Cardiovascular risk factors and target organ damage in hypertensive patients at Hue University of Medicine and Pharmacy Hospital

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Abstract

Background: Hypertension is one of the most common cardiovascular diseases, often referred to as the silent killer. The prevalence of hypertension is increasing globally. This study investigates certain clinical and subclinical characteristics, cardiovascular risk factors in hypertensive patients, and evaluates the correlation between these risk factors and target organ damage with systolic and diastolic blood pressure. **Subjects and methods**: This was a cross-sectional descriptive study of hypertensive patients treated at Hue University of Medicine and Pharmacy Hospital from January 1, 2024, to December 31, 2024. **Results**: The study included 215 hypertensive patients, with a blood pressure control rate of 35.8%. Patients whose blood pressure was controlled had a younger age, lower BMI, a lower incidence of smoking, lower LDL-C levels, and lower rates of cerebrovascular accidents and diabetes, all showing statistical significance compared to the uncontrolled group. The high cardiovascular risk group had higher blood glucose and lower HDL-C levels, both statistically significant compared to the low cardiovascular risk group. A moderate positive correlation was found between systolic blood pressure and smoking, a strong positive correlation between systolic blood pressure and blood glucose, and a moderate positive correlation between systolic blood pressure and the Gensini score. **Conclusion**: There is a correlation between cardiovascular risk factors and blood pressure control. Achieving target blood pressure helps reduce the risk of target organ damage.

Keywords: *Hypertension, target organ damage, cardiovascular risk factors.*

Abbreviations:

- HTN: Hypertension
- MMM (May Measure Month): Blood Pressure Measurement Month Program
- SBP: Systolic Blood Pressure
- DBP: Diastolic Blood Pressure
- BMI: Body Mass Index
- HDL-C: High Density Lipoprotein Cholesterol
- LDL-C: Low Density Lipoprotein Cholesterol
- EF: Ejection Fraction

1. INTRODUCTION

Hypertension (HTN) remains a significant societal issue today. The prevalence of HTN in Vietnam is increasing, with a national epidemiological survey (2001 - 2008) conducted on 9,832 individuals aged ≥25 years showing that 25.1% of the population had HTN, nearly half of whom were unaware of their condition. More recently, results from the May Measure Month (MMM) 2022 program indicated that 36.2% of surveyed individuals had hypertension, and 44% of patients on antihypertensive medication had uncontrolled blood pressure [1].

Additionally, the prevalence of major cardiovascular risk factors in Vietnam is still high. Among those aged 25 - 64 in 2015, the rate of dyslipidemia was 30.2%, and the rate of diabetes was 4.1%. Moreover, among the population aged 25 - 64 in Vietnam, the rate of overweight/obesity was 12.0% in 2010 and rose sharply to 17.5% in 2015. Vietnamese people tend to consume high amounts of salt and sugar, and the rates of smoking and alcohol consumption in men are also high [2]. In 2005, 46% of patients with acute myocardial infarction treated at the Vietnam National Heart Institute were directly related to hypertension, and more than one-third of stroke cases treated at the Vietnam Neurology Institute in 2003 were related to hypertension [3, 4].

Therefore, evaluating and providing information to hypertensive patients regarding their cardiovascular risk is very important. However, in Hue City, there have been relatively few studies on hypertension, cardiovascular risk factors, and target organ damage. For this reason, we conducted the study: **"Cardiovascular Risk Factors and Target Organ Damage in Hypertensive Patients at Hue University Hospital"** aiming at two objectives:

1. To investigate certain clinical, subclinical characteristics and cardiovascular risk factors in hypertensive patients.

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2. To evaluate the correlation between cardiovascular risk factors, target organ damage, and systolic and diastolic blood pressure.

2. SUBJECTS AND METHODS

2.1. Subjects

2.1.1. Inclusion Criteria

All patients with hypertension (≥18 years old) treated at Hue University of Medicine and Pharmacy Hospital from January 2024 to December 2024.

