Mechanical Versus Electrical Dissynchronism in Patients with Heart Failure

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Background: Despite the existence of significant correlation between the mechanical and electric dissynchronism, it is widely known that these two types of dissynchronisms are quite different and there are a number of reasons why mechanical dyssynchronism might be an important variable to measure in addition to electrical dyssynchronism.

Objective: The objective of study was to highlight a group of patients with impaired systolic function who suffer from mechanical dissynchronismin in absence of evident electric dissynchronism (narrow QRS) and who might represent a target group for cardiac resynchronization therapy (CRT).

Materials and methods: We enrolled in study patients with heart failure, NYHA class II-IV and ejection fraction (EF) under 35%, admitted to the Cardiology Department of Internal Medicine Clinic IV. Patients were divided in two groups, according to the duration of QRS complex – one group with wide (≥120 ms) and another one with narrow QRS complex (<120 ms).

Results: Overall, 73.7% of patients had positive criterias for intraventricular dissynchronism - appreciated with ultrasound measurment of septal-to-posterior wall motion delay (SPWMD >130 ms). 10 patients had narrow QRS and 28 had wide QRS. In the wide QRS complex group we found intraventricular dissynchronism at 85.7% of patients, while 14.28% had normal SPWMD. 40% of patients with EF < 35% and narrow QRS had intraventricular dissynchronism.

Conclusions: The duration of QRS complex seems to be an insensitive indicator of ventricular dissynchronism, hence the ultrasound evaluation is recommended for better selection of candidates for CRT.

Keywords: mechanical dissynchronism, electrical dissynchronism, heart failure, CRT

Introduction

There is a statistically significant correlation, between the presence of ventricular dissynchronism (mechanical dissynchronism) and the prolonged QRS complex (electric dissynchronism), proven by multiple studies [1,2]. Despite the existence of this significant correlation between the mechanical and electric dissynchronism, it is widely known that these two types of dissynchronisms are quite different [3,4].

There are a number of reasons why mechanical dyssynchronism may be an important variable to measure in addition to electrical dyssynchronism [3].

Firstly, the QRS duration is only a surface electrocardiogram (ECG) summation of the time required for all ventricular depolarization. This includes electrical activity in the right ventricle (RV) and generally does not provide detail on the timing of activation of different regions of the left ventricle (LV). Some areas of electrical conduction in the LV may not show up as electrical activity on the surface ECG. Secondly, although electrical activity is essential for systolic heart function, it is only an early step in the process. Coordinated myocardial contraction is what moves blood across the aortic valve and there can be regional and variable delays in electromechanical coupling. Thirdly, QRS duration has not uniformly predicted response to cardiac resynchronization therapy (CRT). Fourthly, measurement of mechanical dyssynchronism may have great value in helping to better understand the mechanism of action of CRT. Finally, measurement of mechanical dyssynchronism can be of value in clinical decisions related to the treatment of patients with heart failure (HF) and/or CRT such as selection of patients for CRT, lead placement, assessing response to CRT and optimizing pacemaker settings or physiological tailoring of CRT to the individual patient [3].

Materials and methods

The aim of study was to highlight a group of patients with impaired systolic function who suffer from mechanical dissynchronism in absence of evident electric dissynchronism (narrow QRS) and who might represent a target group for CRT along those with evident electrical dissynchronism.

We enrolled in study patients with heart failure NYHA class II–IV and ejection fraction (EF) under 35%, admitted to the Cardiology Department of Internal Medicine Clinic IV Tîrgu Mures, from September 2010 till January 2011 for specific treatment of the acute heart failure (authors own cases).

A total of 38 patients with acute heart failure and ejection fraction under 35% were prospectively evaluated. We followed the ECG and echocardiography parameters and the patients were divided in two groups, according to the duration of QRS complex – one group with wide (≥120 ms) and another one with narrow QRS complex (<120 ms).

The ventricular dissynchronism was appreciated measuring the septal-to-posterior wall motion delay (SPWMD) parameter with an Aloka Prosound α10 ultrasound. The LV systolic function was determined using Simpson's method.

Table I. Basic clinical characteristics

	Narrow QRS	Wide QRS
Male (%)	23.52	76.47
Age (years)	52.60	71.42
Ischemic cardiopathy (%)	7.14	92.85
EF (%)	13	25.3

Statistical analysis of data: The prevalence of mechanical dissynchronism was highlighted at patients with electrical dissynchronism. We used for statistical analysis Graphpad InStat 3.06, Kolmogorov-Smirnov goodness-of-fit and Fisher's exact test.

Results

The pacients were predominantly male (89.4%) and the average age was 65.4 yrs. The main underlying cardiomyopathy was cardiac ischemia (73.68%). We found dilated stage of underlying cardiomyopathy (LV >55 mm) in 68.4% of the cases. The studied group had systolic dysfunction, measured using the ejection fraction (EF), with a mean value of 23.33%. 33.3% of the patients were pacemaker wearers, with the probe placed in right ventricle. 28 patients were identified with prolonged ventricular depolarization (QRS ≥120 ms) on the surface ECG, performed in emergency, at the time of admission to hospital for acute congestive heart failure.

Overall, 73.7% of patients had positive criterias for ventricular dissynchronism (SPWMD >130 ms).

Patients were divided in two groups, according to the duration of QRS complex – one group with wide (≥120 ms) and another one with narrow QRS complex (<120 ms). The prevalence of ventricular dissynchronism (SPWMD >130 ms) was analyzed for each group.

In the wide QRS complex group we found intraventricular dissynchronism at 85.7% of patients, while 14.28% of patients had segmental function with maintained synchronism, the association not being statistically significant (p = 0.084). However, ventricular dissynchronism was present also at pacients with narrow QRS complexes (p = 0.084). Measuring SPWMD we found normal ventricular synchronism at 60% of patients with narrow QRS complex and ventricular dissynchronism at 40% of these patients.

Discussions

85.7% of patients with heart failure NYHA class II–IV, LV EF <35% and wide QRS had ventricular dissynchronism, but 14.28% of patient from this group did not have ventricular dissynchronism. So, they would not have had any benefits from cardiac resynchronization therapy. This group might represent the non-responders group. Similar results can be found in the speciality literature where aproximately 20% of patients with EF <35% and duration of QRS >150 ms do not show proof of LV mechanical dissynchronism [9,10].

Table II. The prevalence of ventricular dissynchronism

	Narrow QRS	Wide QRS
SPWMD <130 ms	6	4
SPWMD >130 ms	4	24

An important part of the group (40%) of patients with heart failure NYHA class II-IV, LV EF <35% and narrow QRS had ventricular dissynchronism. Similar results can also be found in other studies [3,4,5,6,7,8] using different evaluation techniques (TVI, OWD, SDI). At approximately 50% of patients with heart failure and the duration of QRS complex < 120 ms a mechanical ventricual dissynchronism can be shown [3-11] and these patients will show clinical improvement after CRT.

Conclusions

1. There is a group of patients with narrow QRS complex (without electrical dissynchronism), that presents an important mechanical dissynchronism at ultrasound evaluation. This group might represent a target group for CRT. Thereby, using the duration of QRS as exclusive selection criteria of patients for CRT in the absence of ultrasound criteria, ignores a number of patients with narrow QRS who yet might benefit from CRT.
2. The group of non-responders to CRT might be consisting of those patients who presents electrical dissynchronism (large QRS) in the absence of mechanical dissynchronism.
3. The duration of QRS complex seems to be just an insensitive indicator of ventricular dissynchronism. The ultrasound evaluation is an important additional method for a better selection of candidates for cardiac resynchronization therapy.

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