



COMPARATIVE STUDY OF CHANGES IN ARTERIAL PRESSURE AND HEART RATE DURING DENTAL TREATMENT UNDER LOCAL ANESTHESIA IN HYPERTENSIVE PATIENTS VERSUS NORMOTENSIVE PATIENTS

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ABSTRACT

The aim of this study was to determine changes in arterial pressure (AP) and heart rate (HR) during dental treatment under local infiltration anesthesia (LIA) in patients with controlled arterial hypertension (AHT) versus normotensive patients.

A longitudinal comparative study involving repeated measurements in well-controlled hypertensive (cases) and normotensive patients (controls) was conducted. All patients received standardized preventive periodontal treatment under LIA (1.8 ml of 4% articaine with 1:100000 L-Adrenaline). AP and HR were determined at 5 different phases of treatment.

The study comprised 82 patients, 46.3% of whom were hypertensive, 61% were female. Systolic (SAP) and diastolic (DAP) arterial pressure and HR increased as the procedure advanced and then returned to initial values in both groups. Average HR values were lower in normotensive than in hypertensive patients ($p < 0.001$). Significant differences in AP and HR were observed among initial, mid-procedure, and final values

($p < 0.001$). Both groups exhibited highest SAP values post-LIA administration ($p < 0.01$). Average HR was higher in normotensive than in hypertensive patients.

The hypertensive patients tended to develop AHT ($> 140/90$ mmHg) more frequently throughout the procedure ($p = 0.002$), SHOWING a 4.93-fold higher risk. Logistic regression analysis showed that sex ($p < 0.032$) and AH ($p < 0.007$) were associated with a tendency to develop AHT during treatment.

Controlled hypertensive patients with normal AP values at the onset of dental treatment were found to be at a 5-fold higher risk of developing AHT during the course of dental treatment under local infiltration anesthesia. The observed increases in AP, however, did not reach clinically significant levels. The HR values tended to increase with the progress of dental treatment in all patients. HR was lower in hypertensive patients probably due a drug effect.

Key words: Arterial hypertension; local infiltration anesthesia, dental treatment.

COMPORTAMIENTO DE LA PRESIÓN ARTERIAL Y LA FRECUENCIA CARDÍACA EN PACIENTES HIPERTENSOS DURANTE EL TRATAMIENTO ODONTOLÓGICO

RESUMEN

El objetivo fue determinar el comportamiento de la presión arterial (PA) y la frecuencia cardíaca (FC) durante el tratamiento odontológico con anestesia infiltrativa local (AIL) en pacientes con hipertensión arterial (HTA) controlada.

Se realizó un estudio comparativo, longitudinal y mediciones repetitivas entre pacientes hipertensos controlados (casos) y normotensos (controles).

Todos los pacientes recibieron tratamiento periodontal preventivo estandarizado con AIL (1,8 ml Carticaina 4% con L-adrenalina 1:100000). En cinco etapas distintas del procedimiento se determinaron PA y FC.

Ingresaron 82 pacientes, 46.3% hipertensos, 61% mujeres. La presión arterial sistólica (PAS) y diastólica (PAD) como la FC se incrementaron con el avance del procedimiento para luego retornar a valores basales en ambos grupos. Los normotensos tuvieron promedios de PA más bajos que los hipertensos ($p < 0.001$). Las diferencias entre los valores ini-

ciales, intermedios y finales de PA y FC fueron significativas en ambos grupos ($p < 0.001$). Los valores máximos de PAS se registraron post administración de AIL en ambos grupos ($p < 0.01$). La FC en normotensos fue en promedio más alta que en hipertensos.

Se observó que los pacientes hipertensos desarrollaron más frecuentemente tendencia a la HTA ($> 140/90$ mmHg) en el transcurso del procedimiento ($p = 0.002$), con riesgo 4.93 veces mayor. En el análisis de regresión logística sexo ($p < 0.032$) e HTA ($p < 0.007$) mostraron influencia en la tendencia a la HTA durante el tratamiento.

