

**EKG Abnormalities in PALTC in the COVID Era**

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**Disclosures**

Dr Hidlebaugh and Dr Reyes have no relevant disclosures for this presentation



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**Objectives**

1. Describe the normal physiology of cardiac electrophysiology
2. Interpret and analyze normal variants of ECG strips and determine rate, regularity and rhythm
3. Recognize common ECG abnormalities associated with COVID-19, in clinical scenarios among PALTC patients
4. Identify basic dysrhythmias and their association with common clinical conditions, including COVID-19, presenting in PALTC patients



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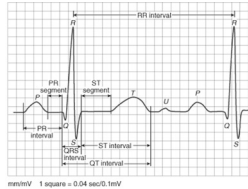
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### Why order EKG in long term/post-acute care

- New patient evaluation
- History of heart disease, arrhythmias
- Symptoms (chest pain, SOB, palpitations, syncope, etc)
- Elevated/depressed heart rate, blood pressure, oxygen saturation on exam
- Monitoring of QT while on certain medications (fluoroquinolones, SSRIs, antipsychotics, etc)
- Post-hospital follow up on abnormal findings
- Always compare to old EKG



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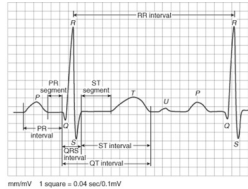
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### EKG Basic Physiology

- Time vs voltage
- 30 large boxes = 6 seconds
- 1 large box = 0.2 seconds, 5 mm
- 1 small box = 0.04 seconds, 1 mm
- 1 mV signal = 10 mm deflection (2 large boxes)
- P wave
- PR interval <0.2 secs
- QRS interval <0.12 secs
- ST segment
- QT interval <450 secs M, <460 F
- T wave
- U wave



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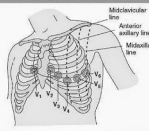
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### EKG Basic Physiology Cont.

- Leads
  - Lateral leads: I, aVL, V5, V6
  - Inferior leads: II, III, aVF
  - Septal leads: V1, V2
  - Anterior leads: V3, V4
    - V4 can be moved to R chest for suspected R sided MI
- Make sure precordial (chest) leads V1-V6 placed properly- poor R wave progression (infarct)



Elements of Chest Leads		
Lead	Positive Electrode Placement	View of Heart
V1	4th intercostal space to right of sternum	Septum
V2	4th intercostal space to left of sternum	Septum
V3	Directly between V2 and V4	Anterior
V4	5th intercostal space at left midclavicular line	Anterior
V5	Level with V4 at left anterior axillary line	Lateral
V6	Level with V4 at left midclavicular line	Lateral

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### EKG Basic Physiology Continued

- Rate (normal 60-100 bpm)
- Rhythm (sinus vs arrhythmia)
- Axis (right vs left)
- Intervals (PR, QRS- bundles, QT)
- ST/T/q wave changes
- Other (LVH, RVH, low voltage, LAE, RAE)

Rowdy Resident Always Interrupts Sign Out (or Signing Orders)



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### EKG Basic Physiology Continued

- Artifact
  - Loose electrodes
  - Broken EKG cables or wires
  - Tremors
    - Clip EKG cable to clothing
  - Patient movement
  - Chest compressions (CPR)
  - 60 cycle interference (improperly grounded electrical equipment or electrical interference)
    - Check for crossing of cable wires with other electrical wires (bed control etc)
- The baseline is key



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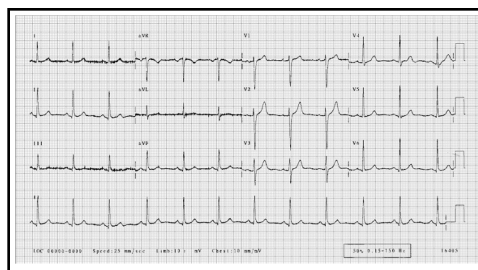
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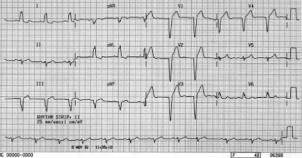
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### CASE A

68 y/o male with hx of hypertension, DM, hyperlipidemia and prior strokes who is a long-term care resident of your facility.

