Effects of total table salt restriction on blood pressure

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Aims
The aim of the study was to evaluate the effect of total omission of dietary salt intake on BP.

Material and methods
The effects of total omission on the consumption of dietary salt over the BP, were evaluated for this study in a group of 30 hypertensive patients between 40-60 years old, uncontrolled, with monotherapy with angiotensin converting enzyme inhibitors or angiotensin II receptor antagonists. BP was recorded over three days at the same time, according to the guidelines of the American Heart Association for correct BP measurement in humans. The average of the three registers measurement was taken as baseline for comparison of the data. The only intervention was the total restriction of table salt and sauces with salt. The patients were followed monthly during the first five months recording BP under the same conditions that basal measurement, after this, were indicated to all the patients the consumption of salt 5g/day (provided by the researchers) and were followed for another five months in the same measurement conditions above.

Results
Total restriction of consumption of dietary salt caused highly significant reduction (P<0.0001) of SBP, which was progressive and was evident from the first week of follow up. In addition, caused a decrease in DBP during the first week of monitoring, but that effect was not continuous, and no significant decrease in DBP was observed during follow-up (P 0.0662).

Discussion and conclusions
We recommend that a minimum restriction to 5g/day would be ideal in this population group.

Keywords
Hypertension • Sodium chloride • Blood pressure • Diet • Sodium dietary

Imprint
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Introduction

The cardiovascular diseases are the main cause of death worldwide; the risk of developing cardiovascular diseases is significantly higher in patients with hypertension (HT), and getting it increases the number of adverse outcomes including mortality [1,2]. Similarly, there is a direct relationship between salt intake, elevated blood pressure and cardiovascular outcomes [3,4]. There is evidence that reducing dietary salt intake lowers blood pressure (BP), therefore, a reduction in salt intake would decrease the BP and cardiovascular risk [5,6].

As estimated for 2010, 1 in 10 cardiovascular deaths were attributable to the consumption of more than 2 g/day sodium, the majority secondary coronary heart disease and stroke; also the 40% of those deaths were recorded in people younger than 70 years [7]. HT is diagnosed more often in regions with average sodium intakes greater than 2.3g/day (100 mEq); however, it is less common in regions with an average sodium intake of less than 1.2g/day (50 mEq) [8]. For this reason various organizations worldwide including the United Nations Organization, the United States Department of Health and Human Services, the World Health Organization and Centers for Disease Control and Prevention, emphasize the reduction of daily salt consumption for all adults [9-12]. European Guidelines on cardiovascular disease prevention and management of hypertension currently recommend the restriction of salt intake of 5-6g/day, with a level of evidence and grade of recommendation 1-A, respectively [13,14].

The mechanisms that explain the relationship between salt intake and HT are unclear, it is known that not only sodium, if not also the chlorine, which is the companion anion in salt (NaCl), play an important role in the increased intravascular volume by their osmotic activity [15]. In addition, some individuals are more sensitive to salt (BP changes to salt intake), as by various mechanisms such as: the higher retention and absorption of sodium, abnormal vascular tone with endothelial damage (higher tendency to vasoconstriction and alteration in normal vasodilation), and others are still not well understood, are more likely to develop HT [16-19].

Recent studies worldwide [20-22] and meta-analysis [3] have been conducted to evaluate the effect of reduced salt intake on BP, their results support the efforts of doctors and patients to reduce sodium intake due their beneficial effects. Therefore it is important to conduct further studies in diverse populations in order to generalize and generate recommendations. The aim of the study was to evaluate the effect of total omission of dietary salt intake on BP.

Materials and methods

Patients

The effects of total omission on the consumption of dietary salt on the BP were evaluated for the study in a group of 30 hypertensive patients between 40 and 60 years old, over two years of diagnosis, uncontrolled, with monotherapy with angiotensin converting enzyme inhibitors (ACEI) or angiotensin II receptor antagonists (ARBs). The 50% were men, and the rest of the patients were women. All patients had mild exercise habits related to moderate daily work activities. No patients were included pregnant, diabetic, with neoplastic, neurological or immunological diseases. The daily consumption of salt pre-study was 15-20g (See Table 1).
Table 1. Population characteristics

<table>
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<td>Baseline systolic blood pressure</td>
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<tr>
<td>Baseline diastolic blood pressure</td>
<td>79,6</td>
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</table>

Design

The study protocol was approved by the Ethics Committee of Centroccidental University Lisandro Alvarado. All patients got their written informed consent before entering in the study. BP was recorded over three days at the same time (15:00 hours), three hours postprandial; according to the guidelines of the American Heart Association for correct BP measurement in humans [23]. The average of the three registers measurement was taken as baseline for comparison of the data. The only intervention was the total restriction of table salt and sauces with salt. Neither other changes in the lifestyle or adjustments to the antihypertensive treatment were recorded. The patients were followed monthly during the first five months by recording BP under the same conditions that basal measurement, after that, indicated was to all the patients the consumption of salt 5g/day (provided by the researchers), and they were followed for another five months under the same measurement conditions as above.

