QUESTIONS

Determine the rate, rhythm, axis, PR interval, QRS duration, QT duration, ST- T-wave changes and diagnosis for each electrocardiogram (ECG) from the following four patients.

1. This ECG is from a 59-year-old man who has had chest pain and weakness for the previous 3 hours.
2. This ECG is from a 63-year-old woman who has a long-term history of pulmonary hypertension secondary to sarcoidosis.

3. This ECG is from a 71-year-old woman with known mitral valve prolapse and mitral regurgitation who presents with increasing dyspnea and fatigue on exertion.
4. This ECG is from an 80-year-old man with a history of ischemic heart disease and recurrent syncopal episodes. His current medications include a tricyclic antidepressant and amiodarone.

ANSWERS AND DISCUSSION

1. A 59-year-old man with chest pain and weakness.
   Rate: 41 bpm
   Rhythm: normal sinus rhythm
   Axis: 40 degrees
   PR interval: variable
   QRS duration: 86 ms
   QT duration: 460 ms
   ST-/T-wave changes: ST elevation in leads II, III, and aVF, with reciprocal ST depression in aVL
   Diagnosis: normal sinus rhythm with second-degree atrioventricular (AV) block (Mobitz type I or Wenckebach) and with an acute, inferior-wall injury
   Discussion: This ECG initially suggests a Mobitz type II, second-degree AV block; however, when an isolated 2:1 block is observed, one should not assume that the block is Mobitz type II. It is necessary to look at a long rhythm strip—especially the part before the block—to find the complexes where the typical PR prolongation is followed by a dropped QRS complex. The fourth QRS complex in the rhythm strip at the bottom shows the PR interval is 280 ms, the next complex is 360 ms, and the sixth complex is 240 ms. This variable PR interval is characteristic of the phenomenon described by Wenckebach, in which the AV conduction gradually prolongs until the atrial impulse is eventually blocked in the AV node. Before the invention of electrocardiography, Wenckebach described this phenomenon by timing the venous pulsations in the jugular vein compared with the carotid impulse and heart tones. By definition, the PR interval before the dropped QRS is the longest; the interval immediately after the dropped beat is the shortest. Transient AV blocks are common in patients with an inferior myocardial infarction.

2. A 63-year-old woman with history of pulmonary hypertension secondary to sarcoidosis.
   Rate: 109 bpm
   Rhythm: atrial flutter with 2:1 conduction
   Axis: 110 degrees
   PR interval: indeterminate
   QRS duration: 84 ms
   QT duration: 360 ms
   ST-/T-wave changes: ST-segment depression and T-wave inversion in V1 to V3
Diagnosis: atrial flutter with 2:1 conduction or right ventricular hypertrophy (RVH)

Discussion: The findings of a tall R wave in lead V1 with an R to S ratio of 1 or more, suggest the presence of RVH. There is counterclockwise rotation of the precordial leads (ie, early R-wave progression). Changes in the right-sided precordial leads suggest diastolic overload of the right ventricle with ST-segment depression and T-wave inversion, termed RVH with strain pattern. With RVH, the most common QRS axis is normal, but right axis deviation can occur.

3. A 71-year-old woman with mitral valve prolapse and mitral regurgitation.
   Rate: 64 bpm
   Rhythm: atrial flutter
   Axis: 20 degrees
   PR interval: indeterminate
   QRS duration: 84 ms
   QT duration: 380 ms
   ST/T-wave changes: nonspecific
   Diagnosis: atrial flutter with 4:1 conduction; nonspecific ST and T-wave abnormalities
   Discussion: This 71-year-old woman presents with increasing dyspnea on exertion and is diagnosed with congestive heart failure, which is commonly associated with many supraventricular and ventricular arrhythmias. The sawtooth configuration of the P waves—typically seen in the inferior limb leads of II, III, and aVF—indicates atrial flutter. The typical rate of atrial flutter waves is 250 to 350/min and averages 300/min. The conduction abnormality (a ratio of four atrial f waves to one ventricular R wave) suggests AV nodal or infranodal conduction disease. Any medication that blocks the AV node should be used cautiously in the treatment of this patient.

4. An 80-year-old man with history of ischemic heart disease whose current medications include tricyclic antidepressants and amiodarone.
   Rate: 80 bpm
   Rhythm: normal sinus rhythm with accelerated junctional
   Axis: 20 degrees
   PR interval: 238 ms
   QRS duration: 95 ms
   QT duration: 700 ms
   ST/T-wave changes: nonspecific
   Diagnosis: normal sinus rhythm with paroxysmal accelerated junctional tachycardia, first-degree AV block, prolonged QT duration, and nonspecific ST-segment abnormalities
   Discussion: Patients who present with QT-duration prolongation are classified as: 1) primary or idiopathic, or 2) secondary or acquired. The idiopathic long QT syndromes are further divided into: 1) Jervell and Lange-Nielsen syndrome (prolonged QT duration, congenital deafness, and syncopal episodes that are associated with sudden death and inherited as an autosomal recessive trait); 2) Romano-Ward syndrome (autosomal dominant inheritance and no associated deafness); or 3) sporadic, long QT syndrome.
   The secondary causes of a prolonged QT duration include coronary artery disease, mitral valve prolapse, cardiomyopathies, intracranial hemorrhage, autonomic nervous system dysfunctions, hypocalcemia, liquid protein diet, drugs (quinidine, procainamide, flecainide, amiodarone, phenothiazines, and tricyclic antidepressants), hypothyroidism, hypothermia, pheochromocytoma, and organophosphorus poisoning. Patients with these conditions are predisposed to arrhythmic death from a polymorphic ventricular tachycardia typically known as torsades de pointes.