Archives of Cardiovascular Disease (2017) xxx, xxx—xxx

Available online at ScienceDirect www.sciencedirect.com

Elsevier Masson France EM|consulte www.em-consulte.com/en

REVIEW

Right ventricular strain in heart failure: Clinical perspective

*Déformation du ventricule droit (*strain*) dans l'insuffisance cardiaque : perspective clinique*

Marijana Tadic[a,*], Elisabeth Pieske-Kraigher[a], Cesare Cuspidi[b], Daniel A. Morris[a], Franziska Burkhardt[a], Ana Baudisch[a], Sabine Haßfeld[a], Carsten Tschöpe[a], Burket Pieske[a,c,d]

[a] *Department of cardiology, Charité-university-medicine Berlin, Berlin, Germany*
[b] *Clinical research unit, university of Milan-Bicocca and Istituto Auxologico Italiano, Meda, Italy*
[c] *Deutsches Zentrum für Herz-Kreislauf-Forschung (DZHK), Standort Berlin/Charité, Berlin, Germany*
[d] *Department of cardiology, Deutsches Herzzentrum Berlin (DHZB), Berlin, Germany*

Received 15 April 2017; received in revised form 2 May 2017; accepted 3 May 2017

KEYWORDS
Heart failure;
Reduced ejection fraction;
Preserved ejection fraction;
Right ventricle;
Strain

Summary The number of studies demonstrating the importance of right ventricular remodelling in a wide range of cardiovascular diseases has increased in the past two decades. Speckle-tracking imaging provides new variables that give comprehensive information about right ventricular function and mechanics. In this review, we summarize current knowledge of right ventricular mechanics in heart failure with reduced ejection fraction and preserved ejection fraction. We searched PubMed, MEDLINE, Ovid and Embase databases for studies published from January 2000 to December 2016 in the English language using the following keywords: ''right ventricle''; ''strain''; ''speckle tracking''; ''heart failure with reduced ejection fraction''; and ''heart failure with preserved ejection fraction''. Investigations showed that right

Abbreviations: CMR, cardiac magnetic resonance; FAC, fractional area change; GLS, global longitudinal strain; HFpEF, heart failure with preserved ejection fraction; HFrEF, heart failure with reduced ejection fraction; LV, left ventricle/ventricular; RV, right ventricle/ventricular; TAPSE, tricuspid annular plane systolic excursion.

* Corresponding author at: department of cardiology, Charité-university-medicine Berlin, campus Virchow Klinikum (CVK), Augustenburger Platz 1, 13353 Berlin, Germany.
E-mail address: marijana_tadic@hotmail.com (M. Tadic).

http://dx.doi.org/10.1016/j.acvd.2017.05.002

ventricular dysfunction is associated with higher cardiovascular and overall mortality in patients with heart failure, irrespective of ejection fraction. The number of studies investigating right ventricular strain in patients with heart failure with reduced ejection fraction is constantly increasing, whereas data on right ventricular mechanics in patients with heart failure with preserved ejection fraction are limited. Given the high feasibility, accuracy and clinical implications of right ventricular strain in the population with heart failure, it is of great importance to try to include the evaluation of right ventricular strain as a regular part of each echocardiographic examination in patients with heart failure. However, further investigations are necessary to establish right ventricular strain as a standard variable for decision-making.

MOTS CLÉS
Insuffisance cardiaque ;
Insuffisance cardiaque à fraction d'éjection ventriculaire gauche réduite ;
Insuffisance cardiaque à fraction d'éjection ventriculaire gauche préservée ;
Ventricule droit ;
Déformation (*strain*)

Résumé Le ventricule droit (VD) a été longtemps considéré comme une cavité cardiaque non indispensable, ne participant pas de façon active à la fonction cardiaque globale. Au cours des deux dernières décennies, le nombre d'études ayant établi le rôle du remodelage ventriculaire droit dans de nombreuses pathologies cardiovasculaires a augmenté. La technique échographique d'étude de la déformation myocardique par le Speckle (Speckle-Tracking Imaging [STI]) donne accès à de nouveaux paramètres permettant une description précise de la fonction ventriculaire droite et de la mécanique du VD. L'importance de la fonction VD chez des patients en insuffisance cardiaque a été confirmée ces dernières années. Les investigations récentes montrent que la dysfonction VD est associée à une augmentation du risque cardiovasculaire et de la mortalité chez des patients en insuffisance cardiaque, indépendamment de la FEVG. Le nombre d'études ayant investigué le *strain* VD (déformation) chez les patients en insuffisance cardiaque à FEVG réduite augmente de façon constante, tandis que les données concernant la mécanique VD dans l'insuffisance cardiaque à FEVG préservée restent limitées. En considérant la faisabilité, la précision et les implications cliniques de l'étude de la déformation VD dans l'insuffisance cardiaque, il est d'importance d'inclure l'examen des patients insuffisants cardiaques à l'aide de cette technique. Cependant, des investigations supplémentaires sont nécessaires pour confirmer que le *strain* VD est un paramètre indispensable ou utile à la prise d'une décision concernant le traitement et l'éventuelle indication d'une transplantation cardiaque. De plus, les études longitudinales évaluant l'importance prédictive de ce paramètre, la déformation VD, dans le groupe d'insuffisance cardiaque à FEVG préservée restent nécessaires. L'objectif de cet article est de réaliser une revue générale des principes d'étude de la mécanique ventriculaire droite et de résumer les principales études cliniques du *strain* VD dans l'insuffisance cardiaque.

Background

Right ventricular (RV) remodelling has been neglected for a long time because the right ventricle (RV) was considered a dispensable cardiac chamber with no influence on overall outcome in cardiac patients. This can be explained largely by the limited number of imaging techniques available for RV visualization. The position of the RV in the chest and its complex shape significantly limit the echocardiographic approach, which is why cardiac magnetic resonance (CMR) imaging is the ''gold standard'' technique for RV evaluation. However, the introduction of new echocardiographic methods has significantly improved our ability to assess RV volumes and function [1]. Three-dimensional echocardiography enables accurate evaluation of RV volumes and ejection fraction, with results that are similar to CMR measurements [2], whereas two-dimensional speckle-tracking imaging provides reliable assessment of RV mechanical changes, with results that are also similar to those achieved with CMR [3,4].

Given these facts, echocardiography is the first choice for evaluation of RV structure, function and mechanics in a wide range of cardiovascular diseases. Previous studies have already shown the predictive importance of RV function and mechanics in patients with heart failure [5]. However, there is still plenty of scope for research into the role of RV remodelling in patients with heart failure with reduced (HFrEF) and preserved ejection fraction (HFpEF). Especially important would be findings regarding a therapeutic approach that improves RV and left ventricular (LV) function and reduces mortality in patients with heart failure.

The aim of this review was to summarize current knowledge about RV mechanics in HFrEF and HFpEF.

Please cite this article in press as: Tadic M, et al. Right ventricular strain in heart failure: Clinical perspective. Arch Cardiovasc Dis (2017), http://dx.doi.org/10.1016/j.acvd.2017.05.002