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Impact of Metabolic Syndrome Components on Left Ventricular Diastolic Function in Hypertensive Patients: Cross-Sectional Study from Bukhara Region

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Abstract: The aim of this study was to evaluate the relationship between components of metabolic syndrome (MetS)—abdominal obesity, dyslipidaemia and impaired glucose metabolism—and left ventricular diastolic dysfunction (LVDD) in hypertensive patients. A cross-sectional sample of 190 adults with confirmed arterial hypertension, followed at a cardiology department in the Bukhara region between 2024 and 2025, was analysed. MetS was diagnosed according to International Diabetes Federation criteria using waist circumference, triglycerides, high-density lipoprotein cholesterol, blood pressure and fasting plasma glucose. Echocardiography was performed to assess LV diastolic function based on transmitral E/A ratio, E/e' index and left atrial size, and LVDD was graded from I to III.MetS was present in 60% of patients; in this group, both the prevalence and severity of LVDD were higher than in those without MetS (78% vs. 49%). The mean E/e' value increased stepwise with the number of MetS components (10.2±2.1 in patients with fewer than three components, 12.8±2.4 in those with three to four components and 15.1±2.9 in those with all five components). Positive correlations were observed between waist circumference, triglyceride levels and LVDD grade. These findings suggest that active identification and targeted treatment of MetS components in hypertensive patients are important for preserving LV diastolic function and slowing progression toward overt heart failure.

Keywords: arterial hypertension, metabolic syndrome, left ventricular diastolic dysfunction, E/e', obesity, dyslipidaemia.

Introduction

Arterial hypertension is a major risk factor for heart failure, particularly heart failure with preserved ejection fraction, in which left ventricular diastolic dysfunction (LVDD) plays a central role. Metabolic syndrome (MetS), characterised by the clustering of abdominal obesity, dyslipidaemia, elevated blood pressure and impaired glucose metabolism, is highly prevalent among hypertensive patients and may aggravate structural and functional changes in the left ventricle.

Although the association between MetS and incident heart failure has been demonstrated in several large cohorts, data on the impact of individual MetS components on LV diastolic function in routine clinical practice are more limited, especially in Central Asian populations. Understanding these relationships may help refine risk stratification and guide targeted interventions in hypertensive patients.

This study therefore examined the prevalence of LVDD in a cohort of hypertensive patients in Bukhara and investigated how the number and type of MetS components relate to echocardiographic markers of LV diastolic function.

Aim of the Study

To assess the impact of metabolic syndrome components on left ventricular diastolic function in patients with arterial hypertension in a regional cardiology clinic in Uzbekistan.

Materials and Methods

This cross-sectional observational study was performed at the Bukhara Regional Cardiology Clinic between January 2024 and June 2025. Adults aged 40–80 years with a diagnosis of essential arterial hypertension were eligible. Patients with significant valvular heart disease, cardiomyopathies, atrial fibrillation or recent acute coronary syndrome were excluded.

MetS was defined according to International Diabetes Federation criteria, using waist circumference thresholds appropriate for this ethnic population along with triglycerides, HDL cholesterol, blood pressure and fasting plasma glucose. Anthropometric measurements and blood pressure were obtained using standard procedures. Laboratory assessments included fasting lipids and glucose.

Transthoracic echocardiography was carried out using a standard protocol. LV diastolic function was evaluated by transmitral inflow (E and A waves), tissue Doppler imaging of the mitral annulus (e') and left atrial volume. LVDD was graded according to current recommendations into grade I (impaired relaxation), grade II (pseudonormal filling) and grade III (restrictive filling). The E/e' ratio was used as a surrogate of LV filling pressure.

Results

Clinical characteristics according to metabolic syndrome status

Parameter	With MetS (n=114)	Without MetS (n=76)
Mean age, years (M±SD)	59.3 ± 8.4	57.1 ± 9.2
Female sex, n (%)	68 (60%)	38 (50%)
Waist circumference, cm (M±SD)	103.5 ± 9.2	89.8 ± 8.5
Triglycerides, mmol/L (M±SD)	2.1 ± 0.7	1.4 ± 0.5

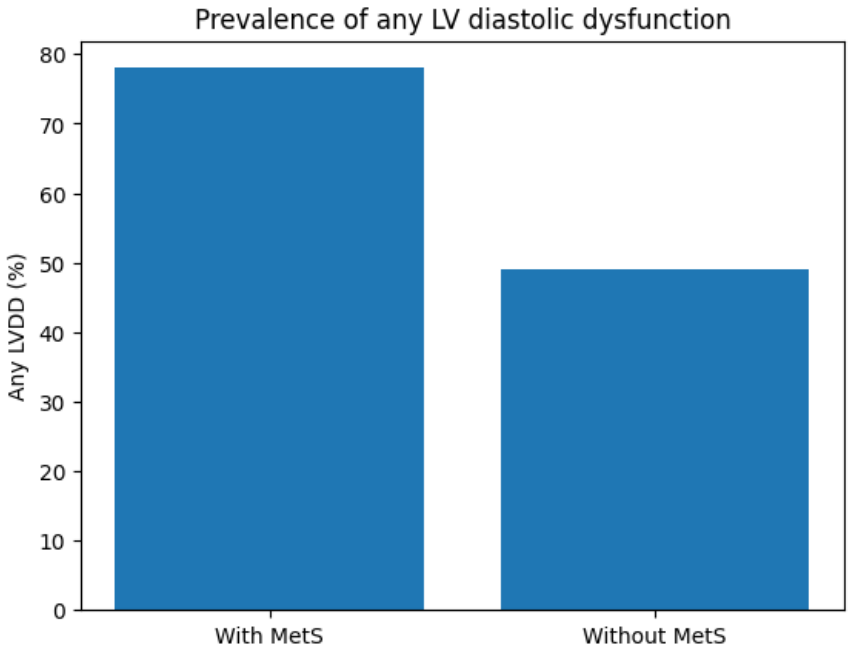
MetS was present in 114 patients (60%). Those with MetS were slightly older and had higher waist circumference and triglyceride levels than patients without MetS.