Los pacientes hipertensos medicados y con valores normales de PA al inicio del tratamiento odontológico quintuplicaron el riesgo de desarrollar HTA durante el procedimiento, sin que los valores alcanzados presenten relevancia clínica.

Palabras clave: Hipertensión, anestesia local infiltrativa, tratamiento odontológico.





INTRODUCTION

Arterial pressure (AP) levels are the result of a delicate, multifactorial balance among the autonomic nervous system, the angiotensin-renin system, sodium levels, circulating volume, chemical and hormonal mediators, and complex interrelated mechanisms of the vascular endothelium which are not yet fully understood (bradykinin, atrial natriuretic hormone, endothelins, endothelial relaxation factor or nitric oxide)¹⁻⁴.

In response to discomfort and/or distress caused for example by pain, fear or anxiety, changes in vascular reactivity occur due to the release of catecholamines. The resulting reactivity triggers a cascade of events which can cause variations in arterial pressure.

The release of adrenaline and noradrenaline causes variations in cardiac output and peripheral vascular resistance. The balance between them determines the maintenance of, and changes in, arterial blood pressure⁵⁻⁸.

Acute variations in chronotropism and inotropism alter cardiac output, whereas variations in vasodilation and vasoconstriction affect peripheral vascular resistance⁹⁻¹³.

Systolic arterial pressure is affected by acute increases in both cardiac output and peripheral resistance, while diastolic arterial pressure reflects potential changes in peripheral resistance.

It is likely that the sympathetic system is stimulated by any invasive procedure involving administration of local infiltration anesthesia (LIA), triggering a chain of events whose outcome may be reflected in an increase in AP and heart rate (HR)¹⁴⁻¹⁶.

OBJECTIVE

To determine variations in arterial pressure (AP) and heart rate (HR) during dental treatment under local infiltrating anesthesia (LIA) comparing patients with controlled AHT to normotensive patients.

MATERIAL AND METHODS

The study comprised patients who visited the Department of Buccodental Pathology of the School of Dentistry, UBA for dental treatment between December 2009 and May 2011.

A longitudinal comparative study involving repeated measurements in well-controlled hypertensive patients (cases) and normotensive patients (controls) was carried out.

Hypertensive subjects with AP values below 140-90 mmHg at the onset of treatment were considered controlled hypertensives¹⁷. Subjects with no clinical or family history of AHT whose AP values were within normal range were considered normotensive¹⁷.

Inclusion criteria: Male and female patients over the age of 18 years, with AP values equal to or below 140-90 mmHg, in need of preventive periodontal treatment for teeth 1.4 and 1.5 and/or 2.4 and 2.5, showing no acute pathology, and who signed the informed consent form agreeing to participate in the study, were included in the study.

Exclusion criteria: Subjects with a clinical history of cardiovascular disease and/or adverse reaction to local anesthetics, and pregnant women, were excluded from the study.

Dental treatment: All patients underwent standardized preventive periodontal treatment in the upper premolar region under local anesthesia as follows: LIA administered by sub-mucosal injection of a local anesthetic in the upper buccal sulcus at the level of teeth 14-15 or 24-25 in order to block the superior dental plexus formed by the superior dental nerve and the middle dental nerve.

Four percent articaine with 1:100,000 L-Adrenaline as a vasoconstrictor, was used as anesthetic. Only one tube containing 1.8 ml of the anesthetic solution was administered.

The standardized prophylactic treatment consisted of:

1. Removal of superficial tartar using ultrasonic instruments for debridement of supragingival or subgingival calculus coronal to the pocket, thus enabling the use of periodontal curettes to access the depth of the pockets.
2. Mechanical treatment of the surface of periodontally affected teeth, involving scaling and root planing using periodontal Gracey curettes.
3. When pocket depth was more than 5 mm, the affected surface was treated using after five or mini-five curettes as needed.

The patients were divided into two groups:

- a) Pharmacologically treated hypertensive patients showing AP values within normal range on admission for treatment.
- b) Normotensive patients.

Determination of AP and HR

AP and HR were determined simultaneously using a validated OMRON digital tensiometer (model HEM – 713C).





Five determinations were made at different phases of the dental treatment.

