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Commentary

Modern Advances in the Seismocardiogram for Assessing Cardiac Activity

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DESCRIPTION

The main cause of mortality in the worldwide is cardiovascular disease. For patients with heart disease, new diagnostic techniques are required to offer early identification and intervention, lower mortality, and improve both the quantity and quality of life. Monitoring heart health as a result became crucial for achieving public health objectives. It can be extremely difficult to identify cardiac irregularities at an early stage since they tend to develop erratically and may advance without being identified. There are several tools available for keeping an eye on heart health. Seismocardiography (SCG) is a noninvasive method for assessing heart activity. However, SCG research was complicated by the SCG signals' intricacy. Recent advancements in low-cost, lightweight sensors, signal processing, and machine learning techniques have helped to rekindle interest in studying the value of SCG. Recent research has shown that SCG signals may be clinically useful for the monitoring and identification of certain cardiovascular diseases.

SCG, unlike BCG, which only detects cardiac response forces operating locally on the chest, investigates mechanical vibrations brought on by the heart. Nuclear Cardiology (NC), a technique where radioisotopes are injected into the circulatory system and the emitted radiation is monitored outside, was first presented in the early 1970s. The X-ray Computed Tomography (X-CT) method is an imaging technique that uses X-rays to make slice pictures of the heart as a later advancement. The next heart imaging technique is based on nuclear magnetic resonance and is called Cardiovascular Magnetic Resonance Imaging (C-MRI). Gyrocardiography (GCG), a noninvasive technology based on SCG, was first presented a few years ago, in 2016. Gyroscope, a sensor that monitors angular motion, is used to evaluate the heart motion. Although the aforementioned methods are trustworthy, they don't reveal much about more intricate cardiac processes. SCG is one of these methods that makes it easier to monitor heart mechanical processes. SCG did not, however, been widely used in clinical settings in the past because to technological constraints and a number of other approaches. However, new advancements in technology have reignited interest in SCG. Additionally, SCG can offer a cost-effective alternative with the added benefit of routine and automated monitoring as compared to that of current cardiac techniques.

The quality of the recorded SCG signals was enhanced by recent developments and the availability of portable, low-noise accelerometers. Recent studies have employed a variety of SCG measuring techniques, including the following: Uniaxial/triaxial piezoelectric accelerometers; Uniaxial/triaxial MEMS accelerometers; Smartphone accelerometers and gyroscopes; Triaxial gyroscopes; Laser Doppler vibrometers; Microwave Doppler radars; Airborne Ultrasound Surface Motion Camera (AUSMC). The axial and rotational components of SCG signals might vary according on the sensors being used. A uniaxial accelerometer, for instance, can be used to measure the dorso-ventral SCG component. To learn more about axial and rotational heart-induced motion in three separate directions, a triaxial accelerometer and triaxial gyroscope can be combined. Unless otherwise specified, this evaluation concentrates on the dorso-ventral portion of the SCG. The sternum or its left lower border is where sensors are most frequently positioned on (or directed to). Other sites, such as above the heart apex (lateral left lower chest) and the "aortic valve listening region" at the right upper sternal border, were utilised for SCG signal capture in several investigations.

SCG, which was derived by monitoring the maximum oxygen intake (VO2 max) during vigorous exercise, was used to evaluate cardiorespiratory fitness. The amplitude and timing interval data derived from SCG signals were utilised in a non-exercise prediction model for VO2 max. There was a contribution to a unique technique for eliminating motion artefacts from SCG signals. The motion artefacts were eliminated using the suggested method's adaptive recursive least squares filters. According to both SCG and BCG signals, in both linear and rotational dimensions, the kinetic energies and their temporal integrals were calculated. SCG was used to calculate cardiac timing intervals and hemodynamic variables including stroke volume in order to measure Pulmonary Artery Pressure (PAP). The findings demonstrate a substantial association between variations in PAP mean and variations in the SCG-dorso-ventral signal, indicating

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the possibility of remote monitoring of HF patients. A standardised approach for guaranteeing the SCG signal quality was put out in. The dynamic-time feature matching approach, which determines signal quality index as a function of the inverse distance between a large group of template signals and the SCG signal, was used to determine the distance between a signal and reference template.