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Heart Disease is a Leading Cause of Morbidity and Mortality around the World

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Editorial

The greatest cause of illness and mortality worldwide is heart disease. Although significant progress has been achieved in disease identification and treatment, little is understood about the mechanisms and traits that lead to the development of diseases. Knowledge of these factors is necessary for the formulation of more efficient treatments and preventative plans. the underlying characteristics of illness development. Patients with maintained heart function, for instance, Conventional therapies that are effective for other types of heart failure are ineffective for those with ejection fraction. Approximately one-third of patients with dyssynchronous contraction in heart failure do not benefit from pacemaker therapy for cardiac resynchronization. Patient-specific it would be very helpful to have information on how to choose interventricular pacing delays and where to place the pacing device leads in order to predict the outcome of cardiac resynchronization therapy. Changes in heart motion and shape are caused by interactions between environmental, genetic, and unfavourable events in sub-clinical disease.

With recent advances in medical imaging, large-scale cohort studies and medical image analysis, it is now possible to address these problems from two perspectives: first by examining how the heart changes its shape and function in response to disease and exposure to risk factors; and second by identifying biophysical parameters that characterise physiological and biomechanical behaviours in health and disease. Cardiac form and function continuously change in response to vascular events, pre-clinical and symptomatic illness, and other factors. Since these changes indicate initially compensatory processes that eventually lead to decompensated remodelling and heart failure, a better quantification of this remodelling could provide more predictive information on the status of heart health and the progression of illness. For instance, higher left ventricular (LV) end-systolic volume, increased left ventricular (LV) sphericity, and concentric remodelling (relative thickening of the heart walls) have all been linked to a lower chance of survival in myocardial infarction patients [1-3].

Although remodelling has traditionally been defined as morphological changes brought on by vascular events, such as myocardial ischaemia or infarction, hypertensive and idiopathic cardiomyopathies (i.e., those with no known cause) can also produce remodelling features, which are crucial clinical indicators of disease progression. Prior to the development of clinical illness symptoms, pre-clinical remodelling can take place in asymptomatic individuals in response to exposure to risk factors and genetic interactions. Additionally, this kind of remodelling has been linked to unfavourable results. Mathematical modelling of cardiac shape, motion and physiology is a rapidly developing field with the potential for providing detailed information on the mechanisms of disease processes and cardiac dysfunction. Models of cardiac function can incorporate geometry, motion, microstructure, nonlinear and anisotropic constitutive behaviour, loading conditions, and kinematic constraints.

Activation models comprise initiation and propagation of action potentials, calcium transients and cross-bridge activation and de-activation, active force generation and relaxation. Patient-specific biophysical parameters governing myocardial stiffness and contractility can be estimated by optimally matching the behaviour of these models to data from medical imaging. In this way, medical imaging examinations can be augmented with model-based interpretation and thereby provide new information on mechanisms of compensatory and decompensated adaptations. Today, structural and functional data on heart state and performance can be precisely quantified thanks to medical imaging, but each modality has unique advantages and disadvantages. Multi-detector computed tomography (CT) is a quick imaging technique that produces accurate 3D pictures with a 0.5 mm isotropic resolution. However, this procedure is not frequently utilised in regular examinations or evaluations of kids with congenital heart disease due to exposure to ionising X-ray radiation. With contemporary 3D transducers, echocardiography may capture more than 50 3D frames per second for a quicker and more affordable evaluation of function. This approach is however limited in many patients due to signal dropout brought on by weak acoustic windows, notably in the right heart [4,5].

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Conflict of Interest

The Author declares there is no conflict of interest associated with this manuscript.

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