



Research Article

Electrocardiographic and Echocardiographic Aspects of Hypertensive Patients at the Renaissance University Hospital Center in N'Djamena, Chad

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Abstract

Introduction and objective: Hypertension is a major global public health problem and is a leading risk factor for cardiovascular diseases worldwide due to its prevalence and complications. The objective of this study was to determine the electrocardiographic and echocardiographic characteristics of hypertensive patients at the Renaissance University Hospital Center in N'Djamena, Chad. **Patients and Methods:** This was a descriptive cross-sectional study with retrospective data collection over a 12-month period from June 1st, 2023 to May 31st, 2024. The study included all medical records of hypertensive patients aged 18 years and older who were on follow up in the Cardiology Department and that underwent an electrocardiogram and a Doppler echocardiogram. We examined sociodemographic, clinical, paraclinical, and therapeutic variables. **Results:** A total of 322 records were collected. The patient population was predominantly male, with a male-to-female sex ratio of 1.3. The mean age was 55.6 years. Civil servants accounted for 33.2% of cases. The main cardiovascular risk factors identified were diabetes (21.4%), obesity (21%), and dyslipidemia (18.6%). Functionally, Dieulafoy's neurosensory signs were the most common, at 52.4%. The most commonly prescribed antihypertensive drugs were calcium channel blockers (62.4%) and angiotensin-converting enzyme inhibitors (49.1%). On electrocardiogram, the most common abnormalities were atrial hypertrophy (16.1%) and ventricular hypertrophy (13.6%). Cardiac arrhythmia due to atrial fibrillation was observed in 3.4% of cases. On echocardiography, the most common abnormalities were ventricular hypertrophy (32.3%), left atrial dilation (14.6%), and reduced left ventricular systolic function (7.1%). **Conclusion:** In this study, electrocardiographic and echocardiographic abnormalities in hypertensive patients were dominated by left ventricular hypertrophy, left atrial dilation, and left ventricular diastolic dysfunction. These abnormalities were most common in patients with long-standing, uncontrolled hypertension.

Keywords

Electrocardiogram, Echocardiography, Hypertension, N'Djamena

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1. Introduction

Hypertension is a major global public health problem. Cardiovascular diseases are the leading cause of death worldwide. Hypertension, is a major risk factor for cardiovascular diseases. It affects one in four adults worldwide, and its prevalence increases with age [1]. Similarly, uncontrolled hypertension, is a powerful, independent risk factor significantly associated with increased morbidity and mortality, which can lead to various adverse clinical conditions such as myocardial infarction, heart failure, kidney failure, and cerebrovascular disease [2]. It is estimated that hypertension affects 1.28 billion people worldwide, and most of them reside in low- and middle-income countries, including regions across sub-Saharan Africa where prevalence is rapidly climbing. Approximately 46% of adults with hypertension are unaware of their condition [3]. In sub-Saharan Africa, the prevalence has been estimated to be at 28.3%. In Côte d'Ivoire, this prevalence rose from 21% in 2006 to 33.4% in 2016 [4]. In Chad, the prevalence of hypertension varies, ranging from 22.28% in 2021 to 38.6% and 43.8% in 2023 [5-7]. However, in Chad, there is little data on electrocardiographic and echocardiographic findings in hypertensive patients. Hence our objective is to conduct a preliminary study to determine these characteristics in hypertensive patients at the Renaissance University Hospital Center.

2. Patients and Methods

2.1. Type and Setting of the Study

This was a descriptive cross-sectional study with retrospective data collection that was conducted in the Cardiology Department at the Renaissance University Hospital Center, over a 12-month period from June 1st, 2023 to May 31st, 2024.

In this study, we included all records of hypertensive patients aged 18 years and older who were on follow up in the Cardiology Department and that underwent an electrocardiogram (ECG) and Doppler echocardiogram. Incomplete records were excluded. Data collection was performed using a pre-established form.

