Acta Cardiologica

ISSN: (Print) (Online) Journal homepage: www.tandfonline.com/journals/tacd20

Highlights of imaging heart structure and function

Patrizio Lancellotti, Adriana Postolache & Raluca Dulgheru

ACTA CARDIOLOGICA
2023, VOL. 78, NO. 4, 383–386
https://doi.org/10.1080/00015385.2023.2206690

EDITORIAL

Highlights of imaging heart structure and function

This issue of Acta Cardiologica is dedicate to imaging heart structure and function. Over the past few decades, we have witnessed a huge expansion in the arsenal of non-invasive imaging technologies capable of providing detailed information about the structure and function of the heart and vasculature. Cardiovascular imaging has thus become essential to achieving a better understanding of cardiovascular diseases. The use of imaging in clinical practice varies, mainly depending on the local availability of technology, expertise and funds and clinician's choice [1–5].

Echocardiography is routinely used in the diagnosis, management, and follow-up of patients with any suspected or known heart diseases. Echocardiography is non-invasive, easy to use and provides high resolution real-time imaging. Two-dimensional echocardiography (2DE) is the most standard form of echocardiography. 2DE is particularly useful for the proper assessment of the morphological and functional properties of the left ventricle (LV). Three-dimensional echocardiography (3DE) allows for a more accurate evaluation of left and right cardiac size and function. In clinical practice echocardiography is often complemented by cardiac magnetic resonance, cardiac computed tomography (CT), nuclear cardiology (single-photon emission tomography and positron emission tomography) to improve patient care [5–7].

Cardiovascular disease and cancer represent the two main causes of death in industrialised countries. In cancer patients, multimodality cardiac imaging is of paramount for the pre-therapy screening and risk stratification, as well as during therapy surveillance of cancer treatment-related cardiotoxicity [8]. Multiple imaging tools are also employed in the evaluation of cardiac masses [9–11] and to detect occult cancer as associated with cardiac and vascular diseases (e.g. atrial fibrillation, superficial or deep venous thromboembolism, pulmonary embolism, splanchnic vein thrombosis and infective endocarditis) [12].

Integrated multimodality approach is also required for the evaluation and management of complex congenital heart disease (Figure 1) [13,14].

Cardiac hypertrophy plays a vital role in cardiac remodelling. It is a critical stage in the development of cardiac structure and function from compensation to decompensation, as well as an independent risk factor for the increased prevalence and mortality of cardiovascular diseases. Early detection of the causes of cardiac hypertrophy using multimodality imaging is critical, considering the availability of the new treatment options in various cardiomyopathies [15]. In their editorial related to the paper of Kis et al. Luchian et al. reported that in 56.6% of the cases the aetiology of LV hypertrophy could be attributed to isolated arterial hypertension, followed by valvular heart diseases in 10.2% and hypertrophic cardiomyopathy in 9.2% of the patients [16,17]. Inhibition of Rho/ROCK signalling pathway related proteins can alleviate LV hypertrophy. In a rat model of myocardial hypertrophy, Kou et al. showed that berberine hydrochloride, a natural plant alkaloid, might inhibit pathological cardiac hypertrophy by regulating the Rho/ROCK signalling pathway [18]. Cardiac amyloidosis is a progressive infiltrative disease that causes myocardial thickening and dysfunction [2]. Tafamidis, which prevents the deposition of amyloid by stabilising transthyretin, is available for the treatment of neuropathy and cardiomyopathy of transthyretin amyloidosis (ATTR-CM). Tafamidis delays myocardial amyloid progression in ATTR-CM patients, resulting in structural, functional, and clinical benefits compared to the natural course [15,19]. Cardiac involvement is a major cause of mortality in sarcoidosis. Both size and function of the left atrium (LA) are powerful prognostic markers in a variety of clinical conditions. 3D echocardiography can better define the complex anatomy of LA with less geometric assumptions than 2D approach. Solmaz et al. showed that 3D-echocardiography derived LA function parameters were significantly impaired in patients with cardiac sarcoidosis [20]. In their editorial commentary, Asteggiano et al. pointed out that although these data need to be validated, the analysis of LA function could be integrated into the diagnostic work-up of patients with cardiac sarcoidosis [21].