First determination: On admission for dental treatment.

Second determination: On the dental chair, before beginning the procedure.

Third determination: After delivery of anesthesia.

Fourth determination: Immediately after completing the dental procedure.

Fifth determination: Immediately before leaving the dental office.

Statistical analyses

The data were entered in a database (Excel spreadsheet) and analyzed using statistical software SPSS (version 16). Descriptive statistics of each variable were performed according to their measurement scale and distribution. The following calculations were made when necessary: 95% confidence intervals; relative risk, ODDS RATIO, Chi square test, Fisher's test, Student's t-test, Wilcoxon test, Kolmogorov-Smirnov test, and ANOVA, MANOVA, mixed analysis of variance for repeated measures. The level of significance was set at $\alpha = 0.05$.

RESULTS

The study comprised 82 patients, 46.3% of whom were hypertensive and 61% were female. The group of normotensive patients was significantly younger than the group of hypertensive patients ($p < 0.001$) (Table 1). When including age as a covariable in the multivariate analysis, no statistically significant difference was observed between groups.

SAP and DAP increased throughout the course of treatment and then tended to return to initial values in both normotensive and hypertensive patients.

The normotensive subjects always had significantly lower average values than the hypertensive patients ($p < 0.001$). The differences among initial, mid-procedure, and final values were statistically significant in both normotensive and hypertensive patients ($p < 0.001$). The highest SAP values were observed after delivery of LIA in both groups, with differences reaching statistical significance ($p < 0.01$) (Figs. 1-2).

HR tended to increase throughout the subsequent phases of treatment and then return to initial values in both groups. Normotensive patients showed significantly higher mean values than hypertensive patients in all phases of treatment ($p < 0.001$). The differences among initial, mid-procedure and final determinations were statistically significant in both normotensive and hypertensive subjects (Fig. 3).

Considering SAP and DAP values of 140 and 90 mmHg respectively as normal reference values, our results showed that in spite of having normal AP values on admission to treatment, hypertensive patients exhibited a statistically significant tendency towards AHT throughout the course of treatment (65.8 % vs 22.7 %) ($p = 0.002$) (Table 2). The group of controlled hypertensive patients was found to be at a 4.93 times higher risk of developing hypertension. It is nevertheless noteworthy that 22.7% of patients considered normotensive also tended to develop hypertension throughout the course of treatment.

Table 1: Mean age of groups according to gender and presence of hypertension.

Mean Age Of Groups According To Gender And Presence Of Hypetension								
Subjects	n	Mean age	Typical Standard Desviation	Typical Standard Error	CI95% Lower limit	CI95% Upper limit	Minimum	Maximun
Normotensive females	27	43.30	12.80	2.46	38.23	48.36	25	79
Hypertensive females	23	55.70	14.44	3.01	49.45	61.94	19	82
Normotensive males	17	36.53	13.20	3.20	29.74	43.32	19	60
Hypertensive males	15	62	11.98	3.09	55.36	68.64	35	79
Total	82	48.79	15.99	1.76	45.28	52.31	19	82



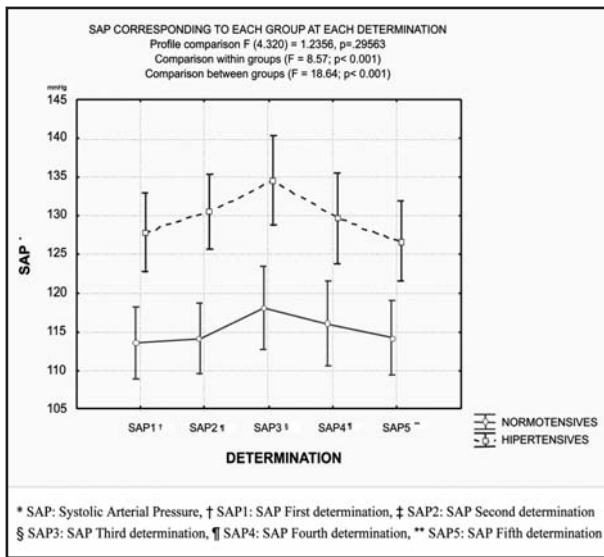


Fig. 1: Systolic Arterial Pressure corresponding to each group at each determination.