Prevalence and grade of left ventricular diastolic dysfunction

Diastolic function	**Total (n=190)**	**With MetS (n=114)**	**Without MetS (n=76)**
Normal	58 (31%)	25 (22%)	33 (43%)
Grade I LVDD	77 (41%)	45 (39%)	32 (42%)
Grade II LVDD	41 (22%)	33 (29%)	8 (11%)
Grade III LVDD	14 (7%)	11 (10%)	3 (4%)

Overall, 69% of patients had some degree of LVDD. Moderate-to-severe LVDD (grades II–III) was more common in patients with MetS (39%) than in those without MetS (15%).

Figure 1. Prevalence of any grade of left ventricular diastolic dysfunction according to metabolic syndrome status.

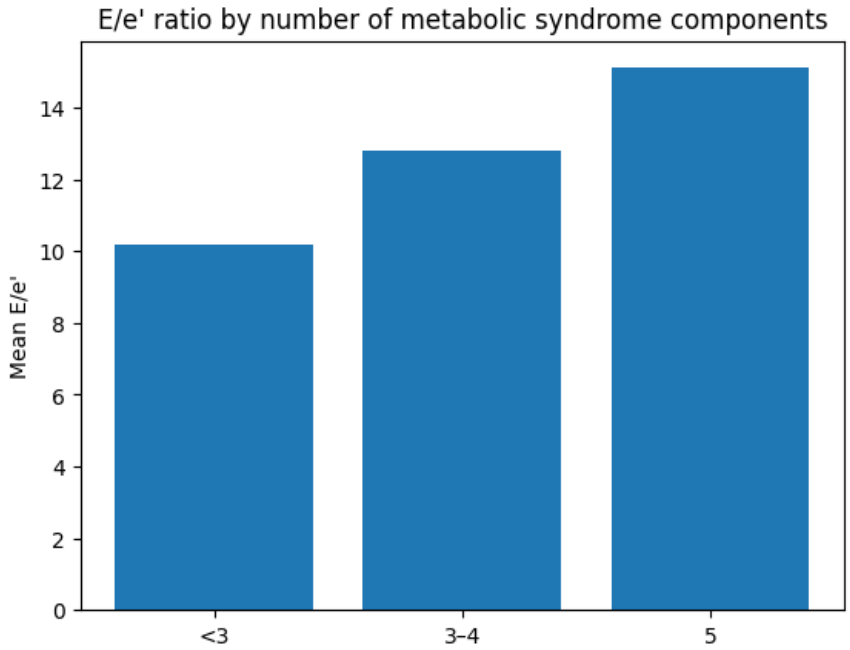


E/e' ratio according to number of metabolic syndrome components

MetS components	n	Mean E/e' (M±SD)
<3 components	69	10.2 ± 2.1
3–4 components	81	12.8 ± 2.4
5 components	40	15.1 ± 2.9

A stepwise increase in the E/e' ratio was observed with a higher number of MetS components, indicating higher LV filling pressures and more advanced LVDD.

Figure 2. Mean E/e' index according to the number of metabolic syndrome components.



Discussion

The present study shows that LVDD is highly prevalent among hypertensive patients in this regional cohort, and that the presence and severity of LVDD are closely linked to MetS and the cumulative burden of its components.

Patients with MetS had a higher prevalence of moderate-to-severe LVDD and higher E/e' values, suggesting that MetS contributes to increased LV stiffness and elevated filling pressures beyond the effect of blood pressure alone. Abdominal obesity and hypertriglyceridaemia emerged as particularly important correlates of LVDD severity.

These findings support the concept that management of hypertensive patients should extend beyond simple blood pressure control to include aggressive treatment of MetS components—weight reduction, optimisation of lipid profile and improvement of glucose metabolism—in order to preserve diastolic function and reduce the risk of heart failure with preserved ejection fraction.

Conclusions

In hypertensive patients from a regional clinic in Uzbekistan, metabolic syndrome is common and is associated with a higher prevalence and greater severity of left ventricular diastolic dysfunction. The E/e' index increases in parallel with the number of MetS components. Targeted identification and correction of MetS components should be considered an integral part of strategies aimed at preventing diastolic heart failure in this population.

Conflict of interest. The author declares no conflict of interest.

Funding. No specific funding was received for this study.

Ethical approval. The study was conducted in accordance with the Declaration of Helsinki; written informed consent was obtained from all participants.

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