

Cardiac and Renal Damage in Hospitalized Hypertensive Patients: Prevalence, Associated Factors, and Clinical Implications

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Abstract

Background: Hypertension is highly prevalent and constitutes a significant risk factor for Target Organ Damage (TOD), such as cardiac and renal lesions, thereby increasing morbidity and mortality. However, the magnitude of these complications among hospitalized patients remains underexplored in Brazil.

Objective: To estimate the prevalence of TOD among hospitalized hypertensive patients and identify associated clinical factors.

Methods: This cross-sectional study included 107 hypertensive inpatients at a university hospital in Minas Gerais, Brazil. Renal damage was assessed through Estimated Glomerular Filtration Rate (eGFR), and cardiac damage through Left Ventricular Hypertrophy (LVH). Sociodemographic, clinical, and laboratory data were collected. Analyses included descriptive and bivariate statistics ($p < 0.05$).

Results: The mean age was 63.6 ± 10.8 years; 53.3% were male and 44.9% self-identified as White. Reduced eGFR was observed in 73.8% of participants, and LVH in 38.3%. Overall, 35% presented both types of TOD, 53% only one, and 12% none. A reduced eGFR was associated with low educational attainment ($p = 0.004$) and a history of prior nephropathy ($p = 0.022$). LVH was more frequent among those with a history of myocardial infarction ($p = 0.002$).

Conclusion: Hospitalized hypertensive patients exhibited a high prevalence of TOD, especially renal involvement, underscoring the need for systematic screening and monitoring protocols to mitigate cardiovascular and renal complications.

Keywords: Hypertension; Target organ damage; Chronic kidney disease; Left ventricular hypertrophy; Hypertensive heart disease.

Introduction

Hypertension is one of the most prevalent chronic diseases and remains a significant public health challenge, representing the leading modifiable risk factor for cardiovascular and renal diseases. Globally, hypertension is associated with 10.8 million annual deaths and 235 million Disability-Adjusted Life Years (DALYs) [1]. In Brazil, approximately 32.3% of adults have hy-

pertension; however, fewer than half of those treated achieve adequate blood pressure control, revealing persistent gaps in diagnosis and therapeutic adherence [2].

Sustained elevation of blood pressure leads to functional and structural changes in target organs [3]. In the kidneys, a decline in Estimated Glomerular Filtration Rate (eGFR) is an early marker of renal injury that may progress to Chronic Kid-

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ney Disease (CKD) [4]. In the heart, Left Ventricular Hypertrophy (LVH) develops as an adaptive response to pressure overload but increases the risk of heart failure, arrhythmias, and sudden cardiac death, particularly when the Left Ventricular Mass Index (LVMI) is elevated [5]. Studies have also described a bidirectional interaction between LVH and CKD, highlighting the interdependence of cardiac and renal lesions [6,7].

In hospital settings, hypertensive patients often present multiple comorbidities and greater clinical complexity [8], factors that increase the frequency of Target Organ Damage (TOD) and complicate therapeutic management. In Brazil, the prevalence and profile of TOD among hospitalized hypertensive patients remain poorly described. Systematic evaluation of parameters such as eGFR and LVMI enables more accurate risk stratification, early identification of high-risk individuals, and tailored therapeutic planning [9].

Therefore, this study aimed to assess the prevalence of cardiac and renal lesions in hospitalized hypertensive patients, focusing on eGFR and LVMI as clinical markers to support safer and more targeted clinical strategies.

Methods

Study design and setting

This observational, cross-sectional, quantitative study was conducted between December 2021 and June 2022 at a large public university hospital in Minas Gerais, Brazil.

Population and sampling

This analysis is a sub-study derived from previously published data [10]. Only patients with complete data for eGFR and LVH assessment were included, totaling 107 participants. As the sample consisted exclusively of inpatients, the study aimed to describe the clinical profile and frequency of TOD in this context, without comparison to outpatient populations.

