



BMH Medical Journal 2015;2(4):102-105 **Brief Review**

## In Search of Hidden Arrhythmia

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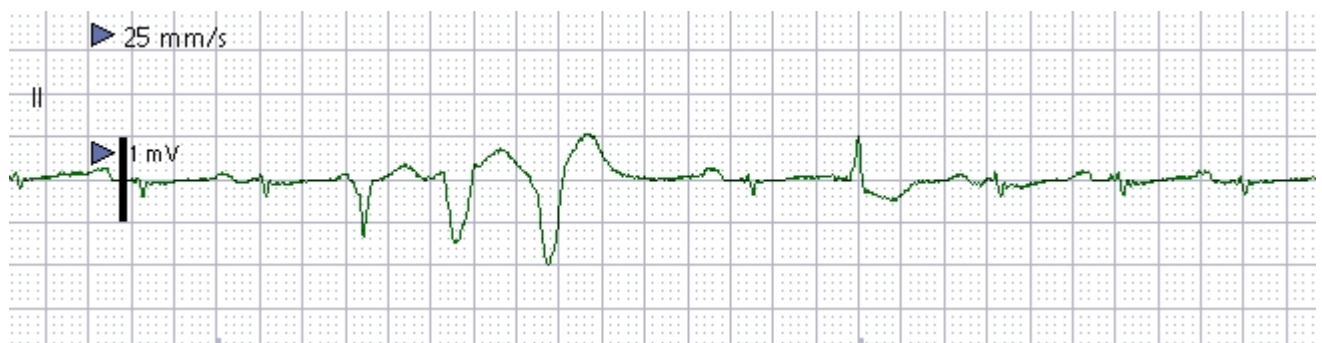
Cardiac rhythm disorders could be very common and minimal significance like isolated ventricular ectopics are very serious and life threatening like ventricular tachycardia or fibrillation. Often it is an irregular pulse or heart beats which calls our attention to the presence of cardiac rhythm disorders. But many times, cardiac arrhythmia is intermittent and not manifest at the time of physical examination. A simple 12 lead electrocardiogram with a long rhythm strip can document cardiac arrhythmia which is frequent, but often fails to record intermittent arrhythmia which can still be quite symptomatic and sometimes life threatening. This brief review is on the various modalities of electrocardiographic recordings used for documenting arrhythmia which is not easily documented by a 12 lead electrocardiogram with a long rhythm strip.

### Continuous monitoring in the intensive care setting

One of the earliest modalities to instituted for detection of intermittent cardiac arrhythmia was continuous monitoring usually in the intensive care unit (**Figure 1**). In the earlier days, it relied mostly on a trained nurse constantly observing a bedside electrocardiographic monitor for disturbances in cardiac rhythm. Strip chart recording facility attached to the monitor was used to get hard copy of the arrhythmia for later discussion or detailed analysis. Freezing the tracing on the monitor was another option for arrhythmia analysis by the treating physician at a later time. Monitoring in the intensive care advanced further with the availability of a central monitoring console in which rhythm data from multiple persons in the intensive care unit could be displayed. Availability of computerized recordings made it easy to have continuous archival of cardiac rhythm data running into several days within the hard disk memory. Built in rhythm analysis software could generate alerts so that one need not scan through the whole recorded data manually, but can recall the events of brady or tachyarrhythmias at a mouse click. This is useful in analysing how an arrhythmia event started. For example, in case of ventricular tachycardia, it will show whether it was preceded by frequent ventricular ectopics or QT interval prolongation. Intermittent atrioventricular blocks which were missed on visual monitoring can also be picked up in this manner. Rhythm print outs of long pauses are useful in documenting the need for permanent pacemaker implantation.

Telemetry monitoring can be used to assess arrhythmia during ambulation in the vicinity of the intensive care unit. With the advent of widespread computer networking in hospitals, it is easy to transmit the data from central monitor across the hospital intranet to computer monitors in the

consultant's office. ICU staff can readily obtain the opinion of the consultant in the outpatient clinic regarding rhythm disturbances. Further transmission to mobile hand held devices of the consultants who are away is also rather common place. Transmission networks need to be secure to prevent unauthorized data access to maintain privacy of transmitted data.



**Figure 1:** Short run of ventricular beats captured from ICU central monitor record. First beat in the run is a late diastolic fusion beat occurring just after the P wave.

