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**Editorial for 'Use of real-time cine MRI to assess the respirophasic variation of the inferior vena cava - Proof-of-concept and validation against transthoracic echocardiography'**

Lamb, H.J.

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# Editorial for “Use of Real-Time Cine MRI to Assess the Respirophasic Variation of the Inferior Vena Cava—Proof-of-Concept and Validation Against Transthoracic Echocardiography”

Cardiovascular MRI has a long-standing history, approximately starting in the mid-80s, and is a versatile imaging technique for evaluation of fetal, congenital, and adult cardiovascular disease. Last decades, cardiovascular MRI had to compete with cardiac ultrasound and CT techniques. Cardiac ultrasound is easily accessible and widely available in the cardiology clinic and can provide basic quantification of cardiovascular function and flow. CT is currently regarded as the gold standard for non-invasive evaluation of coronary artery disease, with a strong focus on anatomical imaging. Cardiovascular MRI is complementary by providing the possibility for dynamic evaluation of heart function, including 4D-flow quantification in fetal, congenital and adult heart disease. Cardiovascular MRI extends beyond possibilities of cardiac ultrasound, since it can also be applied for tissue characterization. Cardiovascular MRI has become a corner stone imaging technique for the diagnosis of complex (non-)ischemic heart disease.<sup>1</sup>

Until recently, cardiovascular MRI was the only non-invasive imaging technique available to provide insights in myocardial oedema, extracellular volume, and fibrosis. Recently, multiple publications have appeared describing similar capabilities of cardiac CT, so CT is catching up in this area as well.<sup>2</sup> Currently, CT is considered gold standard for assessment of coronary artery disease, more specifically for estimation of severity of coronary artery stenosis.<sup>3</sup> CT might also provide more detailed evaluation of plaque composition in the future using multi-energy photon counting CT.<sup>4</sup> On the other hand, cardiovascular MRI can provide a complementary full evaluation non-ischemic cardiomyopathy, including quantification of biventricular function, perfusion, (4D)flow and tissue characteristics, ranging from transient oedema in myocarditis to myocardial scarring in end-stage

heart failure.<sup>5</sup> Without the need for ionizing radiation, cardiovascular MRI can provide almost all desired clinical aspects of complex cardiovascular disease, making it a very efficient clinical decision maker. Recent developments aim to reduce overall acquisition time,<sup>6</sup> and a full cardiomyopathy evaluation of just 15 minutes door-to-door time is within reach for cardiovascular MRI.

The article by Bogaert et al. published in the current issue of JMRI<sup>7</sup> further expands the toolbox of cardiovascular MRI, with use of real-time cine to assess the respirophasic variation of the inferior vena cava. Evaluation of central venous pressure is important in the assessment of (right) heart failure or pulmonary hypertension and is similar to the approach with cardiac ultrasound. The current publication by Bogaert et al.<sup>7</sup> presents a proof-of-concept based on dynamic cardiovascular MRI to map the collapsibility index (CI) of the inferior vena cava (IVC) validated against transthoracic cardiac echocardiography.

Cardiovascular MRI assessment of CI works more or less similar to cardiac ultrasound, by studying the change in diameter of the upper part of the IVC during deep breathing. In addition, cardiovascular MRI was used to go beyond this well known parameter by assessing IVC area, as well as major and minor axis diameters. The targeted cardiovascular MRI acquisition only had a 15 sec scan duration. In total, 38 male elite cyclists were instructed to deeply breathe in and breathe out with a relatively rapid pace, i.e., approximately 3–4 sec per respiratory cycle. Using two transverse slices through the upper part of the liver, expiratory IVC size and inspiratory collapse could be assessed in all subjects. Cardiovascular MRI yielded similar expiratory IVC diameters as transthoracic ultrasound and significantly higher inspiratory collapsibility indices. Using a CI cut-off of more than 50%, excellent

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agreement was found between cardiovascular MRI and ultrasound. In addition to CI, cardiovascular MRI also provided quantification of IVC area, which may be a better alternative to evaluate IVC size and collapsibility, since the IVC has changing oval shape during breathing. IVC area assessment showed the highest intra-reader and inter-reader agreement.

Overall, real-time cine evaluation of the IVC for assessment of CI adds another tool to the already packed toolbox of cardiovascular MRI. The proposed approach only takes 15 sec acquisition time, so it has potential to be integrated into routine cardiovascular MRI protocols. Thereby providing additional valuable information about the presence of increased right heart filling pressures in patients for “free.”

### Hildo J. Lamb, MD, PhD, EBCR

Cardio Vascular Imaging Group (CVIG), Department of Radiology, Leiden University Medical Centre, 2333, Leiden, The Netherlands

E-mail: [h.j.lamb@lumc.nl](mailto:h.j.lamb@lumc.nl)

Address reprint requests to: H.J.L., Cardio Vascular Imaging Group (CVIG), Department of Radiology, Leiden University Medical Centre, Albinusdreef 2, 2333 ZA Leiden, The Netherlands. E-mail: [h.j.lamb@lumc.nl](mailto:h.j.lamb@lumc.nl)

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**Level of Evidence: 5**

**Technical Efficacy Stage: 1**