Inclusion and exclusion criteria

Inclusion criteria were: Age ≥ 18 years, both sexes, prior medical diagnosis of hypertension, and continuous antihypertensive use for at least six months. Exclusion criteria included pregnancy, severe psychiatric illness, significant cognitive impairment, or any condition precluding reliable data collection.

Data collection and variables

Data included sociodemographic (age, sex, self-reported race, education), clinical (weight, height, blood pressure, heart rate, comorbidities such as diabetes mellitus, dyslipidemia, myocardial infarction, stroke, heart failure, nephropathy, obesity), lifestyle (smoking, alcohol use, physical activity), and laboratory parameters from electronic medical records, including serum creatinine for eGFR calculation.

Smoking was defined as the consumption of at least one cigarette per day; alcohol use as any reported consumption regardless of quantity or frequency; and physical inactivity as <150 minutes of moderate activity per week. Weight and height were measured using a digital scale (Omron HBF-214) and a metal stadiometer, with body mass index (BMI, kg/m^2) calculated according to the WHO criteria (2000). Blood pressure was measured using a validated automatic sphygmomanometer (Omron HEM-7113), with the last two of three readings averaged, as recommended by the *Brazilian Hypertension Guidelines* [11].

Assessment of TOD

Renal function: eGFR was calculated using the CKD-EPI equation. Values <60 $\text{mL}/\text{min}/1.73$ m^2 were considered significant renal impairment, and 60-89 $\text{mL}/\text{min}/1.73$ m^2 as mild-to-moderate reduction [11].

Left ventricular hypertrophy: LVH was assessed via transthoracic echocardiography performed by the institutional cardiology department. Left ventricular mass was estimated using the Devereux formula and indexed to body surface area (LVMI). LVH was defined as an LVMI greater than 95 g/m^2 in women and greater than 115 g/m^2 in men [11].

Statistical analysis

Data were entered into an electronic spreadsheet and double-checked for consistency. Analyses were performed using SPSS 23.0. Categorical variables were expressed as absolute and relative frequencies, and continuous variables as mean \pm standard deviation. Associations between categorical variables and outcomes (reduced eGFR, LVH) were tested using Pearson's chi-square or Fisher's exact test, as appropriate. Significance was set at $p < 0.05$.

Ethical considerations

The study was approved by the Institutional Research Ethics Committee (CAAE 3.3792420.0.0000.5152; approval no. 4.567.621). All participants provided written informed consent in accordance with Resolution 466/2012 of the National Health Council.

Results

A total of 107 hospitalized hypertensive patients were included, with a mean age of 63.6 ± 10.8 years, a predominance of males (53.3%), and a higher proportion of self-identified White individuals (44.9%).

The prevalence of TOD was high, with reduced estimated glomerular filtration rate (eGFR) observed in 73.8% and Left Ventricular Hypertrophy (LVH) in 38.3%. The mean Left Ventricular Mass Index (LVMI) was 103.97 ± 47.57 g/m^2 .

Regarding the number of affected organs per patient, 53% had one type of TOD (either reduced eGFR or LVH), 35% had both, and 12% had none. This substantial overlap of renal and cardiac impairment exceeds that reported in outpatient cohorts, suggesting that hospitalized hypertensive patients represent a population with greater clinical severity and cardiovascular risk.

The most prevalent comorbidities were diabetes mellitus (31.8%), dyslipidemia (41.1%), previous myocardial infarction (36.4%), and obesity (30.8%). According to the 2020 Brazilian Hypertension Guidelines, blood pressure levels were optimal in 38.3% of patients and within stages 1-3 hypertension in 27.9% of patients.

Antihypertensive therapy was widely prescribed, with angiotensin receptor blockers (68.2%), diuretics (50.5%), and beta-blockers (47.7%) being the most commonly used medications.

A reduced eGFR was significantly associated with a lower educational level ($p=0.004$) and a history of nephropathy ($p=0.022$). LVH was present in 38.3% ($n=41$) and was more frequent among patients with a history of myocardial infarction ($p=0.002$).