Hypertension was diagnosed if there was a history of diagnosis and/or antihypertensive treatment, or if hypertension was newly diagnosed in the hospital according to the recommendations of the Vietnam National Heart Association (VNHA) 2022. This is defined as having systolic blood pressure (SBP) ≥ 140 mmHg and/or diastolic blood pressure (DBP) ≥ 90 mmHg [4].

2.1.2. Exclusion Criteria

Patients who did not consent to participate in the study.

2.2. Research Methods

2.2.1. Study Design

Cross-sectional descriptive study.

2.2.2. Sample Size

Convenience sampling of 215 patients.

2.2.3. Study Location

Cardiovascular Center, Hue University of Medicine and Pharmacy Hospital.

2.2.4. Research Procedures

All hypertensive patients were interviewed regarding their medical history, clinical history, and underwent clinical examinations.

Anthropometric measurements included height measurement using a TZ 20 scale (calibrated against other scales and placed stably).

Body Mass Index (BMI) was calculated using the formulal:

$$BMI = Weight\ (kg)/Height^2\ (m^2)$$

Waist circumference: Measured with a non-elastic tape at the umbilical level or at the midpoint between the last rib and the iliac crest (for severely obese individuals).

Normal waist circumference: <94 cm for men, <80 cm for women

At-risk waist circumference: ≥94 cm for men, ≥80 cm for women

Blood lipid testing: Serum lipids (Total cholesterol, HDL-C, LDL-C, Triglycerides) were measured using an OLYMPUS automated biochemical analyzer at the central laboratory of Hue University of Medicine and Pharmacy Hospital.

Echocardiography: Conducted at the Echocardiography Unit of Hue University of Medicine and Pharmacy Hospital using a PHILIPS affiniti 70 machine. Measurements were taken in accordance with the American Society of Echocardiography 2015 guidelines [5].

Coronary angiography: Performed on a Philips Azurion 3 M12 digital subtraction angiography system.

Table 1. Atherosclerotic cardiovascular disease based on NLA 2015 [6]

Risk Level	Criteria
Low	- 0 - 1 major risk factor - Consider other risk indicators, if present
Moderate	- 2 major risk factors - Consider quantitative risk scoring* - Consider other risk indicators
High	- ≥ 3 major risk factors - Type 1 or Type 2 diabetes: + 0 - 1 additional major risk factor **AND** + No evidence of target organ damage - Chronic kidney disease stage 3B or 4 - LDL-C ≥ 190 mg/dL (4.9 mmol/L) - Quantitative risk score* indicates high risk

Very High	- Clinical atherosclerotic cardiovascular disease (ASCVD) - Type 1 or Type 2 diabetes: + ≥ 2 major risk factors **OR** + Evidence of target organ damage**

Notes

*Quantitative risk scoring (e.g., using SCORE, Framingham, or other validated risk calculators).

**Evidence of target organ damage may include microalbuminuria, retinopathy, left ventricular hypertrophy, etc.

Table 2. Blood pressure treatment targets [4]

Age Group (years)	SBP Target (Hypertension Without Comorbidity)	SBP Target (Hypertension With Comorbidity)	Additional Note for SBP	DBP Target
18 - 69	120 - < 140 mmHg	120 - <130 mmHg	May lower SBP further if tolerated	<80 mmHg for all patients
≥ 70	< 140 mmHg; if tolerated, may lower to 130 mmHg	May lower SBP further if tolerated	May continue lowering SBP further if the patient tolerates well	<80 mmHg for all patients

Notes:

