The Significance of New Left Bundle Branch Block Complicating Acute Myocardial Infarction

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The aim of our study was to evaluate the impact of new LBBB on left ventricular systolic function and arrhythmic risk in patients with acute myocardial infarction and unicoronarian lesion. We prospectively studied the patients with acute myocardial infarction with and without LBBB and unicoronarian lesion after a mean of 16.51 ± 2.41 months from the onset of acute coronary event. We observed a higher risk of ventricular premature beats and left ventricular systolic disfunction in patients with left bundle branch block. Also, the presence of left bundle branch block ($F = 3.64$; $p < 0.005$; partly $\eta^2 = 0.33$) and the duration of the QRS complex ($F = 4.17$; $p < 0.005$; partly $\eta^2 = 0.36$) was statistically significantly correlated with the value of left ventricular ejection fraction. Almost a double number of patients with left bundle branch block had an ejection fraction below 30%, despite an early revascularization. Patients with acute myocardial infarction and left bundle branch block represent a relatively small group but with an increased risk of malignant ventricular arrhythmias and left ventricular systolic dysfunction, and they should therefore benefit from a promptly and appropriately treatment in order to improve long term outcome.

Keywords: left bundle branch block, acute myocardial infarction, prognostic, prospective study.

By acute and chronic complications, the high rate of morbidity and mortality, the coronary artery disease has become an important socio-economic problem, the costs imposed by this pathology worldwide being extremely high [1,2]. Romania is currently on the ascending trend in the incidence of coronary artery disease, which is revealed in the latest data from the SEPHAR II study [3].

The presence of a new left bundle branch block on a 12-lead electrocardiogram provides prognostic informations and also poses challenges in therapeutic management of patients with acute myocardial infarction. The diagnosis of MI in the setting of LBBB is especially challenging by ECG. Because left ventricular activation is delayed in LBBB and the initial septal activation is from right to left (opposite of the normal situation), septal Q waves indicative of an MI are absent. Additionally, secondary ST-T wave abnormalities that occur in LBBB obscure the recognition of injury currents in ischemia and infarction.

To limit the adverse consequences of this disease, it is required a complex approach in the management of these patients, including aggressive strategies for prevention and early diagnosis [4].

In this clinical and epidemiological context, we conducted a prospective study in order to evaluate the clinical, therapeutic and prognostic significance of new left bundle-branch block occurred in patients with acute myocardial infarction.

Experimental part

In order to evaluate the significance of left bundle branch block on ventricular systolic function and arrhythmic risk in patients with acute myocardial infarction and unicoronarian lesion, we evaluated the patients with acute myocardial infarction with or without left bundle-branch block, hospitalized in our clinic for three years. Between January 2011 to December 2013 in Georgescu Institute of Cardiovascular Disease Ia°i were hospitalized 387 patients with acute myocardial infarction and one coronary lesion and a sum-total of 82 patients were included in the study. According to the presence of new left bundle branch block, they were divided into two groups:

- 42 patients with acute myocardial infarction and new left bundle branch block;

-42 patients with acute myocardial infarction without left bundle branch block.

All these patients included in the study were prospectively studied after a mean follow-up of 16.51 ± 2.41 months, in order to asses their symptoms, biological and echocardiographic characteristics.

All ECGs were reviewed to determine whether criteria for ST-segment elevation or new LBBB are present. All patients with new LBBB have either a documented new LBBB, or new ECG changes or there was no prior ECG to compare and it was 'presumed new' in the setting of ischemic symptoms. LBBB was defined as a QRS duration greater than 120 ms in the presence of a sinus or supraventricular rhythm, a QS or rS complex in lead V1, R wave peak time of more than 60 ms with the absence of Q waves in leads I, V5 or V6. The ECGs were analyzed using the Sgarbossa Criteria for STEMI in the presence of LBBB, defined as the presence of one of the following criteria: ≥ 1 millimeter concordant ST elevation; ≥1 mm ST depression in V1, V2, or V3; or the ratio of the ST segment to the S wave being > 25% [4].

