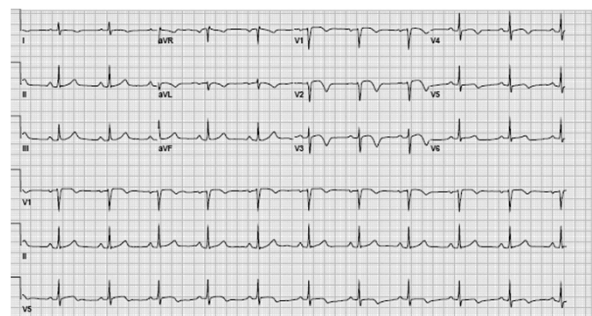| Culprit Lesion (n)	ST III >II (n) (%)	ST Elevated in V_1 + ST III >II	RV AMI
Proximal RCA (19)	17 (89%)	5	6
Mid RCA (25)	20 (80%)	0	4
Distal RCA (8)	1 (12.5%)	0	0
Left circumflex (17)	0	0	0

Slide 14:

Case 3

A 71-year-old man with a history of hypertension, dyslipidemia, and former tobacco use presents to the emergency department with two weeks of chest pressure associated with exertion. He has never had these symptoms before. He currently has no chest pressure. An ECG is obtained. His exam is unremarkable and high-sensitivity troponin (hs-Tn) is < 6 ng/dL. After evaluation, a decision is made to perform coronary angiography. Which of the following would you expect to see?

1. Non-obstructive coronary artery disease
2. Proximal right coronary artery stenosis
3. Proximal left anterior descending artery stenosis
4. Proximal left circumflex coronary artery stenosis

Slide 15:

Slide 16:

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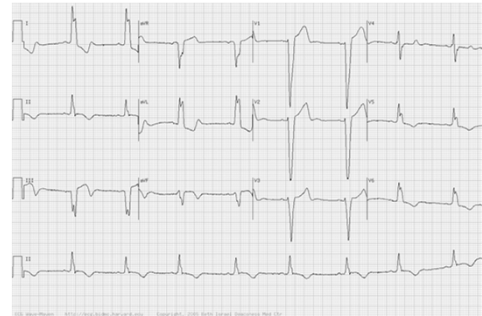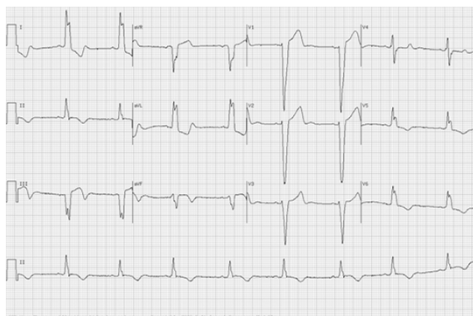

Slide 18:

Case 4

An 82-year-old female with hypertension, diabetes, and known left bundle branch block is brought into the emergency room by her daughter due shortness of breath at rest. An ECG is obtained. Which myocardial territory is abnormal on this ECG?