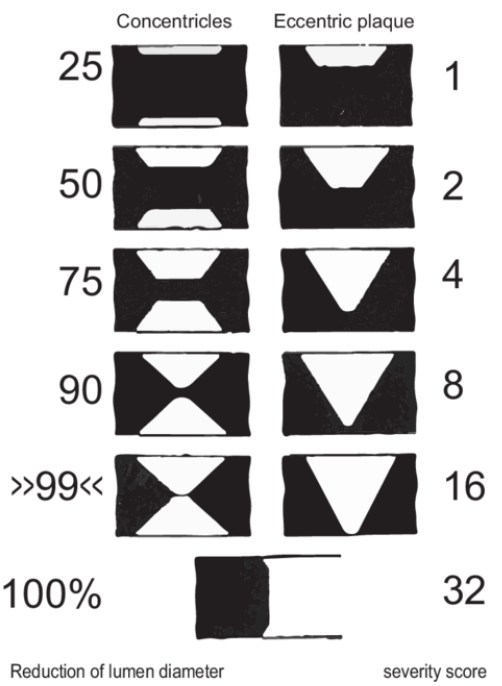
• For both age groups, the goal DBP is <80 mmHg.

• If SBP and DBP fall into different categories, select the higher category for classification.

• Isolated systolic hypertension should be graded according to the systolic value (Grade 1, 2, or 3).

Gensini Score [7]:

Gensini score	
Segment	**Weighting factor**
Proximal RCA	1.0
Mid-RCA	1.0
Distal RCA	1.0
Posterior descending branch	1.0
Left posterior ventricular branch	1.0
LM coronary artery	5.0
Proximal left anterior descending	2.5
Mid-left anterior descending	1.5
Distal left anterior descending	1.0
First diagonal branch	1.0
Second diagonal branch	0.5
Proximal LCX	2.5
Distal LCX	1.0
Obtuse marginal	1.0



2.2.5. Data Processing

Data were analyzed statistically using SPSS 20.0.

3. RESULTS

After studying 215 patients with hypertension at the Cardiovascular Center of Hue University of Medicine and Pharmacy Hospital from January 2024 to December 2024 (blood pressure control rate of them was 35.8%), we drew the following conclusions:

3.1. General Characteristics, Clinical and Subclinical Findings

Table 3. General, Clinical, and Laboratory Characteristics

Variable	Controlled Hypertension (n=77)	Uncontrolled Hypertension (n=138)	p-value
Age (years)	68.53 ± 12.68	60.67 ± 14.31	0.001
Sex			0.314
Male (%)	58 (27%)	95 (44.2%)	
Female (%)	19 (8.8%)	43 (20%)	
Body Mass Index (BMI) (kg/m²)			0.042
< 18.5	10 (4.7%)	5 (2.3%)	
18.5 - <23	19 (8.8%)	33 (15.3%)	
23 - <25	21 (9.8%)	34 (15.8%)	
≥ 25	27 (12.6%)	66 (30.7%)	
Increased Waist Circumference			0.295
Yes (%)	47 (21.9%)	94 (43.7%)	
No (%)	30 (14.0%)	44 (20.5%)	
Smoking (%)	13 (6.0%)	44 (20.5%)	0.017
History of treatment with antihypertensive drugs	40 (18,6%)	33 (15,3%)	<0.001
Total Cholesterol (mmol/L)	5.59 ± 1.50	5.70 ± 1.30	0.564
HDL-C (mmol/L)	1.32 ± 0.41	1.25 ± 0.32	0.231
LDL-C (mmol/L)	2.83 ± 1.03	3.28 ± 1.31	0.012
Triglyceride (mmol/L)	2.51 ± 1.35	2.58 ± 1.86	0.754

Patients with controlled hypertension were older on average, had a lower BMI, had a higher history of treatment with antihypertensive drugs, smoked less, and had lower LDL-C levels, all statistically significant ($p<0.05$) compared to the uncontrolled group.