The leading causes of hospitalization were cardiovascular, followed by metabolic and infectious conditions, highlighting the high clinical complexity of this population.

Table 1: Sociodemographic, clinical, & laboratory characteristics of hospitalized hypertensive patients (n=107).

Characteristics	n (%) or mean±standard deviation
Male sex, n (%)	57(53.3)
Age, Years	63.56±10.81
Self-reported skin color, n (%)	
White	48(44.9)
Brown (Parda)	45(42.1)
Black	14(13.1)
Education level, n (%)	
No formal education	8(7.5)
≤8 years of schooling	65(60.7)
9-11 years of schooling	28(26.1)
≥12 years of schooling	6(5.6)
Retired, n (%)	64(59.8)
Monthly income ≤1 minimum wage, n (%)	63(58.9)
BMI, kg/m²	27.99±6.17
SBP, mmHg	125±23
DBP, mmHg	74±14
Comorbidities, n (%)	
Diabetes mellitus	34(31.8)
Dyslipidemia	44(41.1)
Myocardial infarction	39(36.4)
Stroke	17(15.9)
Heart failure	29(27.1)
Nephropathy	20(18.7)
Obesity	33(30.8)
Lifestyle habits, n (%)	
Smoking	19(17.8)
Alcohol consumption	16(15.0)
Physical inactivity	43(40.2)
Laboratory parameters	
Creatinine, mg/dL	1.08±0.39
Sodium, mEq/L	136.70±13.49
Potassium, mEq/L	4.27±0.59
Total cholesterol, mg/dL	161.57±35.53
Triglycerides, mg/dL	161.30±90.49
LDL, mg/dL	86.73±28.95
HDL, mg/dL	43.42±12.56
Functional parameters	
eGFR, mL/min/1.73 m ²	74.78±27.3
LVMI, g/m ²	103.97±47.57

Values are expressed as mean ± Standard Deviation (SD) for continuous variables and as frequency (percentage) for categorical variables. BMI: Body Mass Index; SBP: Systolic Blood Pressure; DBP: Diastolic Blood Pressure; eGFR: estimated Glomerular Filtration Rate; LVMI: Left Ventricular Mass Index.

Table 2: Association between renal function (eGFR) and sociodemographic and clinical variables among hospitalized hypertensive patients.

Variable	Normal eGFR (n=28)	Reduced eGFR (n=79)	OR (95% CI)*	p-value
Education level				
Studied	22(22.2%)	77(77.8%)	10.500(1.979–55.721)	0.004
Never studied	6(75.0%)	2(25.0%)	—	—
Nephropathy				
No	27(31%)	60(69%)	8.550(1.088–67.186)	0.022
Yes	1(5%)	19(95%)	—	—

CI: Confidence Interval; eGFR: estimated Glomerular Filtration Rate.

Table 3: Association between left ventricular hypertrophy and sociodemographic and clinical variables among hospitalized hypertensive patients.

Variable	No LVH (n=66)	LVH (n=41)	OR (95% CI)*	p-value
Myocardial infarction				
No	50(73.5%)	18(26.5%)	3.993(1.732-9.204)	0.002
Yes	16(41%)	23(59%)	—	—

LVH: Left Ventricular Hypertrophy; OR: Odds Ratio; CI: Confidence Interval; *95% Confidence Interval.

Discussion

This study demonstrates a high prevalence of TOD among hospitalized hypertensive patients, particularly renal and cardiac involvement. Reduced eGFR was observed in nearly three-quarters of participants, and LVH in more than one-third, reflecting a population with marked clinical severity and elevated cardiovascular risk. Systematic assessment of these markers is essential for risk stratification and individualized therapeutic planning.

Beyond traditional contributors to hypertension, some patients experience unpredictable and abrupt blood pressure fluctuations, described as “chaotic hypertension” [12]. Such instability may accelerate TOD progression, especially in hospital environments where close monitoring can be challenging.

