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Contribution of Ambulatory Pulsed Pressure in the Modification of the Left Ventricular Geometry of the African Black People

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Abstract

Introduction-Purpose: Pulsed pressure is recognized as an important predictor of cardiovascular risk. The purpose of this study was to identify a possible association between high ambulatory pulsed pressure and left ventricular geometry change in African black people. **Material and methods:** We conducted a bicentric, retrospective descriptive and analytical study that took place from 2010 to 2015 at the Abidjan Heart Institute and the Polyclinic Sainte Anne Marie in Abidjan. The people were selected from MAPA's archive files. Those aged 18 years and over were included, all of whom had valid echocardiography and MAPA. The analyzed parameters concerned epidemiological data with age, gender and body surface area. The clinical data analyzed included systolic, diastolic, mean and 24-hours pulsed pressures. On the echocardiographic parameters, it was the evaluation of the ventricular mass indexed to the body surface. **Results:** A total of 177 patients records were selected. The mean age of the patients was 56.32 ± 10.51 years. There was a male predominance with a sex ratio of 1.15. The main cardiovascular risk factors found outside high blood pressure were dyslipidemia (06.87%) and obesity (13.7%). In clinical terms, hypertension was found in 75% of cases (n = 133) versus 25% (n = 44) of normotensive patients. These blood pressure profiles allowed us to classify our study population into two groups: hypertensives people and normotensives people. The hypertensives people had significantly higher mean pulsed pressure levels than the normotensives people. All normotensive patients had normal pulsed pressure. In the hypertensive population, the prevalence of high pulsed pressure was 31% (n = 41) versus 69% (n = 92) normal pulsed pressure. Concerning the relationship between

24 hour ambulatory pulsed pressure and left ventricular mass, hypertensives patients with a high ambulatory pulsed pressure had a significantly higher average indexed ventricular mass than the opposite groups (p = 0.039). Their ejection fraction was significantly lower than those of the opposite populations (p = 0.000). On the analysis of the correlation between the left ventricular mass and the tension profile, we noted in our series, a strong and significant correlation (r = 0.6342; p = 0.0000) between pulsed pressure and the ventricular geometry change. **Conclusion:** High ambulatory pulsed pressure remains an independent factor of change in left ventricular geometry in black people.

Keywords

Ambulatory Pulsed Pressure-Left Ventricular Mass Indexed -African Black People

1. Introduction

By definition, High Blood Pressure is based on measurements of blood pressure from the brachial artery. Due to the white coat effect, elevated blood pressure detected by measurements in the office or at home should be confirmed by 24-hour ambulatory blood pressure monitoring (ABPM) [1] [2]. The relationship between blood pressure and cardiovascular risk using conventional blood pressure measurement and, more recently, ABPM has been the subject of several studies. Both techniques provide two measurements of BP (systolic (SBP) and diastolic (DBP)), which represent the extreme values of the sine waveform of blood pressure. In addition, the pressure curve consists of a pulsatile component, pulse pressure (PP), and a constant component, mean arterial pressure (MAP). PP is dependent on ventricular outflow volume, arterial stiffness, and timing of wave reflections, while MAP is dependent on cardiac output and vascular resistance [3] [4].

Studies have shown that systolic blood pressure and pulse pressure are independent risk factors for target organ damage [3]-[10]. There is growing evidence that ambulatory BP can improve the definition of individual cardiovascular risk [11]. In the PIUMA study, cardiovascular events were better predicted on an outpatient basis than by the PP clinic [10]. In hypertensive patients, relationships between PP and cardiovascular complications may be partially mediated by preclinical cardiovascular disease such as left ventricular hypertrophy. Contrasting evidence exists on the relationship between PP and left ventricular mass (LVM) in young and middle-aged hypertensive subjects [12]-[19]. Most of this work between PP and ventricular mass has been done on Caucasians to our knowledge. The prognostic value of outpatient pulse pressure on the left ventricular geometry is currently unknown in our context. The aim of this study was to test a possible association between these two entities in our African context.

2. Material and Methods

We realized a bicentric, descriptive and analytical retrospective study that took place from 2010 to 2015 at the Abidjan Heart Institute and the Polyclinic Sainte Anne Marie in Abidjan. The Polyclinique Internationale Sainte Anne-Marie is a hospital establishment created in 1985 and located in the commune of Cocody (north of Abidjan). It is a multidisciplinary health structure in the private health sector in Côte d'Ivoire. It has a cardiology department with external explorations. The Abidjan Cardiology Institute is a hospital establishment created in 1960 and located in the commune of Treicheville (south of Abidjan). It is a semi-private multidisciplinary health structure. It also has a cardiology department with external explorations. These two centers were chosen because on one hand they have external exploration services and on the other hand, we would like to have a representative sample.

