Correlation of ECG findings with symptoms of palpitations using Novel Multi-lead Mobile Phone ECG

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Background:

Patients who are seen by physicians with symptoms of palpitation are usually evaluated for cardiac arrhythmias. As most of these patients do not have persistent symptoms, the diagnosis will usually require a recording of an ECG during symptoms.

Currently, there are ambulatory and mobile ECG recording devices which are used by physicians to record the ECG during symptoms. Continuous ambulatory ECG monitoring or Holter monitoring continuously records the ECG over a 24- or 48-hour period. The disadvantage of Holter monitoring is that the patients may not have symptoms during the period of recording. Furthermore, the wearing of a Holter monitor throughout this entire period poses significant physical discomfort. Trans-telephonic ECG monitoring is an ambulatory recording which is activated by the patient when the patient has symptoms. The recorded signals must be transmitted via a telephone line to a receiving station. Continuous event recorders with loop memory are able to make continuous one lead ECG recording when the patient activates the device. The signals cannot be transmitted and are retrieved when the device is brought to the physician’s office. Currently there is a novel multi-lead ECG mobile phone device (EPI Life, Singapore) which is able to record the ECG during symptoms upon activation and the recorded ECGs can be stored or transmitted to a 24-hour service receiving centre and these recorded ECGs can be accessed through the internet or by transmission to the physician’s mobile phone.

Objective:

The aim of this study is to correlate the ECG findings with symptoms of palpitation using a novel multi-lead mobile phone ECG.

Methods:

During a period of 6 months, a total of 39 consecutive patients with symptoms of palpitation were seen at our centre were enrolled for the study. All patients had a baseline standard 12-lead ECG was performed. All patients were instructed on the use of the mobile phone ECG (EPI Life, Singapore) to record their ECGs during symptoms.
Recorded ECGs were transmitted via the mobile phone to the 24-hour receiving centre where the ECGs were read by trained personnel and the reply was sent out to the patient within 15 minutes of transmission of the ECG. The patients were advised to contact their physicians if the recorded ECGs were abnormal. A baseline ECG recording on the mobile phone ECG device was sent to the receiving centre for use as a baseline for comparison with subsequent ECGs. The ECG recordings were correlated with the symptoms.

**Results:**

A total of 39 consecutive patients with symptoms of palpitation were enrolled for this study and were monitored for a period of 3-6 months. A total of 130 ECG recordings were received during this period. All ECGs were recorded during the period when patients had symptoms. Of the ECGs recorded during symptoms, 67% were associated with cardiac arrhythmias. Of the 130 ECG recordings, 33% showed sinus tachycardia, 25% showed supraventricular tachycardia, 41% showed ventricular ectopy and 1% show non-sustained ventricular tachycardia. There were no episodes of atrial fibrillation, atrial flutter, sustained ventricular tachycardia or conduction defects recorded (see Table 1).

| Table 1 |
| Types of ECG rhythm detected by Mobile Phone ECG |
| Abnormal Cardiac Rhythms | % |
| Sinus Tachycardia | 33 |
| Supraventricular Tachycardia | 25 |
| Atrial Flutter | 0 |
| Atrial Fibrillation | 0 |
| Ventricular Ectopy | 41 |
| Non-sustained Ventricular Tachycardia | 1 |
| Sustained Ventricular Tachycardia | 0 |
| Conduction Defects | 0 |
Discussion:

ECG recording devices are used by physicians to detect cardiac arrhythmias. One of the earliest ambulatory ECG recording devices, Holter monitoring, has been used since the 1960s.

The Holter monitor is useful if patients have symptoms on a daily basis. However, most patients do not have symptoms on a regular basis and often the Holter monitoring device will not be able to capture an abnormal ECG if the patient is asymptomatic during monitoring. Wearing a Holter monitor can be quite troublesome as the electrodes have to be securely fastened onto the chest wall and they should not be removed during the period of monitoring which can often poses significant discomfort for the patient and makes it impractical for long term use.

In a retrospective study on the diagnostic yield of Holter monitoring on 164 patients, 19% show relevant diagnoses during the first 24 hours and 3% in the second 24 hours.\(^1\)

Trans-telephonic ECG are portable devices which are easy to use, however the recorded signal has to be transmitted via a fixed phone line to the receiving station. In addition, the recorded electrophysiological signal is converted to an audio signal, and this audio signal is transmitted to the receiving station through a fixed phone line. As the signal transmitted is an audio signal, there exists a possibility of distortion of the signals during transmission.

Continuous loop event recorders (CER) with loop memory are also used for the diagnosis of cardiac arrhythmias. These recorders allow the recording of a continuous loop of 1-lead ECG when they’re activated by the patient. The ECG is recorded by means of electrodes attached to the chest wall or direct contact with the recording device. The disadvantage of these event recorders is that the ECGs cannot be transmitted and will usually require the patient to bring the device to the physician’s office for analysis.

There were a total of six studies in comparative studies comparing the use of CER with Holter monitoring. With CER, diagnosis was established in 21-62% of the patients as
compared with a maximum of 30% in patients with Holter monitoring. The CER was better at excluding arrhythmias during symptoms then with Holter monitoring (34% and 2% respectively).\textsuperscript{2-7}

In a randomized trial comparing the diagnostic yield of CER as compared to that of a general practitioner (GP), the CER diagnosed 67% of the patients with a cardiac arrhythmia while the GPs diagnosed 27% of patients with a cardiac arrhythmia (p<0.05) after six months.\textsuperscript{8}

In this study, the use of the mobile phone ECG provided a high diagnostic yield of 67% during symptoms. This is superior to that of Holter monitoring and performs much better than most published studies on the use of continuous event recorders.

The multi-lead mobile phone ECG presents significant advantages over the current types of ECG recording devices. It does not require the patient to wear the device and the ECG is recorded with direct physical contact with the phone using the fingers. The device has a potential to record multiple ECG leads by placing the contact surfaces in different configurations. The recorded ECGs can be stored in the mobile phones or can be transmitted directly to the 24-hour receiving station with no loss of signals. This ECG mobile phone device overcomes the disadvantages of the Holter monitor, the trans-telephonic ECG monitor and the continuous event loop recorder. As the device is a mobile phone with ECG capabilities, it has an advantage of recording and transmitting the ECG signals to the receiving station without distortion of the signals. The recorded ECGs will go into a personal folder of the user which can be accessed by the user through their personal account. There is another advantage that the recorded ECGs can also be transmitted to the physicians looking after the patients so that they can have quick access to any abnormal ECGs that have been recorded. Another advantage of this device is that it is a mobile phone. Mobile phones are ubiquitous and have become part of everyone’s daily lives. For patients with heart conditions, this phone allows the users with underlying heart conditions to carry a mobile phone which can be used for their daily usage and has the additional capability to record their ECGs when symptomatic. It is possible that in the near future, patients with heart problems could be using mobile phones with this additional ECG recording capability. This may
potentially reduce the morbidity and mortality arising from life threatening cardiac arrhythmias in patients with underlying heart disease.

**Conclusion:**

In this study, the mobile phone ECG was a useful diagnostic tool for detecting arrhythmias and can potentially prevent morbidities and mortalities arising from cardiac arrhythmias.

**References:**