1. Anterior
2. Posterior
3. Inferior
4. Lateral

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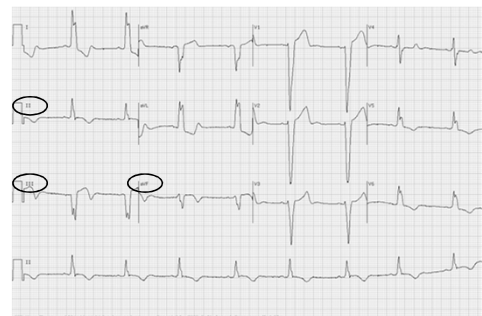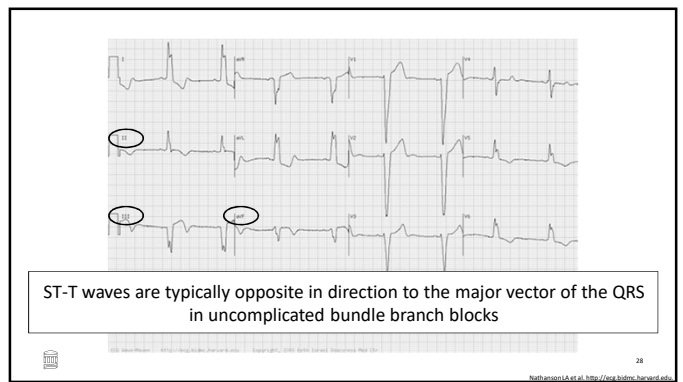
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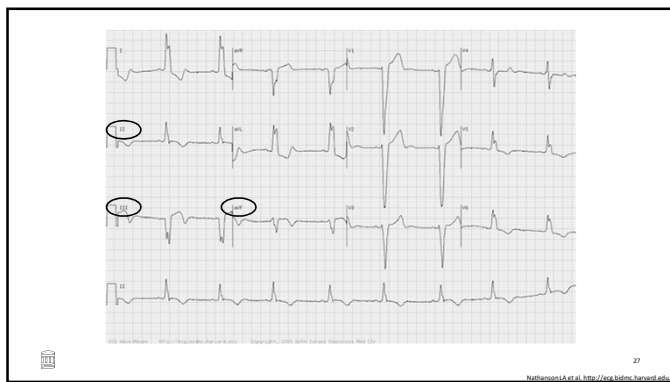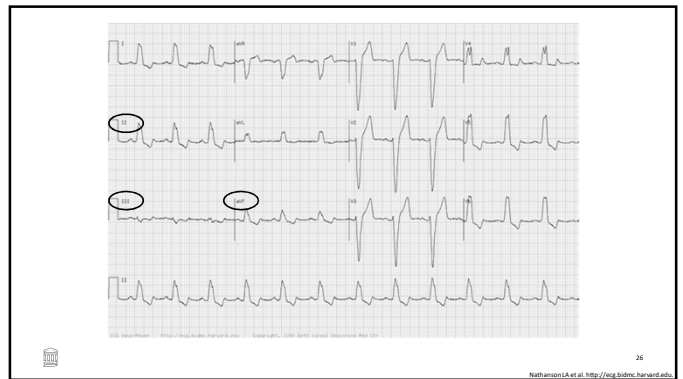2. Posterior
3. **Inferior**
4. Lateral

Slide 25:

Slide 26:

Slide 27:

Slide 28:

ST-T waves are typically opposite in direction to the major vector of the QRS in uncomplicated bundle branch blocks

Slide 29:

Case 5

An 80-year-old female with a history of pacemaker placement due to sick sinus syndrome and Mobitz Type II secondary degree heart block presents with dizziness, lightheadedness, and nausea approximately 90 minutes in duration. An ECG is obtained. What is the most likely cause of her symptoms?

1. Myocardial infarction
2. Atrial lead malfunction
3. Ventricular lead malfunction
4. Pericardial effusion

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3 ECG criteria with independent value in diagnosis of acute MI in the presence of LBBB

- ST segment elevation of 1mm or more that is in the same direction (concordant) as the QRS complex in any lead
- ST segment depression of 1 mm or more in any lead from V1 to V3
- ST segment elevation of 5mm or more that is discordant with the QRS complex

Early Electrocardiographic Diagnosis of Acute Myocardial Infarction in the Presence of Ventricular Paced Rhythm

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Case 6

This ECG is most consistent with which of the following clinical scenarios?
1. A 54-year-old man with a history of diabetes with crushing, central chest pressure acute in onset
2. A 72-year-old woman with a history of hypertension and dyslipidemia with acute onset epigastric pain and diaphoresis
3. A 32-year-old man with a history of morbid obesity with asymmetric leg swelling and shortness of breath two days after abdominal surgery
4. A 44-year-old woman with a history of hypertension with positional, pleuritic chest discomfort

Case 6

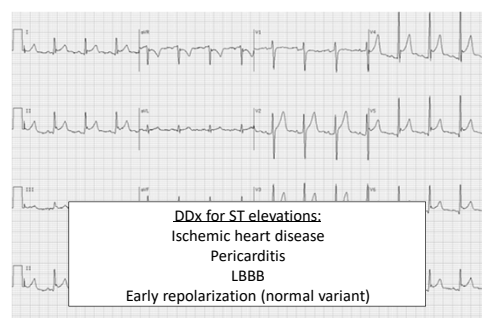This ECG is most consistent with which of the following clinical scenarios?
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4. **A 44-year-old woman with a history of hypertension with positional, pleuritic chest discomfort**

DDx for ST elevations:
Ischemic heart disease
Pericarditis
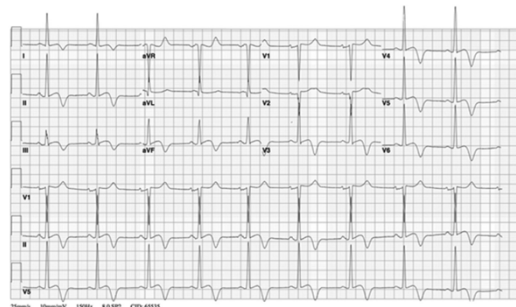LBBB
Early repolarization (normal variant)

Case 7

A 58-year-old female with a history of hypertension presents to her primary care physician's office for peri-operative risk assessment before a total knee replacement. She has no cardiovascular symptoms. An ECG is obtained. Which of the following is the most likely cause of this patient's ECG abnormalities?