He was hospitalized six months ago after COVID infection. He recovered well and is currently at his baseline.

Today, you are completing his Medicare Annual Wellness visit you completed an EKG. Prior EKG's have been within normal limits.



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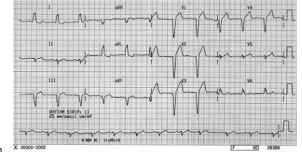
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### LBBB

1. QRS duration greater than 120 milliseconds
2. Absence of Q wave in leads I, V5 and V6
3. Monomorphic R wave in I, V5 and V6
4. ST and T wave displacement opposite to the major deflection of the QRS complex
5. QRS complexes in leads facing the left ventricle (I, aVL and V6) show an M shaped pattern



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### LBBB & COVID

- Ischemic disease
- Hypertensive heart disease
- Idiopathic conducting system disease. Cardiomyopathy (restrictive, dilated and hypertrophic)

The American Journal of Cardiology

Left Bundle Branch Block and Mortality in COVID-19 Patients

Marco Zain, MD, Gianluca Rigatelli, MD, PhD, [...], and Giovanni Zullani, MD, PhD

Am J Cardiol. 2021 Aug 15;153:149-150

Higher mortality risk in COVID-19 patients with LBBB

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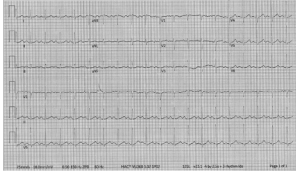
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**CASE B**

Nurse calls you because a 90 F patient is experiencing acute onset SOB. She was recently admitted to your facility for short stay rehab after hospitalization and surgical repair of a R hip fracture. She had no complications.

PMHx includes well controlled T2DM, well controlled HFpEF, peripheral neuropathy, mild cognitive impairment.

Vitals: O2 sat 90% on RA, BP 100/50, Temp 98.6 F



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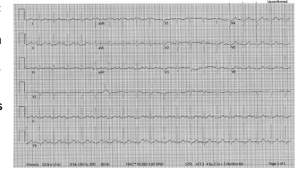
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**Sinus Tachycardia & Pulmonary Embolism**

- 1) Large box method for rate: ~110
- 2) P before every QRS (which appears narrow)
- 3) P-P and R-R appear similar
- 4) Normal axis, intervals
- 5) No ST, T changes, q waves
- 6) May have some LAE
- 7) No other significant changes



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**Pulmonary Embolism**

- Most commonly occur 2-10 days after surgery, but up to 3 months
- Sinus tachycardia is most common
- ~70% of time see nonspecific ST and T wave changes
- Classic finding but uncommon: S1Q3T3, also RV strain, new incomplete RBBB
- Poor prognostic findings: atrial arrhythmias, bradycardia or tachycardia, new RBBB, inferior q waves, anterior ST-segment changes and T wave inversion, S1Q3T3



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### CASE C


92 y/o male community dwelling with hx of dementia with psychotic features living with this family.

He has had several unsuccessful Seroquel GDR's in the past

He was sent to the hospital for COVID infection with superimposed bacteria PNA.

He is admitted as a Post-Acute patient.


EKG at admission to the hospital as follows (last one the day of hospitalization WNL)



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### QTc Prolongation


1. QTc were: Age < 40 years, men 430 ms, women 440 ms;
2. Age 40 to 69, men 440 ms, women 450 ms;
3. Age ≥ 70 years, men 455 ms, and women 460 ms.