Cardiac monitoring for arrhythmia detection has now extended beyond the coronary care to all intensive care units, labour rooms and operation theater where cardiac monitoring is routine. In some instances, certain arrhythmias detected during such routine monitoring may not carry future prognostic significance [1]. The most common clinically significant arrhythmia detected in the perioperative period is atrial fibrillation, which is known to increase perioperative morbidity and length of hospital stay [2]. Mobile intensive care units and ambulances also provide arrhythmia detection and immediate management in the current era. In this scenario also transmission by mobile phone service to the consultant at the receiving hospital is common.

## 24 / 48 hour Holter monitoring

With the ongoing miniaturization of ECG monitoring devices with capability of long term recording, 24 and 48 hour continuous ambulatory Holter monitoring is now common place in the hospital setting. Holter recorders are usually of the size of a mobile phone and can be worn on a belt with the electrocardiographic leads for two channel or three channel recordings attached over the chest. They can be worn fairly unobtrusively within the dress so that it is even possible to use it during routine diurnal activities. Data stored in the monitor is retrieved by the Holter analyzer after the recording period is over and analyzed by the software. A visible digital clock and an event marker button for the subject to mark any symptomatic events on the record are part of the usual equipment. A physical diary is also kept by the subject to track any symptomatic events during the recording period to compare with the corresponding rhythm during analysis. Holter monitoring is used to detect episodes of paroxysmal tachy or bradycardia. Long pauses and atrioventricular blocks can be documented. As in the case of ICU monitoring, the rhythms leading to a dangerous rhythm can be noted on the Holter record. Newer Holter monitors can also detect paroxysmal atrial fibrillation (AF) and calculate the total AF burden. An interesting case of atrial ectopic beats precipitating atrial fibrillation detected on Holter has been reported from our institution earlier [3]. A recent survey conducted by the European Heart Rhythm Association showed that Holter monitoring and external loop recorders (see below) are the preferred monitoring techniques for persons with recurrent palpitation or unexplained syncope [4].

## External loop recorders

While the ICU monitors and Holter monitors record electrocardiographic data continuously, loop recorders monitor data continuously and record only the needed events on to the hard memory. In this way, they are able to record for extended periods like one week or more. They are useful in detecting silent episodes of atrial fibrillation after catheter ablation of atrial fibrillation [5]. The recording can be activated either manually by the subject or automatically by the software when the set upper and lower limits of heart rate are exceeded. Trans telephonic (land line) transmission of

recorded events' data has been in vogue for a long time [6].

Newer external loop recorders have the facility for transmission of data through the mobile phone network to an external server, which may sometimes be hosted on another continent. Services are currently available in which a central monitoring facility monitors the incoming data and alerts are issued to the treating consultant by internet, mobile phone short message service or even direct telephone calls in case of life threatening arrhythmias. Data transmission in this case will certainly depend on the mobile network connectivity available in the region, especially if the subject lives in a remote village. But the advantage of this form of recording is that arrhythmic events which occur during day to day activities can be captured.

### **Implantable loop recorders**

Implantable loop recorders function just like external loop recorders, but recording only events, while monitoring continuously [7]. They are implanted subcutaneously by a minor surgical procedure. The devices are explanted after a diagnostic recording is obtained or the useful battery life of the device is over, typically up to three years at present. Implantable loop recorders are very useful in documenting infrequent arrhythmias and are a very useful in differentiating recurrent seizure from arrhythmic syncope. Events can be recorded manually by the subject by applying a programming wand over the device in case of any symptom. Automatic recording to hard memory occurs at preset upper and lower rate cutoffs even otherwise. Depending on the models, records of electrograms preceding the event are also available, helping in identification of the mechanism of arrhythmia origin. Wireless enabled devices can transmit data on a daily basis so as to prevent clogging of the device memory between device interrogations leading to loss of data. Transmissions usually occurs automatically at preset timings when the person is in the vicinity of the mobile transmitting interface at home.

### **Interrogation of implantable therapeutic device memory**

Interrogation of device event memory of implanted devices like pacemakers, defibrillators and heart failure devices are another method of retrieving important data on cardiac arrhythmias. Though these device data may not provide diagnostic electrocardiograms in some cases, event data is useful in most cases.

Trans continental interrogation and transmission of device data is also picking up with the availability of internet enabled device programmers [8]. Several studies have documented the efficacy of remote monitoring of implantable defibrillators and pacemakers [9-11].

### **Arrhythmia detection during treadmill exercise testing**

Though treadmill exercise testing is usually done to look for inducible ischemia, it can be used to detect exercise induced arrhythmia like catecholaminergic polymorphic ventricular tachycardia [12]. Many benign ventricular ectopy usually disappear with exercise and reappear during recovery. Exercise induced ventricular arrhythmia may also occur in those with severe coronary artery disease, though induction of arrhythmia by itself may not indicate inducible ischemia.

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