Editorial

Quantitative cardiovascular imaging

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Cardiovascular disease is the leading cause of death in advanced countries and its prevalence is increasing among developing countries. Various imaging modalities are increasingly used in the diagnostic evaluation of cardiovascular disease, among which cardiac computed tomography (CT) angiography, cardiac MR, and echocardiography represent the most commonly performed imaging examinations in routine clinical practice, while nuclear medicine imaging such as cardiac single photon emission CT (SPECT) and positron emission tomography (PET) is also frequently used to provide functional assessment of cardiovascular disease (1-5). Quantitative analysis of cardiac images enables more accurate and reliable assessment of cardiovascular risk, and depiction of subtle changes. The goal of this special issue is to bring together experts in the field of cardiac imaging research to foster engagement across areas of cardiac imaging techniques and to identify novel applications to challenging cardiovascular problems. This special issue will give particular attention to contributions describing the state of the art, advantages and disadvantages, current limitations and future directions of the use of cardiac imaging modalities in the quantitative analysis of cardiovascular disease. The special issue has 15 papers consisting of 2 research articles, 7 review papers, 2 case reports, 2 commentaries, 1 images of the issue and 1 special report. Details of these papers are as follows.

Of two research articles, one is about comparative study between ECG-gated cardiac MR and transthoracic echocardiography (TTE) in the diagnostic assessment of aortic root dimensions (6). Hoey *et al*. in this retrospective study reviewed 68 patients who underwent both cardiac MR and TTE examinations over a period of 12 months. A good correlation was found between the two measurements with the mean aortic root dimension being 3.2±0.5 and 3.4±0.4 cm, corresponding to the measurement by TTE and MRI, respectively. Statistical analysis shows significant difference in the mean difference between TTE and MRI with MRI producing significantly higher aortic root dimension that that measured with TTE ($P<0.05$). Authors concluded that TTE results in underestimation of dilated aortic root dimension, while cardiac MR is recommended to be integrated into imaging assessment of patients with suspected aortic root disease, although further studies are required to verify their findings. Another research article by Cakmakci *et al*. studied low-dose CT protocol with low contrast volume in patients with non-cardiac chest pain (7). This prospective study included 45 patients with non-cardiac chest pain who were assigned to undergo CT angiography on a 128-slice CT scanner. A low-dose protocol of 80 kVp and 150 effective mAs was used in these patients with no heart rate control, but limited to the body mass index (BMI) of less than 25 kg/m^2. Diagnostic quality images were obtained in all patients with mean attenuation of 264 and 249 HU in the pulmonary truncus and ascending aorta, respectively. The mean effective dose was 0.83 mSv for CT angiography, showing the feasibility of such a low-dose protocol, although the study was only based on a small sample size and limited to patients with small BMI.

There are seven review articles with six focusing on cardiac MR in cardiovascular disease, while the remaining one provides a comprehensive review of the cardiac CT applications (8-14). The first article by Zhang *et al*. deals with an overview of recent progress in cardiac MR, the real-time MRI imaging of cardiac function (8). This review article covers technical developments of cardiac MR, image reconstruction by nonlinear inversion (NLINV) for

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generation of real-time cardiac MR, quantitative assessment of real-time cardiac MR and clinical applications of real-time MRI with inclusion of a number of high-resolution images showing the diagnostic advantages of real-time cardiac MR. Results from preliminary studies further confirm the superiority of real-time MRI and real-time phase-contrast flow MRI in the diagnostic evaluation of cardiac anatomy, function, and blood flow during free breathing without relying on ECG synchronization. More clinical studies are required to validate the clinical value of real-time MRI in cardiovascular disease. The second review article focuses on the increasing value of multi-parametric cardiac MR in the assessment of stable coronary heart disease and acute coronary syndromes (9). Authors in this review provide an evidence-based overview of the cardiac MR with use of multi-parametric protocols compromising T2 weighted imaging, stress and rest perfusion MRI, contrast-enhanced MRI and cine imaging for regional and global ventricular function assessment. Diagnostic and prognostic value of cardiac MR in coronary heart disease, and cardiac MR in the assessment of myocardial viability after acute coronary syndromes have been well discussed with support of literature review of studies conducted at multicentre sites.

The third review article by Jiang and Yu discussed the two commonly used cardiac MR techniques, namely, tissue tagging and displacement encoding with stimulated echoes (DENSE) with regard to their clinical applications in the quantitative assessment of regional myocardial function (10). The first part of this article focuses on technical details of cardiac MR for measurement of myocardial mechanics, while the second part of the article presents clinical applications of cardiac MR tissue tagging and DENSE in the measurement of regional wall motion in a number of cardiac diseases such as coronary artery disease, aortic stenosis, hypertrophic cardiomyopathy and muscular dystrophy. The fourth review article is contributed by Feng *et al*. who also discussed the quantitative cardiac MR research (11). However, this article is different from others as in this review authors provided a summary of their research development of cardiac MR based on rabbit models. In their preclinical research platform based on animal models with myocardial infarction, they have demonstrated the diagnostic value of cardiac MR in quantitative assessment of myocardial function and viability in the presence of myocardial infarction. In addition, advanced imaging techniques and novel methods for multifunctional images have been reviewed which may play a role in the development of new diagnostic and therapeutic approaches in cardiovascular disease.

The fifth article by Hoey *et al*. reviewed the diagnostic value of MRI in hypertrophic cardiomyopathy (12). Authors first reviewed the non-invasive imaging techniques comparing TTE with cardiac MR, followed by a summary of cardiac MR technique, including late gadolinium enhancement, clinical applications of cardiac MR in hypertrophic cardiomyopathy including risk stratification and screening. The last article on cardiac MR is contributed by He who focused on reviewing the cardiac MR T2* technique for the assessment of cardiac iron in patients with thalassemia major (13). Tissue iron assessment by cardiac MR T2* has been reviewed and T2* measurement technique explained, with current status and future directions being highlighted.

The last review article is a review of CT angiography in the diagnosis of cardiovascular disease (14). Authors in this evidence-based review showed how CT angiography played a significant role in changing the cardiovascular practice. Specifically, this article reviewed the diagnostic value of CT angiography in common cardiovascular abnormalities including abdominal aortic aneurysm, aortic dissection, pulmonary embolism and coronary artery disease with evidence of showing how CT angiography serving as the first line technique in most of these diseases. In addition, dose-reduction strategies were discussed to indicate that low-dose CT protocols are currently widely available with significant progress having been made in reducing radiation exposure to patients.

There are three case reports dealing with the clinical value of multislice CT angiography in the diagnosis of cardiovascular disease, confirming the reliability of CT angiography in making accurate clinical diagnosis (15-17).

In addition to the above-mentioned articles, this special issue also includes one special report and two commentaries (18-20). The special report by Zhang *et al*. provided independent views from a number of specialists with regard to the topic of whether clinicians in China should engage in research. Furthermore, opinions by researchers from USA and Europe are also provided in this special report. One of the commentaries is related to this special report, while another one discussing the topic of big data and clinical research in mainland China.

In summary, these 15 papers contributed by researchers with a wealth of knowledge in different research fields provide readers with valuable sources of information and examples on the recent progress in cardiac imaging research. We hope this special issue will serve as a platform

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for researchers, clinicians and healthcare professionals to collaborate on some research areas with the aim of promoting cardiac imaging research.

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