The Only EKG Book You'll Ever Need

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Contents

The Basics

- QT interval

QT interval

- QTc is prolonged if > 440ms in men or > 460ms in women
- QTc > 500 is associated with increased risk of torsades de pointes
- QTc is abnormally short if < 350ms
- A useful rule of thumb is that a normal QT is less than half the preceding RR interval

Hypertrophy and Enlargement of the Heart

- Right atrial enlargement (RAE)
- Left atrial enlargement (LAE)
- Right ventricular hypertrophy (RVH)
- Left ventricular hypertrophy (LVH)

Right atrial enlargement (RAE)

- P waves with an amplitude exceeding 2.5 mm in the inferior leads
- No change in the duration of the P wave
- Possible right axis deviation of the P wave

Left atrial enlargement (LAE)

- The amplitude of the terminal (negative) component of the P wave may be increased and must descend at least 1 mm below the isoelectric line in lead V1
- The duration of the P wave is increased, and the terminal (negative) portion of the P wave must be at least 1 small block (0.04 second) in width
- No significant axis deviation is seen because the left atrium is normally electrically dominant

Right ventricular hypertrophy (RVH)

- Right axis deviation is present, with the QRS axis exceeding +100°
- The R wave is larger than the S wave in V1, whereas the S wave is larger than the R wave in V6

Left ventricular hypertrophy (LVH)

- The R wave in V5 or V6 plus the S wave in V1 or V2 exceeds 35 mm
- The R wave in aVL exceeds 13 mm
- Left axis deviation exceeding –15° is also present

Arrhythmias

- Atrial tachycardia (AT)
- Multifocal atrial tachycardia (MAT)
- Atrial flutter
- Atrial fibrillation (AF)
- AV nodal reentrant tachycardia (AVNRT)

Atrial tachycardia (AT)

- Regular
- Rate: 100-200 bpm
- Characteristic warm-up period in the automatic form
- Carotid massage: no effect, or only mild slowing

Multifocal atrial tachycardia (MAT)

- Irregular
- At least three different P wave morphologies
- Rate: 100-200 bpm; sometimes less than 100 bpm
- Carotid massage: no effect

Atrial flutter

- Regular, saw-toothed
- 2:1, 3:1, 4:1, etc., block
- Atrial rate: 250-350 bpm
- Ventricular rate: one-half, one-third, one-quarter, etc., of atrial rate
- Carotid massage: increases block

Atrial fibrillation (AF)

- Irregular
- Undulating baseline
- Atrial rate: 350-500 bpm
- Ventricular rate: variable
- Carotid massage: may slow ventricular rate

AV nodal reentrant tachycardia (AVNRT)

- Regular
- P waves are retrograde if visible
- Rate: 150-250 bpm
- Carotid massage: slows or terminates

Conduction Blocks

- First degree AV block
- Second degree AV block: Mobitz type I (Wenckebach)
- Second degree AV block: Mobitz type II
- Third degree AV block
- Right bundle branch block (RBBB)
- Left bundle branch block (LBBB)
- Left anterior hemiblock (LAH)
- Left posterior hemiblock (LPH)

First degree AV block

- The PR interval is greater than 0.2 seconds
- All beats are conducted through to the ventricles

Second degree AV block: Mobitz type I (Wenckebach)

- Second degree AV block: Mobitz type I (Wenckebach)

Second degree AV block: Mobitz type II

- All-or-nothing conduction, in which QRS complexes are dropped without prolongation of the PR interval

Third degree AV block

- No beats are conducted through to the ventricles
- There is complete heart block with AV dissociation, in which the atria and ventricles are driven by independent pacemakers

Right bundle branch block (RBBB)

- QRS complex widened to greater than 0.12 seconds
- RSR′ in V1 and V2 (rabbit ears) with ST segment depression and T wave inversion
- Reciprocal changes in V5, V6, I, and aVL

Left bundle branch block (LBBB)

- QRS complex widened to greater than 0.12 seconds
- Broad or notched R wave with prolonged upstroke in leads V5, V6, I, and aVL, with ST segment depression and T wave inversion
- Reciprocal changes in V1 and V2
- Left axis deviation may be present

Left anterior hemiblock (LAH)

- Normal QRS duration and no ST segment or T wave changes
- Left axis deviation between –30° and +90°
- No other cause of left axis deviation is present

Left posterior hemiblock (LPH)

- Normal QRS duration and no ST segment or T wave changes
- Right axis deviation
- No other cause of right axis deviation is present

Preexcitation Syndromes

- Wolff-Parkinson-White (WPW) syndrome
- Lown-Ganong-Levine (LGL) syndrome

Wolff-Parkinson-White (WPW) syndrome

- PR interval less than 0.12 seconds
- Wide QRS complexes
- **Delta wave** seen in some leads

Lown-Ganong-Levine (LGL) syndrome

- PR interval less than 0.12 seconds
- Normal QRS width
- No delta wave

Myocardial Ischemia and Infarction

- Pathological Q wave
- Non-Q wave myocardial infarction (NQMI)

Pathological Q wave

- The Q wave must be greater than 0.04 seconds in duration
- The depth of the Q wave must be at least one-third the height of the R wave in the same QRS complex

Non-Q wave myocardial infarction (NQMI)

- T wave inversion
- ST segment depression persisting for more than 48 hours in the appropriate setting

Finishing Touches

- Hyperkalemia
- Hypokalemia
- Hypercalcemia
- Hypocalcemia
- Hypothermia
- Digitalis
- Pericarditis
- Hypertrophic cardiomyopathy (HCM)
- Myocarditis
- Chronic obstructive pulmonary disease (COPD)
- Acute pulmonary embolism
- Central nervous system disease
- Brugada syndrome
- Athletic heart syndrome (AHS)

Hyperkalemia

- Evolution of peaked T waves, PR prolongation and P wave flattening, and QRS widening
- Ultimately, the QRS complexes and T waves merge to form a **sine wave**, and ventricular fibrillation may develop

Hypokalemia

- ST depression
- T wave flattening
- **U waves**

Hypercalcemia

- Shortened QT interval

Hypocalcemia

- Prolonged QT interval

Hypothermia

- **Osborn waves**
- Prolonged intervals
- Sinus bradycardia
- Slow atrial fibrillation; beware of muscle tremor artifact

Digitalis

- Therapeutic levels associated with ST segment and T wave changes in leads with tall R waves
- Toxic levels associated with tachyarrhythmias and conduction blocks
- PAT with block is most characteristic

Pericarditis

- Diffuse ST segment and T wave changes
- A large effusion can cause low voltage and electrical alternans

Hypertrophic cardiomyopathy (HCM)

- Ventricular hypertrophy
- Left axis deviation
- Septal Q waves

Myocarditis

- Conduction blocks

Chronic obstructive pulmonary disease (COPD)

- Low voltage
- Right axis deviation
- Poor R wave progression
- Chronic cor pulmonale can produce P pulmonale and right ventricular hypertrophy with repolarization abnormalities

Acute pulmonary embolism

- Right ventricular hypertrophy with strain
- right bundle branch block
- S1Q3
- Sinus tachycardia and atrial fibrillation are the most common arrhythmias

Central nervous system disease

- Diffuse T wave inversion, with T waves typically wide and deep
- U waves

Brugada syndrome

- A pattern resembling right bundle branch block
- ST segment elevation in leads V1, V2, and V3

Athletic heart syndrome (AHS)

- Sinus bradycardia
- Nonspecific ST segment and T wave changes
- Left and right ventricular hypertrophy
- Incomplete right bundle branch block
- First-degree or Wenckebach AV block
- Occasional supraventricular arrhythmia