CIRCADIAN BLOOD PRESSURE VARIABILITY AND LEFT VENTRICULAR DIASTOLIC FUNCTION IN HYPERTENSIVE MILITARY PERSONNEL: INSIGHTS FROM AMBULATORY MONITORING

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Abstract

Background. Hypertension is highly prevalent among military populations and contributes to early cardiovascular remodeling. Ambulatory blood pressure monitoring (ABPM) enables detection of pathological circadian patterns strongly associated with target-organ damage.

Objective. To evaluate 24-hour blood pressure parameters and circadian BP profiles in servicemen with hypertension, depending on left ventricular diastolic function.

Methods. Forty-six male servicemen (mean age 45.9 ± 3.1 years) with stage I arterial hypertension (per 2018 ESC/ESH criteria) underwent echocardiography and ABPM. Patients were stratified into two groups: those with preserved diastolic function (n = 23) and those with impaired relaxation type diastolic dysfunction (n = 23).

Results. Compared with patients with normal diastolic function, servicemen with diastolic dysfunction had significantly higher mean 24-h systolic BP (134.8 ± 2.1 vs 120.6 ± 1.7 mmHg, $p<0.001$) and diastolic BP (87.2 ± 1.3 vs 75.1 ± 1.4 mmHg, $p<0.001$). The non-dipper pattern was more frequent in the diastolic dysfunction group (47.8% vs 13.0%). Conclusion. In hypertensive servicemen, LV diastolic dysfunction is associated with higher average BP levels and adverse circadian profiles, underscoring the importance of ABPM for risk stratification and targeted intervention.

Introduction

Hypertension remains the leading cause of premature morbidity and mortality worldwide. According to the WHO Global Report 2021, nearly 1.3 billion adults live with elevated blood pressure, with particularly high prevalence in men of working age. Military personnel represent a unique subgroup due to physical stress, irregular sleep, and occupational exposures that predispose to disturbed hemodynamic regulation. Beyond absolute clinic blood pressure values, circadian BP variability assessed by ambulatory monitoring has emerged as an independent predictor of cardiovascular outcomes. Non-dipping and reverse-dipping patterns are strongly associated with left ventricular hypertrophy, diastolic dysfunction, and stroke. Left ventricular diastolic dysfunction (LVDD) often precedes systolic impairment and reflects subclinical myocardial remodeling. Previous studies (2017–2024) demonstrate that nocturnal hypertension correlates with impaired diastolic indices (E/A ratio, deceleration time, e′

velocity) [1,2,6]. However, data remain limited in military cohorts. This study aimed to assess 24-hour BP parameters and circadian BP profiles in servicemen with arterial hypertension according to diastolic function.

Methods

Study Population. A total of 46 male servicemen aged 41–55 years (mean 45.9 ± 3.1 years) with newly diagnosed stage I hypertension were included.

Exclusion criteria: diabetes mellitus, ischemic heart disease, heart failure, secondary hypertension, chronic kidney or liver disease, and prior antihypertensive therapy.

Ambulatory Blood Pressure Monitoring (ABPM). ABPM was performed using a validated oscillometric device (Schiller BR-102 Plus). BP was measured every 30 minutes during the day and every 60 minutes at night. Circadian patterns were classified as dipper, non-dipper, over-dipper, or night-peaker.

Echocardiography. Diastolic function was evaluated by Doppler indices: early (E) and late (A) mitral inflow velocities, E/A ratio, deceleration time, and isovolumic relaxation time.

Statistics. Data are presented as mean ± standard deviation (SD). Comparisons were made using Student's t-test and χ^2 test. A p-value <0.05 was considered significant.

Results

In the group with diastolic dysfunction, daytime and nighttime SBP/DBP values were significantly higher. This demonstrates increased hemodynamic load on the myocardium. Pulse pressure and heart rate did not differ substantially (Table 1 ABPM parameters).

Table 1

ABPM parameters in both groups

Parameter	Normal LVDF (n=23)	LVDD (n=23)	p-value
Daytime SBP (mmHg)	124.5 ± 1.8	139.6 ± 2.0	<0.001
Daytime DBP (mmHg)	78.3 ± 1.5	89.7 ± 1.4	<0.001
Nighttime SBP (mmHg)	111.8 ± 1.1	126.3 ± 1.9	<0.001
Nighttime DBP (mmHg)	66.4 ± 1.3	80.6 ± 1.6	<0.001
24-h SBP (mmHg)	120.6 ± 1.7	134.8 ± 2.1	<0.001
24-h DBP (mmHg)	75.1 ± 1.4	87.2 ± 1.3	<0.001
Pulse pressure (mmHg)	45.5 ± 1.0	47.6 ± 1.3	0.112

Pathological non-dipper profile predominated (50%) among those with impaired diastolic function, whereas dipper profile predominated in the normal function group (87.5%). This indicates a strong relationship between nocturnal BP patterns and early myocardial changes (Table 2. Circadian BP profiles).

Table 2.

Circadian blood pressure profiles

BP Profile	Normal LVDF (n=23)	LVDD (n=23)	p-value
Dipper	20 (87.0%)	10 (43.5%)	0.002
Non-dipper	3 (13.0%)	11 (47.8%)	0.004
Over-dipper	0	2 (8.7%)	–
Night-peaker	0	0	–

Discussion

This study shows that hypertensive servicemen with LVDD demonstrate both higher 24-h BP averages and increased prevalence of non-dipping patterns compared with those with normal diastolic function.

Our findings confirm prior reports that circadian BP variability strongly predicts cardiovascular remodeling. Non-dipping has been linked to LV hypertrophy, diastolic impairment, and cerebrovascular events [3,4]. Recent data also highlight the role of nighttime hypertension as a determinant of incident HFpEF, a condition rooted in diastolic dysfunction [5]. In military populations, disrupted sleep and high stress levels may exacerbate these patterns. Recognition of LVDD in conjunction with ABPM data could allow early intervention through chronotherapy, renin–angiotensin–aldosterone system blockade, and lifestyle optimization. Strengths include a homogeneous male cohort, standardized ABPM, and echocardiographic phenotyping. Limitations are modest sample size and lack of advanced diastolic indices. Future studies should explore whether conversion from non-dipper to dipper profile improves diastolic parameters and long-term prognosis in hypertensive servicemen.

Conclusion

In military personnel with arterial hypertension, impaired diastolic function is associated with higher BP levels and unfavorable circadian patterns on ABPM. Combined use of echocardiography and ABPM enhances early risk detection and may guide individualized preventive strategies.

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