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SA Heart

Guest Editor, Ntobeko A.B. Ntusi

The Department of Medicine, University of Cape Town and Groote Schuur Hospital, Cape Town, South Africa. The Cape Universities Body Imaging Centre, University of Cape Town, Cape Town, South Africa. The Hatter Institute for Cardiovascular Research in Africa, Department of Medicine, University of Cape Town, Cape Town, South Africa.

Cardiovascular imaging in South Africa: challenges and opportunities

Over the last 50 years we have witnessed the development and proliferation of medical technology and clinical research which has significantly expanded the range of both cardiovascular diagnostic and research imaging. Importantly, these invasive and non-invasive imaging technologies, many of which have overlapping capabilities, have widened the cardiovascular clinical armamentarium available to the cardiologist, and non-cardiologist, for advanced diagnostic capacity, with greater accuracy, precision and reproducibility. The challenge, in many societies, is how the clinician, hospital manager and healthcare funder should respond to these constant advances in cardiovascular diagnostic capabilities in the development of treatment approaches meant to provide maximum benefit for the patient.

Chest radiography and echocardiography, through their wide availability, portability, affordability and relative ease of performance, are routine and first-line imaging modalities for many cardiovascular diseases. Echocardiography lends itself well to the assessment of cardiac function, chamber size, wall thickness, wall motion abnormalities, diastology and cardiac haemodynamics. Stress echocardiography is a robust tool for the assessment of myocardial ischaemia.

Coronary computed tomography (CT) angiography (CCTA) is the most rapidly developing imaging modality with evolution from a single slice CT to multislice CT, and now with easily available 128 and 320 slice scanners. CCTA is excellent for the visualisation of coronary anatomy and non-invasive assessment of obstructive coronary artery disease and coronary artery calcification. The diagnostic sensitivity of ≥64 slice CT has significantly improved and its greatest value is its high specificity and negative predictive value (both >99%), particularly in patients with low and intermediate probability of coronary artery disease (CAD), thereby preventing unnecessary invasive coronary angiography. The annual cardiac event in the general population with a negative CCTA study is <1%. Through iterative reconstruction and faster gantry rotation, the radiation dose of a CCTA examination is significantly reduced.

Cardiovascular magnetic resonance (CMR) provides excellent soft tissue contrast, ultrastructural phenotyping with the capacity for 3-dimensional imaging in any orthogonal plane, with high temporal and spatial resolution and without any ionizing radiation. CMR is the gold standard tool for the assessment of left and right ventricular volumes, mass and ejection fraction. Through its ability to characterise myocardial tissue, it provides valuable information about oedema,

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inflammation and both focal and diffuse myocardial fibrosis in patients with inflammatory heart disease, infiltration and scarring conditions. It is the ideal test for viability assessment. CMR stress perfusion imaging for assessment of inducible ischaemia is superior to other functional tests and provides greater resolution with a sensitivity and specificity in excess of 90%.

Myocardial perfusion imaging with stress gated single photon emission computed tomography (SPECT) is widely used in the diagnosis of CAD and is a well-established modality for noninvasive risk stratification with high diagnostic accuracy when compared to CCTA. The presence of ischaemia on SPECT imaging may be used to classify which patients may benefit from optimal medical therapy and which patients should be considered for revascularisation. Like CCTA, SPECT myocardial perfusion imaging may be seen as a gatekeeper to invasive coronary angiography. Likewise, a negative SPECT study has excellent prognostic predictive value with an annual cardiac event rate of <1%.

Cardiac positron emission tomography (PET) is also established for the assessment of ischaemia, blood flow quantification, inflammatory burden, myocardial viability and perfusion. Cardiac PET utilising 18F-fluorodeoxyglucose (FDG) is considered the most sensitive modality for the detection of hibernating, viable myocardium. PET images provide incremental prognostic information to the clinical and angiographic information as regards event-free survival in CAD assessment.

Invasive coronary angiography remains one of the most widely performed tests by general and interventional cardiologists in the assessment of suspected and known CAD. Fractional flow reserve (FFR) guidance has significantly improved the ability of clinicians to intervene on haemodynamically significant stenoses. The use of invasive imaging modalities, like intravascular ultrasound (IVUS) and optical coherence tomography (OCT), has improved the characterisation of coronary lesions and has been shown to improve interventions when used for planning and post-procedural assessment.

South Africa has a 2 tiered-health system: a public system which is chronically underfunded and woefully over-resourced, catering for about 48 million people on whom a third of the national health expenditure is spent; and a private health system, which consumes two-thirds of the health expenditure, while catering for less than 10 million members of the population. The country has about 160 qualified cardiologists, the vast majority of whom are employed in the private sector. Similarly, there is great mobility of cardiology clinical technologists, with many state technologists constantly relocating to the private sector, where salaries are much higher.

A greater collaboration between cardiologists in the public and private sectors needs to be established. The selection regarding which test to use to establish a diagnosis of abnormal cardiovascular function should be based on a broad perspective of expert knowledge of what each available modality can offer, what the advantages are and what the limitations of each test are. This is only possible if colleagues experienced in each imaging modality can collaborate fully. In this way choices are not constrained by knowledge and practice limited by a single technology. Similarly, experts in different imaging subspecialties should produce joint recommendations and guidelines from which shared diagnostic protocols can be developed and promulgated. Cardiovascular imaging practice should be based on clear, evidence-based research with a focus on establishing accuracy, reproducibility and safety. Importantly, the clinical use of diagnostic imaging technologies available in a cardiac unit and hospital should be coordinated through a joint service.

In North America and Europe there are well-established fellowship programmes for training in advanced cardiovascular imaging subspecialties. South Africa also needs to move towards joint educational programmes which rotate fellows training in cardiology through echocardiography, cardiovascular CT, CMR and nuclear cardiology. This training time should be scheduled and protected. Cardiology units and departments around the country need as many noninvasive experts as there are interventional cardiologists performing coronary interventions and electrophysiological studies.

Abraham Lincoln stated that "the best way to predict the future is to invent the future". I believe that cardiology in South Africa is on the edge of multiple possibilities, and it is up to us to choose what we want the future of cardiology and cardiovascular imaging, in particular, to look like in this country. The field of cardiovascular imaging will continue to advance at a rapid pace with advancements in imaging technology refinements, including high-end CT equipment, faster MR scanners, automated postprocessing, greater availability of 3-dimensional echocardiography, improved nuclear approaches, greater use of molecular imaging and miniaturisation of hand-held devices. Through research we will need to identify the best approaches for disease detection and management all the while focusing on safety, cost and accuracy. Experts in different imaging modalities will need to collaborate and not compete. The establishment of a joint service for both clinical management and training of fellows is important to the future of the profession.

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