A Novel Hybrid Non-invasive Clinical-Signal Processing Technique as Biomarker of Atrial Fibrillation

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Atrial fibrillation (AFib) is a type of arrhythmia, where atria contract fast/irregularly due to a dysfunctional cardiac electrical system. AFib starts paroxysmally, and advances to persistent/permanent stage. Early diagnosis and treatment in the paroxysmal stage, reduces chances of stroke, however AFib usually remains undiagnosed until disease progresses. Peripheral Artery Disease (PAD) is narrowing of arteries due to atherosclerosis, causing reduced blood flow to limbs. PAD and AFib share common risk factors such as hypertension, hyperlipidemia, atherosclerosis, and could coexist, increasing risk for stroke. The goal of this research is to investigate a hybrid technique combining two non-invasive methods 1. Ankle Brachial Index Pressure Test (ABI) – a clinical procedure, and 2. Electrocardiogram Signal Analysis (ECGSA) Test - a biomedical signal processing approach, for insights into early diagnosis of AFib. ABI test which uses Doppler Ultrasound to diagnose PAD was used to verify coexistence of AFib with PAD, and create a Weighted Scoring System (ABI-WSS) to diagnose AFib. The ECGSA technique used MATLAB to process patient ECG by template-selection, correlation and averaging, to produce averaged ECG beat from which P-wave was examined for abnormal atrial contractions, a precursor for AFib. ABI-WSS had sensitivity of 86% and specificity of 88%, while ECGSA had sensitivity of 95% and specificity of 95%. Results indicated that while each technique provided a partial solution, the combination provided a comprehensive diagnostic path for identifying AFib. While ABI-WSS could screen and detect severity of AFib, ECGSA predicted inclination to develop AFib in future, thus making the hybrid combination of ABI-WSS and ECGSA instrumental in diagnosing atrial fibrillation.