3.2. Correlation between cardiovascular risk factors, target organ damage, and hypertension

Table 4. Target Organ Damage and Comorbidities

Comorbidity/Condition	Controlled Hypertension	Uncontrolled Hypertension	p-value
Stage 3 or Higher CKD	13 (16.9%)	15 (10.9%)	0.209
Stroke (Cerebrovascular Accident)	2 (0.9%)	15 (7.0%)	0.031
Heart Failure	4 (1.9%)	17 (7.9%)	0.092
Coronary Artery Disease	8 (3.7%)	30 (14.0%)	0.650
Diabetes Mellitus	13 (6.0%)	45 (20.9%)	0.013

Patients in the controlled group had a significantly lower incidence of cerebrovascular accidents (stroke) and diabetes compared to the uncontrolled group ($p<0.05$).

Table 5. Association of cardiovascular risk factors across different risk stratification groups

Parameter	Low (n/a)	Moderate (n/a)	High (n/a)	Very High (n/a)	p-value
BMI (kg/m²)	25.22 ± 4.32	24.62 ± 3.00	23.64 ± 4.16	24.54 ± 3.20	0.326
Waist Circumference (cm)	87.06 ± 10.08	84.45 ± 5.01	82.17 ± 8.48	82.65 ± 10.10	0.172
SBP (mmHg)	148.82 ± 27.07	142.05 ± 22.45	153.15 ± 18.48	152.96 ± 27.17	0.079
DBP (mmHg)	81.18 ± 17.72	82.39 ± 16.65	83.26 ± 15.32	84.26 ± 13.84	0.820
Blood Glucose (mmol/L)	6.96 ± 3.11	7.22 ± 2.43	7.05 ± 3.11	10.19 ± 5.37	<0.01
Total Cholesterol (mmol/L)	5.79 ± 1.0	5.94 ± 1.16	5.69 ± 1.57	5.50 ± 1.42	0.344
Triglycerides (mmol/L)	2.64 ± 2.12	2.42 ± 0.88	2.34 ± 1.09	2.68 ± 2.05	0.648
HDL-C (mmol/L)	1.31 ± 0.28	1.43 ± 0.29	1.14 ± 0.26	1.26 ± 0.41	0.002
LDL-C (mmol/L)	3.10 ± 0.91	3.29 ± 1.18	3.34 ± 1.26	2.96 ± 1.27	0.257

Notes:

- BMI = Body Mass Index, SBP = Systolic Blood Pressure, DBP = Diastolic Blood Pressure.
- Values are shown as mean ± standard deviation.
- p-value <0.05 is considered statistically significant.
- "Low," "Moderate," "High," and "Very High" refer to different cardiovascular risk strata.
- Patients with higher cardiovascular risk had higher blood glucose levels and lower HDL-C, both statistically significant ($p < 0.05$) compared to lower-risk groups.

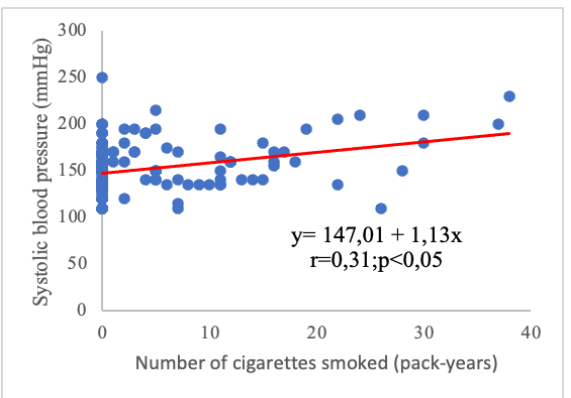


Figure 1. Correlation Between Smoking and Systolic Blood Pressure

A moderate positive correlation was observed between smoking and systolic blood pressure.