Echocardiographic strain imaging can quantify regional and global myocardial function (longitudinal, radial, circumferential). Today, strain imaging, particularly global longitudinal strain, is an integral part of our routine clinical practice. Right ventricular longitudinal strain (RV-GLS) has recently demonstrated prognostic value in various cardiovascular diseases. In patients hospitalised for non-severe COVID-19 pneumonia, RV-GLS has been shown to improve significantly between acute disease and six-month after discharge. Interestingly, right atrial reservoir strain also improved in these patients [22]. RV myocardial work (MW) is a novel indicator to quantitatively analyse RV function. RVMW indices are acquired by integrating the RV-GLS, pulmonary artery pressures, and tricuspid and pulmonic valvular events by specific software. In their study, Wu et al. assessed the physiological determinants of RVMW and the reference ranges for normal RVMW indices in 263 healthy volunteers (median age: 34 years, males: 38%) (Figure 2) [23].

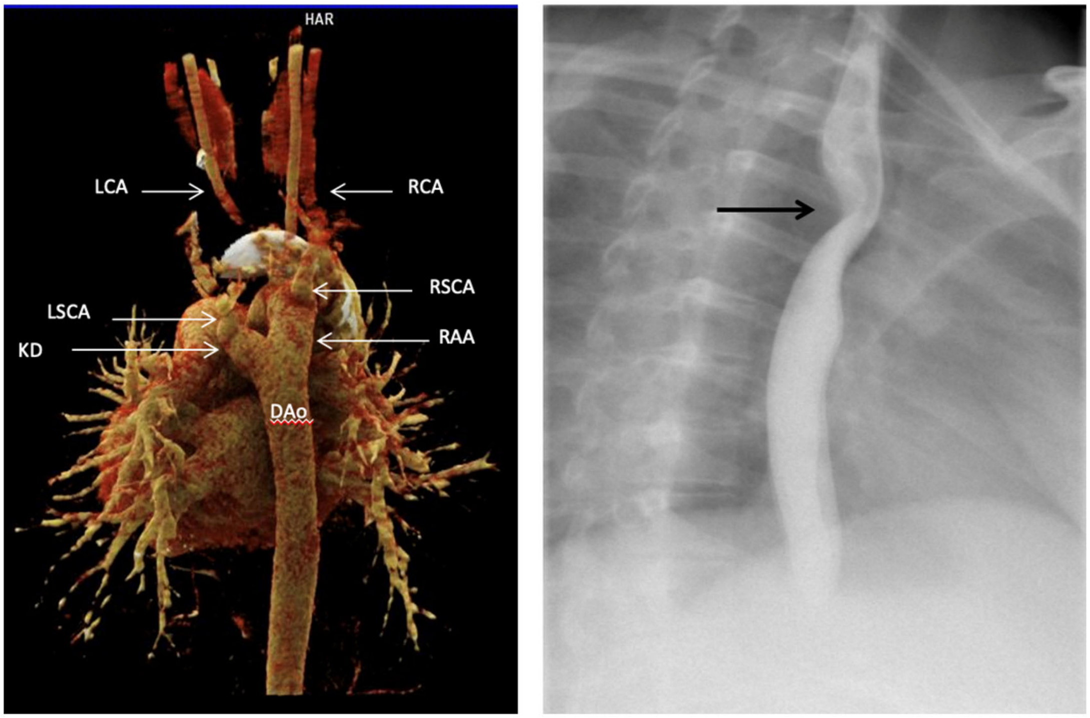

Figure 1. Right: 3D reconstruction of the computed tomography angiography of the aortic arch and the descending aorta. Posterior view of the right-sided aortic arch (RAA) with the origin of the right subclavian artery (RSCA) and the common origin of Kommerell diverticulum (KD) and the aberrant retro-oesophageal left subclavian artery (LSCA) and the right- (RCA) and left carotid arteries (LCA). DAo: descending aorta. Left: Barium swallow contrast radiography of the oesophagus showing a posterior oesophageal compression [13] (arrow).

