

Mind your P's and Q's

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Ready for some ECG interpretation? Let's get started.

You're caring for Mrs. Rogers, 83, who was admitted through the ED with sudden-onset chest pain. The pain started 3 hours before she arrived in the ED, and she described it as a severe pressure sensation. An initial ECG revealed an acute anterior-wall myocardial infarction (MI). She was taken to the cardiac catheterization lab and underwent successful revascularization with angioplasty and stenting of a proximal left anterior descending lesion. Her early course was uncomplicated with no heart failure, chest pain, or arrhythmias. She was transferred to the telemetry step-down unit on day two.

The most common alarm she had was for a missed beat. Mrs. Rogers was without complaints and anxious to go home. Monitoring was continued, and no further events were recorded over the next 24 hours. Her two-dimensional echocardiogram showed that her ejection fraction was 40% with ante-

rior hypokinesia. She ambulated without difficulty with the appropriate heart rate and BP response and was discharged home on the third day. Discharge medications included a beta-blocker, aspirin, clopidogrel, an angiotensin-converting enzyme inhibitor, and a statin. While she was getting into her car after discharge, she became lethargic and collapsed. She was brought back to the ED, with telemetry revealing a change in her rhythm (see *Identifying sinus node arrhythmia*).

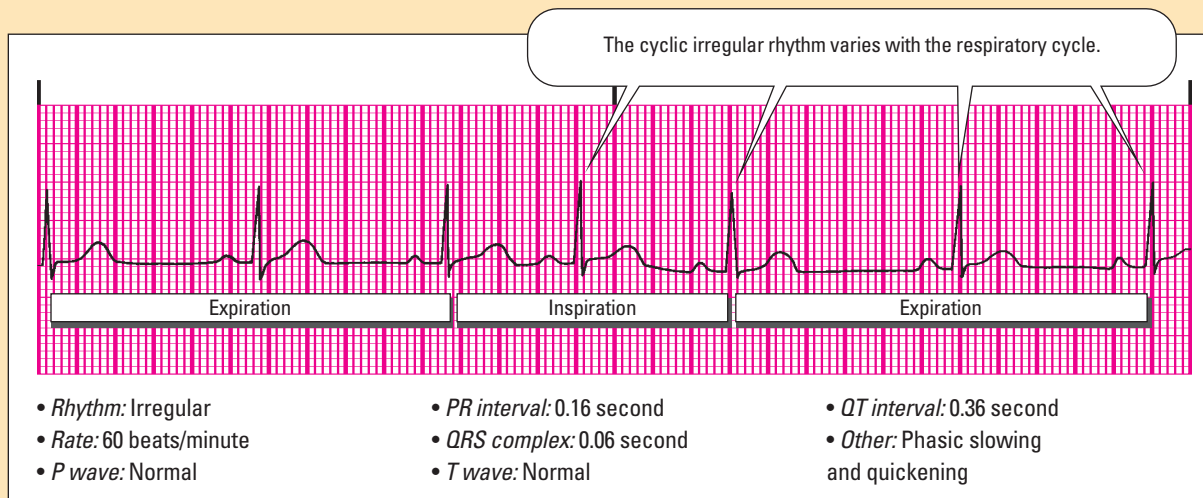
It's this scenario that reminds us to mind our P's and Q's when caring for the post-MI patient. In this article, we'll show you how.

Alarms: Red and yellow

The early treatment of acute MI has changed dramatically in the past 20 years. Early catheter-based revascularization has been shown to decrease mortality and is the recommended treatment of choice. However, most patients don't present early enough to



Identifying sinus node arrhythmia



Rhythm strip interpretation review

Normal P wave

- *Location*—before the QRS complex
- *Amplitude*—2 to 3 mm high
- *Duration*—0.06 to 0.12 second
- *Configuration*—usually rounded and upright
- *Deflection*—positive or upright in leads I, II, aV_F, and V₂ to V₆; usually positive but may vary in leads III and aV_L; negative or inverted in lead aV_R; biphasic or variable in lead V₁

Normal PR interval

- *Location*—from the beginning of the P wave to the beginning of the QRS complex
- *Duration*—0.12 to 0.20 second