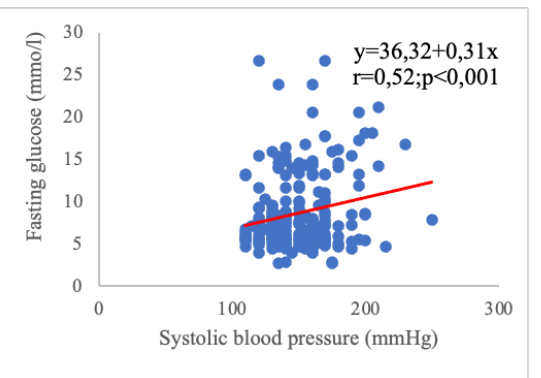


Figure 2. Correlation Between Systolic Blood Pressure and Blood Glucose

A strong positive correlation was found between systolic blood pressure and blood glucose.

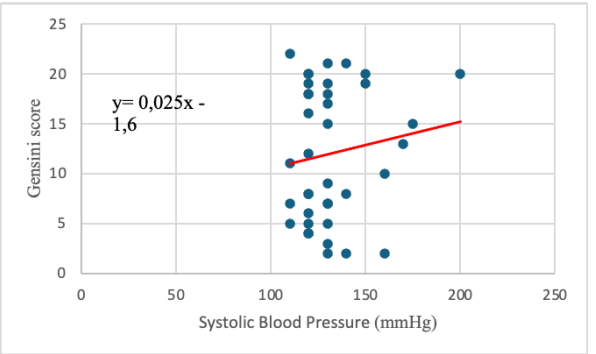


Figure 3. Correlation Between Systolic Blood Pressure and Gensini Score
A moderate positive correlation was found between systolic blood pressure and Gensini score.

4. DISCUSSION

4.1. General characteristics, clinical, and subclinical findings

The study results show that among the hypertensive patients admitted, the blood pressure control rate was 35.8%. This finding aligns with the study by Huynh Van Minh et al. (2025) during the MMM 2022 program in Vietnam, which reported a 30.3% control rate among hypertensive patients, indicating that the proportion of well-controlled hypertension remains low [1].

Regarding the general characteristics of the research subjects, there was no statistically significant difference in sex between the controlled and uncontrolled blood pressure groups. This differs from the study by Nguyen Vu Thao Vy (2023), in which a significant difference in sex was observed between the two groups [8]. The discrepancy may stem from the fact that the former study was conducted in an outpatient clinic, whereas our study was on inpatients. Meanwhile, the age of patients in the controlled BP group was statistically older than that of the uncontrolled group. This could be explained by younger patients, who had not been previously diagnosed with hypertension, being admitted mainly for high blood pressure, whereas older patients with a prior diagnosis of hypertension had already been treated to target levels but were hospitalized for reasons other than high blood pressure. This finding differs from the study by Than Hong Anh et al. (2019), possibly because their subjects were elderly patients [9].

Our study also reveals that the group with uncontrolled hypertension had a significantly higher BMI. This observation is consistent with the findings of Duong Ngoc Dinh (2021), who reported that overweight and obesity were 3.52 times more prevalent in the uncontrolled BP group compared to the group with controlled BP [10]. This highlights the association between being overweight/obese and the increased likelihood of failing to achieve target blood pressure. However, in our study, no link was found between waist circumference and uncontrolled blood pressure. The results also show that patients who smoke have a statistically higher rate of uncontrolled blood pressure, aligning with the research of Dong Thi Ngoc Lam (2022), which indicated that non-smokers had a higher rate of achieving target blood pressure [11]. Furthermore, our study also demonstrates that patients in the controlled BP group had significantly lower LDL-C levels compared to those in the uncontrolled BP group, whereas total cholesterol, HDL-C, and triglycerides showed no difference between the two groups.

Additionally, the study shows that patients with uncontrolled hypertension had significantly higher rates of stroke (cerebrovascular accidents) and diabetes compared to those whose blood pressure was controlled. This aligns with the findings of Seiji Umemoto (2017), who observed that diabetes was significantly lower in patients with well-controlled blood pressure compared to poorly controlled patients ($p<0.001$) [12]. Compared to the study by Huynh Thi Ngoc Giau (2024), in which 21.3% of patients had an eGFR <60 ml/min/1.73 m^2, our results were lower-possibly due to that study's focus on patients with resistant hypertension [13]. The research by Cairu Li et al. also found no statistically significant difference in the prevalence of coronary artery disease between controlled and uncontrolled hypertension groups, while those who achieved thorough blood pressure control could prevent a significant proportion of first-time strokes [14].