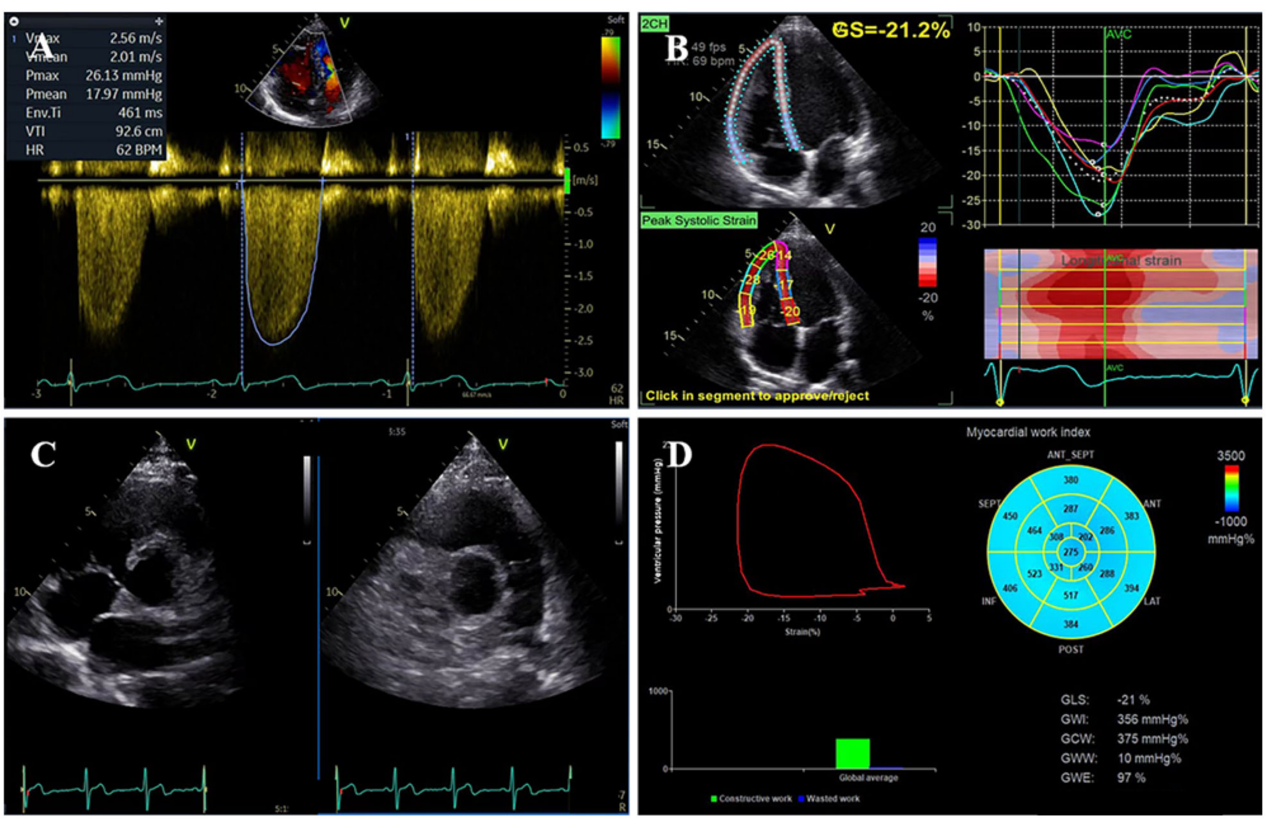

Figure 2. Tracing the tricuspid regurgitation velocity-time integral; (B) Analysis of speckle tracking echocardiography-derived right ventricular global longitudinal strain; (C) Evaluation of the event timings of the tricuspid valve and pulmonic valve in the parasternal short-axis views; (D) Measurement of right ventricular myocardial work by incorporating pulmonary pressures, right ventricular strain, and cardiac cycle timings [23].

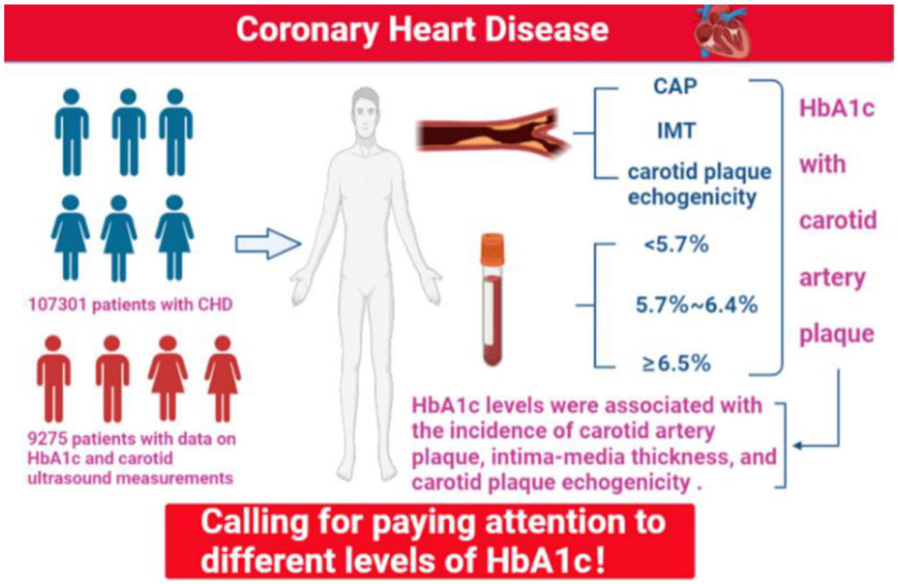

Figure 3. Relationship between HBA1c and carotid artery plaque (CAP) incidence, intima-media thickness (CMP), and plaque echogenicity [32].