Statistical analyses were performed using the Statistical Program for Social Sciences (version 17.0 SPSS Inc.). Data were labeled as nominal or quantitative variables. Nominal variables were described using frequencies. Quantitative variables were tested for nominality of distribution by means of Kolmogorov-Smirnov test and were described by median and percentiles or by mean and standard deviation, whenever the case. The frequencies of nominal variables were compared with a chi-square test. Differences in the means and medians or between groups were analyzed using t-test or Mann-Whitney test when appropriate. Comparisons were made among patients with acute myocardial infarction and left bundle branch block and those with acute myocardial infarction without left

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bundle branch block. A value of $P<0.05$ was considered significant. Patients were informed about the study and their written, informed consent was obtained. Institutional review board approval was obtained for data collection, follow-up, and data analysis.

Results and discussions

Patients with acute myocardial infarction and new left bundle branch block, had a higher mean age at onset of the acute coronary event compared with patients in the control group, with a statistically significant differences between the two groups (67 ± 9.31 vs. 58 ± 10.39 years, p=0.007).

We observed a higher number of male patients with acute myocardial infarction without left bundle branch block (p=0.005) (fig.1).

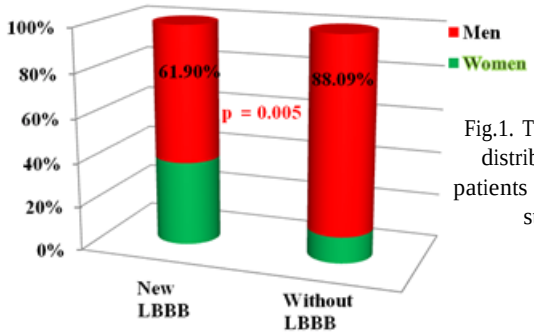

Fig.1. The gender distribution of patients included in study

Patients with acute myocardial infarction and new left bundle branch block had a more frequent history of coronary artery disease, hypertension, diabetes mellitus, obesity and dyslipidemia, but without statistically significant differences between the two groups. In our study we also observed that more than half of patients without left bundle branch block were smokers or former smokers (57.14%), compared with a rate of 35.71% for those with left bundle branch block, but without statistically significant differences between the two groups of patients (p = 0.076).

If in the onset of coronary event almost half (46.42%) of patients included in the study were smokers, at the control visit 82.15% of patients were no longer smokers.

We observed a significant reduction of the body mass index in both study groups, but without statistically significant differences between patients with and without left bundle branch block (p = 0.782).

We also observed a significant reduction in lipid profile values in the control evaluation as compared to the initial values. However, only 20 patients with left bundle branch block and 15 patients in the control group reached the target LDLc, respectively ≤ 70 mg/dL or more than 50% reduction from baseline.

We evaluated the left ventricular systolic function of our patients according to the value of the ejection fraction. Patients with new left bundle branch block had no impaired left ventricular systolic function or whether it was present it was not significant. In contrast, patients from the control group had a moderate left ventricular systolic dysfunction, 64.28% had an ejection fraction between 30-50%. In assessing control, we noticed an increase number of patients with severe systolic dysfunction, especially those with left bundle-branch block. Thus, almost a double number of patients with left bundle branch block had an ejection fraction below 30%, despite an early revascularization in these patients compared with those in the control group, the differences being statistically significant, p = 0.001 (fig.2).

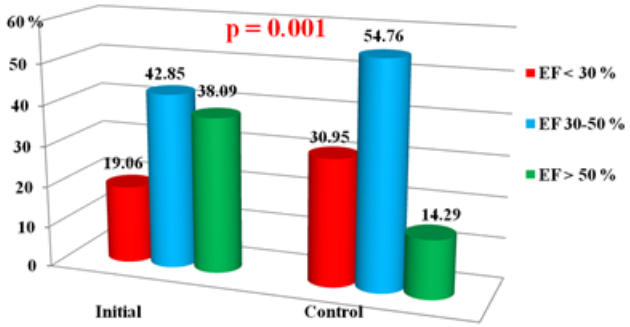

Fig. 2. Left ventricular systolic function in patients with myocardial infarction and left bundle branch block: initial vs. control assessment

In contrast, in patients with acute myocardial infarction without left bundle branch block, we observed a significant improvement of left ventricular systolic function (9 vs. 24 patients in control assessment having an ejection fraction > 50%).