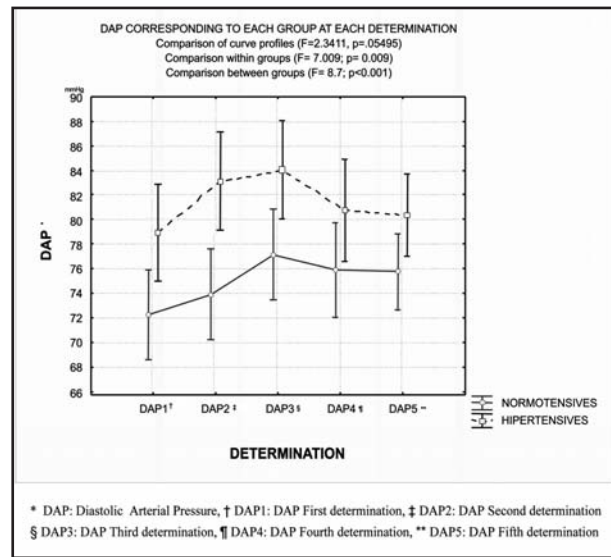


Fig. 2: Diastolic Arterial Pressure corresponding to each group at each determination.

Logistic regression analysis showed that gender ($p < 0.032$; IC 95%:1.01/ 9.33) and the presence of AHT ($p < 0.007$; IC 95%:1.56/16.36) significantly influenced the presence of (tendency toward) AHT throughout the course of treatment.

DISCUSSION

The use of vasoconstrictors in local anesthetics ensures a more prolonged effect of the anesthetic agent at the site of deposition. Its use in hypertensive patients remains controversial due to potential side effects. The present study sought to evaluate AP and HF response to dental treatment under LIA in pharmacologically controlled hypertensive patients, considering minimum values for systolic and diastolic blood pressure of 140 - 90 mmHg respectively. The importance of determining hemodynamic response lies in the high prevalence of AHT in the adult population [from 29 to 34% (18)] who also have a high rate of cardiovascular comorbidities, thus placing hypertensive subjects at potential risk when even slight variations in AP and HR occur. All the patients included in the study received similar dental treatment, with equivalent doses of the anesthetic and adrenaline. In order to decrease inter-subject variations, the treatment was standardized for the upper pre-molar region since this location allows non-traumatic and highly effective anesthetic block. This is due to the presence of a depressed area on the surface of the maxilla (canine fossa) where the ante-

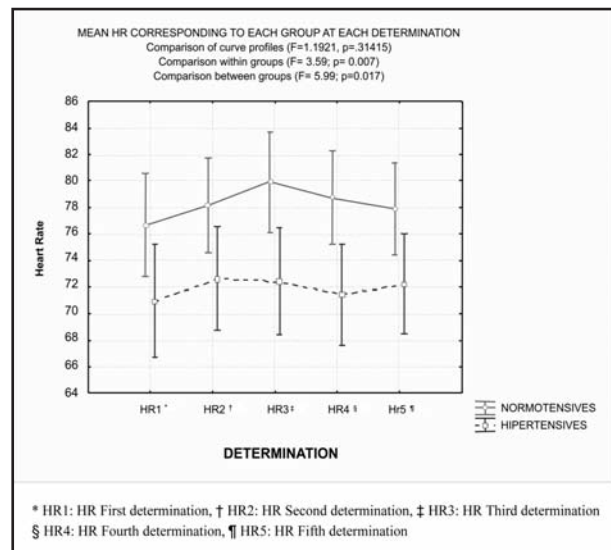


Fig. 3: Mean heart rate corresponding to each group at each determination.

Table 2: Contingency table Arterial Hypertension and tendency toward hypertension.

