Considerable controversy exists regarding impairment of cardiac function in prediabetic conditions\textsuperscript{1-3}. The role of arterial hypertension (AH) and diabetes mellitus (DM) as risk factors in coronary heart disease (CAD) is known but the role of elevated glucose levels in patients who are apparently non-diabetic but suffering from hypertensive heart failure is controversial. The role of hypertension and diabetes mellitus as risk factors in coronary heart disease is known but the role of elevated glucose levels in patients who are apparently non-diabetic but suffering from hypertensive heart failure is controversial\textsuperscript{1-3}. The role of hypertension and diabetes mellitus as risk factors in coronary heart disease is known but the role of elevated glucose levels in patients who are apparently non-diabetic but suffering from hypertensive heart failure is controversial\textsuperscript{1-3}. 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Volume) was already existed in their medical files that was done during the previous 12 months. The patients with EF ≤ 40% entered the study.

Patients with heart valve diseases, renal diseases, and atrial fibrillation excluded from the study.

Finally, sixty eight (68) hypertensive patients (M=42, F=26, mean age=70±8 years) under sufficient anti-hypertensive treatment (Table 1), based on their medical files, during the last six months (Blood pressure control seemed to be optimal until that time according to the WHO guidelines) before the last admission entered the study. Although the AH seemed to be sufficiently managed the BP elevation may be attributable to emotional stress or increased workload or non sufficiently filled medical files.

The taken blood samples at the day of patients’ discharge (baseline) after at least of four days hospitalization, were estimated for glucose levels, total cholesterol, and triglycerides (Reflotron). Concerning glucose estimation, the IV administration of any dextrose solution was discontinued; as baseline level was considered the mean value of the last two fasting (at least six hours) glucose estimations in different blood samples, performed at the day of discharge.

Our patients were divided into two groups based on baseline glucose levels; Group A consisted from 21 patients (M=8, F=13, mean age=68±9 years) with glucose levels higher than 120 mg/dl whilst the remaining 47 patients (M=34, F=13, mean age=72±10 years) without hyperglycemia composed Group B.

Evaluation of systolic (ejection fraction by cubing the sort axis and mitral E point to ventricular septal separation-EPSS) and diastolic (left atrial emptying index-LAEI) function of the left ventricle, by means of ultrasound (Aloka SSD 630), was performed in all patients at the day of discharge (Table 2). The mean glucose level was significantly higher in Group A (180.3 ± 34.1 mg/dl) compared to Group B (105.9 ± 7.1 mg/dl). The diastolic function as was estimated by LAEI was impaired especially in Group A compared to Group B (0.32 ± 0.03 vs. 0.41 ± 0.04, p<0.01) patients (Table 2); the systolic function was also impaired in Group A (EF=29.4 ± 4.3 %, NS and EPSS=10.8 ± 2.9 mm, p<0.01) compared to Group B patients (EF=34.2 ± 2.9 % and EPSS=6.8 ± 1.7 mm) (Table 2). The mean cholesterol and triglycerides levels were higher in Group A (224.4 ± 28.8 mg/dl, NS and 216.8 ± 12.5 mg/dl, p<0.001) compared to Group B (204.0 ± 17.4 mg/dl and 189.0 ± 17.3 mg/dl respectively) (Table 2).

The differences in estimated EF before (medical files) and during hospitalization were significant (Table 3).

Linear regression analysis revealed statistically significant correlation between glucose levels and EF values (r=-0.646, p<0.01, Figure 2), EPSS values (r=0.602, p<0.01, Figure 3), LAEI values (r=-0.533, p<0.01, Figure 4), total cholesterol levels (r=0.447, p<0.01, Figure 5) and triglycerides levels (r=0.576, p<0.01, Figure 6). The mean BP measurements where within normal limits without significant differences between two groups (p<0.5); the proportion also of drugs used was without differences between groups.

**DISCUSSION**

Patients with diabetes mellitus are particularly vulnerable to cardiovascular disease. Although structural and functional myocardial complications are present in patients with diabetes alone, they are particularly severe in patients with both diabetes and hypertension. Considerable evidence, both in experimental animal models and in humans, points to hypertension as of critical importance in the pathogenesis of severe diabetic heart disease. In diabetic hypertensive cardiomyopathy, CAD as well as structural and functional abnormalities are more pronounced than what would be expected from either process alone. The myocardial damage is attributed mainly to hypertension, whereas the myocellular dysfunction is attributed mainly to glucose metabolism disturbances. It is generally accepted that the disturbances of glucose metabolism affect the cardiovascular system through many ways...
Although DM has been long recognized as a major risk factor for CAD, the effect of "elevated" levels to upper normal limits of glucose in people without diabetes has been unclear. It is reported that glucose elevations that remain in the "normal" range may be responsible for more heart attacks than the amount caused by diabetes itself. The level and the way that glucose disturbances act on left ventricular function, systolic and diastolic, consist subject for controversies.