People were selected from ambulatory measurement blood pressure archive (ABP) records. Were included in the study, people aged 18 years and over, of any gender, not hypertensive, who have all had valid echocardiography and ABP. These subjects were admitted for the exploration of blood pressure variability. Had been excluded, pregnant women, patients with primary or secondary cardiomyopathy of etiology other than arterial hypertension, patients with renal insufficiency and hemodialysis, and patients with organic valvulopathies. Similarly, those who had with isolated diurnal or nocturnal arterial hypertension were not included in the study.

The parameters analyzed were epidemiological data with age, sex and body surface area calculated from the Dubois formula [20]. Clinical data analyzed for systolic, diastolic, mean and pulsed arterial blood pressure. The evaluation of ventricular mass indexed to the body surface was performed to facilitate indexation of the ventricular mass. All these data were taken from the files of these centers.

3. Statistical Analysis

The processing and statistical analyses of the data were performed using the STATA 12.0 software. The evaluation of the relationship between the pulsed pressure between the left ventricular mass was done through a linear regression with calculation of the correlation coefficient r. The statistical significance threshold was set at 0.05.

4. Results

- **Epidemiological data**

A total of 177 files were selected. The average age of patients was 56.32 ± 10.51 years. There was a male predominance with a sex ratio of 1.15. The main cardiovascular risk factors found outside high blood pressure were dyslipidemia (06.87%) and obesity (13.7%). These risk factors are identified in **Figure 1**.

- **Clinical data**

In our series, hypertension was diagnosed in 75% of cases (n = 133) versus 25%

(n = 44) of normotensive patients. These blood pressure profiles made to classify our study population into two groups; hypertensives and normotensives. Hypertensive patients had significantly higher average pulsed pressure levels than normotensive patients. These different data are identified in Table 1. All normotensive patients had normal pulse pressure. In the hypertensive population, the prevalence of high pulse pressure was 31% (n = 41) versus 69% (n = 92) normal pulse pressure. These different data are summarized in Table 2.

- **Relationship between ambulatory 24 hours pulsed pressure and indexed left ventricular mass (ILVM)**

Hypertensives patients with a high ambulatory PP had significantly higher average indexed ventricular mass than hypertensive patients with normal PP.

Patients with high indexed ventricular mass had a significantly lower ejection fraction than the opposite population. These results are summarized in Table 2.

- **Analysis of the correlation between the left ventricular mass and the pulsed pressure profile**

In our series, there was a strong and significant correlation between the pulsed pressure and the change in ventricular geometry. These observations are identified in Figure 2.

Table 1. Distribution of mean blood pressure level and heart rate based on blood pressure profile.

	General population (n = 177)	Hypertensives population (n = 133)	Normotensives population (n = 44)	p-value
SAP (mmHg)	132.95 ± 12.37	138.31 ± 11.76	116.48 ± 9.38	**<0.001**
DAP (mmHg)	82.31 ± 7	85.40 ± 10.38	72.68 ± 5.44	**<0.001**
PP (mmHg)	50.70 ± 11.2	52.91 ± 11.61	43.80 ± 5.77	**0.000**
HR (bpm	76.31 ± 9.82	76.02 ± 12.09	77.07 ± 9.82	0.613

SAP: systolic arterial pressure, **DAP**: diastolic arterial pressure, **PP**: pulsed pressure HR: heart rate (bpm: beat per minute).

Table 2. Distribution of echocardiographic data according to the pulsed pressure profile.

	Nomotensives population	Hypertensives population		
PARAMETERS	**PP normal (n = 44)**	**High PP (n = 41)**	**normal PP (n = 92)**	**p-value**
LAD (mm)	35.78 ± 5.39	38.20± 6.45	37.61 ± 5.15	0.339
EDDVG (mm)	49.20 ± 5.82	50.66 ± 5.82	50 ± 5.82	0.517
EFVG (%)	69.56 ± 8.58	65.65 ± 5.58	68.37 ± 5.58	**0.000**
LVMI (g/m²)	81.13 ± 28.28	95.27 ± 28.28	83.62 ± 28.28	**0.039**

PP: pression pulsée **EDDVG**: End diameter of diamètre left ventricular **LAD**: Left atrium diameter **EFVG**: Ejection fraction of left ventricular **LVMI**: Left ventricular mass index.