4.2. Relationship between cardiovascular risk factors, target organ damage, and hypertension

Our study indicates that patients with higher cardiovascular risk had significantly higher blood glucose and LDL-C levels and lower HDL-C levels than the low-risk group. These findings are consistent with a study by Hoang Anh Tien et al. (2024) on hypertensive patients, in which total cholesterol did not differ among risk groups, but HDL-C did: patients with reduced HDL-C and classified at very high cardiovascular risk according to SCORE2 and SCORE2-OP accounted for 83.3%, while the low-to-moderate risk group was only 10.0% [15]. Several clinical trials, including the Framingham Study, have concluded that low HDL cholesterol predicts coronary artery disease independently of other risk factors. Each 1 mg/dL decrease in HDL-C is associated with a 2% increase in coronary artery disease risk for men and 3% for women. The Veterans Affairs HDL Intervention Trial, which investigated the impact of fibrate therapy on cardiovascular risk, showed that a 6% increase in HDL-C was associated with a 22% reduction in coronary events [16].

Our study also found a moderate positive correlation between smoking status and systolic blood pressure, a strong positive correlation between systolic blood pressure and blood glucose, and a strong positive correlation between systolic blood pressure and the Gensini score. This can be explained by the fact that smoking impairs endothelial function, increases arterial stiffness and inflammation, alters lipid profiles, and accelerates atherosclerosis, leading to cardiovascular events. Smoking causes acute increases in blood pressure primarily through sympathetic nervous system stimulation [17]. Meanwhile, patients with hypertension may also have metabolic syndrome, characterized by insulin resistance (accompanied by hyperinsulinemia), central obesity, and dyslipidemia, which in turn increases the risk of diabetes and significantly increases cardiovascular risk. Diabetes and hypertension have a synergistic effect on increasing the risk of cardiovascular complications as well as retinopathy and nephropathy [18]. The link between hypertension and coronary artery disease (CAD) is quite common; there are multiple pathophysiological mechanisms that link the two. Hypertension leads to endothelial dysfunction and aggravates atherosclerosis, contributing to plaque instability. Left ventricular hypertrophy-frequently seen in hypertension-reduces "coronary reserve" and increases myocardial oxygen demand, both of which lead to myocardial ischemia [19].

5. CONCLUSION

Based on the study of 215 hypertensive patients treated at the Cardiovascular Center of Hue University of Medicine and Pharmacy Hospital, the blood pressure control rate was 35.8%. Patients with uncontrolled blood pressure tended to have a higher BMI, higher rates of smoking, higher LDL-C, and a higher incidence of cerebrovascular accidents and diabetes. We found a correlation between cardiovascular risk factors and blood pressure control, indicating that achieving target blood pressure helps reduce the risk of target organ damage.

REFERENCES

1. Minh HV, Lan VN, Quoc HNV, Kiem HT, Minh TN, Kim ST, Van HN, Van TN, Le Van T and Truong SC. May Measurement Month 2022: an analysis of blood pressure screening results from Vietnam. *European Heart Journal Supplements*. 2025:suaf057.

2. Vu Quynh Hoa VTXH. Knowledge, attitude, practice on salt of Ho Chi Minh city housewives in 2018. *Ho Chi Minh city Journal of medicine*. 2019;23:417-423.

3. Son P, Quang N, Viet N, Khai P, Wall S, Weinehall L, Bonita R and Byass PJJohh. Prevalence, awareness, treatment and control of hypertension in Vietnam—results from a national survey. *Journal of human hypertension*. 2012;26:268-280.

