

**ORTHOSTATIC BLOOD PRESSURE IN PRIMARY HYPERTENSION**

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**ABSTRACT**

**Background:** Measurements of blood pressure (BP) are usually done on supine position. Studies on orthostatic BP (Ortho BP) in hypertension (HT) would be of interest. The objective of this work is to assess the Ortho BP in hypertensive patients. **Patients and methods** : This prospective study included a group of 121 primary hypertensive patients (mean age: 54 years). Ortho BP was recorded for 10 minutes at the rhythm of 3 measurements per minute and was compared to the mean value of supine preorthostatic BP (mean Preortho BP). According to the changes in Ortho BP, three subgroups of primary hypertensive patients were selected as follows: Subgroup A: Ortho BP

was higher than mean Preortho BP by 10 mm Hg or more. Subgroup B: Ortho BP was lower than mean Preortho BP by 20 mmHg or more. Subgroup C: there were no significant pathologic changes in Ortho BP compared to mean Preortho BP :  $-20 \text{ mm Hg} < (\text{Ortho BP} - \text{mean Preortho BP}) < +10 \text{ mmHg}$ . **Results** : supine mean BP was  $154.2 \pm 12.7 \text{ mmHg}$  while orthostatic mean BP, not including patients with orthostatic hypotension, was  $172.0 \pm 16.5 \text{ mmHg}$ . In orthostatic position, 22,3 % of hypertensive patients showed an increase of their BP,  $\Delta\text{BP}$  equal or higher than 10 mmHg, and 14.9 % showed orthostatic hypotension (OH). Also, 2/3 of patients maintained or increased their BP at orthostatism. **Discussion:** the increase in Ortho BP could be explained by sympathetic hyperactivity. **Conclusion:** orthostatic test (OT) would be performed in all patients with high BP, in order to detect associated orthostatic HT or OH.

**KEY WORDS** : orthostatic test, sympathetic nerve activity, essential hypertension, autonomic nervous system, orthostatic hypotension, orthostatic blood pressure.

**Background:** Essential HT is the most prevalent cardiovascular disorder worldwide and is associated with high morbidity and mortality<sup>[1; 2]</sup>. Normalisation of BP is difficult to reach in essential HT, indeed 70 % of hypertensive patients have a poorly controlled BP values<sup>[3; 4]</sup>.

Measurements of BP are usually done on sitting or supine position during few minutes<sup>[5]</sup>. The measure of orthostatic BP during 10 min would be of interest in hypertensive patients. This work was proposed then to assess the Ortho BP in hypertensive patients.

## MATERIALS AND METHODS

**Criteria of selection:** The patients that had measures of basal BP above or equal to 140/85 mm Hg (basal BP  $\geq$  140/85 mm Hg) were selected for the study referring to the European Society of Hypertension (ESH) and the European Society of Cardiology (ESC)<sup>[6]</sup>. All the patients who had moderate hypertension, with no complication and not yet treated were kept for the study,

**Criteria of exclusion:** The patients who had secondary hypertension, complicated HT and who were under antihypertensive treatment were excluded from the study.

**Orthostatic Test Progress:** The OT was performed in a group of 121 primary hypertensive patients (mean age: 54 years) in the Center of Diagnosis and Treatment of Autonomic Dysregulations, Department of Cardiology A, CHU IBN SINA, Rabat. This test was done on hypertensive patients with no complication and not yet treated. An informed consent was obtained for every patient. The patient was placed into a quiet environment in a supine position. The monitoring of BP was realized by a Dynamap (CRITIKON, 1846SXP) and for heart rate (HR), a display (LCD CS 503 E; HELIGE, EK 512 E) was used.

The basal BP and HR were recorded in rest using the two hands, every five minutes during at least 30 minutes. After that, the OT was realized following the standards norms of Autonomic Nervous System (ANS) exploration<sup>[7; 8]</sup>.

The measures of Ortho BP were recorded for 10 minutes at a rate of 3 measurements per minute: mean Ortho BP was obtained, and compared to mean Preortho BP and were represented as mean Ortho BP.

### Three subgroups of primary hypertensive patients were selected as follows

1. Subgroup A: Ortho BP was higher than mean Preortho BP by 10 mm Hg or more.
2. Subgroup B: Ortho BP was lower than mean Preortho BP by 20 mmHg or more.
3. Subgroup C: there were no significant pathologic changes in Ortho BP compared to mean Preortho BP :  $-20 \text{ mm Hg} < (\text{Ortho BP} - \text{mean Preortho BP}) < +10 \text{ mmHg}$ .

A decrease of BP more than 20 mm Hg maintained for at least 3 measurements is considered as an OH. The peripheral sympathetic stimulation consecutive to orthostatic stress generally increases the BP. We can record the alpha and beta adrenergic sympathetic activity respectively according to the following formula:  $[(\text{Ortho BP} - \text{Preortho BP}) / \text{Preortho BP}] \times 100$ , we can also get it using the HR variations as follows:  $[(\text{Ortho HR} - \text{Preortho HR}) / \text{Preortho HR}] \times 100$ . Usually, an increase between 10% and 15 % is considered as normal, beyond 15% we consider it as a sympathetic hyperactivity, below 10% as a sympathetic deficiency<sup>[7;9]</sup>.

### Statistic Analyses

The values were represented in mean or in percentage.

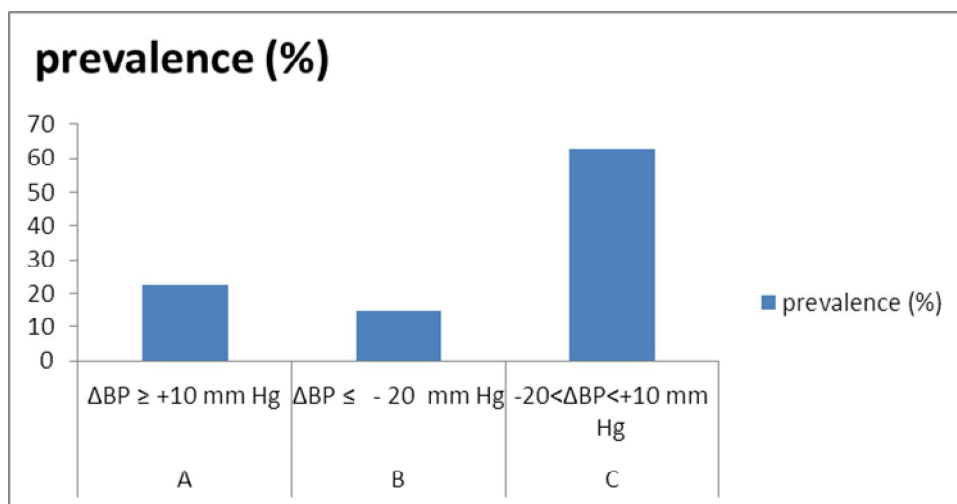
### RESULTS

The mean age of the 121 hypertensive patients was 54 years ranging from 40 to 79 years. The mean Preortho BP was  $154,0 \pm 11,5$  mm Hg. The mean basal HR was:  $68,9 \pm 8,2$  beats per minute. During orthostatism, excluding the patients with an OH, the Ortho BP was 172,0 mm Hg (ranging from 135 to 220 mm Hg of systolic BP).

In the subgroups, 62,8 % of hypertensive patients had no significant change of their BP at OT (fig I), but considering the orthostatic BP, the majority of patients had a high Ortho BP. Indeed, BP, generally high in supine remains elevated during the OT and the prevalence of orthostatic HT is important (fig I).

**Table I: Prevalence of hypertensive patients having an Ortho BP above 150 mm Hg during the OT.**

Hypertensive patients n=121	Ortho BP	Prevalence (%)
	$\geq 150 \text{ mm Hg}$	31,1
	$\geq 160 \text{ mm Hg}$	28,8
	$\geq 170 \text{ mm Hg}$	13,3
	$\geq 180 \text{ mm Hg}$	3,5
Total		65,8



**Fig 1: Prevalence of each subgroup of hypertensive patients according to the Ortho BP changes ( $\Delta BP$ ) during the OT.**

According to these results, and using the formula previously cited, the alpha adrenergic sympathetic response in our hypertensive patients, excluding patients with an OH, was 20 % (the normal response being around 10 %). OH has to be evaluated by a complete autonomic study.

## DISCUSSION

The OT was realised in the Center of “Cardiology A” from 2004. The OT is a simple, non-invasive and reproducible test involving the measurement of BP and HR during upright posture. In our study, 2/3 maintain their hypertension during OT and 1/4 of patients increase their orthostatic systolic BP by at least 10 mmHg and sometimes the value of systolic BP is more than 220 mm Hg (as in 3 patients). The Ortho BP refers to an increase in the BP in an upright posture. In subgroup A, elevation of orthostatic BP was related to an increase in the sympathetic response, as described in the literature <sup>[9;14]</sup>. In this work, the sympathetic response was increased at 20%. This work brings the same results as a previous study into the same center of ANS in “Cardiology A” with a different population that made an evaluation of the sympathetic response in hypertensive patients <sup>[9]</sup>.