Normal QRS complex

- *Location*—follows the PR interval
- *Amplitude*—5 to 30 mm high but differs for each lead used
- *Duration*—0.06 to 0.10 second, or half the PR interval
- *Configuration*—consists of the Q wave, the R wave, and the S wave
- *Deflection*—positive in leads I, II, III, aV_L, aV_F, and V₄ to V₆ and negative in leads aV_R and V₁ to V₃

Normal ST segment

- *Location*—from the S wave to the beginning of the T wave
- *Deflection*—usually isoelectric; may vary from –0.5 to +1 mm in some precordial leads

Normal T wave

- *Location*—after the S wave
- *Amplitude*—0.5 mm in leads I, II, and III and up to 10 mm in the precordial leads
- *Configuration*—typically round and smooth

- *Deflection*—usually upright in leads I, II, and V₃ to V₆; inverted in lead aV_R; variable in all other leads

Normal QT interval

- *Location*—from the beginning of the QRS complex to the end of the T wave
- *Duration*—varies; usually lasts from 0.36 to 0.44 second

Normal U wave

- *Location*—after T wave
- *Configuration*—typically upright and rounded
- *Deflection*—upright

Interpreting a rhythm strip: 8-step method

- Step 1: Determine the rhythm
- Step 2: Determine the rate
- Step 3: Evaluate the P wave
- Step 4: Measure the PR interval
- Step 5: Determine the QRS complex duration
- Step 6: Examine the T waves
- Step 7: Measure the QT interval duration
- Step 8: Check for ectopic beats and other abnormalities

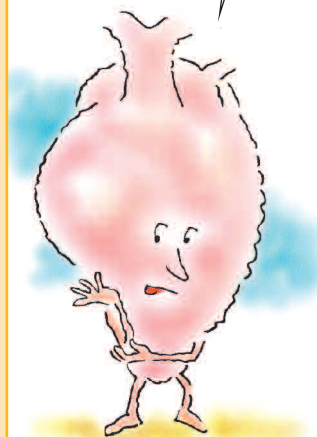
Characteristics

- Regular rhythm
- Normal rate
- P wave for every QRS complex; all P waves similar in size and shape
- All QRS complexes similar in size and shape
- Normal PR and QT intervals
- Normal T waves

Normal sinus rhythm

Normal sinus rhythm is the standard against which all other rhythms are compared.

And I thought
“Mind your P’s
and Q’s” was
just an old
saying!



prevent some degree of myocardial necrosis, resulting in myocardial injury. Bradyarrhythmias, especially atrioventricular (AV) block, are common and can be seen early in the post-MI period in 30% to 40% of cases. Mechanisms involved in AV block include enhanced vagal tone, which is usually transient and benign, and necrosis of the conduction system, which can be life threatening.

Earlier discharge places increased demand

on postprocedure and predischarge monitoring. Monitoring can take place in the ICU or telemetry unit, in which arrhythmia alarms are employed. The setup for alarms includes high (red) or moderate (yellow) risk. A red alarm indicates a high-priority status with a potentially life-threatening arrhythmia. Yellow alarms are a lower priority and occur regularly during monitoring. In addition to the visual color coding, alarms are usually associated with an audio signal to which a

healthcare team member responds, analyzes the rhythm, and has the option to delete or save the rhythm and decide whether the alarm requires further investigation. Among these are the pause and missed beat alarms.

The majority of yellow alarms aren't indicative of a life-threatening situation; however, attention to detail and minding your P's and Q's is important when responding to

these alarms. One approach is to identify the P waves and QRS complexes before, during, and after a pause alarm (see *Rhythm strip interpretation review*). Let's take a closer look.

The P's and Q's of heart block

Our patient, Mrs. Rogers, had a very transient but significant AV block that was recorded as a missed beat. The most com-

Recognizing type I and type II second-degree AV block

This rhythm strip illustrates type I second-degree atrioventricular (AV) block. Look for these distinguishing characteristics.

The PR interval gets progressively longer...

...until a QRS complex is dropped.

