ELECTROCARDIOGRAPHIC ARTIFACTS

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A 34-year-old nurse complained of recurrent attacks of palpitations in the past 2 months. The palpitations were not related to any specific event or physiological changes. Twenty-four-hour ambulatory electrocardiographic monitoring of her cardiac rhythm using a Holter recorder did not reveal any arrhythmias, even though she reported several attacks of palpitations during the recording. The electrocardiogram (ECG) in Figure 1 was recorded following an emotionally stressful period and when she complained of having palpitations. The patient was alert at the time, and her blood pressure was normal.

QUESTIONS

1. The interpretation of the ECG is which of the following?
   a. supraventricular tachycardia
   b. ventricular tachycardia
   c. atrial flutter with 1:1 atrioventricular conduction
   d. ventricular flutter
   e. none of the above

2. Artifact may be caused by which of the following?
   a. muscle tremors
   b. Parkinson’s disease
   c. poor skin-electrode contact
   d. electrical interference
   e. errors in electrode position
   f. any of the above

3. Electrocardiographic artifacts that mimic ventricular arrhythmias may result in which of the following?
   a. intravenous antiarrhythmic therapy
   b. the implantation of cardiac devices
   c. blood transfusions
   d. cardiac catheterizations
   e. any of the above

ANSWERS

1. e. none of the above

The ECG represents a pseudo-arrhythmia due to artifacts. Two clues direct you to the correct interpretation. The first clue reveals sinus rhythm in lead II. The normal appearance of the complexes in lead II is a result of the cancellation of artifacts and not because of a transient return to normal rhythm. The second clue is that most of the leads show sharp deflections that are regular and at the same intervals as those of the R-R cycles in lead II. An example can be seen in Figure 2, where an enlargement of leads II and V3 (taken from Figure 1) reveals “X” marks above the “tips” of the QRS complexes.

The native rhythm has been altered by artifacts, which are revealed as small pointed deflections on the “tips” of the QRS complexes. An artifact may be classified as a pseudo-arrhythmia or a nonarrhythmia. In this case, the artifact has the appearance of an arrhythmia. However, artifacts may not resemble an arrhythmia, but nevertheless can alter the configuration of the native underlying rhythm. This altered configuration would occur with misplaced electrodes and is considered to be a nonarrhythmic artifact. Artifacts can be found in any setting where electrocardiographic monitoring information is stored, which includes Holter monitoring, continuous bedside ECG monitoring, or use of event recorders.

2. f. any of the above

Muscle tremors may appear as rapid variations in the baseline that may be either coarse or fine and mimic atrial flutter or a runaway pacemaker.1 Tremors that reflect fine artifacts can be seen with Parkinson’s disease. Artifacts should be considered initially when
sudden changes occur during an ECG recording in a patient with Parkinson’s disease or muscle tremors. The artifacts related to Parkinson’s disease are more prominent in the limb leads and represent the action potentials of active striated muscles. This active movement also occurs in disoriented patients who cannot relax. The effects of upper extremity tremor may be minimized by having patients sit on their hands during the ECG recording.

Poor skin-electrode contact is corrected by pressing on the electrode to ensure better contact. If poor skin-electrode contact persists, the electrodes should be changed. Current best-practice standards call for cleaning the skin with alcohol to remove skin oils before electrode placement and/or shaving the area if necessary. Electrical interference may produce a rhythm that has regular sawtooth peaks and is referred to as 60-cycle alternating current (AC) interference. This artifact, which was common in the past, occurs less often with newer equipment. ECG cable wires should not cross other electrical wires such as transducer cables or the line of the call light. Other electrical sources such as electric beds, lighting fixtures, ventilators, or electrical wiring may generate artifacts (even when not in use). Unplugging the surrounding electrical equipment may be necessary to eliminate 60-cycle AC artifacts. Finally, moving the patient to a different location may alleviate the problem. Proper grounding initially can prevent many of the electrical artifacts.

Errors in electrode placement can alter the interpretation; as a result, appropriate therapy may be jeopardized. If the precordial lead $V_1$ is misplaced by 1 intercostal space, the morphology of the QRS complex may be altered and ventricular tachycardia could be misinterpreted as supraventricular tachycardia. Practitioners should be familiar with the routine placements of electrode leads on the chest. Begin at the top of the manubrium at the jugular notch and palpate inferiorly until the angle of Louis is felt. The angle of Louis (sternal angle) represents the prominent border between the sternum and manubrium. Directly to the right of the angle of Louis is the second rib. The space below the second rib is the second intercostal space. By palpat ing inferiorly, one can locate the fourth intercostal space for placement of lead $V_4$ to the right and $V_3$ to the left of the sternum. The other chest leads are then easily located; lead $V_4$ at the fifth intercostal space to the left of the midclavicular line and $V_3$ midway on a
line between V₂ and V₄. Lead V₅ is located at the same level as V₄, but at the anterior axillary line, and V₆ is on the horizontal level of V₄ and V₅ at the midaxillary line. The common practice of “eyeballing” precordial lead placements is not acceptable and does not come close to the best-practice standards!

3. e. any of the above

It is obvious from the ECG in Figure 1 that artifacts can be misinterpreted as ventricular tachycardia. Similar examples can be found in textbooks; however, reports on ECG artifacts in the literature are rare. Nevertheless, it is noteworthy that a report published in the New England Journal of Medicine describes 12 patients in whom diagnostic or therapeutic interventions were initiated as a direct result of misdiagnosed artifacts; for example, monomorphic ventricular tachycardia in 5 patients and polymorphic ventricular tachycardia in 7 patients.

The clinical consequences of a misdiagnosis are potentially ominous, because the pharmacological interventions and the precordial thumps performed in these patients are superfluous and potentially harmful. A misdiagnosis of torsades de pointes can result in an unnecessary implantation of a permanent pacemaker and an automatic implantable defibrillator. Diagnostic cardiac catheterizations have been performed on the basis of misdiagnosed artifacts. Electrocardiographic interpreters who have average skills in ECG analysis can readily recognize and differentiate electrocardiographic artifacts. These skills are learned through attendance at organized ECG courses and honed by experience, not by osmosis. Unfortunately, organized courses in ECG interpretation are “history” in nursing and medical school curricula.

Summary

Skills in differentiating electrocardiographic artifacts are mandatory for healthcare providers who use electrocardiography in diagnosis and treatment. Artifacts are more common than appreciated. Clues are usually present, but you see only what you look for and recognize only what you know. In the case described here, the stable clinical state during the ECG recording is evidence that the cardiac rate was not that of the artifactual oscillations; namely, 220 beats per minute. Finally, a diagnosis is not made and management is not determined on the basis of an ECG interpretation, rather the ECG interpretation is one factor in determining the complete diagnosis.

ACKNOWLEDGMENTS

Supported in part by a grant from the Applebaum Foundation in loving memory of Mr. Joseph Applebaum.

REFERENCES


SELECTED REFERENCES

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Am J Crit Care 2007;16 90-92
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