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Commentary

Identification of Congestive Heart Failure by Heart Rate Variability

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DESCRIPTION

Congestive heart failure-related diseases claim the lives of millions of people worldwide each year. In this regard, significant efforts are made to extend the lives of subjects. Furthermore, treatment for cardiac pathologies is among the most expensive for the healthcare system in low- and middle-income countries. As a result, governments are requiring the development of simple and low-cost methods for detecting heart failure during preventive exams. In fact, such a feat would represent a significant advance in the fight against life-threatening diseases. Traditional methods of diagnosing heart failure at the clinical level rely on a combination of tests and clinical history to determine whether or not the patient has heart failure. The Boston criteria have a sensitivity of 50% and a specificity of 78% among the tests used.

Electrocardiography (ECG) methods, such as the electrocardiogram, have a sensitivity of 81.14% and a specificity of 51.01% when analyzing abnormal ECGs. Echocardiograms show suboptimal values of 5%–10% at rest and 20% when stressed. As can be seen, the current issue with conventional diagnostic methods is the significant difference in the percentages of correct and incorrect initial diagnoses. As a result, false-negatives will result in unnecessary tests, whereas false-positives will result in late diagnostics.

However, the diagnostic reliability could be improved if the screening test for heart failure could be aided by signal processing techniques and biomedical analysis. Several studies in recent years have demonstrated the possibility of classifying subjects with heart failure. For example, Işler and Kuntalp demonstrated using short-term heart rate variability intervals that normalizing classical Heart Rate Variability (HRV) and entropy measures can result in high levels of sensitivity and specificity, implying that the classification accuracy of heartbeat time series can be greatly improved and even reach maximum accuracy if support vector machines are used. A joint wavelet and Support Vector Machine (SVM) for example, have one of the highest success rates when it comes to distinguishing Congestive Heart Failure (CHF) from normal sinus rhythm.

Thuraisingham reported the highest success rate when using a second-order difference plot of RR intervals, but at the expense of long-term RR intervals. There are also numerous studies that use multistate entropy as a fundamental parameter to determine discriminative power. As an example, a recent study proposed using reduced data and dual-scale metrics to achieve 100% accuracy using 500 RR samples. However, MSE-based measures are heavily skewed in terms of sample size, scales, and block analysis. A classification and regression method has demonstrated a promising use of short-term intervals.

It demonstrates that by taking into account the average variation over 24 hours of consecutive heartbeat intervals, sensitivity and specificity can be increased to 89.7 and 100%, respectively. Regardless of the number of sample tests and methodologies used, the proposed techniques have varying degrees of complexity. They are particularly interested in identifying patterns that could be used to predict sudden death due to heart failure. Finding a representation that could be considered the representative pattern sub serving the genesis of autonomic cardiac control is one interesting perspective on this problem. For example, the authors demonstrate that cardiopathies can be distinguished by scaling the behaviour of heartbeat intervals with wavelets.

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