Electrical and mechanical dyssynchrony in patients with right bundle branch block

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The prevalence of Right Bundle Branch Block (RBBB) as seen in a routine electrocardiogram is about 3 to 5 % of the general population. Patients with RBBB have specific signs of conduction delay seen on ECG with wide QRS (electrical dyssynchrony). RBBB may be associated with some anatomical heart disease and some with arrhythmias. Although the majority of patients with RBBB on ECG have fairly benign reputation, in some reports, RBBB is an independent predictor of cardiovascular mortality as well as all-cause mortality.^{1–3} Moreover, the new onset of RBBB predicts a higher rate of coronary artery disease, congestive heart failure, and cardiovascular mortality. When cardiac disease is present, the coexistence of RBBB suggests an advanced disease.¹ One of the mechanisms for heart failure is that RBBB can cause left ventricular mechanical dyssynchrony (LVMD). The LVMD might be interventricular, intraventricular, or both. Several articles showed some correlation with electrical activation.^{4–7} Still, the relationship between electrical disturbance and LVMD is partly unclear among these patients with RBBB.

However, patients with RBBB may have as well LVMD with or without LV dysfunction. The relevance of LVMD in patients with RBBB and LV dysfunction is in applying those patients for cardiac resynchronization therapy (CRT).

The major indication for CRT is in patients with LBBB with QRS width above 120 msec and LV

dysfunction and heart failure.^{8–10} The importance of LVMD in those patients with LBBB has been vastly studied by several imaging modalities especially by echo-Doppler, and also by MRI and phase analysis by GATED SPECT MPI.^{8–12} LVMD in LBBB is part of the guidelines in selection of patients for CRT.

Several studies compared the efficiency of LVMD in LBBB compared to RBBB. The first study on dogs by MJ Byrne et al found that less LVMD is induced by RBBB than in LBBB in failing hearts as such the impact of CRT on these dogs is reduced.⁸

RBBB was studied in patients with impaired LV function. It was found that patients with increased time difference (TD) of septal-lateral activation by echo-Doppler, improved clinically after CRT.⁴

However in a large study on 561 consecutive patients who received CRT, 89 (16%) patients had RBBB. LV dyssynchrony was assessed by tissue echo-Doppler, before and 6 months after CRT. The authors found that at long-term follow-up, LVMD and mitral regurgitation were identified as independent predictors of all-cause mortality and heart failure hospitalization among RBBB patients.¹² As such assessment of LVMD may have a crucial decision in the treatment of CHF patients with RBBB by selecting CRT as a preferable treatment in addition to medical therapy.

Most of those studies assessing the LVMD in patients with RBBB were done by echo-Doppler. Although there are many publications on LVMD including different clinical subsets by phase analysis and SPECT MPI,^{10–17} the issue on patients with RBBB specifically has not been evaluated.

In this issue of the Journal of Nuclear Cardiology, Sillanmaki et al.¹⁸ studied patients with RBBB by vector electrocardiography (VECG) compared to the control group. They investigated LVMD by phase analysis from gated SPECT MPI. Reviewing the literature, it is the first study that investigates LVMD by phase analysis SPECT MPI specifically in patients with RBBB on vector ECG.

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They studied 30 patients with RBBB and 60 matching controls with vector electrocardiography and myocardial perfusion imaging (MPI) phase analysis. RBBB group was divided into those with and those without LVMD measured by phase standard deviation (SD) and histogram bandwidth (BW).

They found that the prevalence of LVMD among RBBB patients was 50% and among controls 22%. Odds ratio (OR) for LVMD in patients with RBBB vs. controls without RBBB was 3.6 (95% CI 1.4 to 9.3). Ejection fraction (EF), end-systolic volume, the angle between QRS and T vectors, and the QRS angle in the sagittal plane were significantly different between RBBB patients with and without LVMD. The QRS width duration was comparable in these groups. LVEF was associated independently with LVMD explaining 60% of its variation. A cut-off value of $LVEF \leq 55\%$ was detected in LVMD with 100% specificity and 47% sensitivity.

The merits of the study are: (1) Showing that LVMD exists in about 50% of patients with RBBB while QRS width was comparable in all these patients. (2) It seems that EF, rather than electrical parameters, is the main determinant of LVMD.

However, there are significant disadvantages: (1) A small group of RBBB patients was studied and therefore results should be confirmed in a larger group. (2) The results of LVMD better to be calculated from normal local database, thus, abnormal values will be considered as 2 Standard Deviation above normal values. (3) Regarding LVEF, it seems that the majority of the patients were in the normal range of $\geq 55\%$ and only 11% were with $LVEF < 40\%$ which might be relevant for CRT. In spite of all these limitations, this article demonstrated that substantial number of patients with RBBB have LV mechanical dyssynchrony which is correlated with reduced LV function. This information might be useful when evaluating indications for cardiac resynchronization therapy. However, larger group of RBBB patients with and without LV dysfunction should be studied, in order to appreciate the usefulness of LVMD in selection of patients for CRT.

Of note, gated SPECT MPI and phase analysis is a useful comprehensive cardiac imaging that supplies an accurate and reproducible assessment of myocardial ischemia and scar as well as systolic, diastolic function and LVMD. All these variables have crucial value in assessing patients with heart failure with or without LBBB or RBBB for therapeutic decision including CRT.

Disclosure

The authors declare that they have no financial conflicts of interest.

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