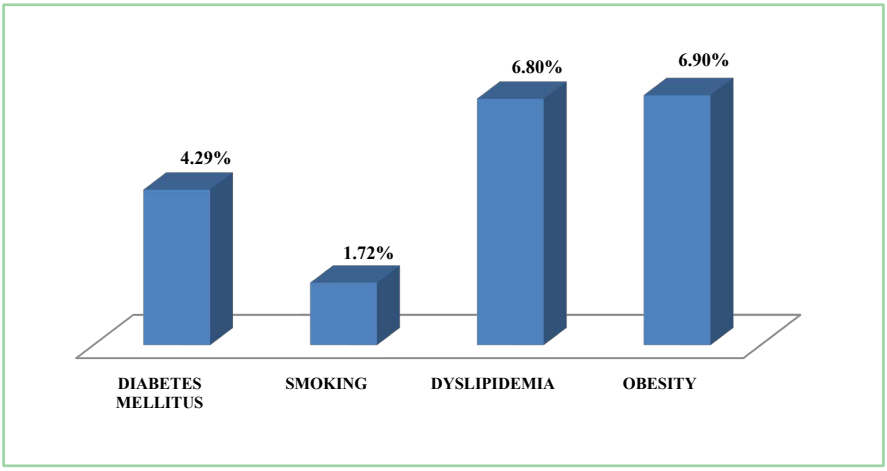

Figure 1. Proportion of major cardiovascular risk factors identified other than hypertension.

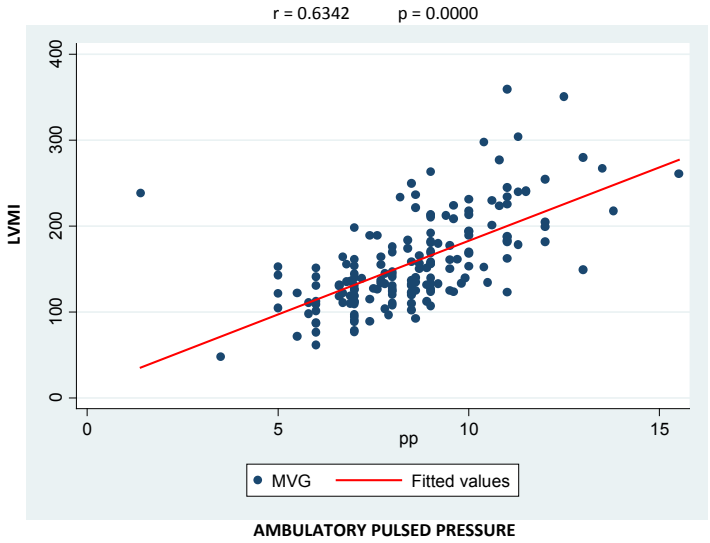

Figure 2. Correlation between ambulatory pulsed pressure and left ventricular mass index. **LVMI**: Left ventricular mass index.

5. Discussion

➢ Epidemiological data

The average age of patients was 56.32 ± 10.51 years. It is superior to those of N'GUETTA *et al.* in 2003 in Ivory Coast [21] and AJE *et al.* in Nigeria [22] with respective ages of 50.2 ± 11 years and 54.08 years. It was under that of WITTKE *et al.* [23] in Brazil with an average age of 58 years. These age variations can be related to different study populations. In all these observations, there are adult people. In fact, a linear relationship between age and arterial hypertension has been established because of three main factors: increased sensitivity to sodium with age, endothelial dysfunction modifying the ability of the arteries to dilate, and an increase in vascular rigidity [24]. Some studies suggest that, in the elderly, pulsed pressure (defined as the difference between systolic and diastolic blood

pressure is a parameter associated with cardiovascular risk.) Pulsed pressure, an indicator of arterial rigidity, is linearly related to age [25] [26]. Our study and that of AJE *et al.* [22] included obeses, in low proportion to facilitate the indexation of the left ventricular mass.

➢ **Ambulatory pulsed pressure (APP) and ventricular geometry**

In our series, in hypertensive patients with high PP, there was a significant increase in MVGI.

Studies have reinforced this observation. VERDECCHIA *et al.* [19] concluded in a study in untreated hypertensives that the association between APP and left ventricular hypertrophy was related to systolic blood pressure, which is a determinant of left ventricular mass in the hypertensive patient. These observations were also done by CELENTANO *et al.* [18].

➢ **Correlation between pulsed pressure and left ventricular mass**

Twenty-four hour PP was significantly correlated with left ventricular mass in our study. The studies of ROWLANDS *et al.* [27], DEVEREUX *et al.* [28] did the same observation but with lower correlations than ours. Pulsed pressure reflects the constant flow in the aorta and in the main arteries. Thus, the hemodynamic significance of high PP results from a loss of compliance in large arteries, increased reflection of peripheral waves and stronger resistance in small peripheral arteries, associated with high blood pressure. In the hypertensive and the elderly, the pulse wave returns to the heart at a faster rate during heart systole, which is responsible for left ventricular hypertrophy [28].

6. Conclusion

High ambulatory pulsed pressure remains an independent factor of change in left ventricular geometry in black people. Thus, the interpretation of any ambulatory blood pressure monitoring must take this into account and indicate an echocardiogram if it remains high with evaluation of the ventricular geometry.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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