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ORIGINAL ARTICLE

An intelligent noninvasive model for coronary artery disease detection

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Abstract Coronary artery disease (CAD) is one of the leading causes of death globally. Angiography is one of the benchmarked diagnoses for detection of CAD; however, it is costly, invasive, and requires a high level of technical expertise. This paper discusses a data mining technique that uses noninvasive clinical data to identify CAD cases. The clinical data of 335 subjects were collected at the cardiology department, Indira Gandhi Medical College, Shimla, India, over the period of 2012–2013. Only 48.9% subjects showed coronary stenosis in coronary angiography and were confirmed cases of CAD. A large number of cases (171 out of 335) were found normal after invasive diagnosis. Hence, a requirement of noninvasive technique was felt that could identify CAD cases without going for invasive diagnosis. We applied data mining classification techniques on noninvasive clinical data. The data set is analyzed using a hybrid and novel k-means cluster centroid-based method for missing value imputation and C4.5, NB Tree and multilayer perceptron for modeling to predict CAD patients. The proposed hybrid method increases the accuracy achieved by the basic techniques of classification. This framework is a promising tool for screening CAD and its severity with high probability and low cost.

Keywords Coronary artery disease · Angiography · Data mining · Classification · Clustering

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Introduction

Cardiovascular diseases (CVD) are due to disorders of the heart and blood vessels [1]. It is one of the leading causes of death and disability. Early diagnosis and treatment of the disease can reduce the threat of having a further severity of the disease. It is necessary to gain clear understanding of risk and prevention factors as well as to improve the accuracy of diagnosis [2]. CAD is a cardiovascular disease in which presence of atherosclerotic plaques in arteries can restrict blood flow to the heart muscle by physically clogging the artery, leads to cardiac death or myocardial infraction [3]. CAD can be diagnosed using noninvasive and invasive methods. These tests help in evaluating the severity of disease and its effect on the function of the heart and possible form of treatment to be given to a patient. Noninvasive diagnostic methods are echocardiogram, exercise stress testing, magnetic resonance imaging, single photon emission computer tomography, but the result of these methods are inconclusive and not reliable as angiography [4–8]. Angiography is an invasive, costly and highly technical procedure. It cannot be utilized for screening of large population or close follow-up of treatments [9]. Moreover, these methods utilize enormous amount of resources such as time, require expensive laboratory setup, specialized tools and techniques. Limitations of diagnostic methods encourage researchers to seek other less expensive and noninvasive methods for diagnosis of CAD such as data mining that can lead to easy detection of CAD without going through angiography. Various epidemiological studies have been done in the past including Framingham Heart study [10,11], Nippon–Honolulu–San Francisco study [12,13], Monitoring Trends and Determinants in Cardiovascular Disease [14,15], INTERHEART study [16,17] for understanding the patterns, cause and risk factors for the disease. Data mining methods have been used

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