The prevalence of TOD observed here was considerably higher than that reported in population-based Brazilian studies, which typically range from 8% to 15% for reduced eGFR and 20% to 25% for LVH [13,11]. This reinforces that hospitalized patients constitute a high-risk subgroup, often with multiple comorbidities and greater cardiovascular vulnerability. Few national studies have specifically investigated TOD markers in hypertensive inpatients, underscoring the novelty and relevance of these findings.

Community-based studies report LVH prevalence between 15% and 25% and reduced eGFR in 20% or less [13,14], whereas the present study found prevalence rates of 38% and 74%, respectively. The coexistence of LVH and reduced eGFR denotes a high-risk phenotype associated with increased hospitalization and cardiovascular mortality rates [7]. Thus, combined assessment of renal and cardiac damage may facilitate early identification of high-risk patients, supporting preventive interventions in hospital settings.

Renal function

The association between hypertension and declining renal function is well established, as elevated blood pressure contributes to the development and progression of CKD [15,7,16]. Mechanisms include activation of the renin–angiotensin–aldosterone system, hemodynamic overload, and endothelial dysfunction, leading to vascular remodeling and interstitial fibrosis [17].

In this study, prior nephropathy was strongly associated with reduced eGFR, reinforcing renal evaluation as a robust marker of cardiovascular and renal risk. The association between reduced eGFR and low educational attainment suggests that socioeconomic disparities may influence renal injury progression through reduced healthcare access, inadequate blood pressure control, and poor treatment adherence [18].

Left ventricular hypertrophy

LVH is an independent risk factor for cardiovascular morbidity and mortality, linked to heart failure, arrhythmias, and coronary artery disease [11,19,13]. The strong association between LVH and prior myocardial infarction in this study likely reflects post-ischemic ventricular remodeling characterized by necrosis, fibrosis, and compensatory hypertrophy, which increases ventricular mass and susceptibility to future events [20,21]. These findings underscore the importance of rigorous clinical follow-up and use of therapies that attenuate adverse remodeling, such as renin–angiotensin–aldosterone system blockers and beta-blockers in selected patients. The predominant use of angiotensin receptor blockers, diuretics, and beta-blockers aligns with current *Brazilian Hypertension Guidelines* [11], particularly for patients with CKD and LVH.

Study limitations

This study has limitations. The cross-sectional design precludes causal inference regarding the relationship between clinical factors and TOD. The temporal progression of markers during hospitalization could not be assessed and warrants further longitudinal studies. The relatively small sample, limited to patients with complete renal and echocardiographic data, may restrict generalizability. Self-reported lifestyle data (smoking, alcohol, physical activity) are subject to recall bias. The absence of systematic records on the length of hospital stay prevented analysis of its correlation with TOD severity. Finally, the lack of data on recent cardiovascular events limits the interpretation of the clinical impact of the identified lesions.

Conclusion

Hospitalized hypertensive patients present a high prevalence of TOD, particularly renal and cardiac, highlighting the need for systematic screening, continuous monitoring, and individualized management strategies. Compared with outpatient populations, hospitalized patients exhibit a markedly higher prevalence and coexistence of TOD, underscoring the importance of dedicated hospital-based screening and risk-stratification protocols. Integrated assessment of renal and cardiac parameters provides crucial insights to guide therapeutic decision-making and reduce cardiovascular morbidity and mortality in this high-risk population.

Clinical implications

The high prevalence of TOD—especially renal dysfunction—indicates that hospitalized hypertensive patients represent a

population at substantial cardiovascular and renal risk. Routine integration of eGFR and LVH assessment into hospital care protocols could enable more accurate risk stratification and earlier detection of complications. Moreover, these findings underscore the importance of reviewing inpatient and discharge therapeutic approaches to optimize antihypertensive treatment and ensure structured post-discharge follow-up, ultimately reducing readmissions and adverse outcomes.

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