Statistical analysis

The data were collected in EXCEL spreadsheet firsthand and processed in GraphPAD PRISM 5.0 for Windows. The data were analyzed with ANOVA, comparing each month tracking your basal previous month and the results are presented in graphs with the average +/- standard deviation taking significant difference as a value of P <0.05.
Results

Changes in systolic blood pressure (SBP)
Restriction total of consumption of dietary salt caused highly significant reduction (P < 0.0001) of SBP, which was progressive and was evident from the first week of follow up. However, after the start use of the salt administered by the researchers, the SBP increased progressively during follow up to 5 months without significant statistical difference when compared with restart the fifth month of salt intake with the value of the fifth month of salt restricted without reaching its basal level of BP (see Fig. 1).

![Figure 1. Effects of salt consumption on Systolic Blood Pressure](image)

Changes in diastolic blood pressure (DBP)
Restriction total of consumption of dietary salt caused a decrease in DBP during the first week of monitoring, but this effect was not continuous and no significant decrease in DBP was observed during follow-up (P 0.0662), after the first use of the salt administered by the researchers, the DBP was increased up to similar to the baseline measurement values (Fig 2).

![Figure 2. Effects of salt consumption on Dyastolic Blood Pressure](image)
Discussion and conclusions

The present study shows that the total omission of salt intake causes a significant immediate and progressive decrease in SBP, and the effect was not observed for the DBP. The decrease in SBP in following for five months was greater than 20 mmHg, and it might deduce that patients who were out of targets (>140 or 150 mmHg) reached goals only with that simple, economic and accessible intervention to all hypertensive patients. The mechanism that could intervene in the marked and immediate decrease in SBP may be mediated by a decrease in the concentration of sodium in the blood; eating a meal that containing salt raises the levels of serum sodium at 120 minutes, while a food without salt decreases concentration and in its turn the osmolality, this phenomenon decreases significantly the SBP, but the same effect for DBP is not observed. The high concentration of sodium in plasma, and therefore osmolality causes three responses that seek to increase blood volume: 1. Movement of fluid from the intracellular to the extracellular space; 2. It stimulates thirst, and 3. It increases secretion of antidiuretic hormone, which is evidenced clinically with an increase of 1.91mmHg in SBP with increasing the concentration of serum sodium in 1 mmol/L [28,29]. In addition, the patients that are more sensitive to salt, with the salt intake may have a greater increase in SBP and proteinuria, this may be due to an alteration in renal hemodynamics in this patients group [30].

The absence of significant reduction in DBP may be due to the hypertensive mechanism inducing by the salt is mainly mediated by changes in blood volume rather than changes at peripheral vascular resistance, which is the main modulator of PAD. In addition, vascular resistance also can be increased in response to the decrease in blood volume induced by low sodium intake. An increased activity of aldosterone renin-angiotensin-axis with the less consumption of salt has been already described. This may increase vascular resistance; activation axis in response to the absence of salt intake is not evident in black, elderly and / or chronic renal failure patients. It explains a greater reduction in BP with this intervention in this group of patients [31,32]. This divergence between the reduction in SBP and DBP had already been demonstrated in other studies [21,29]. This is an important finding since it is proven that the PAS is more associated with cardiovascular disease and predicts risk more accurately than the PAD [30-32].

The subsequent progressive increase of SBP with the consumption of salt administered by the researchers, which did not exceed the 10 mmHg, may be due to basal consumption levels in patients on average were 15-20g/day compared with 5g/day given by the researchers, this SBP would be within the targets set for hypertensive patients, so it would appear that a minimum restriction to 5g/day would be ideal in this population group.

List of abbreviations

HT – hypertension
BP – blood pressure
ACEi – angiotensin converting enzyme inhibitors
ARBs – angiotensin II receptor antagonists
SBP – systolic blood pressure
DBP – diastolic blood pressure
Statement on ethical issues
Research involving people and/or animals is in full compliance with current national and international ethical standards.

Conflict of interest
None declared.

Author contributions
All authors coordinated and helped to draft the manuscript. All authors read and approved the final manuscript.

References


