The Egyptian Heart Journal (2014) 66, 217–225

HOSTED BY

Egyptian Society of Cardiology

The Egyptian Heart Journal

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REVIEW

Echocardiographic assessment of left ventricular mechanical dyssynchrony – A practical approach

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Received 8 June 2013; accepted 6 August 2013
Available online 17 September 2013

KEYWORDS

Ventricular dyssynchrony;
Echocardiography;
Tissue Doppler;
Heart failure;
Three-dimensional echocardiography

Abstract Echocardiographic assessment of left ventricular mechanical dyssynchrony (LVMD) received great interest with the appearance of Cardiac resynchronization therapy ever since the first successful implants. Recent guidelines still keep QRS duration as the main selection criterion for diagnosing the presence of LVMD. However, measurement of QRS duration, which is an electrical phenomenon, seems to provide only a crude estimate on myocardial activation and is poorly correlated with the presence of LVMD. Echocardiography seems to be a more reliable tool for correctly identifying candidates for CRT and thus reducing the number of clinical non-responders.
Recently LMVD was found to be associated with other cardiac and noncardiac diseases. Therefore, echocardiographic assessment of LVMD will always remain of importance.
The aim of this article is to present a simplified, step-wise approach for the assessment of LVMD which can be easily followed and performed by echocardiographers to produce reliable, reproducible results for the assessment of LVMD.

Contents

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[1] Accredited by the European Association of Echocardiography for the practice of adult trans-thoracic echocardiography (2012–2017)
Peer review under responsibility of Egyptian Society of Cardiology.

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http://dx.doi.org/10.1016/j.ehj.2013.08.002

1. Introduction

Echocardiography has played an essential role in Cardiac resynchronization therapy (CRT) ever since the first successful implants whether it was for the estimation of left ventricular ejection fraction (LVEF), LV volumes, grade of mitral regurgitation, etiology of heart failure (HF), or the assessment of left ventricular mechanical dyssynchrony (LVMD). In recent guidelines, QRS duration still remains the main selection criterion for diagnosing the presence of LVMD in clinical practice. This is mainly because the large prospective, randomized trials solely relied on the QRS width as the only marker for dyssynchrony.[1] However, measurement of QRS duration, which is an electrical phenomenon, seems to provide only a crude estimate on myocardial activation and is poorly correlated with the presence of mechanical dyssynchrony.[2]

In spite of the promising results of the randomized clinical trials, analysis of individual responses revealed that 20–30% of patients did not respond to CRT.[3]

In contrast, echocardiography allows the severity of mechanical dyssynchrony and its impact on cardiac hemodynamics to be assessed in a quantitative manner. It therefore seems to be a more reliable tool for correctly identifying candidates for CRT and thus reducing the number of clinical non-responders.[4]

At first glance, echocardiographic assessment of LVMD seems to be time consuming, requiring special expertise, and the optimal protocol for dyssynchrony assessment has not yet been defined. However, important information about the presence and severity of dyssynchrony can be obtained from conventional echocardiographic techniques and dyssynchrony assessment can be easily integrated into daily routine practice.[1]

The role of echocardiography in assessing LVMD in CRT patients remains controversial to date. The Predictors of Response to Cardiac Resynchronization Therapy (PROSPECT) trial examined the predictive value of many echocardiographic parameters of dyssynchrony (Doppler, M-mode, tissue Doppler imaging [TDI], and delayed longitudinal contraction) on LV reverse remodeling and composite clinical score. It concluded that given the modest sensitivity and specificity in this multicenter setting despite training and central analysis, no single echocardiographic measure of dyssynchrony may be recommended to improve patient selection for CRT beyond current guidelines.[5] However, another study from three experienced centers in dyssynchrony assessment reproduced a positive role for TDI. In that study, three parameters derived from 12 LV segments and septal-to-lateral wall delay predicted LV reverse remodeling and improvement of LV ejection fraction.[6]

Three different levels of dyssynchrony can be distinguished by echocardiography: (1) **Atrioventricular dyssynchrony:** delayed ventricular activation in relation to the atria owing to prolongation of the PR interval. (2) **Interventricular dyssynchrony:** delayed onset and end of LV systole due to delayed LV electrical activation in comparison to the RV. (3) **Intraventricular dyssynchrony:** delayed activation of some LV segments with prolonged contraction after aortic valve closure.[7]

The first two levels can be easily identified by conventional echocardiography. Tissue Doppler tissue imaging (TDI) is currently regarded as the most sensitive technique for quantification of intraventricular dyssynchrony.[1]

2. Aim

The aim of this article is to present a simplified, step-wise approach for the assessment of LVMD which can be easily followed and performed by echocardiographers to produce reliable, reproducible results for the assessment of LVMD.

3. Review

Echocardiographic measurements of LVMD that will be reviewed in detail in this article are:

1. Septal-to-posterior wall motion delay (SPWMD).
2. Inter-ventricular mechanical delay (IVMD).
3. Tissue Doppler tissue imaging indices:
   a. Mechanical dyssynchrony index/Yu index.
   b. Maximal difference in Ts.
   c. Basal septal-to-lateral wall Ts.
4. Systolic dyssynchrony index (SDI-16).

Table 1 lists all these measurements of LVMD with their normal values, cut-off values for the presence of LVMD, advantages and disadvantages.

All measurements of LVMD listed in this article are in concordance with the recommendations for performance and reporting of the American Society of Echocardiography Dyssynchrony Writing Group.[11]

4. Preparation

The echocardiographer should start by properly preparing both the patient and the echocardiography machine in order to enhance the quality of acquired images and loops which will facilitate analysis later on. This is achieved by doing the following: