

Does isolated systolic hypertension occur with ambulatory blood pressure measurement?

John P. Cox, Neil Atkins, Kevin O'Malley and Eoin O'Brien

Journal of Hypertension 1991, 9 (suppl 6):S100–S101

Keywords: Isolated systolic hypertension, blood pressure measurement, ambulatory blood pressure measurement.

Introduction

The diagnosis of isolated systolic hypertension is traditionally based on a clinic measurement [1]. However, casual blood pressure measurements taken in the clinic setting are poorly representative of blood pressure prevailing during normal daily activities in individual patients [2].

Therefore, a retrospective analysis was carried out to further examine the relationship between ambulatory and clinic measurement of blood pressure in patients with isolated systolic hypertension.

Methods

Office and 24-h ambulatory blood pressure measurements in 815 healthy subjects, who were employees of the Allied Irish Bank [3], were taken as reference values. Data on 318 patients, referred to the Blood Pressure Unit at Beaumont Hospital and diagnosed as having isolated systolic hypertension (clinic systolic pressure equal to or greater than 160 mmHg and diastolic pressure equal to or less than 94 mmHg) were analysed. The group was further subdivided into those on and off medication at the time of the blood pressure measurement.

Clinic blood pressure measurement

Clinic blood pressure was measured with a standard mercury sphygmomanometer [4], taking Korotkov phase V as diastolic pressure. At each office/ clinic visit a minimum of two measurements was taken in each patient in the sitting position after 3 min of rest.

Ambulatory blood pressure measurement

Twenty-four-hour ambulatory blood pressure monitoring was performed with either the SpaceLabs 90202 [5] or the 90207 [6] (Redmond, Washington, USA). Most patients were fitted with the recorder between 0900 and 1300 h; the recorder was programmed to deflate at intervals not greater than 30 min for 24 h.

Data analysis

Clinic blood pressure was taken as the mean of two measurements.

The 24-h ambulatory blood pressure recordings were left unedited, because we considered that any editing process introduced a potential source of bias. The 24-h interval was divided into daytime and night-time periods (1000–2259 and 0100–0659 h). Statistical significance was tested with Student's t-test and a regression analysis using the SAS Software Package (SAS Institute, Cary, North Carolina, USA).

Office and ambulatory blood pressure data on 815 subjects (399 males, 416 females) aged 17–79 years (mean 36 ± 11) in the Allied Irish Bank Study were available for analysis [3].

Clinic and ambulatory blood pressure data on 318 patients (132 males, 186 females; mean age 59 ± 13 years) with isolated systolic hypertension were analysed.

Results

Mean (\pm s.d.) office blood pressure was $119 \pm 15/76 \pm 10$ mmHg in the healthy normotensive subjects, and $178 \pm 28/84 \pm 9$ mmHg in the patients with iso-

From The Blood Pressure Unit, Beaumont Hospital, Dublin 9, and the Department of Clinical Pharmacology, Royal College of Surgeons in Ireland, St Stephen's Green, Dublin 2, Ireland.

Sponsorship: This work was supported by research grants from the Charitable Infirmary Charitable Trust, the Irish Heart Foundation, the Royal College of Surgeons in Ireland and ICI.

Requests for reprints to: Dr Eoin O'Brien, The Blood Pressure Unit, Beaumont Hospital, Beaumont, Dublin 9, Ireland.

calculated according to the method of Scatchard [8]. The lymphocyte β_2 -adrenoceptor values in 18 normotensive control subjects were 1378 ± 356 binding sites/cell (ranging from 1039 to 1719, the latter being considered the upper normal limit), K_d 0.14 ± 0.14 nmol/l (range 0.04–0.3 nmol/l).

Data are expressed as means \pm s.d. Student's paired t-test was used for analysis. Correlation coefficients were calculated by the least squares method. $P < 0.05$ was considered significant.

Results

The β_2 -adrenoceptor density in the hypertensive patients (1819 ± 424 binding sites/cell, range 1129–2841) was significantly higher than in the normotensive controls ($P < 0.01$). The dissociation constant (0.11 ± 0.08 nmol/l, range 0.03–0.5) was not different from that of the controls.

Seventeen out of 35 patients showed an increased β_2 -adrenoceptor density, and were classified as group 1, the remaining patients presenting a normal β_2 -density (group 2). There were no differences between these two groups with respect to age, sex, mean arterial pressure, heart rate, plasma catecholamine levels or β_2 -adrenoceptor affinity (Table 1).