In terms of the interval from the onset of symptoms to coronary angiography, we observed that most patients (64.28%) in the control group had a late presentation, to over 10 h of the onset of symptoms, but without statistically significant differences between patients (p = 0.290). Angiographic data were obtained from the catheterization laboratory report and the culprit lesion as determined by the interventional cardiologist defined the coronary artery responsible for the STEMI. In most of the cases, the culprit lesion was localized on the left descendent artery in both groups, but without statistically significant differences (54.77% vs. 69.12% in control group, p = 0.131).

Assessing the medication given within 24 h of hospitalization, we observed that patients with left bundle branch block more frequently received beta-blocker treatment, antiarrhythmic, diuretics and ACE inhibitors.

Studying the link between QRS complex duration from the initial hospitalization and ejection fraction from control assessment, we noticed that a prolonged QRS duration in the initial hospitalization was associated with an important systolic dysfunction in control assessment (table 1).

Table 1

PEARSON CORRELATION BETWEEN QRS COMPLEX DURATION AND EJECTION FRACTION IN CONTROL ASSESSMENT

		EF	QRS duration
EF	Pearson Correlation	1	-0.522
	Sig. (2-tailed)		0.000
	N	84	84
QRS duration	Pearson Correlation	-0.522	1
	Sig. (2-tailed)	0.000	
	N	84	84

Using another model of multivariate regression, we did not observe a statistically significant association between QRS duration, the initial ejection fraction, the interval from the onset of symptoms to coronary angiography and the risk of ventricular tachycardia.

Assessing the long term arrhythmic risk in patients with acute myocardial infarction and left bundle branch block, we observed a higher risk of ventricular premature beats in patients with left bundle branch block (18 vs. 5, p = 0.003), both on the initial hospitalization and control assessment, with statistically significant differences compared with patients without left bundle branch block (fig.3).

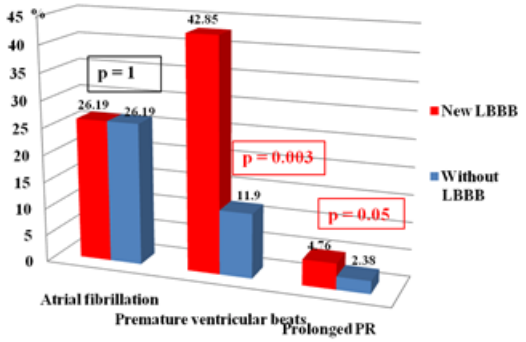

Fig.3. Long term arrhythmic risk in patients with acute myocardial infarction and left bundle branch block

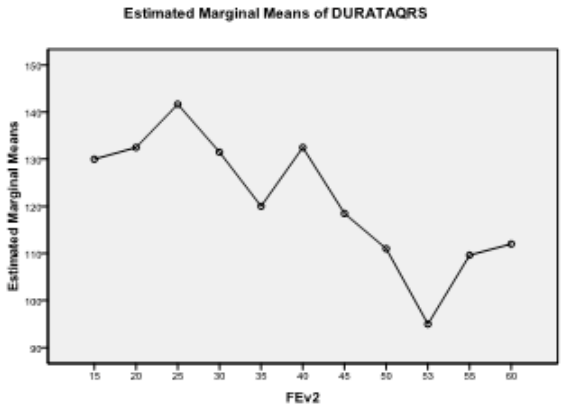

Fig.4. Evolution of left ventricular ejection fraction according to the QRS duration

We also observed that the presence of left bundle branch block ($F = 3.64$; $p < 0.005$; partial $\eta^2 = 0.33$) and the duration of the QRS complex ($F = 4.17$; $p < 0.005$; partial $\eta^2 = 0.36$) is statistically significantly correlated with the value of left ventricular ejection fraction.

Comparing the distribution of patients according to QRS duration, we noted that patients with a prolonged QRS duration have a severe systolic dysfunction on long term (fig.4).

Therefore, the presence of left bundle branch block and especially a prolonged QRS duration, is significantly associated with a severe left ventricular systolic dysfunction on long-term, in our case, after a mean follow-up of 17 months.

An important objective of our study was to quantify the impact of left bundle branch block on ventricular systolic function and arrhythmic risk. We observed a more frequent association (almost in two thirds of patients) between the anterior myocardial infarction and left bundle branch block. Also, patients with acute myocardial infarction and new left bundle branch block had a higher risk of atrial fibrillation and premature ventricular beats as compared with patients without left bundle branch block. After a median follow-up of 17 months, patients with new left bundle branch block had a worsening left ventricular systolic function, with a significant correlation between the initial QRS duration and the value of ejection fraction. Basically, patients with prolonged QRS duration had a severe systolic dysfunction on long term.