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### QTc Prolongation and COVID

- Associated with the use of multiple medications:
  - macrolide and fluoroquinolone antibiotics antifungal medications
  - antihistamines
  - antipsychotic and antidepressant medications
  - methadone
  - class Ia and class III antiarrhythmics
- Prolonged QTc (>450 ms) considered a High-Risk in Syncope
- Greatest risk of sudden cardiac death with with a QTc interval >500 ms

**Open**  
OSF  
Open Science Framework

Cardiac Conduction System Changes Among Patients Treated for COVID-19 Infection During the Early Phase of the Pandemic  
Wang, Henry, et al. 2020. DOI: 10.1101/2020.05.14.20100000

**COVID-19 infection is independently associated with significant mean QTc prolongation**

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### CASE D

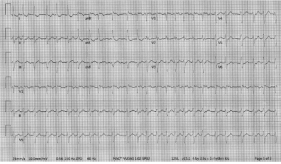
The daughter of a LTC resident of yours (80 yo M) stops you during rounds to let you know that his i-watch was beeping, alerting for an arrhythmia.

He has a PMHx of HFrEF, Hyperthyroidism and Dementia.

You review his chart and note that his Metoprolol was held this morning due to low BP. He has also been refusing his Methimazole most mornings.

Vitals: BP 90/60, O2 sat 93% RA, Temp 98 F

You obtain a 12 lead EKG



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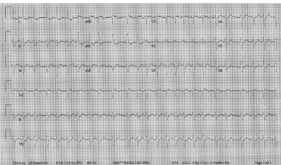
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### Atrial Fibrillation and RVR

- 1) Rate- 30 large boxes = 6 seconds, count R in that time = ~150 bpm
- 2) Rhythm- R to R irregular, no consistent P before every QRS
- 3) Axis- LAD
- 4) Intervals- can't determine PR in irregular rhythm, QRS incomplete RBBB, QTc long 498
- 5) Slight ST depressions laterally
- 6) LVH by aVL
- 7) Poor R wave progression



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### I-Watches & Cardiac Monitoring

- Apple Watches EKG feature is FDA approved to detect Atrial fibrillation only
  - One lead, similar to lead I
- AliveCor's KardiaBand device (watch band and app) and app that works with Apple Watch
- AliveCor personal ECG monitor (KardiaMobile) can be used with phone
  - Original (1 lead, FDA approved for Afib "and more")
  - Card device (FDA approved for Afib, can detect other arrhythmias but not FDA approved)
  - 6L (leads I, II, III, aVL, aVR, and aVF, FDA approved, can detect other arrhythmias)
  - Membership program (EKGs reviewed remotely by board certified cardiologist licensed in patient's state, 4 per year)
- Apple Watches EKG feature can also detect bradycardia
- WatchOS 9 has medication tracking features (set schedules, reminders), sleep monitoring
  - AFib History feature, estimates how often in atrial fibrillation, can be shared as PDF (FDA cleared)
  - Sleep monitoring includes HR and RR data, time spent in REM, core, or deep sleep stages



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### CASE E

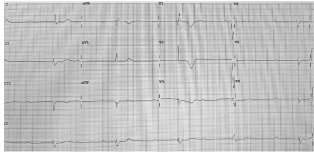
53-year-old man meeting at your ALP with history of DM and HTN, is being evaluated at the facility's office for progressive dyspnea, weakness, and fatigue for 4 days.

Vital signs were remarkable for blood pressure of 120/80 mm Hg, heart rate of 44 bpm, and oxygen saturation at 78% on room air, which improved to 92% with NC.

He does not want to be transferred to a hospital.

Chest radiography (CXR) demonstrated multifocal pneumonia and an enlarged cardiac silhouette.

