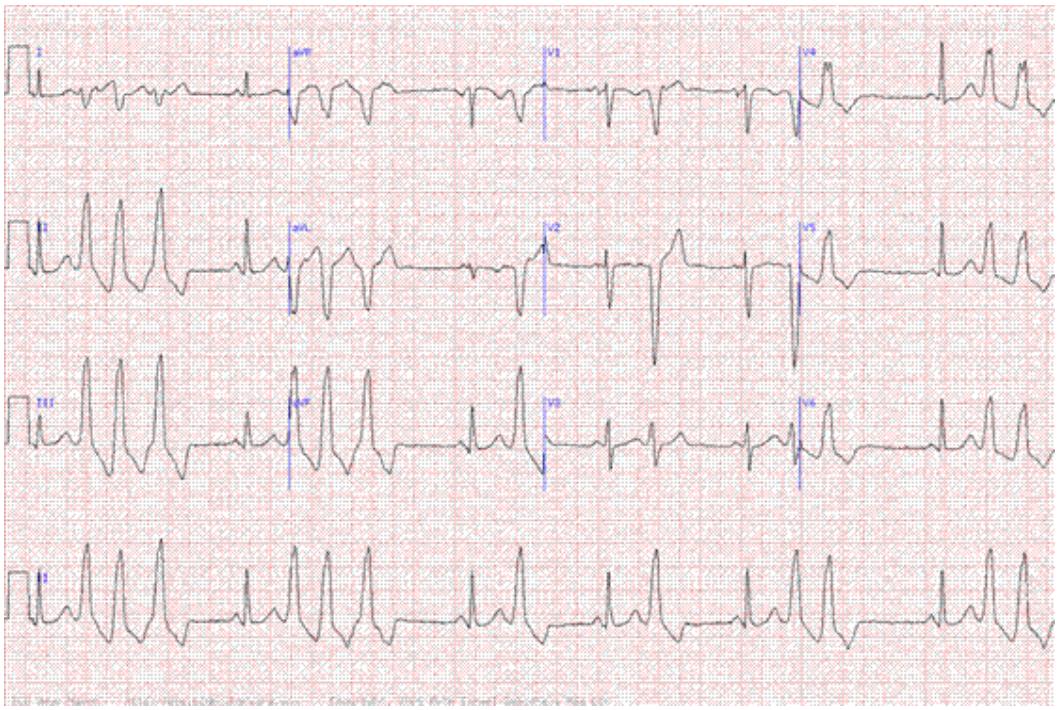
QUICK QUIZ
WHAT IS THE DIAGNOSIS?

BACKGROUND

An 80-year-old man has a preoperative ECG performed before elective surgery. The patient denied having any chest pain, palpitations, or a history of arrhythmias, but he did report experiencing some shortness of breath when he walked or performed chores around the house. The patient felt that the shortness of breath was due to his "lung problems" from his many years of smoking cigarettes. He also volunteered that he had experienced brief episodes of lightheadedness but again denied having any other associated symptoms, such as chest pain, nausea, presyncope, and loss of consciousness. There is no history of myocardial infarction or established history of coronary artery disease. As a result of the reported symptoms and ECG findings, the patient was admitted to the hospital for further evaluation.

Upon admission, the patient was found to be afebrile with a blood pressure of 125/67 mm Hg, a heart rate of 84 bpm, a respiratory rate of 20 breaths per minute, and an oxygen saturation of 91% breathing room air. He had a regular heart rhythm with frequent skipped beats and a slightly accentuated second heart sound. No murmurs, rubs, or gallops were appreciated. He had no JV distention and no carotid bruits. Auscultation of his chest revealed distant breaths sounds without wheezes, crackles, or rhonchi. No peripheral oedema was present. The remainder of the examination was unremarkable.



QUESTION

1. **What is the diagnosis?**

ANSWER & DISCUSSION

1. Diagnosis

Nonsustained ventricular tachycardia (NSVT)

Wide-complex tachycardias (WCTs) are, by definition, cardiac dysrhythmias with a ventricular rate greater than 100 bpm and a QRS duration of 120 milliseconds (0.12 seconds) or longer. A WCT can originate from either a ventricular or supraventricular focus with a conduction abnormality. WCTs arising in the ventricle almost invariably widen the QRS complex.

Ventricular tachycardia (VT) is the most common cause of WCT in patients, accounting for as many as 80% of cases. The frequency is higher in patients with structural or ischemic heart disease. However, in a minority of cases, the widening of the QRS complex can occur in association with a supraventricular tachycardia (SVT) with abnormal conduction. Finally, one should also keep in mind that an electronic pacemaker or an implantable cardioverter-defibrillator (ICD) with pacemaker capability typically widens the QRS complex and can be present as a WCT in certain settings.