2.2. Variables Studied

- 1) Sociodemographic: age, sex, occupation, associated cardiovascular risk factors, place of origin.
- 2) Clinical: characteristics of hypertension (duration, severity, treatment adherence), functional symptoms (chest pain, dyspnea, headaches, dizziness, phosphenes, tinnitus, palpitations, etc.), and physical signs of heart failure.
- 3) Paraclinical tests: ECG (arrhythmias such as 'atrial fibrillation, atrial flutter, atrial and ventricular extrasystoles, atrioventricular or intracardiac blocks, atrial and ventric-

ular hypertrophy), Doppler echocardiogram (left ventricular ejection fraction, left ventricular diastolic dysfunction, ventricular dilation, left ventricular hypertrophy), blood electrolyte levels, creatinine, urea, blood glucose, lipid profile, uric acid, BNP (brain natriuretic peptide).

- 4) Therapeutic agents: antihypertensives (thiazide diuretics, beta-blockers, calcium channel blockers [CCBs], angiotensin-converting enzyme inhibitors [ACE inhibitors], angiotensin II receptor blockers [ARBs], centrally acting agents).

The echocardiographic criteria are those of the American Society of Echocardiography and the European Association of Cardiovascular Imaging [8].

2.3. Statistical Analysis

We used Microsoft Office 2019 for data entry and SPSS V26 for data analysis. The results were presented in figures and tables. Quantitative variables were expressed as mean $\pm$ standard deviation, and qualitative variables as percentages. The Chi-square test was used to compare variables. A p -value of ≤ 0.05 was considered statistically significant.

2.4. Declaration of Ethics

The study complied with the Declaration of Helsinki.

3. Results

3.1. Epidemiological Characteristics

A total of 322 patients met the inclusion criteria. The majority were male, with a male-to-female ratio of 1.3. The mean age was 55.6 ± 13.2 years, ranging from 23 to 91 years. Patients aged 60 years and older were the most common, accounting for 34.2% of cases. Civil servants accounted for 33.2% of cases. The main cardiovascular risk factors associated with high blood pressure were diabetes (21.4%), obesity (21%) and dyslipidemia (18.6%) (Table 1).

Table 1. Patients Characteristics.

Settings	Number (n)	Percentage (%)
Sex		
Men	137	43
Women	185	57
Age (year)		
Means	55.6	

Settings	Number (n)	Percentage (%)
18 – 29	3	0.9
30 – 39	41	12.7
40 – 49	69	21.4
50 – 59	99	30.7
60 et plus	110	32.4
Profession		
Civil servant	107	33.2
Commerçant	39	12.1
Farmer	2	0.6
Housewife	97	30.1
Other	77	23.9
Cardiovascular risk factors		
Diabetes	69	21.4
Obesity	67	21
Dyslipidemia	60	18.6
Smoking	16	5
Kidney failure	9	3

3.2. Clinical and Therapeutic Characteristics of Hypertension

Symptomatically, Dieulafoy's neurosensory signs were the most frequent, occurring in 52.4% (n=169). Patients also complained of exertional dyspnea, chest pain, and palpitations occurring in 22% (n=70), 19% (n=61) and 8.4% (n=27) of cases, respectively.

Regarding the characteristics of hypertension, the duration was predominantly more than 5 years (34.8%), and patients adhered to their treatment regularly in only 42.2% of cases. The majority of patients (72%) had elevated blood pressure,

with 19.3% having grade 3 hypertension. Hypertension was controlled in only 28% of cases (Table 2).

Table 2. Characteristics of Hypertension.

Settings	Number (n)	Percentage (%)
Duration (years)		
< 1	107	33.2
1 – 2	35	10.9
3 – 4	68	21.1
≥ 5	112	34.8
Severity		
Controlled	90	28
Grade 1	99	30.7
Grade 2	71	22
Grade 3	62	19.3
Patient follow up		
Yes	191	59.3
No	131	40.7
Therapeutic adherence		
Regular	136	42.2
Irregular	186	57.8

The most frequently prescribed antihypertensive drugs (Figure 1) in patients were CCBs and ACE inhibitors, at 62.4% and 49.1% of cases, respectively, either as monotherapy (33.5%) or in combination with other antihypertensive drugs. Dual therapy was the most frequently prescribed combination of antihypertensive drugs at 52.2% of cases, followed by triple therapy at 10.2% of cases and quadruple therapy at 1.2% of cases.

