Geometric Subtypes of the Left Ventricle in Patients with Left Bundle Branch Block

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1. INTRODUCTION
Several studies have shown that the prognosis for patients with left ventricular hypertrophy (LVH) depends on the geometric subtype of the left ventricle (LV), which can be determined echocardiographically (1, 2, 3). On the basis of the established left ventricular mass (LVM) and the LV relative wall thickness (RWT) it is possible to distinguish among normal LV geometry (normal LVM and normal RWT), LV concentric remodelling (normal LVM and increased RWT), LV concentric LVH (increased LVM and normal RWT) and LV eccentric LVH (increased LVM and increased RWT). It was proved that patients with a concentric LVH subtype run the greatest risk of cardiovascular events (1, 3, 4, 5).

Until recently the left bundle branch block (LBBB) was viewed only as an electrophysiological abnormality. Today its haemodynamic consequences are also important (6, 7, 8). By asynchronous interventricular and intraventricular activation the LBBB may cause ischemic changes, damage to systolic and diastolic LV function, and it may lead to LV remodelling (9, 10). The association of the LBBB with the LVH is well known (11,12), but less known is the relation of the LV geometry to the LV function in patients with LBBB (3). Some studies examined the LV geometry in patients with LBBB and the LVH finding (3). Less known is what the finding is like of LV geometry in patients with LBBB without an LVH finding. The aim of this study was to examine the LV geometry in patients with LBBB who have an LVH and in those who do not have an LVH. In Bosnia and Herzegovina no investigations into the LV geometry have been reported so far.

2. PATIENTS AND METHODS

2.1. Patients
Included in the examination were 132 patients with a left bundle branch block in their ECG, aged above 35 years (44-84), since in persons below 35 years of age the determination of the LVH by measuring the voltage of individual waves is not reliable. Completely worked up were 124 patients: 53 women (42,74%) and 71 men (57,26%). Eight patients were excluded from the examination because of a technically poor echocardiographic finding.

Patients under 35 years of age, patients with an electro-stimulator, patients with pre-excitation, and patients with anaemia and thyrotoxicosis were not included in the examination, because their basic condition may change the ECG picture even without the left bundle branch block.

Characteristics of patients by aetiology are presented in Table 1.

2.2. Methods
The examination was prospective, randomised. It was carried out at the Policlinic „Sunce” in...
Siroki Brije, Bosnia and Herzegovina, in the 2002-2005 period.

All the patients found with a left bundle branch block had a complete clinical examination done, their bodily weight and height measured, their body mass index (BMI) determined, and routine laboratory tests, X-ray of the heart and lungs, ECG, and echocardiographic heart examination done. The patients with a left bundle branch block were divided into two groups: examinees’ group and control group. The examinees’ group included patients with a left bundle branch block in whom LVH was echocardiographically established. In this group there were 106 patients (85.48%) out of whom 41 women (36.68%) and 65 men (61.32%). The average age of men was 69 years (+/-15), and that of women 62 years (+/-18). The control group was made up of patients with a left bundle branch block in whom no LVH was echocardiographically evidenced. In this group there were 18 patients (14.52%), out of whom 12 women (66.66%) and 6 men (3.88%). The average age of women was 64 (+/-12), and that of men 62 years (+/-8).

LBBB was defined according to the Minnesota Code 7.1. The LVH was proved by measuring the LV mass echocardiographically, according to Devereux and Reichek formula, corrected by the autopsy finding (13, 14). The measurement was done according to the ASA Convention. As evidence of the LVH presence, the value of 261 g or more was taken for men and 172 g or more for women; or, the left ventricular mass index (LVMI) 125 g/m² for men and 112 g /m² for women (14, 15, 16). The relative wall thickness (RWT) was determined in the following way: 2x PWd / LVDD. The RWT was deemed increased when 0.45 or more was found.

Possible LV geometric subtypes were: normal geometry (normal LVM, normal RWT), concentric remodelling (normal LVM, increased RWT), eccentric LVH (increased LVM, normal RWT), concentric LVH (increased LVM, increased RWT).

2.3. Statistical analyses

In the analysis of the data, STSS 10 software was used. Continuous variables were expressed as the mean +/- SD. Frequencies were expressed as percentages. Comparison between groups was analysed with the chi-square for categorical variables and Student’s t-test for independent variables. Statistical significance was done at the level p<0.05.

3. RESULTS

3.1. Clinic characteristics

In 106 (85.48%) out of 124 patients with LBBB, the LVH was established by echocardiographic determination of the LVM (examinees’ group), and in 18 patients no increased LVM was found (control group). In the study, the LBBB was found more frequently in men than in women (71:53; 1:0.74). LVH was also more frequent in men with LBBB than in women with deviation (s) = 86.41.

The average LVM in the control group: Men (m)=313.26 g, standard deviation (s)= 79.67. Women (f) = 222.99 g, standard deviation (s) = 45.86.

LVM varies more in women than in men. Variability in the examinees’ group: men (m) = 25.43%, women (f) = 26.75%; in the control group: m= 22.69%, f = 31.33%.

3.3. Echocardiographic findings

Once the geometric subtype of the left ventricle had been determined in all 124 patients with LBBB, the following was found: 21 examinees had a normal LV geometry, 18 examinees had a concentric remodelling, 55 patients had an eccentric LVH, and 30 patients a concentric LVH. Figure 1 graphically presents the distribution of geometric subtypes of the left ventricle in all 124 patients with LBBB.