1. Prior myocardial infarction
2. Current ischemia
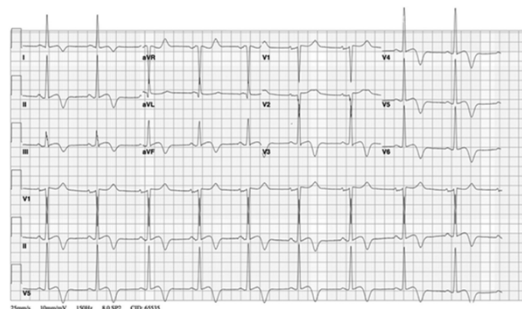3. Hypertrophic cardiomyopathy
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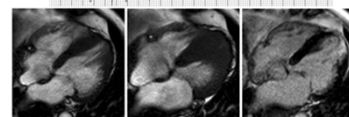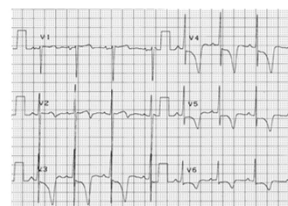3. **Hypertrophic cardiomyopathy**
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Nomenclature: Sigmoidal HCM, Reverse curve HCM, Apical HCM, Neutral HCM

Nomenclature	Sigmoidal HCM	Reverse curve HCM	Apical HCM	Neutral HCM
Prevalence	40-50%	30-40%	10%	10%
Age group	> 50-60 years	< 50-60 years	< 50-60 years	< 50-60 years

Canepa M et al. Heart. 2016 Jul 15;102(14):1087-94.

49

Case 8

A 39-year-old male presents to the emergency department with two weeks of intermittent chest discomfort while jogging. An ECG is obtained. Troponin-T was elevated at 0.07 ng/mL. Due to concern for a non-ST-elevation myocardial infarction, he underwent coronary angiography which revealed no obstructive coronary artery disease. Which of the following is the most likely cause of the ECG abnormalities?

1. Myocarditis
2. Pulmonary embolism
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4. Left ventricular hypertrophy and associated strain pattern

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52

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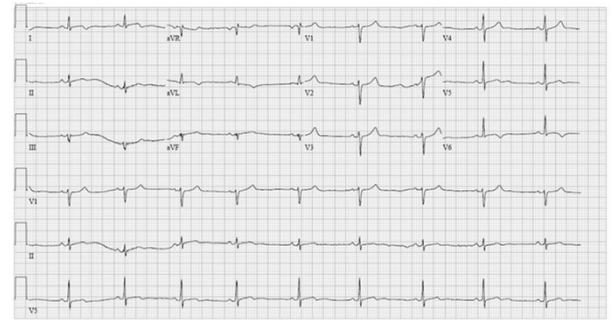4. Left ventricular hypertrophy and associated strain pattern

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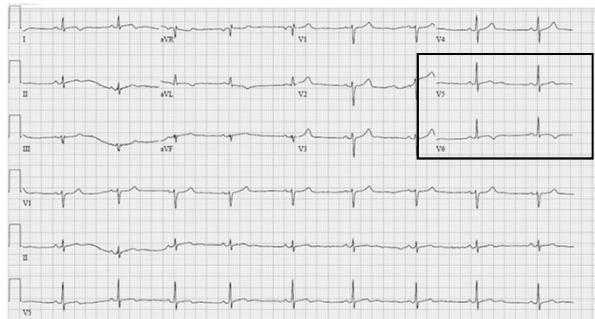
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+Troponin in the absence of overt ischemic heart disease

Type II MI	Non-ischemic myocardial damage	Indeterminate/ Multifactorial
Tachyarrhythmias Shock HTN urgency/emergency Cocaine use	Cardiac contusion Defibrillator shocks Myocarditis Cardiotoxic agents	Stress cardiomyopathy Severe pulmonary embolism Severe neurologic disease Infiltrative cardiomyopathy Sepsis

Thygesen K et al. Eur Hear J. 2010;31(18):2197-2206.

