EDITORIAL

The Evaluation of the Patient with Unexplained Palpitations: Maximizing Diagnostic Yield while Minimizing Unnecessary Frustration

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Patients often seek medical attention after experiencing a sensation of palpitations. The symptom itself is relatively nonspecific and the differential diagnosis quite broad. In general, it is important to differentiate an arrhythmic (ranging from simple isolated atrial or ventricular ectopy to sustained atrial or ventricular arrhythmias) from a nonarrhythmic etiology. It is thus typically necessary to obtain an electrocardiographic (ECG) recording at the time the patient is experiencing typical symptoms. The clinician has at their disposal numerous tools to obtain an ECG recording; these have historically ranged from a variety of ambulatory external ECG recorders to insertable cardiac monitors.¹ The latter have recently become remarkably miniaturized and thus can be implanted quickly with minimal morbidity.²

The 24–48-hour Holter monitor is frequently used as the starting point of evaluation, especially in patients in whom symptoms occur frequently. However, the diagnostic yield of this test is limited, especially in patients ≤ 50 years of age.^{3,4} Prolonged ambulatory external ECG monitoring is feasible using patient-activated event recorders ("no wires") as well as external loop recorders (including mobile cardiovascular telemetry monitors). However, most insurance carriers in the

United States limit coverage to a month at a time biannually. Thus, it is important to understand the diagnostic yield of any given strategy in this fixed period of time.

In this issue of *Annals*, Attanasio et al. sought to investigate this issue.⁵ They report on 1404 patients who were referred for evaluation of unexplained palpitations. All patients had an ECG, 48-hour Holter monitor, and an echocardiogram. Following this initial evaluation, the diagnosis remained undefined in 139 (10%) of these patients. After excluding 48 patients who had prior history of syncope, the authors investigated the remaining 91 patients, who represented 6.5% of the overall cohort.

These 91 patients were given a patient-activated event recorder ("no wires") and asked to record ECG tracings during symptoms of palpitations and when symptoms had passed. The population was young (mean age 44 years) and predominantly female. Nearly 80% of patients recorded at least one ECG. Of these patients, 51% recorded an ECG within the first week, 80% within the first month, and 93% by two months. In 60% of patients, the ECG showed only sinus rhythm or sinus tachycardia. An arrhythmia was documented in the other 40% of patients, which included AV

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nodal reentrant tachycardia or AV reciprocating tachycardia in 7 patients, atrial fibrillation or flutter in 9 patients and premature atrial or ventricular ectopy in 12 patients. Importantly, a nonarrhythmic diagnosis was made within a median 4 days as compared to patients with an arrhythmic diagnosis in whom the diagnosis required a median of 21 days (IQR up to 38 days). These data suggest that an arrhythmic diagnosis will be missed in some patients if ambulatory ECG monitoring with an event recorder is arbitrarily limited to a month.

In recent years, there has been a shift away from using patient-activated event recorders, largely in part to the recognized limitations of these systems. In particular, short-acting arrhythmias are not recorded and arrhythmic triggers are not revealed since the onset of the arrhythmia is not recorded. Thus, guidelines have largely focused on either external loop recorders or insertable cardiac monitors.⁶ However, younger patients like that seen in this patient cohort are reluctant to wear leads inherent to an external loop recorder for an extended duration or consider insertion of a cardiac monitor. Not surprisingly, clinical experience shows that very few eligible patients are actually implanted with a cardiac monitor, even though long-term continuous ECG monitoring appears to be associated with a high likelihood of making a diagnosis.^{7,8}

There are several issues with the study by Attanasio et al. First, no information is provided about the patients in whom a diagnosis was achieved solely on the basis of initial evaluation. In fact, it is somewhat surprising that a diagnosis could be reached in 90% of patients without having to resort to longer term ECG monitoring. This may have been in large part a result of the inclusion of very young patients with a normal ECG and echocardiogram, no evidence of underlying structural heart disease, and very frequent symptoms. Second, although patient-activated event recorders could achieve a diagnosis in only 80% of patients within the first month, it is possible that a much higher diagnosis would have been achieved had an external loop recorder been used from the onset. In fact, a recent study has suggested a diagnostic yield of nearly 90% using this approach.⁹ Nonetheless, the very high diagnostic yield observed with patient-activated event recorders in this study suggests that maybe the value of this technology should at

least be reassessed in patients with unexplained palpitations given the inherent simplicity of this technology.

There are still many challenges inherent to patient-activated event recorders. First, the patients have to carry the devices with them; as the duration of monitoring increases, this becomes more challenging. In our experience, allowing the patients to keep the recorder with them for more than a month significantly increases the likelihood that they will lose the recorder altogether. Second, when patients experience symptoms and record an ECG, there is no real-time feedback. Instead, they have to transmit the stored ECG to a central server and wait for a health care professional to interpret the recording and communicate the findings. Third, when the nature of symptoms changes or when there is a desire to assess the response to therapy, another monitor must be prescribed. This may or may not be covered by insurance; thus, this technology is not well suited to use on an ongoing basis.

These limitations, along with the high diagnostic yield associated with event recorders in this study's population, raise hope for alternative technologies such as smartphone based ECG recording applications. As an example, AliveCor (San Francisco, CA, USA) offers a smartphone application and lightweight hardware component that can be affixed to a smartphone or tablet device. When the user holds the electrodes on the hardware piece with both hands, a 30-second single lead ECG tracing is generated. This technology allows patients to have real-time feedback about their ECG. In a prior prospective study, it was demonstrated that in comparison to a standard 12-lead ECG, smartphone-based technology was easier to use, reliably assessed rate and rhythm, and was actually preferred by users.¹⁰ The same type of technology was recently compared with patient-activated event recorders in a post-atrial fibrillation ablation population.¹¹ A 100% sensitivity and 97% specificity for the detection of atrial fibrillation and atrial flutter was observed. Importantly, only 2% of the patients found it difficult to use the technology and 92% of users preferred the technology to event recorders.

In summary, the patient with palpitations offers the perfect opportunity to take advantage of the smartphone mania that has swept the world over the past decade. These patients are young, have sporadic symptoms that often wax and wane over

months, and usually do not have characteristics that portend an underlying malignant arrhythmia. Attanasio et al. have shown that event recorders, if used for several months, can make a diagnosis in the vast majority of patients. If this is the case, empowering the symptomatic patient to assume the responsibility of long-term self-monitoring of ECG rate and rhythm with their own smartphone may hold great promise in the future. There is no further need to arbitrarily limit the duration of ECG monitoring. Thus, in the end, this approach may maximize diagnostic yield while minimizing patient and provider frustration.

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