<i>Contingency Table Aht*/Tendency Toward Hypertension</i>		
<i>Toward Hypertension</i>	<i>NO n (%)</i>	<i>YES n (%)</i>
With AHT	25 (56.8%)	19 (43.2%)
Without AHT (normotensive)	8 (21.1%)	30 (78.9%)
Total	33 (40.2%)	49 (59.8%)

*AHT: Arterial Hypertension



rior wall of the body of the maxilla is thinnest, and to the presence of abundant cribriform areas in the maxilla, which allow a better diffusion of the anesthetic solution towards the nerve plexus in the buccal cortical plate of these teeth. AHT is a multifactorial disease, and identifying associated risk factors is of paramount importance to its prevention, treatment, and control. One of the risk factors is stress, defined as a situation caused by external or internal stimuli and which results in an increase in physiological responses. Dental procedures are an example of stressors that can alter normal response to a stimulus.

Hypertensive subjects respond to stress (exposure to experimentally induced emotions) with greater elevation of blood pressure and HR than normotensives¹⁹. Some of the mechanisms involved in the increase in AP include: 1) Increased cardiac output due to increased HR, with no changes in total peripheral resistance and regional flow, including myocardial regional flow; 2) Increased HR together with stimulation of the hypothalamus-pituitary adrenal axis, causing a significant and similar increase in adrenalin and noradrenaline secretion, activation of the renin-angiotensin-aldosterone system (RAAS 3), and increases in ACTH, cortisol and vasopressin (hormone responses, which contribute to the increase in AP values); 3) The sympathetic nervous systems causes vasoconstriction, increased cardiac frequency and contractility (chronotropism and inotropism), with increased systemic vascular resistance. The sympathetic hyperactivity that occurs in longstanding hypertension and the increased activity of the RAAS lead to an increase in AP values.

Our results showed that, though within normal range, initial blood pressure values of hypertensive patients were higher than those of normotensive subjects. Although this finding may be due to heightened reactivity to stressors, as would be facing dental treatment, it is also possible that the initial AP values encountered in the group of hypertensive patients correspond to target blood pressure levels of antihypertensive treatment and intrinsic changes in blood vessel walls. The latter is the more likely cause, since the behavior of arterial blood pressure was similar in both groups, following the same pattern in the different phases of treatment. Moreover, whereas AP values were always significantly higher in hypertensive than in normotensive patients, the difference between values recorded during the procedure and initial values was similar in both groups. This observation weakens the hypothe-

sis that hypertensive patients exhibited greater hemodynamic reactivity in response to the different phases of treatment. Despite maximum AP values of hypertensive patients being above the normal range, they were not clinically significant.

The highest AP value in both groups was observed post-anesthesia, and could be due to the combined effect of the psychological stress generated by the anxiety of undergoing a dental procedure and the physical stress caused by the pain of anesthesia infiltration. The low dose of adrenaline and the presence of small caliber vessels in the region render it unlikely that the vasoconstrictive effect (stimulation of alpha receptors) might have generated the variations in AP observed in this phase of treatment²⁰⁻²².

The hypertensive patients exhibited significantly lower HR values in the different stages of treatment due to antihypertensive treatment with negative chronotropic drugs (beta blockers).

Within the limitations of this study, we noted that normotensive group was younger than the group with hypertension, a feature recurring in the general population, in which the increasing age correlates with a higher prevalence of hypertension.

CONCLUSION

These results allow us to conclude that pharmacologically treated hypertensive patients presenting normal AP values prior to dental treatment under local infiltration anesthesia were at a 5-fold higher risk of developing AHT throughout the course of treatment, though the observed values were not clinically significant. The HR values tended to increase with the progress of dental treatment in patients with controlled hypertension and in normotensive patients. However, HR was lower in hypertensive patients probably due to a drug effect. These findings lead to the recommendation that checking AP prior to dental treatment not only allows the normotensive state of hypertensive patients to be established, but also elevated AP values in patients with undetected hypertension to be detected.

Added to the elevated incidence of AHT in the adult population is the fact that almost half are unaware of having the disease. Hence, checking blood pressure before initiating treatment would not only allow cardiovascular complications to be avoided during the procedure but would also highlight the important role of the dental health professional in disease detection and prevention of the deleterious health consequences of this silent malady.





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