Case 9

A 61-year-old male presents to urgent care clinic due to non-exertional, sharp chest pain over the last 2-3 months. An ECG is obtained. Evidence of which of the following is present on his ECG?

1. Right bundle branch block
2. Right ventricular hypertrophy
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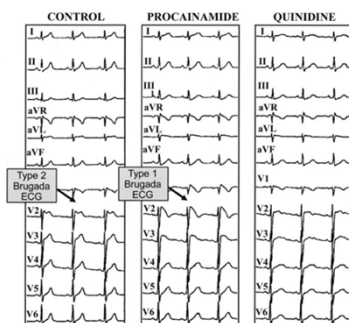3. Right ventricular strain
4. **Brugada pattern**

Brugada Syndrome

Associated with a high risk for sudden cardiac death
- Estimated to be responsible for at least 4% of all sudden deaths and at least 20% of sudden deaths in patients with structurally normal hearts

Causative mutations in the SCN genes SCN5A and SCN10A (encode α subunit of the cardiac sodium channel gene)

Cases of suspected Brugada syndrome should have evaluation for underlying heart disease by a cardiologist and imaging

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Antzelevitch C et al. Circulation 2005 Feb 8;111(5):659-70.

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2. Mobitz Type I 2nd Degree AV Block
3. Mobitz Type II 2nd Degree AV Block
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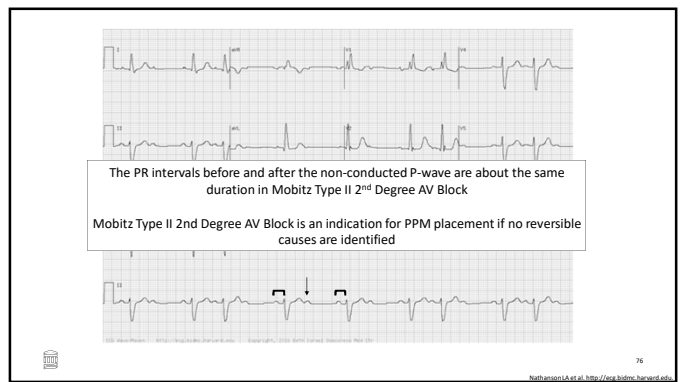3. **Mobitz Type II 2nd Degree AV Block**
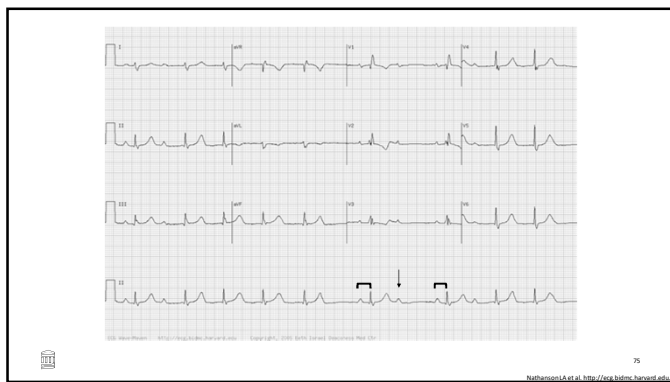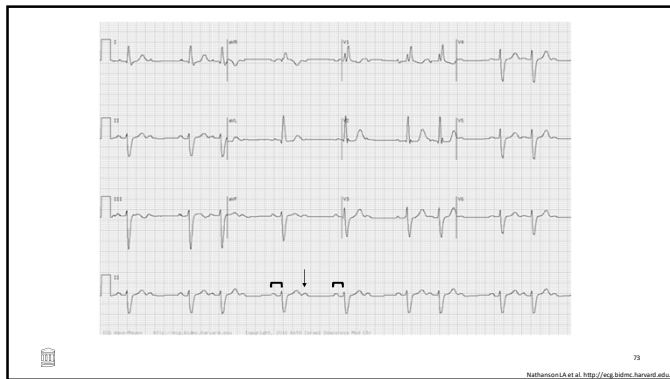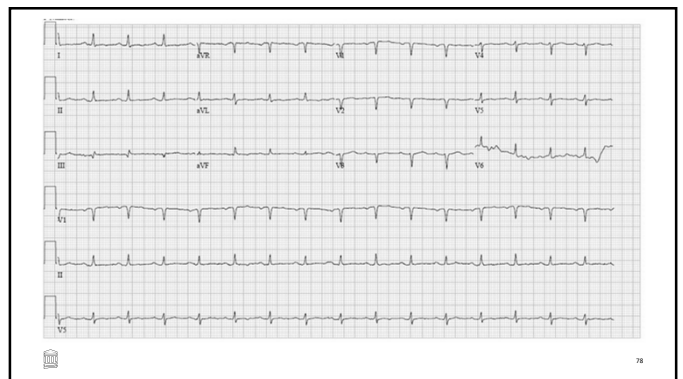4. 3rd Degree AV Block