Accurate diagnosis of the focus of a WCT is critical in determining treatment and management, both emergently, if the patient is hemodynamically unstable, and for long-term management. A specific note of interest is with medications routinely used to treat SVT. When these drugs are given to patients with a WCT with a ventricular focus (ie, VT), they can cause severe hemodynamic deterioration by potentially inducing the relatively stable rhythm of VT to degenerate into ventricular fibrillation with subsequent cardiac arrest. Misdiagnosis of VT as SVT with abnormal conduction in patients presenting with a WCT is not uncommon, especially if the abnormal rhythm is hemodynamically tolerated. (VT typically results in hemodynamic compromise, but not necessarily, and thus the patient's blood pressure and mental status must not be used to distinguish VT from SVT.)

It should be kept in mind that no single criterion or combination of criteria provides complete diagnostic accuracy in evaluating WCT and differentiating it as VT versus SVT with abnormal conduction. However, some characteristics and clues can be of use. The first is a systematic algorithm consisting of 4 differentiating characteristics proposed by Brugada (1991):

1. If an RS complex cannot be identified in any precordial lead, VT can be diagnosed with 100% specificity.
2. If an RS complex is clearly distinguished in one or more precordial leads, the interval between the onset of the R wave and the deepest part of the S wave (RS interval) is measured. If RS complexes are present in several precordial leads, the longest RS interval is used. If the RS interval is >100 milliseconds, VT can be diagnosed with 98% specificity.
3. If the RS interval is <100 milliseconds, the presence or absence of atrioventricular (AV) dissociation must then be determined. Evidence of AV dissociation is 100% specific for VT because AV dissociation does not occur in SVT. AV dissociation is characterized by atrial activity (the P wave) that is completely independent of ventricular activity. Although the presence of AV dissociation establishes VT as the aetiology, its absence is not as helpful. VT with retrograde conduction of ventricular impulses through the AV node produces an atrial rhythm. This phenomenon, called retrograde ventriculoatrial conduction, is easily misinterpreted as AV conduction due to the presence of P waves.

4. If the RS interval is <100 milliseconds and if AV dissociation cannot clearly be demonstrated, QRS morphology may be evaluated. Morphologic criteria suggestive of VT are extensive and complex and should be evaluated in conjunction with a cardiologist, if necessary.

As alternatives to formal application of the Brugada criteria, which may not practically be applicable in some instances, certain other characteristics of the ECG can be helpful in quickly establishing the diagnosis of VT:

- Slight irregularity of R-R intervals suggests VT. Marked irregularity of R-R intervals occurs in polymorphic VT but otherwise indicates atrial fibrillation with aberrant conduction. Most SVTs are characterized by regularity of the R-R intervals.
- The width of the QRS complex can also be useful in distinguishing SVT from VT. In general, a wide QRS complex >140 milliseconds suggests VT. However, QRS duration <140 milliseconds is not helpful for excluding VT because VT is sometimes associated with a relatively narrow QRS complex.
- Concordance is present when the QRS complexes in the 6 precordial leads (V1-V6) are all positive in polarity (tall R waves) or all negative in polarity (deep QS complexes). Although the presence of concordance (QRS complexes in the precordial leads all of the same polarity) strongly suggests VT (specificity >90%), the absence of concordance (not all of the QRS complexes with the same polarity) is not diagnostically helpful (sensitivity approximately 20%). Negative concordance (deep QS complexes) is strongly suggestive of VT; positive concordance (tall R waves) is less so.
- Fusion occurs when a supraventricular impulse reaches the AV node simultaneously with a ventricular impulse. The resulting QRS complex has hybrid morphology between a narrow atrial complex and a wide ventricular complex. Intermittent fusion beats during a WCT indicate AV dissociation and therefore VT.
- A capture beat occurs when a supraventricular rhythm briefly conducts in a normal fashion with a resultant normal QRS complex. The term capture beat implies that the normal conduction system has momentarily replaced the control of a ventricular focus; hence, VT is present.

In general, if the clinician is unsure, a WCT should be presumed to be VT until the presence of SVT can be definitively discerned. A patient with WCT in unstable condition should receive immediate electrical cardioversion. In patients with stable VT or with WCT of unclear origin, pharmacologic agents, including amiodarone, may be used in accordance with established ACLS guidelines (not reviewed in this discussion). If a determination is made that a WCT is SVT with abnormal conduction, treatment with adenosine should be administered.

Image courtesy of ECG Wave-Maven: Self-Assessment Program for Students and Clinicians (http://ecg.bidmc.harvard.edu).