Characterization of HRV by Poincaré Plot Analysis among the Female Tea Garden Workers of Northern Hilly Regions of West Bengal

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ABSTRACT

Recent research on Heart Rate Variability (HRV) has proven that Poincaré Plot is a powerful tool to mark Short Term and Long Term Heart Rate Variability. This study focuses a comprehensive characterization of HRV among the Tea Garden Workers of the Northern Hilly Regions of West Bengal. The characterization, as available from the data sets, projects the average values of SD1 characteristics, that is, Short Term HRV in females as 58.265ms and SD2 as 149.474. The SDRR shows a mean value of 87.298 with a standard deviation of 119.669 and the S Characterization as 16505.99 ms and Standard deviation of 45882.31 ms. The SDRR shows a mean value of 87.298 with a standard deviation of 119.669 and the S Characterization as 16505.99 ms and Standard deviation of 45882.31 ms. ApEn Characterization showed mean value of 0.961 and standard deviation of 0.274.

Keywords: Heart Rate Variability (HRV), HRV Characterization, Poincaré Plot, SD1, SD2

I. INTRODUCTION

The Poincaré plot (PP) is one of the important markers which analyses short as well as long term HR recordings. It is:

- A visual technique which can make use of pattern Recognition and a
- Quantitative one, which includes various parameters (called descriptors) which quantify the information contained in a Poincaré plot (Brennan, Palaniswami, & Kamen, 2001; Brennan, Palaniswami, & Kamen, 2002).

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Developed by Henri Poincaré for analyzing complex systems, is used in physics, astronomy, meteorology, mathematical biology, geophysics and medical sciences (Ott, 1993). Medical sciences use it for quantifying the heart rate variability (HRV) and it stands as an effective measure of this marker (Brennan, Palaniswami, & Kamen, 2001; Brennan, Palaniswami, & Kamen, 2002; NASPE, 1996). It summarizes the entire recording, and simultaneously makes it possible to extract the information on short and long time behavior of the heart action. Being highly resistant, a reasonable Poincaré plot may be produced even from a recording containing a considerable amount of outliers and artifacts thus making it advantageous to the Discrete Fourier Transform (DFT) (usually realized by the Fast Fourier Transform (FFT) algorithm), where all outliers and artifacts must be noticed and dealt with. Concluding on information on sinus rhythm is important as many of the conclusions drawn from HRV analysis refer to the sinus rhythm (NASPE, 1996).

II. HEART RATE VARIABILITY

Heart beats are caused by electrical depolarization of the heart muscle (Eckberg, 1997; Eckberg, 2003; Parati, Saul, & Castiglioni, n.d.; Mrowka, Persson, Theres, & Patzak, 2000). Electrical depolarization of the different parts of heart can be observed on an electrocardiogram (ECG) (Figure 1).

The momentary heart rate and the duration of the $RR$ interval is a consequence of constant interaction between the intrinsic activity of the sinus node and the influence of the autonomic nervous system, various substances circulating in the blood and present in the heart tissues (Eckberg, 2003; Parati, Saul, & Castiglioni, n.d.). Breathing appears to be the most important factor modulating heart rate (Eckberg, 2003; Parati, Saul, & Castiglioni, n.d.; Guzik et al., 2005). The changes in blood pressure modulated by baroreflex are another example of a separate system regulating the heart rate. The control of heart rate is modulated by both sympathetic and parasympathetic branches of autonomic nervous system as well as many other autonomic reflexes (e.g., chemoreflexes) (Parati, Saul, & Castiglioni, n.d.; Guzik et al., 2005; Guzik et al., 2005) All these systems and reflexes are responsible for changing of the duration of $RR$ interval from one beat to another and this phenomenon is called heart rate variability (HRV) [13, 15, 7, 8]. It is accepted that the higher HRV, the better prognosis in survivors of myocardial infarction or patients with heart failure. HRV is reduced in patients with diabetes and autonomic dysfunction. Frequency–domain analyses contributed to the understanding of the autonomic background of RR interval fluctuations in the heart rate record (Seely & Macklem, 2004). Frequency-domain or spectral analysis of time series of $RR$ intervals is performed with Discrete Fourier Transformation (usually by FFT) or autoregressive models. Derived from spectral HRV analysis, the total power represents total HRV, the power of high frequency (HF) correspond to parasympathetic activity while the

Figure 1. A strip of ECG presenting heart’s electrical activity recorded in a healthy person
Clinical Data Mining in Small Hospital PACS: Contributions for Radiology Department Improvement
www.igi-global.com/chapter/clinical-data-mining-small-hospital/75632?camid=4v1a

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