Impact Of Obesity And Metabolic Comorbidities On Functional Capacity And Quality Of Life In Heart Failure With Preserved Ejection Fraction

Normatov Murod Buribayevich
Assistant of Samarkand State Medical University
Khusainova Munira Alisherovna
Assistant of Samarkand State Medical University
Ergasheva Ma'mura Tashtemirovna
Assistant of Samarkand State Medical University
Uzokov Jurabek Bakhtiyorovich
Assistant of Samarkand State Medical University
Yarmatov Suvon Tatlibayevich
Assistant of Samarkand State Medical University
Khaydarov Sanjar Nizamitdinovich
Assistant of Samarkand State Medical University
Samarkand State Medical University

Abstract
Heart failure with preserved left ventricular ejection fraction is a common clinical form of chronic heart failure and is frequently associated with arterial hypertension, ischemic heart disease, obesity, and diabetes mellitus. These comorbidities significantly affect symptom severity, myocardial remodeling, and quality of life. Objective. To evaluate clinical manifestations, anthropometric obesity indicators, quality of life, physical performance, and echocardiographic characteristics in patients with heart failure with preserved ejection fraction. Materials and Methods. The study included 72 patients aged 47–77 years (mean age 59.6 ± 7.8 years). Clinical status and New York Heart Association functional class were assessed. Quality of life was evaluated using the Minnesota Living with Heart Failure Questionnaire. Physical performance was assessed by the six-minute walk test. Anthropometric parameters included body mass index calculated by the Quetelet formula and waist circumference. Transthoracic echocardiography and serum N-terminal pro-brain natriuretic peptide measurement were performed. Results. Excess body weight or obesity was detected in 59 patients (81.9%), and abdominal obesity was present in 49 patients (68.1%). Dyspnea on exertion was reported by 69 patients (95.8%). Increasing functional class was associated with higher body mass index, larger waist circumference, greater left ventricular myocardial mass, shorter walking distance in the six-minute test, and worse quality-of-life scores.
Conclusion. Heart failure with preserved ejection fraction is characterized by universal diastolic dysfunction, high prevalence of obesity, reduced exercise tolerance, and impaired quality of life. Metabolic comorbidities significantly worsen the clinical course of the disease.
Keywords: heart failure with preserved ejection fraction, diastolic dysfunction, obesity, body mass index, waist circumference, quality of life.

INTRODUCTION

To identify independent predictors of reduced exercise tolerance and impaired quality of life, multivariate linear regression analysis was performed. The dependent variables included six-minute walk distance and total Minnesota Living with Heart Failure Questionnaire score. Independent variables entered into the regression model were age, sex, body mass index, waist circumference, presence of diabetes mellitus, severity of arterial hypertension, left ventricular mass index, and left atrial diameter.

The total questionnaire score was significantly higher in women compared with men (48.5 [36.0; 59.0] versus 21.5 [14.5; 40.0], $p < 0.001$). Exercise tolerance correlated inversely with quality of life ($r = -0.39$, $p = 0.002$). Diabetes mellitus and ischemic heart disease were associated with reduced physical performance and more severe clinical symptoms.

Statistical analysis was performed using Statistica software version 6.1. Quantitative variables were initially assessed for distribution normality using the Shapiro–Wilk test. Variables demonstrating a normal distribution were expressed as mean values with standard deviation, while non-normally distributed variables were presented as median values with interquartile ranges.

For comparison of two independent groups with normally distributed data, the Student's t-test was applied. In cases of non-normal distribution, the Mann–Whitney U test was used. Comparisons among three or more independent groups were conducted using one-way analysis of variance with post hoc multiple comparison testing for normally distributed variables, and the Kruskal–Wallis test for non-parametric data.

Categorical variables were expressed as absolute numbers and percentages. Group differences in categorical data were evaluated using the chi-square test. Correlation analysis was performed using Spearman's rank correlation coefficient to assess relationships between clinical, anthropometric, functional, and echocardiographic parameters.

Multicollinearity was assessed prior to model construction using variance inflation factor values, with a threshold of less than 5.0 considered acceptable. Model goodness-of-fit was evaluated using the coefficient of determination. A two-sided p-value less than 0.05 was considered statistically significant.

MATERIALS AND METHODS

The study included seventy-two patients aged forty-seven to seventy-seven years (mean age 59.6 ± 7.8 years) diagnosed with heart failure with preserved left ventricular ejection fraction. Among them, thirty-five patients (48.6%) had arterial hypertension as the primary cause, while thirty-seven patients (51.4%) had both arterial hypertension and coronary artery disease. All patients provided written informed consent prior to participation. Inclusion criteria were age between forty and eighty years, New York Heart Association functional class I to III, and left ventricular ejection fraction of forty-five percent or higher. Exclusion criteria included left ventricular ejection fraction below forty-five percent, myocardial infarction or unstable angina within the last three months, significant valvular heart disease, decompensated heart failure class IV, secondary hypertension, clinically significant arrhythmias, severe pulmonary, hepatic, or renal disease, and oncologic disorders.