Coronary flow reserve (CFR) is an integrated measure of coronary macro- and microvascular morphology and function and is defined as the ratio of hyperaemic coronary blood flow during maximum vasodilation of the coronary vascular bed to resting coronary blood flow [24,25]. Coronary flow velocity reserve is a surrogate of coronary flow reserve and offers information additive and complementary to standard regional wall motion analysis [26]. In elderly patients, Doppler coronary flow velocity scanning during routine echocardiography is a feasible and valuable tool for assessment of short-term prognosis [27]. The same group also showed that coronary velocity parameters provided long-term prognostic information in non-selected patients [28].

Improvements in ultrasound technology have enabled direct, transthoracic visualisation of long portions of coronary arteries: the left anterior descending (LAD), circumflex (Cx) and right coronary artery. 3DE is particularly interesting since it offers better visualisation of cardiac structures, which can be imaged in all dimensions as illustrated by Sánchez et al. in an image focus [29]. 3DE reconstruction of the atrium and valvular annulus can also be used to localise accessory pathway along the valvular annulus during catheter ablation [30]. Peri-coronary epicardial adipose tissue is related to cardiovascular risk factors and coronary artery calcification. In COVID-19 patients, Turker Duyuler et al. showed that epicardial and peri-coronary adipose tissue thicknesses measured with computed tomography were correlated to the severity of infection, suggesting a potential link into the physiopathology of COVID-19 [31]. Diabetes has been proved to be a risk factor for atherosclerosis and carotid artery plaques. HbA1c levels are positively associated with carotid atherosclerosis, as assessed by carotid intima-media thickness. In a large cohort of 9.275 Chinese adults with coronary heart disease, Cheng et al. showed that HbA1c levels were notably associated with carotid artery plaque incidence, intima-media thickness, and plaque echogenicity (Figure 3) [32].

Disclosure statement

No potential conflict of interest was reported by the author(s).

References

[1] Lancellotti P, Cosyns B. Highlights of acta cardiologica. Acta Cardiol. 2022;77(6):469–470.

[2] Lancellotti P, Petitjean H, de Marneffe N, et al. Focus issue on cardiomyopathies. Acta Cardiol. 2022;77(9):765–767.

[3] Lancellotti P, Petitjean H, Postolache A, et al. Focus on valvular heart disease. Acta Cardiol. 2022;77(10):861–863.

[4] Charbonneau E, Donal E, Nessler N, et al. Constrictive epicarditis in adult-onset still's disease. Acta Cardiol. 2023;78:468–471.

[5] Lancellotti P, Płońska-Gościniak E, Garbi M, et al. Cardiovascular imaging practice in Europe: a report from the European Association of Cardiovascular Imaging. Eur Heart J Cardiovasc Imaging. 2015;16(7):697–702.

[6] Piron S, Tridetti J, Marchetta S, et al. Freedom in the chest. Acta Cardiol. 2023;78:459–462.

[7] Zwaenepoel BAC, De Smet K, Schroeyers P, et al. Image focus: giant spontaneous pseudoaneurysm of the ascending aorta. Acta Cardiol. 2023;78:476–477.

[8] Lancellotti P, De Pauw M, Claeys M. Cardio-oncology: where do we stand for in Belgium? Acta Cardiol. 2021;76(2):204–208.

[9] Jacobs A, Gevaert T, Volders W, et al. Heart of lymphoma: a case report. Acta Cardiol. 2023;78:509–513.

