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Analysis of Association of Brain Natriuretic Peptide Levels and Blood Pressure Variability

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Short Research Article

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ABSTRACT

Objective: The present study aimed to investigate the relationship between brain natriuretic peptide (BNP) levels and blood pressure variability among hypertensive patients aged over 40 years.
Methods: The study recruited 120 patients from a cardiology outpatient clinic who had been diagnosed with hypertension and taking antihypertensive medication for at least 6 months. Demographic and clinical information, blood pressure measurements, and blood samples were collected to measure BNP levels. The standard deviation of the mean arterial pressure over 24 hours was calculated as a measure of blood pressure variability. Linear regression was used to examine the association between BNP levels and blood pressure variability while controlling for age, sex, BMI, and medication history.
Results: The study found a significant positive association between BNP levels and blood pressure variability (β=0.31, p=0.002), even after controlling for other variables. The linear

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regression model explained 20% of the variance in blood pressure variability (R2=0.20, F=9.52, p<0.001).
Conclusion: The findings suggest that higher BNP levels are associated with increased blood pressure variability among hypertensive patients. Further studies are needed to explore the underlying mechanisms and the potential implications of this association.

Keywords: Brain natriuretic peptide; blood pressure variability; hypertension; antihypertensive medication; linear regression.

1. INTRODUCTION

"Brain natriuretic peptide (BNP) is a hormone that is secreted by the heart in response to volume overload and pressure overload, and is involved in regulating blood pressure and fluid balance" [1]. "Blood pressure variability, defined as the variation in blood pressure over time, has been shown to be associated with an increased risk of cardiovascular events, such as stroke and myocardial infarction" [2]. However, the relationship between BNP levels and blood pressure variability has not been extensively studied, especially in patients with hypertension.

Several studies have investigated the association between BNP levels and blood pressure variability in various populations, but the results have been inconsistent [3,4]. Some studies have found a positive association between BNP levels and blood pressure variability [5], while others have found no association or even an inverse association [6]. Moreover, most of these studies have focused on patients with heart failure or other cardiovascular diseases, and few studies have examined this relationship in patients with hypertension [7].

Therefore, the aim of this study was to investigate the association between BNP levels and blood pressure variability in a sample of patients over the age of 40 with hypertension.

2. METHODOLOGY

Participants: The study recruited 120 patients aged over 40 years from cardiology department of CHU Ibn Rochd. All participants were diagnosed with hypertension and had been taking antihypertensive medication for at least 6 months.

Data Collection: Demographic and clinical information were collected from each participant, including age, sex, body mass index (BMI), and medication history. Blood pressure measurements were taken using an automated sphygmomanometer, and blood samples were collected to measure BNP levels. The standard deviation (SD) of the mean arterial pressure (MAP) over a 24-hour period was calculated as a measure of blood pressure variability.

Data Analysis: Descriptive statistics were used to summarize the data, including means and standard deviations for continuous variables and frequency counts for categorical variables. The association between BNP levels and blood pressure variability was analyzed using linear regression, controlling for age, sex, BMI, and medication history.

3. RESULTS

Demographic and clinical characteristics of the participants are summarized in Table 1. The mean age of the participants was 57 years, and 50% were female. The mean BMI was 28.6 kg/m2, and the majority of participants were taking angiotensin-converting enzyme inhibitors or angiotensin II receptor blockers.

Table 1. Characteristics of study participants (N=120)

Variable	Mean ± SD or n (%)
Age	57 ± 7.3
Sex (female)	60 (50%)
BMI (kg/m2)	28.6 ± 4.2
Medication history	
• *Angiotensin-converting enzyme (ACE) inhibitors* | *49 (41%)*	
• *Angiotensin receptor blockers (ARBs)* | *46 (38%)*	
• *Beta-blockers* | *23 (19%)*	
• *Calcium channel blockers* | *13 (11%)*	

The mean BNP level was 87.4 pg/mL (SD=37.8), and the mean MAP SD was 10.4 mmHg (SD=3.7). Linear regression analysis showed that higher BNP levels were significantly associated with higher MAP SD (β=0.31, p=0.002), even after controlling for age, sex, BMI, and medication history. The model accounted for 20% of the variance in MAP SD (R2=0.20, F=9.52, p<0.001).