- **Rhythm:** Atrial—regular; ventricular—irregular
- **Rate:** Atrial—80 beats/minute; ventricular—50 beats/minute
- **P wave:** Normal
- **PR interval:** Progressively prolonged
- **QRS complex:** 0.08 second
- **T wave:** Inverted
- **QT interval:** 0.46 second
- **Other:** Wenckebach pattern of grouped beats; PR interval appearing progressively longer until QRS complex drops

This rhythm strip illustrates type II second-degree atrioventricular (AV) block. Look for these distinguishing characteristics.

The atrial rhythm is regular...

The PR interval is constant.

...but the ventricular rhythm is irregular.

A QRS complex should be here.

- **Rhythm:** Atrial—regular; ventricular—irregular
- **Rate:** Atrial—60 beats/minute; ventricular—50 beats/minute
- **P wave:** Normal
- **PR interval:** 0.28 second
- **QRS complex:** 0.10 second
- **T wave:** Normal
- **QT interval:** 0.60 second
- **Other:** PR and RR intervals constant before a dropped beat with no warning

mon etiology for a missed beat is a nonconducted premature atrial contraction, which is benign. However, Mrs. Rogers progressed to a high-grade AV block due to an anterior-wall MI. The missed beat on day two was a warning sign of things to come.

A pause without a visible P wave (no P or Q) has two main etiologies. The most common, as stated above, is a nonconducted premature atrial contraction, in which a P wave can't be seen on the limited telemetry views or is hidden in the preceding T wave. This will be recognized by carefully analyzing the shape of the T wave before and after the pause. A difference in configuration is due to a superimposed P wave from the premature atrial contraction. The other etiology is due to the sinus node: The sinus node may simply pause for a variable interval or fire on time but fail to exit the node. In order to result in atrial contraction, the electrical stimulus must leave the sinus node and enter the atrial tissue. If it fails to exit the node, there will be no atrial beat. Sinus exit block can be differentiated from sinus pause by carefully measuring the P-to-P interval on consecutively conducted beats and noting that the pause is exactly twice this interval.

First-degree AV block is a prolonged PR interval, greater than 2 seconds, with no missed ventricular complexes (a P for every Q). A pause with a visible P wave but an occasional missed QRS complex (P but no Q) is a problem at the level of the AV node and is called second-degree AV block. The telemetry alarm will commonly be for a pause or missed beat and not be flagged as a red alarm. There are two types of second-degree AV block: Mobitz type I and Mobitz type II (see *Recognizing type I and type II second-degree AV block*).

Mobitz type I is a common bradyarrhythmia and may be caused by increased vagal stimulation, as well as cardiac medications, MI, and coronary artery disease. The rhythm will have regular P-to-P intervals, with prolonging PR intervals leading up to a missed QRS complex. The PR interval following the missed beat will, again, be short. Alone, without symptoms, this rhythm doesn't warrant pacemaker insertion. Mobitz type I is very common at night when patients are

sleeping, and patients on rate-slowing drugs, such as beta-blockers and nondihydropyridine calcium channel blockers, are prone to it, especially during times of increased vagal or decreased sympathetic tone.

Second-degree AV block Mobitz type II, however, is often a warning sign of a higher-grade AV block, including complete heart block. This rhythm will have constant PR intervals on consecutively conducted beats with a sudden missed QRS complex. There's no prolongation of the preceding PR intervals, and the PR intervals before and after the missed beat are the same. It's a Class I indication for temporary pacing with transcutaneous patches and pacing in the early course of acute MI with continued monitoring and a Class I indication for permanent pacing if it persists or progresses to complete heart block. For this reason, Mobitz type II requires further evaluation, including notification of the healthcare provider, review of the patient's medications, and availability of transcutaneous pacing at the bedside.

Third-degree AV block is also called complete heart block. The P waves are regular, as are the QRS complexes; however, there's no association between the two. The sinus rhythm will be faster than the ventricular rate. This requires action similar to second-degree AV block Mobitz type II.

Be proactive

The above scenarios are just a few examples of the many types of dysrhythmias that may be associated with your patient who's experienced a cardiac event. For this reason, postprocedure and predischarge monitoring should be a proactive intervention whether or not the patient is symptomatic. Attention to detail is critical, so remember to mind those P's and Q's! ■

Learn more about it

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Monitoring is key for post-MI patients.