Compared with the data from an older study [5], the number of patients with acute myocardial infarction and new left bundle branch block appeared lower, but comparable to the results of recent studies published by Chang [6] and Liakopoulos [7]. This may reflect temporal changes in the incidence of myocardial infarction with aging and with the occurrence of comorbidities.

Assessing the long term prognosis of patients with acute myocardial infarction and new left bundle branch block, we noticed that despite an earlier myocardial revascularization of these patients, there is a progressive reduction of the left ventricular systolic function after a median follow-up of 17 months, with a statistically significant correlation between the initial QRS duration and the value of ejection fraction in the control evaluation.

We also noticed a direct correlation between the initial QRS duration and the value of left ventricular ejection fraction in assessing control, practically a greater QRS duration at the onset of myocardial infarction is associated with a severe left ventricular systolic dysfunction in the assessing control. Instead, we found no correlation between the QRS duration, the value of ejection fraction from initial hospitalization and the risk of long term ventricular arrhythmias in patients with acute myocardial infarction and new left bundle branch block. In the same time, a prolonged QRS duration in patients with left bundle branch block is associated with a reserved prognosis due to severe left ventricle systolic dysfunction, the severe coronary lesions and the increased risk of arrhythmia.

The combination of the left bundle branch block in patients with heart failure leads to a reserved prognosis, the prolonged duration of the QRS complex being considered an independent negative predictor [8-12]. Most patients with left ventricular systolic dysfunction and prolonged QRS complex duration have also left bundle branch block [13-15].

In patients with coronary pathology, left ventricular systolic dysfunction and ventricular tachycardia, the increase QRS complex duration in the context of a left bundle branch block is associated with a 50% increase in both arrhythmic and mortality risk [10]. The association between the electrocardiographic aspect and the risk of malignant ventricular arrhythmias is explained by an increase in repolarization disorders before the onset of arrhythmia [16,17]. The prolonged duration of the QRS complex along with these repolarization changes play an important role in the occurrence of sudden cardiac death by facilitating reentry tachyarrhythmias [18,19].

In a study published by Godman et al. [20], which aimed to evaluate the prognosis of patients with acute myocardial infarction complicated with bundle branch block, it was observed that of the total of 806 patients with acute myocardial infarction, 68 had new bundle branch block. During the hospitalization, the mortality of these patients was 56%, 25 of 48 patients with right bundle branch block, and 13 of 20 patients with left bundle branch block. Regarding the risk of total atrioventricular block, 21 of 68 patients with bundle branch block had total atrioventricular block, 13 requiring protective cardiostimulation. This was instead associated with a significant increase in the risk of ventricular arrhythmias without a significant reduction in mortality in 9 of the 21 patients who had total atrioventricular block.

Erne et al. [21] demonstrated in a recent study that patients with acute myocardial infarction and new or presumed new LBBB were treated less aggressively because they were less likely to receive the optimal medical treatment for an acute coronary syndrome, such as aspirin, P2Y12 inhibitors, b-blockers and statins, and also to undergo percutaneous coronary interventions. Also, the in-hospital mortality of patients with LBBB was higher than the mortality of patients without LBBB, althought mortality has halved during the last 20 years, from 22.6% in 1997-2001 to 11.9% in 2012-2016.

In the absence of a single criterion that clearly distinguish patients with acute myocardial infarction in the presence of left bundle branch block, all patients with new left bundle branch block and high clinical suspicion of acute myocardial infarction should benefit of urgent reperfusion therapy, preferable percutaneous coronary intervention, if is timely available.

Conclusions

Patients with acute myocardial infarction and left bundle branch block represent a relatively small group but with an increased risk of malignant ventricular arrhythmias and left ventricular systolic dysfunction. These patients should therefore benefit from a promptly and appropriately treatment in order to improve long term outcome. Also, considering the fact that one in two patients with acute myocardial infarction and new left bundle branch block die in the first year after the acute coronary event, we believe that these patients are candidates for automatic implantable defibrillators, with or without cardiac resynchronization therapy.

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