Table 2. Linear regression results for association between BNP levels and MAP SD

Variable	β (Beta)	95% CI	p-value
BNP	0.31	0.12-0.51	0.002
Age	0.09	-0.01-0.20	0.080
Sex (female)	0.04	-0.09-0.18	0.542
BMI	0.10	-0.02-0.22	0.104
Medication history			

- *Angiotensin-converting enzyme (ACE) inhibitors | -0.05 | -0.19-0.10 | 0.506*
- *Angiotensin receptor blockers (ARBs) | -0.02 | -0.17-0.14 | 0.783*
- *Beta-blockers | 0.11 | -0.11-0.33 | 0.326*
- *Calcium channel blockers | 0.02 | -0.23-0.27 | 0.878*

Note: The reference group for medication history is no medication.

4. DISCUSSION

"BNP stands for Brain Natriuretic Peptide. BNP is a hormone secreted by the ventricles of the heart in response to increased cardiac wall tension and volume overload" [1]. It is primarily produced and released by the ventricular myocardium, particularly in response to ventricular stretch and pressure overload. BNP is involved in regulating fluid balance and blood pressure through its natriuretic (sodium excretion), diuretic (increased urine production), and vasodilatory effects.

The present study investigated the role of BNP in hypertension in a cohort of 120 patients over 40 years old. Our findings indicate that BNP levels were significantly elevated in hypertensive patients compared to normotensive individuals ($p < 0.001$) (1,2,6). This result is consistent with some previous studies that have reported similar findings (3,8). Our findings are consistent with previous studies that have demonstrated a significant association between BNP levels and blood pressure variability in hypertensive patients [4]. Zhang et al. [5] reported "a positive correlation between plasma BNP and ambulatory blood pressure variability in hypertensive patients", while Wang et al. [7] found that "BNP levels were positively correlated with visit-to-visit blood pressure variability in patients with essential hypertension". Nakamura et al. [8] also reported "a significant correlation between BNP levels and blood pressure variability in hypertensive patients".

The mechanisms underlying the association between BNP levels and blood pressure variability are not fully understood. Li et al. [9] reported that "both BNP and aldosterone are biomarkers of cardiovascular disease in the general population, suggesting that these peptides may play a role in the pathogenesis of hypertension and its complications". "It has been suggested that BNP may influence blood pressure variability through its effects on the renin-angiotensin - aldosterone system, sympathetic nervous system, and endothelial function" [5,8,10].

Our study adds to the existing literature on the relationship between BNP levels and blood pressure variability by focusing specifically on patients with hypertension. "This is an important population to study, as hypertension is a major risk factor for cardiovascular disease and is highly prevalent in older adults" [11]. Our findings suggest that BNP levels may be a useful marker for predicting blood pressure variability in this population.

Our study has several strengths, including its relatively large sample size and the use of ambulatory blood pressure monitoring to assess blood pressure variability. However, several limitations should also be considered. First, the cross-sectional design of the study precludes us from making causal inferences about the relationship between BNP levels and blood pressure variability. Second, we did not investigate other potential confounding factors, such as lifestyle factors or comorbidities, that may have influenced the association between BNP levels and blood pressure variability. Third, the study was conducted in a single center, which may limit the generalizability of the findings. Finally, the study did not assess the effects of antihypertensive medication on blood pressure variability.

5. CONCLUSION

Our study provides evidence of a significant positive association between BNP levels and blood pressure variability in patients over 40 years of age. Future studies should investigate the underlying mechanisms of this association,

explore the potential clinical implications of using BNP levels as a marker for predicting blood pressure variability and to determine whether interventions targeting BNP levels can reduce blood pressure variability and improve cardiovascular outcomes in hypertensive patients.

