Atrial fibrillation or unstable angina? Utilization of a mobile electrocardiographic device to diagnose acute coronary syndrome

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Introduction

Ambulatory cardiac monitoring is an established method for managing patients with arrhythmias. However, the utility of using a mobile electrocardiogram (mECG) device for diagnosing ischemia has not been well studied. The research reported in this paper adhered to standard case report guidelines and practices. The patient provided consent for de-identified case details to be used by the authors.

Case report
Patient information

A 59-year-old woman with moderate intermittent asthma, hypertension, and paroxysmal atrial fibrillation (PAF) was being followed as an outpatient after successful ablation of PAF. After the patients was admitted to the hospital for a cerebral vermis hemorrhage in the setting of severe hypertension, anticoagulation was discontinued. The possibility of left atrial appendage occlusion was considered for nonpharmacologic mitigation of stroke risk, but the patient refused. Instead, aspirin was continued after shared decision-making.

The patient regularly used KardiaMobile (AliveCor, Mountain View, CA), a commercially available mECG device that is relatively inexpensive and works with a smartphone or tablet application. Using electrode sensors for the right and left fingers, the device provides a 30-second or longer tracing corresponding to lead I of a standard 12-lead electrocardiogram (ECG). Although she had been well after her ablation procedure 14 months before presentation, she subsequently reported symptoms of rest and exertional squeezing chest pressure along with reduced exercise tolerance. Due to concern for recurrent PAF, she recorded her rhythm during a symptomatic episode and shared the recording with her outpatient cardiologist (Figure 1).

KEY FINDINGS

- Commercially-available, mobile ECG monitors are being increasingly used without the direct acquisition by healthcare providers.

- In addition to rhythm monitoring, ST-segment abnormalities may reveal coronary ischemia.

- As the technology progresses to multi-lead recordings to approach that of the 12-lead ECG, it is likely that the sensitivity will improve.

Clinical findings and diagnostic assessment

The lead I tracing demonstrated sinus rhythm but also revealed horizontal ST-segment depressions >1 mm that were suggestive of coronary ischemia (Figure 1). The patient's baseline ECG demonstrated sinus rhythm, isolated premature atrial contraction, normal axis, normal intervals, and nonspecific ST-T changes (Figure 2). Given her typical symptoms of angina and ST changes that were consistent with myocardial ischemia, she was referred directly for coronary angiography. Angiography revealed significant 2-vessel disease, with 90% stenosis of the proximal left anterior descending coronary artery (LAD), serial 60% and 70% lesions of the mid-LAD, 70% stenosis of the proximal left circumflex artery, and 70% stenosis of the first oblique marginal artery (OM1) (Figure 3). Transthoracic echocardiogram demonstrated preserved left ventricular ejection fraction without segmental wall-motion abnormalities or significant valvular disease.

Therapeutic intervention

The patient was evaluated by the cardiothoracic surgical service and underwent successful robotic-assisted coronary artery bypass surgery with left internal mammary artery–LAD, radial–OM1, and left atrial appendage ligation due to presumed ongoing thromboembolic risk in the setting of a relative contraindication to anticoagulation. Clopidogrel was added to her medication regimen, as well as diltiazem for its antispasmodic effect.
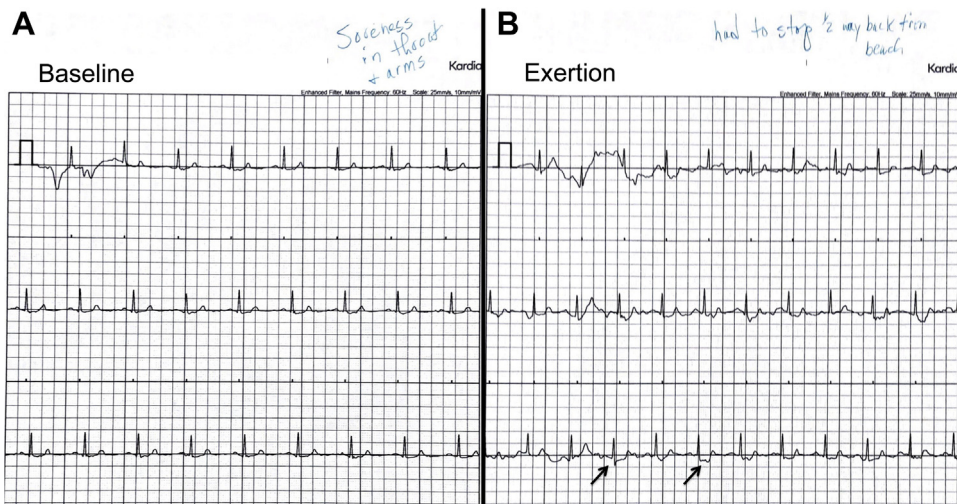
Figure 1   Mobile electrocardiogram recording suggesting ischemia. **A:** Baseline Kardia tracing. **B:** Tracing obtained during exertion showing >1-mm horizontal ST depression (*arrows*).

Follow-up and outcome

The patient completed cardiac rehabilitation during follow-up. She denied any symptoms suggestive of either recurrent PAF or angina. Clopidogrel and diltiazem ultimately were discontinued.

Discussion

The utility of a patient-owned mECG device for diagnosing ischemia has not been well studied. Although our case highlights a serendipitous finding, it suggests a potential application of mECG technologies to diagnose coronary ischemia.