4. Minh HV. Recommendations of the Hypertension Society - Vietnam Cardiology Association (VSH/VNHA) on diagnosis and treatment of hypertension. Vietnam Cardiology Association. 2022.

5. Marwick TH, Gillebert TC, Aurigemma G, Chirinos J, Derumeaux G, Galderisi M, Gottdiener J, Haluska B, Ofili E and Segers PJEHJ-CI. Recommendations on the use of echocardiography in adult hypertension: a report from the European Association of Cardiovascular Imaging (EACVI) and the American Society of Echocardiography (ASE). *European Heart Journal Cardiovascular Imaging*. 2015;16:577-605.

6. Kirkpatrick CF, Sikand G, Petersen KS, Anderson CA, Aspry KE, Bolick JP, Kris-Etherton PM and Maki KCJJocl. Nutrition interventions for adults with dyslipidemia: A Clinical Perspective from the National Lipid Association. *Journal of clinical lipidology*. 2023;17:428-451.

7. Wang K-Y, Zheng Y-Y, Wu T-T, Ma Y-T and Xie X. Predictive value of Gensini score in the long-term outcomes of patients with coronary artery disease who underwent PCI. *Frontiers in Cardiovascular Medicine* 2022;8:778615.

8. Vy NVTV, Le Thi Bich Thuy, Long P, Nhan TTT. Study on the proportion of patients with uncontrolled hypertension among outpatients and related factors at the Internal Medicine Clinic, Hue University of Medicine and Pharmacy Hospital. *Hue Journal of Medicine and Pharmacy - Hue*

University of Medicine and Pharmacy. 7:190-197.

9. Anh TH and Nhan VT. Assessement the situation of the blood pressure control and some related factors in in elderly people with hypertension at 175 military hospital. *Journal of 175 Practical Medicine and pharmacy*. 2019:9-9.

10. Dinh DNĐ and Dung LN. Study on the situation and some related factors in patients with uncontrolled hypertension at kien giang general hospital in 2021-2022. *Cantho Journal of medicine and pharmacy*. 2022:34-40.

11. Dong TNLĐ and Yen NTB. To study some factors related to the results of blood pressure control in hypertensive patients treated as outpatients at luc ngan district general hospital. *Vietnam Medical Journal*. 2021;509.

12. Umemoto S, Ogihara T, Matsuzaki M, Rakugi H, Ohashi Y and Saruta TJHR. Effects of calcium channel blocker benidipine-based combination therapy on target blood pressure control and cardiovascular outcome: a sub-analysis of the COPE trial. *Hypertension Research*. 2017;40:376-384.

13. Giau HTN and An TV. Target organ damages in difficult-to-control hypertension paiteints in Can Tho Hospital. *Journal of Vietnamese Cardiology*. 2024.

14. Li C, Engström G, Hedblad B, Berglund Gr and Janzon LJS. Blood pressure control and risk of stroke: a population-based prospective cohort study. *Stroke* 2005;36:725-730.

15. Tien HA, Tran Thanh Toan and Thang ĐC. Predicting 10 - year cardiovascular risk using score2 and score2-op scale in hypertension patients. Journal of Clinical Medicine Hue Central Hospital. 94

16. Kabakci G, Koylan N, Ilerigelen B, Kozan O and Buyukozturk KJIbpc. Impact of dyslipidemia on cardiovascular risk stratification of hypertensive patients and association of lipid profile with other cardiovascular risk factors: results from the ICEBERG study. 2008:5-13.

17. Virdis A, Giannarelli C, Fritsch Neves M, Taddei S and Ghiadoni L. Cigarette smoking and hypertension. *Current pharmaceutical design*. 2010;16:2518-2525.

18. Waeber B, Feihl F and Ruilope LJBp. Diabetes and hypertension. *Nature clinical practice Endocrinology & metabolism*. 2001;10:311-321.

19. Escobar E. Hypertension and coronary heart disease. *Journal of human hypertension*. 2002;16:S61-S63.