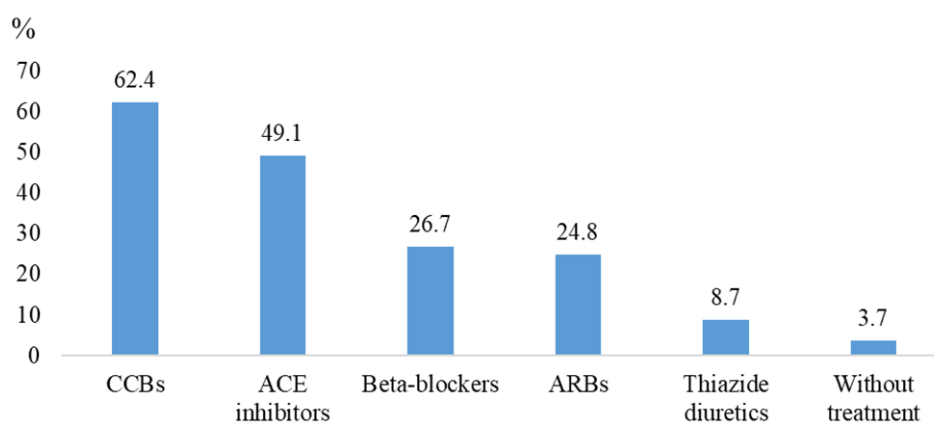


Figure 1. Antihypertensive medications.

3.3. Electrocardiographic and Echocardiographic Data

Electrocardiographic abnormalities were predominantly atrial (16.1%) and Left ventricular hypertrophy (LVH) (13.6%). Complete arrhythmia due to fibrillation was observed in 19% of cases (Table 3).

Table 3. Electrocardiographic abnormalities.

Settings	Number (n)	Percentage (%)
Arrhythmia		
Atrial fibrillation	11	3.4
Atrial extrasystole	6	2
Atrial flutter	2	0.6
Ventricular extrasystole	15	4.6
Conduction disorder		
1st degree AV block	21	6.5
2nd degree AV block	3	0.9
3rd degree AV block	2	0.6
Hypertrophy		
Left atrial appendage	52	16.1
Right atrial appendage	3	0.9
Left ventricular	44	13.6
Right ventricular	1	0.3

On echocardiography, the most noted abnormalities were LVH with 32.3% of cases, of which 17.1% of cases were concentric, left atrial dilation in 14.6% of cases, left ventricular (LV) dilation in 10.2% of cases and reduced LV systolic function in 7.1% of cases (Table 4).

Table 4. Echocardiographic abnormalities.

Settings	Number (n)	Percentage (%)
LVEF (%)		
<40	23	7.1
40–49	17	5.3
>50	282	87.6
LV Diastolic Dysfunction		
Yes	188	58.4
No	134	41.6

Settings	Number (n)	Percentage (%)
Cavity dilation		
Left atrium	47	14.6
Right atrium	9	2.7
Left ventricle	33	10.2
Right ventricle	4	1.2
Proximal aorta	4	1.2
LV hypertrophy		
Concentric	55	17.1
Eccentric	49	15.2

LVH was correlated with the duration of hypertension ($p = 0.03$) (Table 5). However, there was no significant statistical association between the occurrence of LVH, sex, age, blood pressure control, and therapeutic class ($p > 0.05$).

Table 5. Correlation between left ventricular hypertrophy and duration of hypertension.

LVH	Duration of hypertension (years)				Total	p
	< 1	1 - 2	3 - 4	≥ 5		
Yes	33	5	21	45	104	0.03
No	74	30	47	67	218	
Total	107	35	68	112	322	

4. Discussion

4.1. Keys Findings

In this study, the mean age of the patients was 55.6 years. This result is similar to those of Ou édraogo et al. in Burkina Faso in 2021, and those of Ikama et al. in Congo in 2019, who found mean ages of 57.45 and 54.7 years, respectively [1, 9]. This age homogeneity suggests that hypertension increases with age, linked to vascular aging and risk factors accumulated over time. The majority of patients were male, representing 57.5% of cases. This male predominance was also found in some African series, notably Ikama et al. in Congo in 2019 and Abdelmadjid et al. in Chad in 2021, who found 55.2% and 56% of cases, respectively [9, 10]. These results could be explained by the fact that male sex is indeed a cardiovascular risk factor.