[10] Audiat C, Anghel L, Duttmann R, et al. Rapidly growing cardiac hemangioma in a patient with tetralogy of fallot case report and brief literature review. Acta Cardiol. 2023;78:498–502.
[11] Yeni M. COVID-19 BNT162b2 mRNA vaccine induced myocarditis with left ventricular thrombus in a young male. Acta Cardiol. 2023;78:483–485.
[12] Seto J, Sehly A, Ryan T, et al. Occult malignancy in patients with pericarditis and concurrent cardiovascular diseases: a population-based cohort study. Acta Cardiol. 2023;78:505–508.
[13] Questiaux JF, Farhat N, Kempeneers C, et al. A late diagnosis of vascular ring: right-sided aortic arch with Kommerell diverticulum and aberrant left subclavian artery in an adolescent. Acta Cardiol. 2023;78:474–475.
[14] Zhou F, Zheng Z, Pan Y. Pulmonary artery dissection secondary to pulmonary hypertension due to patent ductus arteriosus: echocardiography and computed tomography findings. Acta Cardiol. 2023;78:478–479.
[15] de Marneffe N, Dulgheru R, Ancion A, et al. Cardiac amyloidosis: a review of the literature. Acta Cardiol. 2022;77(8):683–692.
[16] Kis M, Dogan Y, Yildirim A, et al. Evaluation of demographic, clinical, and aetiological data of patients admitted to cardiology clinics and diagnosed with left ventricular hypertrophy in Turkish population (LVH-TR). Acta Cardiol. 2022;12;1–10.
[17] Luchian ML, Motoc AI. Left ventricle Hypertrophy - What else is there? Acta Cardiol. 2023;78:503–504.
[18] Kou T, Luo H, Shen Y, et al. Effects of berberine hydrochloride on left ventricular structure and function in rats with myocardial hypertrophy. Acta Cardiol. 2023;78:433–441.
[19] Itzhaki Ben Zadok O, Kornowski R. 18-Month effect of tafamidis on the progression of cardiac amyloidosis evaluated according to a multiparametric expert consensus tool. Acta Cardiol. 2023;78:417–422.
[20] Solmaz H, Ozdogan O. Left atrial phasic volumes and functions changes in asymptomatic patients with sarcoidosis: evaluation by three-dimensional echocardiography. Acta Cardiol. 2022;77(9):782–790.
[21] Asteggiano R, Parrini I, Coletti Moia E, et al. Left atrial phasic volumes and functions changes in asymptomatic patients with sarcoidosis: evaluation by three-dimensional echocardiography. Acta Cardiol. 2023;78:495–497.
[22] Sonsoz MR, Guven G, Yildiz U, et al. Right atrial reservoir strain and right ventricular strain improves in patients recovered from hospitalization for non-severe COVID-19. Acta Cardiol. 2023;78:400–408.
[23] Wu J, Huang X, Huang K, et al. The noninvasive echocardiographic assessment of right ventricular myocardial work in a healthy population. Acta Cardiol. 2023;78:423–432.
[24] Lancellotti P, Petitjean H, Nchimi A, et al. Special issue on ischemic heart disease. Acta Cardiol. 2023;78(1):1–4.
[25] Picano E. Coronary flow velocity reserve with transthoracic echocardiography: a game changer. Acta Cardiol. 2023;78:491–494.
[26] Picano E. Coronary flow velocity at rest: a speed limit for a safe prognostic journey? Acta Cardiol. 2023;78:488–490.
[27] Zagatina A, Kalinina E, Caprnda M, et al. Prognostic value of doppler echocardiographic coronary flow velocity assessment at rest in elderly patients. Acta Cardiol. 2023;78:409–416.
[28] Zagatina A, Guseva O, Kalinina E, et al. Additive prognostic value of high baseline coronary flow velocity to ejection fraction during resting echocardiography: 3-year prospective study. Acta Cardiol. 2023;78:389–399.
[29] Sánchez ME, Corneli M, Garcia-Zamora S, et al. Evaluation of the circumflex artery with three-dimensional transesophageal echocardiogram prior to valvular surgery. Acta Cardiol. 2023;78:480–482.
[30] Robaye B, Caulier C, Collet B, et al. 3D reconstruction of the left atrium for precise localisation and ablation of accessory pathway. Acta Cardiol. 2023;78:472–473.
[31] Turker Duyuler P, Duyuler S, Demirtaş B, et al. Epicardial and pericoronary adipose tissue in severe COVID-19 infection. Acta Cardiol. 2023;78:451–458.
[32] Cheng X, Li Z, Yang M, et al. Association of HbA1c with carotid artery plaques in patients with coronary heart disease: a retrospective clinical study. Acta Cardiol. 2023;78:442–450.

Patrizio Lancellotti
Department of Cardiology, CHU SartTilman, University of Liège Hospital, GIGA Cardiovascular Sciences, Liège, Belgium
Gruppo Villa Maria Care and Research, Maria Cecilia Hospital, Cotignola, and Anthea Hospital, Bari, Italy
plancellotti@chuliege.be

Adriana Postolache and Raluca Dulgheru
Department of Cardiology, CHU SartTilman, University of Liège Hospital, GIGA Cardiovascular Sciences, Liège, Belgium