

CSI Company Confidential

Noninvasive ECG comparison of CSI BP Pattern Identification Technology to Identify and Confirm BP Measurements as a Prescreening ECG

Robert J. Bryg, MD
Division of Cardiology
David Geffen School of Medicine at UCLA
Olive View UCLA Medical Center
Sylmar, CA 91342

Introduction:

Blood pressure monitoring outside of the physician's office continues to expand. There are many advantages to BP readings outside of the clinical setting. These include more frequent blood pressure results, results at different times of day, and a chance to see blood pressure without "white coat syndrome". In addition to measuring the blood pressure, these devices routinely provide the pulse for the patient. Recordings of the pulse to date have not been utilized in determining the rhythm of patients.

Recent data suggests that just measuring the regularity of pulse is a reliable indicator of whether a patient is in sinus rhythm or atrial fibrillation.

Many patients are followed for intermittent atrial fibrillation. They, however, can have problems with taking their own pulse and reliably determining whether they remain in a regular rhythm.

In this study, we test the hypothesis that a recording of the pulse wave can be reliably utilized to determine whether a patient is in sinus rhythm or has an arrhythmia that may need further medical attention.

Methods:

Twenty nine patients were enrolled in this study. BP measurements were obtained utilizing a modified version of a commercially available blood pressure monitor Computerized Screening, Inc, Model 6K. This version was modified to provide a separate text file of voltage on the pulse wave to determine the heart rhythm. Simultaneous ECG's were obtained utilizing a Marquette MAC5 ECG machine. All recordings were performed by a single technician trained in the performance of the CSI BP monitor.

The rhythm from the ECG was read by both the computer and the principal investigator.

The K sound tracing was digitized at 1000 samples per second and saved in a separate text file. This file was then converted to an Excel file and the K sound amplitude was graphed versus time to produce a tracing similar to a pulse tracing. These tracings were then printed out for interpretation.

The rhythm strips from the BP measurements were analyzed by 5 physicians who were blinded to the results of the ECG. They were asked whether the patient was in a regular or irregular rhythm. If the patient was in an irregular rhythm, they were to determine if the rhythm was a sinus rhythm with early beats such as PAC's or PVC's or if it was atrial fibrillation. These results were then compared to the ECG data. We assessed the degree of inter observer and intra observer variability.

Results:

Twenty one patients had underlying rhythms of Sinus rhythm. Six of these had early beats, including PAC's and PVC's. One patient had a pacemaker. One patient was in atrial flutter, and six were in atrial fibrillation.

In the 21 patients with sinus rhythm, there was agreement on regularity 97% of the time. In one ECG with significant sinus arrhythmia, there was disagreement on the underlying rhythm.

In the patients with early beats, there was agreement that there was an arrhythmia, but disagreement on the underlying mechanism. This was especially true in the patient with PAC's, PVC's, and short runs of SVT. Most reviewers felt this was atrial fibrillation.

In the patient with atrial flutter and the patient with a paced rhythm, the practitioners felt these were regular. The underlying mechanism of the rhythm could not be discerned.

Discussion:

In general, this technique is able to discern regular from irregular rhythms. There was overall good correlation with the simultaneously recorded ECG, though one reviewer significantly overread the rhythm and assigned irregularity to many of the tracings that were associated with sinus rhythm.

This study demonstrates that measurements by automatic blood pressure cuffs can provide a reliable estimation of the underlying rhythm and whether it is regular or irregular.

There are some limitations of this study. These include the fact that this is a preliminary study to determine the feasibility of utilizing BP monitoring to determine the regularity of the heart rhythm with only a small number of data points. In spite of this, there was a good correlation between the results that the computer gave and the rhythm blindly determined by the cardiologist.

Several rhythms could not be successfully determined, including paced rhythms, atrial flutter, and complex arrhythmias with an underlying sinus tachycardia. ECG determinations would still be necessary for these rhythms. Direct calculation of beat to beat variability may help with differentiation of sinus rhythm from other forms of regular rhythm.

Further study is necessary to validate these results on a larger population. In addition, an automated version of the rhythm analysis is necessary to help the patient determine whether further consultation with a physician is warranted.