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The PR intervals before and after the non-conducted P-wave are about the same duration in Mobitz Type II 2nd Degree AV Block

Mobitz Type II 2nd Degree AV Block is an indication for PPM placement if no reversible causes are identified

Case 11

A 33-year-old female with systemic lupus erythematosus presents to her rheumatologist's office with increased shortness of breath over the last two weeks. The examination is notable for tachycardia. An ECG is obtained. What is the likely etiology of the patient's shortness of breath based on the ECG?

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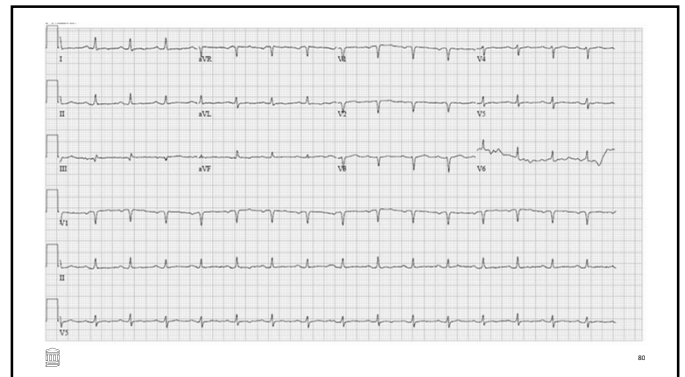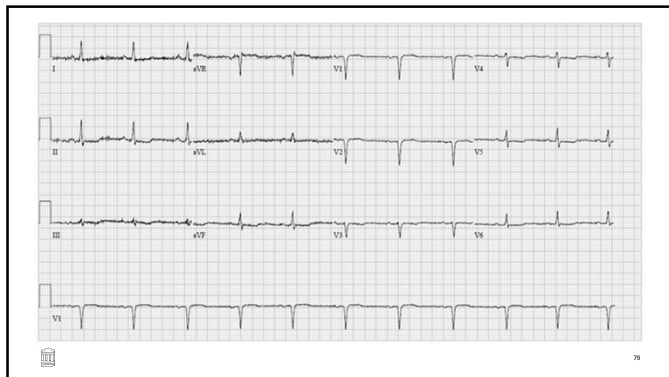4. Ischemic heart disease

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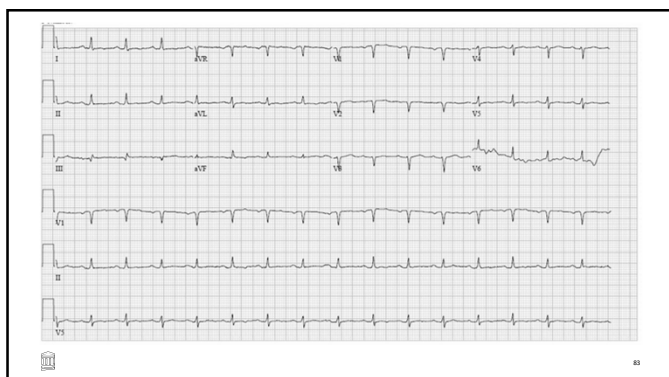4. Ischemic heart disease

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Low-Voltage

QRS amplitude <5 mm in limb leads and <10 mm in the precordial leads

Low-Voltage

QRS amplitude <5 mm in limb leads and <10 mm in the precordial leads
Causes:
- **Pericardial and pleural effusions**
- **Infiltrative cardiomyopathy**
- **Pulmonary disease**
- **Hypothyroidism**
- Constrictive pericardial disease
- Diffuse myocardial necrosis or fibrosis
- Normal variant

Madias JE et al. J Am Coll Cardiol. 2001;38(3):756.

Electrical Alternans

Alternating QRS amplitude from beat to beat on ECG

Rosenbaum DS et al. N Engl J Med. 1994 Jan 27;330(4):235-41.