Figure 1. Geometric subtypes of the left ventricle in the group of patients with left bundle branch block

<table>
<thead>
<tr>
<th>Geometric subtype</th>
<th>With LVH</th>
<th>Without LVH</th>
<th>X2</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal geometry</td>
<td>17 (16.03%)</td>
<td>4 (22.22%)</td>
<td>0.77</td>
<td>0.856</td>
</tr>
<tr>
<td>Concentric remodelling</td>
<td>9 (8.49%)</td>
<td>8 (44.44%)</td>
<td>15.19</td>
<td>0.002</td>
</tr>
<tr>
<td>Eccentric LVH</td>
<td>49 (46.22%)</td>
<td>6 (33.33%)</td>
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<td>0.0792</td>
</tr>
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<td>Concentric LVH</td>
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</tbody>
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Table 1. Patients with left bundle branch block by aetiology (n=124)

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Table 2. Geometric subtypes of the left ventricle in the group of patients with left bundle branch block with and without left ventricular hypertrophy (n=124)

LBBB (91.54 %;77.35% ; 1:0.84). Increased bodily weight or BMI, equal to or higher than 30, is more common in men than in women.

3.2. Left ventricular Mass

The average LVM in the examinees’ group: Men (m)=313.26 g, standard deviation (s)= 79.67. Women (f) = 322.99 g, standard deviation (s) = 86.41.

When the geometric subtype of the left ventricle was determined in the examinees’ group for the patients who have a proved LVH, the following data were obtained: the number of patients with LVH totalled 106 (85.48%), 14 patients (13.20%) had a normal LV geometry, 10 patients (9.43%) had a con-
centric LV remodelling, 52 patients (49,05%) had an eccentric LVH, and 30 patients (28,30%) had a concentric LVH.

In the control group there were 18 examinees. Normal LV geometry was found in 7 examinees (38,88%), concentric LV remodelling in 8 (44,44%), eccentric LVH in 3 (22,22%), while there were no patients with a concentric LVH.

The finding of geometric subtypes in the examinees’ group with LVH and the control group without LVH is shown in Table 2.

4. DISCUSSION

The LBBB finding is in a very high correlation with LVH. Mehta reports that the LBBB in most cases (92%) also means an LVH when the ECG before death is compared with autopsy findings (17). In our examination the LBBB finding in the ECG was associated with an echocardiographically proved LVH in 85,48% patients (16). By an asynchronous activation of the ventricle the LBBB causes damage to the systolic and diastolic function of the left ventricle, and ischemic changes of the LV myocardium in the absence of an occlusive coronary disease (18). By longer duration it leads to structural changes of the LV myocardium causing remodelling (6), and may be a cause to a non-ischemic dilated cardiomyopathy (18).

LVH constitutes an independent risk factor of increased cardiac mortality, sudden death, brain stroke and overall mortality. According to the Framingham Study, the finding of ECG signs for LVH increases the risk, stratified by age, of coronary disease more than three times, the risk of all cardiovascular events 4-7 times, and the risk of a sudden death 3-5 times (19). The SOLVD Study showed that the LV mass > or = 298 g and the left atrium (LA) size > or = 4.17 cm are associated with an increased risk of mortality and CV hospitalisation (2).

Our study showed that the most common LVH geometric subtype in patients with LBBB was the eccentric LVH (44,35%), followed by the concentric LVH (24,19%), normal LV finding was in 16,93% patients with LBBB, while 14,51% patients had concentric remodelling. In the group of patients with LBBB in whom LVH was proved, the percentage of the eccentric LVH is still higher (49,05%), as well as that of the concentric LVH (28,30%), along with a considerably lower percentage of normal findings (13,20%) and concentric remodelling (9,43%).

In the control group (patients with LBBB and without LVH) there were 18 patients in all, which renders the statistic interpretation and valid conclusions more difficult. Namely, the LBBB alone has got a relatively small prevalence (5,03%) in patients with hypertension and LVH in the LIFE Study (3), and patients with LBBB without a LVH finding are very rare. If one switches over from sample to population on the basis of a corresponding statistical formula, the data may be adequately used (21). In this group there was no finding of concentric LVH, eccentric LVH was represented in 22,22 %, while there were most findings of concentric LV remodelling. The finding corroborates earlier observations that LBBB alone leads to structural changes of the LV, even in the absence of LVH. In both groups the variation of the LVM as well as that of the distribution of geometric abnormalities of the LV was somewhat higher in women than in men.

In the LIFE Study comparison was made of the LV geometry finding in patients with hypertension in relation to normal persons. A considerably higher percentage of concentric LVH 25-29% : 3-4% , and eccentric LVH 45-51%:13-17 % was found, while the finding of concentric remodelling was 8-11%:12-14 % (3).

Similar is the distribution of LV geometric subtypes with other authors who examined LVH. In hypertensive Nigerians with LVH the eccentric LVH was the most frequent finding (75-30,4 %), followed by concentric geometry (3,3-25,6 %). Normal geometry was found in 26-38,9 % of hypertensive patients (22). The percentages depend on the set criteria for LVH and on the normalisation of LVM absolute values in grams in relation to the surface of the body or weight.

5. CONCLUSIONS

During the research it was shown that patients with LBBB even without an LVH finding may have a changed LV geometry. Patients with LBBB without an LVH finding change LV geometry in the highest percentage by concentric remodelling, while patients with LBBB and with LVH finding have an eccentric LVH subtype.

By using X^2 test a statistically significant difference was found in the distribution of LVH geometric subtypes in patients with LBBB between men and women (p<0,05).

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