Table 1. Characteristics of essential hypertensive patients included in each group.

	Group 1	Group 2
Age (years)	40.2 ± 8.1	40.8 ± 10
Sex (males/females)	8/9	7/11
Mean AP (mmHg)	118.2 ± 7.1	121.2 ± 8.5
Heart rate (beats/min)	77.7 ± 13.7	80.3 ± 10.4
Epinephrine (pg/ml)	57.5 ± 40.7	43.5 ± 24
Norepinephrine (pg/ml)	246 ± 110	213 ± 124
Density (sites/cell)	2177 ± 373	$1509 \pm 147^*$
K_d (nmol/l)	0.11 ± 0.04	0.11 ± 0.1

Means \pm s.d. AP, arterial pressure. K_d , dissociation constant. * $P < 0.01$ versus group 1.

The β_2 -adrenoceptor density was inversely correlated with plasma epinephrine in patients with a normal β_2 -adrenoceptor density ($r = -0.71$, $P < 0.01$), but not in patients from group 1 ($r = 0.014$). The β_2 -adrenoceptor density was not correlated with mean arterial pressure, heart rate or norepinephrine levels in any group or with both groups taken together.

Discussion

Our results confirm previous studies indicating that the lymphocyte β_2 -adrenoceptor density is higher in

essential hypertensive patients than in normotensive control subjects, with a similar affinity constant [3,4]. However, we failed to find a relationship with mean arterial pressure, as described in previous studies performed with lipophilic ligands [3].

However, there was a considerable overlap between the hypertensive patients and the normotensive controls. Therefore, the hypertensive patients were divided into two groups according to the number of receptors. Patients with a normal β_2 -adrenoceptor density showed an inverse correlation with plasma epinephrine levels, as occurs in normotensive subjects [9], suggesting that the β_2 -adrenoceptor density is physiologically regulated by the levels of the corresponding agonist in these patients. In contrast, patients with a high β_2 -adrenoceptor density showed no such correlation. Furthermore, plasma catecholamine levels were slightly higher (although the differences did not reach statistical significance) in patients from group 1 than in patients with a normal β_2 -adrenoceptor density, contrary to what would be expected if there was a physiological regulation of these receptors in this subset of patients.

In summary, the data presented suggest that in essential hypertension there is a subset of patients with an abnormal regulation of β_2 -adrenoceptors, as shown by an increased adrenoceptor density and an impaired downregulation induced by the corresponding agonist.

References

1. FOLKOW B: Physiological aspects of primary hypertension. *Physiol Rev* 1982, 62:347–504.
2. GOLDSTEIN DS: Plasma catecholamines in essential hypertension: an analytical review. *Hypertension* 1983, 5:86–89.
3. BRODDE OE, SCHUTZ N, DEMUTH V, ET AL: Alpha and beta adrenoceptors in circulating blood cells of essential hypertensive patients: increased receptor density and responsiveness. *Clin Exp Hypertens* 1985, A7:1135–1150.
4. PARCERISA X, CASES A, BOTTEY A, ET AL: Lymphocyte β_2 -adrenergic receptors in essential hypertension: studies in basal conditions and after dynamic exercise. *Clin Exp Hypertens* 1989, A11 (suppl 1):303–309.
5. STAEHELIN M, SIMMONS P, JAEGGI K, WIGGER N: CGP-12177: a hydrophilic β -adrenergic receptor radioligand reveals high affinity binding of agonists to intact cells. *J Biol Chem* 1983, 258:3496–3502.
6. PEULER JD, JOHNSON GA: Simultaneous single isotope radioenzymatic assay of plasma norepinephrine, epinephrine and dopamine. *Life Sci* 1977, 21:625–636.
7. BOYUM A: Isolation of mononuclear cells and granulocytes from human blood: isolation of mononuclear cells by one centrifugation, and of granulocytes by combining centrifugation and sedimentation at 1g. *Scand J Clin Lab Invest* 1968, 21 (suppl 97):77–89.
8. SCATCHARD G: The attraction of proteins for small molecules and ions. *Ann NY Acad Sci* 1949, 51:660–672.
9. FELDMAN RD, LIMBIRD LE, NADEAU J, ROBERTSON D, WOOD AJJ: Leukocyte β -receptor alterations in hypertensive subjects. *J Clin Invest* 1984, 73:648–653.