Outpatient continuous electrocardiogram (cECG) monitoring has long been used in the management of patients with heart disease. Although it is more frequently used for monitoring arrhythmia and conduction disorders, since its introduction in the 1960s the technology has been used to identify patients at high risk for ischemic events.[1–3]

Applications of cECG monitoring include diagnosing the etiology of chest pain, identifying patients who may be having silent ischemia, and assessing the magnitude of ischemic burden in patients with known coronary disease.[4] Numerous studies have reported the prognostic and survival benefits of cECG monitoring in patients with known coronary disease and chronic angina.[5–8]

Provocative testing also has been used to diagnose ischemia. Treadmill stress testing has an estimated sensitivity of 68% and specificity of 77% in detecting coronary disease.[9] cECG monitoring has been found to have comparable diagnostic potential.[10] However, widespread application of this technology has been limited by bulky hardware, reduced patient compliance, and poor data recording quality.

Commercially available, ad hoc ECG monitors in the form of smartwatches or other portable devices are an evolving technology being adopted by an increasing portion of the
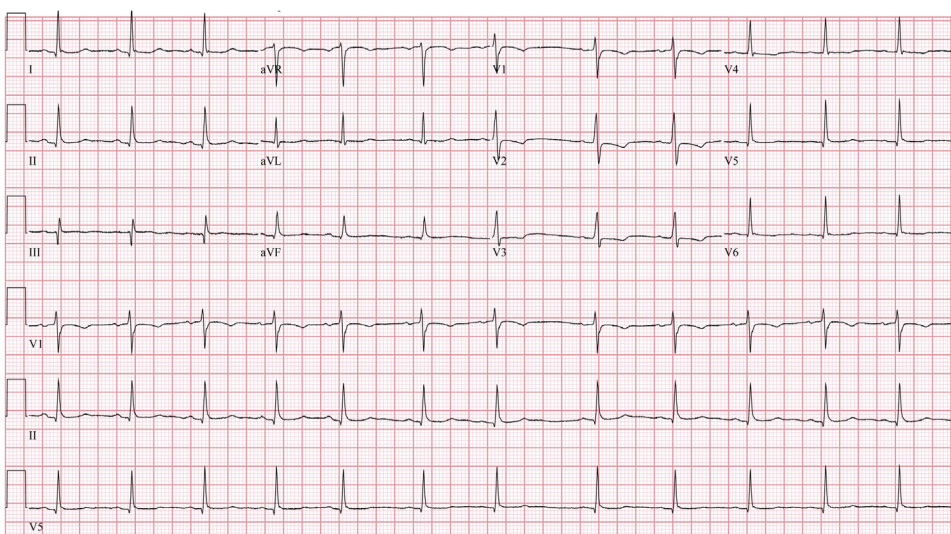

Figure 2   Baseline electrocardiogram demonstrating sinus rhythm, isolated premature atrial contraction, normal axis, normal intervals, and nonspecific ST-T changes.
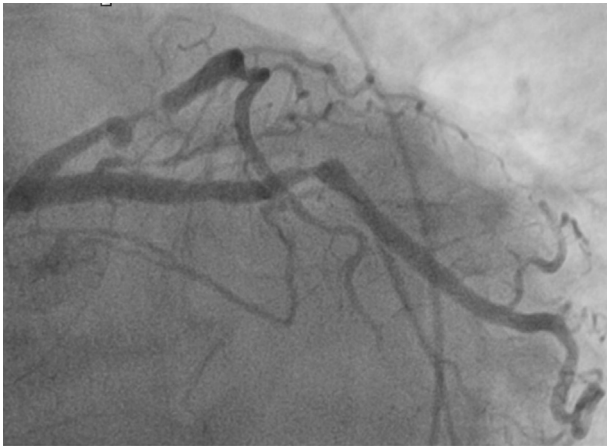
Figure 3 Coronary angiogram demonstrating severe multivessel coronary disease.

population.[11,12] Newer devices are smaller, lighter weight, and capable of recording more data than ambulatory ECG devices of the past.

A recent study reported the potential of an mECG device to diagnose ST-elevation myocardial infarction by recreating a 12-lead ECG.[13] These mECG recordings were obtained by a trained research team that applied electrodes sequentially to obtain a multilead recording. Given its low fidelity and resolution in comparison to a standard 12-lead ECG, the sensitivity of a single-lead ambulatory ECG modality at identifying clinically significant ischemia is low, although its specificity likely is higher. Nonetheless, investigators have observed mECG device recordings that have identified clinically significant ischemia.[14]

An important consideration with mECG devices is that they currently are too insensitive for general screening. However, when mECGs are being reviewed for rate and rhythm evaluation, there may be value in assessment of ST segments. Abnormal findings may suggest ischemia and should prompt a dedicated ischemic evaluation. This case serves to remind clinicians of the potential of this evolving technology. Accessibility, ease of use, and the ability of patients to record independently without the assistance of additional health care providers may facilitate wider adoption of wearable technology. Furthermore, with the introduction of multilead mECG devices, recordings are likely to become more reliable and yield higher diagnostic potential. With ongoing technology improvements, the applications of this technology can guide clinicians in better identifying patients with coronary ischemia.

Funding Sources

Disclosures

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