The most common cardiovascular risk factors are diabetes (21.4%), obesity (21%), and dyslipidemia (18.6%). These

findings are also observed in certain African studies, notably that of Brouri et al. in Algeria in 2018, which found out that 25% of cases of hypertension were associated with diabetes. Benyaich et al. in Morocco in 2025 and Jacques et al. in the Democratic Republic of the Congo in 2023 found prevalence rates of obesity of 16.3% and of 16.6%, respectively. El Boukhrissi et al., in Morocco in 2017, found a prevalence of dyslipidemia of 18% [11-14]. This similarity in prevalence could be explained by the epidemiological transition currently underway in African countries, which is exposing our populations to cardiovascular risk factors.

Dieulafoy's neurosensory signs and dyspnea were the most common symptoms, accounting for 52.44% and 27.3% of cases, respectively, followed by chest pain (18.9%) and palpitations (8.4%). In a 2016 study conducted in Senegal, Sarr et al. found a prevalence of chest pain (5.3%) and palpitations (12.5%) [2]. This highlights the inadequate control of hypertension in our setting.

On electrocardiographic examination, the abnormalities were predominantly atrial hypertrophy (16.1%) and LVH (13.6%). Several authors have reported comparable results in various series [2]. Indeed, these abnormalities reflect the impact of hypertension, which leads to left ventricular remodeling with increased filling pressures and, consequently, also affects the left atrium. The ECG remains a simple, accessible, and inexpensive tool for detecting complications of hypertension. Although the ECG has a high specificity of 90%, its sensitivity remains low at 30% for detecting LVH compared to echocardiography [15].

The ECG also revealed other abnormalities, such as ventricular arrhythmias characterized by ventricular premature beats (4.6%). These are exacerbated by hypertension; they are often benign but may be malignant depending on the severity of the hypertension. At the supraventricular level, atrial fibrillation is the most common (3.4%). It increases the risk of cardiovascular complications, particularly strokes. Hypertension is a risk factor for the development of atrial fibrillation, especially with advancing age [2, 16].

Doppler echocardiography is an important tool for assessing, among other things, cardiac function and heart damage associated with hypertension. It is more specific and, above all, more sensitive than an ECG for detecting LVH with the calculation of LV mass index and an assessment of LV geometry [4].

In our study, the most common echocardiographic abnormalities were LVH (32.3%), left atrial dilation (14.6%), LV dilation (10.2%), LV diastolic dysfunction (58.4%), and reduced LV systolic function (7.1%). LVEF remains preserved for a long time in the majority of cases despite chronic hypertension, although impairment may occur over time.

Hypertension remains to be the most common cause of LVH, which is found in 30% of patients with hypertension. It leads to remodeling and subsequently concentric hypertrophy due to an increase in LV afterload [17, 18]. Although LVH initially represents to be an adaptive process, it has adverse

consequences over time. It is now recognized as an independent risk factor for cardiovascular morbidity and mortality [19]. In this series, LVH is correlated with the duration of hypertension ($p = 0.03$) in patients with hypertension who are often uncontrolled. Indeed, long-standing, poorly controlled hypertension remains the most significant factor in the development of LVH.

These echocardiographic abnormalities are common in patients with hypertension. They characterize hypertensive heart disease, which can progress to complications, particularly heart failure [2, 15].

Properly managed antihypertensive therapy can reduce LV mass and, consequently, improve the patient's prognosis [20].

4.2. Limitations of Our Study

First, this was a single-center study. Second, there was a lack of echocardiographic and laboratory data in many of the patient records.

5. Conclusion

In this study, electrocardiographic and echocardiographic abnormalities in patients with hypertension are primarily characterized by left ventricular hypertrophy, left atrial and left ventricular dilation, and left ventricular diastolic dysfunction. These abnormalities are more common in patients with long-standing, uncontrolled hypertension.

6. Recommendations

We suggest promoting screening, therapeutic education, and early management of hypertension, along with facilitating access to antihypertensive treatment. These measures can help prevent the occurrence of these complications.

Abbreviations

ECG	Electrocardiogram
BNP	Brain Natriuretic Peptide
CCBs	Calcium Channel Blockers
ACE	Angiotensin-Converting Enzyme
ARBs	Angiotensin II Receptor Blockers
LV	Left Ventricular
LVH	Left Ventricular Hypertrophy
EF	Ejection Fraction

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Conflicts of Interest

The authors declare no conflict of interest.

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