The results of ANS studies confirmed the increase of sympathetic activity in hypertensive patients <sup>[10;14]</sup>. For instance, microneurography, used as an autonomic test by neurologists, showed that the increased activity of the sympathetic fibers is specifically proportional to the severity of the essential HT, and has no implication in secondary HT. This could help to explain why some metabolic risk factors and some common diseases related with essential

HT are not found in secondary HT <sup>[15; 24; 25]</sup>. Otherwise, spectral analysis techniques provide important information regarding nervous control alterations in essential HT and show an increase in sympathetic activity <sup>[15; 25]</sup>. The exact causes of sympathetic overactivity in hypertensive patients are only partially known. The hereditary factor has been much studied. For example, similarities found only in monozygotic twins compared to fraternal twins lead to the assumption that this factor has a role in the genesis of sympathetic hyperactivity <sup>[10; 15]</sup>. Besides the hereditary component, other factors may be involved in the genesis of HT. Some studies revealed autonomic imbalance as an independent risk factor for cardiovascular diseases regarding their impact on HT complications <sup>[26; 27]</sup>.

Biochemically, measures of norepinephrine radiotracers passage in plasma help to study physiopathology of sympathetic hyperactivity in HT <sup>[19]</sup>. Thus, their rates are higher in young normotensive subjects with a family history of HT compared to those with no family history of HT <sup>[20; 22]</sup>. Also, same studies have found higher levels of noradrenaline in cerebrovascular circulation in patients with primary HT compared to the healthy subjects, suggesting that an underlying increase of norepinephrine in central nervous system could form the basis of sympathetic hyperactivity <sup>[10; 19]</sup>. The discovery of an autonomic imbalance in hypertensive patients not only helps to identify the mechanism of HT, but also to understand the physiopathology of the cardiovascular risk due to HT through their metabolic, trophic, hemodynamic and rheological consequences <sup>[10; 16]</sup>. The elevation of sympathetic activity increases BP, and is also responsible of cardiac, renal, and vascular stimulation, respectively increasing, cardiac output, fluid retention, and vascular resistance with hypertrophy of vascular smooth muscle cells <sup>[23]</sup>.

Prognosis of HT depends on the reduction of sympathetic hyperactivity. It is desirable to develop antihypertensive treatment acting as well on the sympathetic overactivity. In this issue, Zachariah et al. <sup>[24]</sup> examined this question, comparing BP measured in three different positions: sitting, supine and standing. They found that changing posture has a marked effect on diastolic pressure, that in their study increased by 12 mmHg between lying and standing. But several studies showed that systolic BP is a more potent determinant of cardiovascular risk than diastolic BP <sup>[25]</sup>.

The clinical significance of postural changes of BP received surprisingly little attention, despite the ease of measure. In the normative aging study, Sparrow et al <sup>[26]</sup> followed patients

with an orthostatic increase of BP and found that these patients have an increased risk to become hypertensive at follow-up.

Seated BP were also used by several authors in the hypertensive patients <sup>[27]</sup>. The American Heart Association is somewhat vague in its recommendations <sup>[28]</sup>., and states that “two or more BP measurements from the same arm with the subject supine or seated, then standing, should be obtained at one examination”. Zachariah et al. emphasizes the crucial importance to determine the circumstances in which BP measurements are made <sup>[24]</sup>.

In this work, OH is also found with low rate as in the sub-group B (15, 9 %). It was also known that 20% of hypertensive and 4% of normotensive patients have an OH <sup>[24]</sup>. Thus, OH is to look for systematically especially in the elderly and diabetic. So, when we find OH in hypertensive patients, anti hypertensive attitude become difficult, because treatment of one has a negative impact on the other. So, therapeutic measures depend on the severity of OH in addition to the importance of high BP values. The usual treatment causes sometimes OH especially in elderly patients with diuretic prescription <sup>[2; 32]</sup>. For that, we need to develop antihypertensive therapeutics acting on the sympathetic hyperactivity, as already discussed by several authors <sup>[13; 29; 33]</sup>.

## CONCLUSION

It is important to note that Ortho BP in the hypertensive patients remains or increases in 2/3 of cases. The OT in hypertensive patients helps to diagnosis the association HT–orthostatic HT, to predict cerebral vascular accidents, and also to diagnosis OH in the hypertensive patients, situation that makes physicians adjust therapeutics. This study reveals the interest of making a prospective study in the purpose to determine the effect of the different therapeutic classes on the orthostatic BP in hypertensive patients at short and long term.

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