Electrical Alternans

Alternating QRS amplitude from beat to beat on ECG
Causes:
- **Pericardial effusion**
- Supraventricular tachycardia
- Wolff-Parkinson-White (WPW)
- Ventricular tachycardia
- Myocardial disease
- Pneumothorax
- Emphysema

Rosenbaum DS et al. N Engl J Med. 1994 Jan 27;330(4):235-41.

Case 12

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Table 1
The current methods of QT correction and their mathematical formulas.

QT Correction (QTc)	Formula
1. Bazett	$QTcB = QT/RR^{1/2}$
2. Fridericia	$QTcFri = QT/RR^{1/3}$
3. Framingham	$QTcFra = QT + 0.154\,(1\text{-}RR)$
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Pourmand A et al. Am J Emerg Med. 2017 Dec;35(12):1928-1933.

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560 ms

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RR interval = 60/HR
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QTc = QT/(sqrt(RR))

QTc = 536 ms

560 ms

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HR = 55 bpm

RR interval = 1.09 sec

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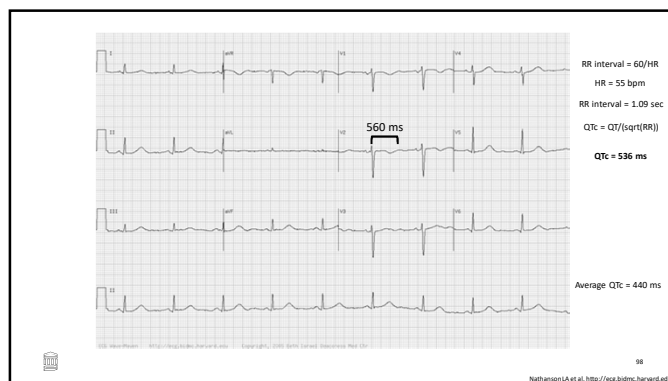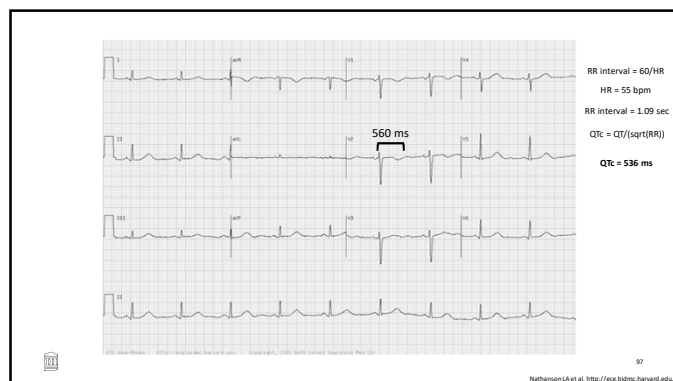
QTc = 536 ms

560 ms

Average QTc = 440 ms

Table 3
Medications that prolong the QTc interval.

Medication category	Medications prolonging QTc	Implicated mechanism of QTc prolongation
Antipsychotics	Thioridazine, Pimozide, IV Haloperidol	Direct IKr channel antagonism [13]
Antiarrhythmics	Class IA (Quinidine)	Na + channel blockers: reentry arrhythmia [18]
	Class III (Sotalol, Amiodarone)	K+ channel blockers: delayed repolarization [18]
Antibiotics	Macrolides (Erythromycin and Clarithromycin), Trimethoprim, Pentamidine, Azoles, Fluoroquinolones	Indirect IKr channel blockage and dispersion of repolarization [19,20]
Antiemetics	Ondansetron (Zofran), Granisetron	Potent IKr channel blockage [21]

IKr (rapidly-activating potassium currents); IV (intravenous); Na + (sodium); K+ (potassium).

AHA/ACCF Scientific Statement

Prevention of Torsade de Pointes in Hospital Settings
A Scientific Statement From the American Heart Association and the
American College of Cardiology Foundation
Endorsed by the American Association of Critical-Care Nurses, the International Society for Computerized Electrocardiology, and the Heart Rhythm Society

After initiation of a drug associated with TdP, ECG signs indicative of risk for arrhythmia include an **increase in QTc from pre-drug baseline of 60 ms** and marked **QTc interval prolongation >500 ms**

Thank You

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Nathanson LA, McClennen S, Safran C, Goldberger AL. ECG Wave-Maven: Self-Assessment Program for Students and Clinicians. http://ecg.bidmc.harvard.edu.