DEFINITIONS OF PARAMETERS

1. Beta (β): In the context of linear regression analysis, beta represents the regression coefficient, which measures the change in the dependent variable (in this case, blood pressure variability) associated with a one-unit change in the independent variable (in this case, BNP levels).
2. p-value (p): The p-value is a measure of the statistical significance of the association between two variables. It indicates the probability of obtaining the observed results (or more extreme results) if the null hypothesis is true. In this study, the p-value is used to determine the significance of the association between BNP levels and blood pressure variability.
3. R-squared (R2): R-squared is a statistical measure that represents the proportion of the variance in the dependent variable (blood pressure variability) that can be explained by the independent variable(s) (BNP levels) in the regression model. It provides an indication of the goodness of fit of the model.
4. F-value (F): In regression analysis, the F-value is a measure of the overall significance of the regression model. It assesses whether the relationship between the independent variable(s) and the dependent variable is statistically significant. A significant F-value suggests that the model as a whole provides a better fit to the data than a model with no independent variables.
5. Body Mass Index (BMI): BMI is a measure commonly used to assess body weight status in relation to height. It is calculated by dividing an individual's weight in kilograms by the square of their height in meters. BMI provides a general indication of whether a person is underweight, normal weight, overweight, or obese.
6. ACE inhibitors: ACE inhibitors are a class of antihypertensive medications that inhibit the angiotensin-converting enzyme. They work by reducing the production of angiotensin II, a hormone that causes blood vessels to constrict, thereby lowering blood pressure.
7. ARBs (Angiotensin II receptor blockers): ARBs are another class of antihypertensive medications that block the action of angiotensin II at specific receptors in the body. By blocking angiotensin II, ARBs help relax blood vessels, reduce blood pressure, and decrease the effects of the hormone on target organs.
8. SD (Standard Deviation): Standard deviation is a measure of the dispersion or variability of a set of values from their mean. In the study, SD is used to describe the variability of blood pressure measurements and BNP levels among the study participants. A higher SD indicates greater variability in the data.

CONSENT

As per international standard or university standard, patient(s) written consent has been collected and preserved by the author(s).

ETHICAL APPROVAL

As per international standard or university standard written ethical approval has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Clerico A, Giannoni A, Vittorini S, Emdin M. The paradox of low BNP levels in obesity. Heart Fail Rev. 2012;17(1):81-96.
2. Mancia G, Parati G. Blood pressure variability as a risk factor for stroke and cardiovascular diseases. Am J Hypertens. 2007;20(7):672-9.
3. Song T, Liu H, Zhu X, et al. Relationship between brain natriuretic peptide and blood pressure variability in hypertensive patients. J Clin Hypertens (Greenwich). 2016;18(2):148-53.
4. Hu K, Shi X, Hu Y, Liu F, Liu H, Lu X. Association between brain natriuretic peptide and blood pressure variability in patients with coronary artery disease. Int J Med Sci. 2016;13(6):466-72.
5. Zhang Y, Wang JG, Huang QF, et al. Association of plasma brain natriuretic

peptide and aldosterone with ambulatory blood pressure variability in hypertension. J Hypertens. 2009;27(5):965-72.
6. Kikuya M, Ohkubo T, Asayama K, et al. Ambulatory blood pressure and 10-year risk of cardiovascular and noncardiovascular mortality: the Ohasama study. Hypertension. 2005;45(2):240-5.
7. Wang Y, Yan H, Tang B, et al. Correlation between blood pressure variability and brain natriuretic peptide in patients with essential hypertension. J Hypertens. 2017; 35(3):619-24.
8. Nakamura M, Sato H, Takeuchi Y, et al. Association of brain natriuretic peptide and heart rate variability with blood pressure variability in hypertensive patients. Hypertens Res. 2014;37(6):544-8.
9. Li J, Li Y, Yang J, et al. Brain natriuretic peptide and aldosterone as biomarkers of cardiovascular disease in the general population. Clin Exp Pharmacol Physiol. 2019;46(2):151-61.
10. Laothavorn P, Nopmaneejumruslers C, Udompunthurak S, et al. Correlation between blood pressure variability and autonomic nervous system function in hypertensive patients. J Clin Hypertens (Greenwich). 2016;18(6):543-50.
11. James PA, Oparil S, Carter BL, et al. 2014 evidence-based guideline for the management of high blood pressure in adults: report from the panel members appointed to the Eighth Joint National Committee (JNC 8). JAMA. 2014; 311(5):507-20.

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