Although the blood pressure control seemed to be optimal according to the WHO guidelines, this disturbance (oedema) happened suddenly without any obvious predisposing factor and may be due to non close follow-up or to emotional stress and to acute elevation of workload.

The evaluation of our results indicates a statistically greater impairment on systolic and diastolic LV function in hypertensive patients with raised glucose levels than in euglycaemic hypertensive patients. Our findings are close to other reported data.

The strong correlation of glucose levels with the indices of LV function confirms the effect of glucose metabolism on these parameters although the EF values appeared statistically non significant between the two groups. In contrary to EF, the other LV function indices appeared to be statistically significant affected by raised glucose levels, fact that confirms the sensitivity of these indices in revealing systolic (EPSS) and diastolic (LAEI) dysfunction of the LV.

Although there is statistically strong evidence of direct influence of elevated glucose levels on LV function in hypertensive patients, the small number of our cases may indicate the need of further investigation; the metabolic pathways that enable this action, need to be declared.

This distinct study, which relates to the prevalence of newly diagnosed DM in a patient population presenting with pulmonary oedema,

<p>| Table 1. Basic demographic data and hypertensive treatment before hospitalization in both studied groups (hyperglycaemic-Group A and euglycaemic-Group B) of patients. |
|----------------------------------|----------------|----------------|----------------|----------------|----------------|</p>
<table>
<thead>
<tr>
<th>Sex</th>
<th>Age</th>
<th>b-blocker</th>
<th>Ca++</th>
<th>ACE</th>
<th>Combinations</th>
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</thead>
<tbody>
<tr>
<td>Hyperglycaemic n = 21</td>
<td>M=8</td>
<td>68±9</td>
<td>5</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>F=13</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Euglycaemic n = 47</td>
<td>M=34</td>
<td>72±10</td>
<td>12</td>
<td>8</td>
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<tr>
<td>F=13</td>
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*NS, **p<0.01 and *** p<0.001 compared to non-diabetics.

<table>
<thead>
<tr>
<th>Table 2. Differences found in parameters studied between hyperglycemic (Group A) and euglycaemic (Group B) patients.</th>
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<tbody>
<tr>
<td>EF (%)</td>
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<tr>
<td>Hyperglycaemic n = 21</td>
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<tr>
<td>F=13</td>
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<tr>
<td>Euglycaemic n = 47</td>
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<td>F=13</td>
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</tbody>
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*NS, **p<0.01 and *** p<0.001 compared to non-diabetics.

<table>
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<th>Table 3. Differences found in estimated EF before and during hospitalization.</th>
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<tr>
<td>EF before (%)</td>
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<tr>
<td>Hyperglycaemic n = 21</td>
</tr>
<tr>
<td>Euglycaemic n = 47</td>
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</tbody>
</table>

*p<0.01 compared to non-diabetics.
Figure 1. Method of estimation of the left atrial (LA) emptying index (LAEI). The time of passive atrial emptying ($t_{pae}$) is defined by the distance between points O and A. Point O corresponds to the onset of LA active emptying, immediately after the electrocardiographic P wave.

Figure 2. Correlation of glucose to EF ($r=-0.646$, $r^2=66$, $p<0.01$).

Figure 3. Correlation of glucose to EPSS ($r=0.602$, $r^2=66$, $p<0.01$).
Figure 4. Correlation of glucose to LAEI ($r=-0.533$, $\nu=66$, $p<0.01$).

Figure 5. Correlation of glucose to total cholesterol ($r=0.447$, $\nu=66$, $p<0.01$).

Figure 6. Correlation of glucose to triglycerides ($r=0.576$, $\nu=66$, $p<0.01$).
and AH, confirms that – in these clinical settings – diabetes mellitus patients have a more pronounced dysfunction of the heart and a poorer prognosis although it was done with crude but easy and cheap M-mode echocardiographic measurements of ejection fraction, of ejection and of filling function, combined with total cholesterol and triglycerides levels.

Our sense is that this study adds no original information on this subject although superficially seems to confirm previous published data.

CONCLUSIONS

The diabetes mellitus, in our study, shows a clear significant negative effect on the left ventricular systolic and diastolic function in the hypertensive patients. In hypertensive patients with heart failure the endothelial dysfunction and/or the insufficient treatment of diabetes mellitus may contribute to the appearance of left ventricular systolic and diastolic dysfunction. Also, the coexistence of diabetes and hyperlipidaemia could predispose to underlying subclinical coronary arterial disease which may contribute to left ventricular failure.

Our results in combination with other reported data would focus attention on the high prevalence of LV function disturbances in hypertensive patients with glucose metabolism disturbances and may lead to innovative ways of preventing adverse episodes in this group of population.

REFERENCES


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