All clinical evaluation. Heart failure symptoms were assessed using the Clinical State Assessment Scale, and functional capacity was determined by the six-minute walk test. Physical examination included measurement of blood pressure, heart rate, body weight, height, and waist circumference. Body mass index was calculated using the Quetelet formula. Patients were classified according to obesity status based on standard body mass index thresholds: normal weight (18.5–24.9 kg/m²), overweight (25.0–29.9 kg/m²), obesity class I (30.0–34.9 kg/m²), obesity class II (35.0–39.9 kg/m²), and obesity class III (≥40.0 kg/m²). Abdominal obesity was defined as waist circumference greater than ninety centimeters in women and greater than one hundred centimeters in men. Health-related quality of life was evaluated using the Minnesota Living with Heart Failure Questionnaire, which includes physical, emotional, and socioeconomic domains. Higher total scores indicated greater impairment of quality of life. Transthoracic echocardiography was performed using SonoScape 8000 and VIVID 3 systems in M-mode, B-mode, and Doppler mode. Structural parameters assessed included left ventricular end-diastolic and end-systolic diameters, interventricular septal thickness, posterior wall thickness, left atrial diameter, right atrial and ventricular dimensions, and left ventricular mass index. Systolic function was evaluated by left ventricular ejection fraction, while diastolic function was assessed using early diastolic filling velocity (E), late atrial filling velocity (A), E/A ratio, deceleration time, and isovolumic relaxation time. Left ventricular remodeling patterns were classified according to the Ganau classification.

Correlation analysis demonstrated significant associations between anthropometric obesity indicators and functional capacity. Body mass index showed a moderate inverse correlation with six-minute walk distance ($r = -0.41$, $p < 0.001$), while waist circumference demonstrated

a similar inverse relationship ($r = -0.43$, $p < 0.001$). Both parameters correlated positively with total quality-of-life score, indicating worse perceived health status with increasing obesity (body mass index $r = 0.44$, $p < 0.001$; waist circumference $r = 0.47$, $p < 0.001$).

Exercise tolerance exhibited a significant inverse correlation with symptom severity and quality of life. The six-minute walk distance correlated negatively with the total Minnesota questionnaire score ($r = -0.39$, $p = 0.002$) and positively with left ventricular diastolic relaxation parameters.

Age demonstrated a positive correlation with left ventricular mass index ($r = 0.42$, $p < 0.001$) and left atrial diameter ($r = 0.35$, $p = 0.008$), indicating progressive myocardial remodeling with increasing age.

The presence of diabetes mellitus was associated with significantly reduced exercise tolerance and worse clinical status. Patients with diabetes mellitus walked a shorter distance during the six-minute test (365.9 ± 58.4 m) compared with patients without diabetes mellitus (414.6 ± 76.2 m, $p = 0.03$). Total quality-of-life scores were also higher in patients with diabetes mellitus (52.1 ± 13.7 versus 38.6 ± 14.2, $p = 0.01$).

Multivariate linear regression analysis identified waist circumference, presence of diabetes mellitus, left ventricular mass index, and female sex as independent predictors of reduced exercise tolerance. The final regression model explained 46.2% of the variability in six-minute walk distance.

A separate regression model for quality of life demonstrated that waist circumference, New York Heart Association functional class, diabetes mellitus, and left atrial diameter were independent determinants of higher total questionnaire scores. This model accounted for 49.7% of the variance in quality-of-life outcomes.

Severity of arterial hypertension showed significant positive associations with left ventricular mass ($r = 0.26$, $p = 0.03$), left ventricular mass index ($r = 0.32$, $p = 0.01$), and right ventricular diameter ($r = 0.30$, $p = 0.01$). Inverse correlations were observed between hypertension severity and six-minute walk distance ($r = -0.40$, $p < 0.001$), as well as overall quality-of-life measures.

RESULTS

Clinical evaluation revealed that 69 patients (95.8%) complained of dyspnea during physical exertion, while 3 patients (4.2%) experienced dyspnea at rest. Peripheral edema of varying severity was observed in 54 patients (75.0%). Signs of pulmonary congestion were detected in 10 patients (13.9%), and hepatomegaly was present in 12 patients (16.7%).

Anthropometric assessment demonstrated a high prevalence of obesity. The mean body mass index was 31.2 ± 4.6 kg/m². Normal body weight was observed in 13 patients (18.1%), overweight in 21 patients (29.2%), obesity class I in 26 patients (36.1%), obesity class II in 10 patients (13.9%), and obesity class III in 2 patients (2.7%). The mean waist circumference was 101.4 ± 11.8 cm. Abdominal obesity was identified in 68.1% of patients.

Exercise tolerance decreased progressively with worsening functional class. The mean six-minute walk distance was 462 ± 54 m in functional class I, 398 ± 62 m in functional class II, and 332 ± 58 m in functional class III ($p < 0.001$).

Quality-of-life assessment demonstrated a significant deterioration with increasing disease severity. The total Minnesota questionnaire score was 22.3 ± 8.6 in functional class I, 39.7 ± 12.4 in functional class II, and 58.9 ± 14.1 in functional class III ($p < 0.001$). Women demonstrated significantly higher total scores compared with men (48.5 [36.0; 59.0] versus 21.5 [14.5; 40.0], $p < 0.001$).

Echocardiographic examination revealed diastolic dysfunction of the left ventricle in all patients. Concentric hypertrophy was observed in 76.2% of cases. Increasing functional class was associated with progressive thickening of the interventricular septum, increased posterior wall thickness, and enlargement of the left atrium.

Patients with diabetes mellitus demonstrated lower exercise tolerance (365.9 ± 58.4 m versus 414.6 ± 76.2 m) and higher symptom severity scores (4.2 ± 1.4 versus 3.4 ± 1.25). The

presence of ischemic heart disease was associated with more pronounced myocardial remodeling and reduced functional capacity.

CONCLUSION

1. Diastolic dysfunction of the left ventricle was detected in 100% of patients with heart failure with preserved ejection fraction.
2. Obesity and abdominal fat accumulation were present in more than 80% of patients and were associated with worse clinical outcomes.
3. Increasing functional class was accompanied by reduced exercise tolerance, deterioration of quality of life, and progression of myocardial hypertrophy.
4. Women reported significantly poorer quality of life compared with men.
5. Diabetes mellitus and ischemic heart disease negatively influenced physical performance and clinical status.

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