Initial EKG is as follows



AppleCare  
Your Health

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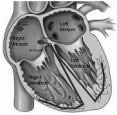
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### AV- Block



ECG Description	ECG Description
1. Normal sinus rhythm	2. First-degree AV block
3. Second-degree AV block (Type I)	4. Second-degree AV block (Type II)
5. Third-degree AV block	6. Bundle branch block

AppleCare  
Your Health

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### A-V Block and COVID

#### Two Theories

Myocarditis due to COVID-19 has been reported

Elevation in cardiac and inflammatory markers may reflect a direct effect of the virus on the cardiac conduction system

Hypoxia may lead to conduction defects, potentially mediated via endogenous adenosine

Treatment of the patient's hypoxia did not resolve the atrioventricular block as would have been expected if poor oxygenation were the driving cause

AppleCare  
Your Health

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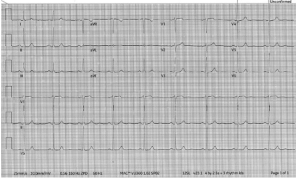


### CASE F

Your facility physical therapist approaches you on rounds that your 78 yo F patient who has been undergoing rehab after hospitalization for COVID has been experiencing new onset SOB. Prior to this she has been making good progress with PT without SOB. PMHx of HTN, CVA.

SLUMS last week showed score of 16/30 and per family's request you started patient on Donepezil.

Vitals: O2 sat 97% RA, Temp 98.1 F, BP 128/70



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### Sinus Bradycardia

- 1) Rate- R to R ~50, counting R in 6 secs ~60, computer read 55
- 2) Rhythm- P before every QRS, P-P and R-R similar
- 3) Normal axis
- 4) Normal intervals
- 5) No ST-T wave changes, good R wave progression
- 6) No other abnormalities



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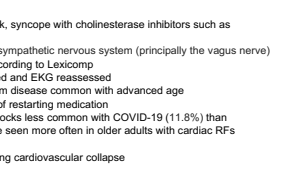
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### Sinus Bradycardia & Donepezil/COVID

- Risk of bradycardia, AV block, syncope with cholinesterase inhibitors such as Donepezil
  - Cis-potentiate the parasympathetic nervous system (principally the vagus nerve)
  - Risk of syncope 2% according to Lexicomp
- Medication should be stopped and EKG reassessed
- Underlying conduction system disease common with advanced age
- Consider risks and benefits of restarting medication
- Sinus bradycardia and AV blocks less common with COVID-19 (11.8%) than tachyarrhythmias but may be seen more often in older adults with cardiac RFs
  - May be sign of impending cardiovascular collapse



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**CASE G**

85 y/o female with hx of CAD, anemia, and HTN s/p COVID infection. She was transferred to your SNF after her hypoxemia resolved.

One week after her arrival, you receive a call at 1 am because the patient is complaining of respiratory distress, tachycardia, and pleuritic chest pain.

EKG is as follows



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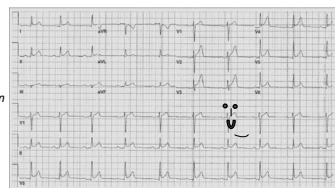
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**Pericarditis**

1. diffuse ST-T wave elevation
2. "Smiley face"



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**Pericarditis and COVID**

**Pericarditis in patients with COVID-19: a systematic review**

Diego-Alexander Cardenas, Saucedo-Chinchipe, Jose; Imazio, Massimo  
Journal of Cardiovascular Medicine 22 p 693-700, September 2021

- COVID-19 patients with pericarditis had similar clinical features to other viral cardiotropic infections
- Most frequent electrocardiographic pattern (56%) is diffuse ST-elevation and PR depression
- Pericardial effusion and cardiac tamponade in 35% of cases, respectively
- Short term prognosis was good

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### Questions?



APOLLO

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### Clinical Pearls

- EKGs are important part of management of PALTC patients and can provide valuable information
- Always compare to old EKGs, check leads, adjust for artifact, use systematic approach
- Arrhythmias are common in older adults due to underlying cardiac disease and aging conduction system
- COVID-19 infection can lead to arrhythmias, pericarditis, AV block, QT prolongation, can increase their related mortality
- I-Watches and Kardiaband devices can provide helpful information such as Afib and heart rate but should always be validated with 12-lead EKG

APOLLO

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### References

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APOLLO

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