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Research article

Evaluation of rational antihypertensive drug use and treatment outcomes in hospitalized hypertensive patients

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ABSTRACT

Hypertension is one of the most prevalent chronic non-communicable diseases worldwide and remains a major risk factor for cardiovascular morbidity and mortality. Despite the availability of evidence-based clinical guidelines and a wide range of antihypertensive medications, blood pressure control is still suboptimal in many patients, particularly in hospital settings. This study aimed to evaluate the rational use of antihypertensive drugs and treatment outcomes in hospitalized patients with hypertension, as well as to identify factors associated with achieving target blood pressure according to current clinical guidelines. A cross-sectional descriptive study was conducted on hospitalized hypertensive patients at a tertiary general hospital in Vietnam. Data were retrospectively collected from medical records, including demographic characteristics, clinical conditions, antihypertensive prescribing patterns, and blood pressure measurements at admission and discharge. The rationality of drug use was assessed based on appropriateness of indication, contraindication, dosage, dosing frequency, drug combinations, and potential drug–drug interactions. Treatment outcome was defined as achieving target blood pressure at discharge. The results showed that combination therapy was more frequently prescribed than monotherapy, with calcium channel blockers, angiotensin-converting enzyme inhibitors, and angiotensin receptor blockers being the most commonly used drug classes. Most antihypertensive prescriptions met rational use criteria, and a high proportion of patients achieved target blood pressure at discharge. However, higher hypertension grade, obesity, presence of comorbidities, and irrational drug use were significantly associated with failure to achieve treatment goals. In conclusion, rational use of antihypertensive medications was generally well implemented and associated with favourable treatment outcomes; however, individualized treatment strategies and continuous monitoring of prescribing practices are necessary to further improve blood pressure control.

Keywords: Hypertension, Antihypertensive drugs, Rational drug use, Treatment outcome, Blood pressure control.

INTRODUCTION

Hypertension is a major global public health problem and one of the leading causes of premature mortality worldwide. It is a key risk factor for cardiovascular diseases, stroke, chronic kidney disease, and other serious complications [1,2]. According to the World Health Organization, the prevalence of hypertension continues to increase, particularly in low- and middle-income countries, due to population aging, urbanization, unhealthy dietary patterns, physical inactivity, and obesity [1]. Effective blood pressure control has been shown to significantly reduce the risk of cardiovascular morbidity and mortality; however, achieving and maintaining target blood pressure remains a major challenge in clinical practice [2,3].

Over the past decades, numerous evidence-based clinical guidelines for hypertension management have been developed and regularly updated, providing recommendations on diagnosis, treatment targets, and pharmacological therapy [3,4]. Antihypertensive medications, including calcium channel blockers, angiotensin-converting enzyme inhibitors, angiotensin receptor blockers, diuretics, and beta-blockers, have proven efficacy in reducing blood pressure and

preventing complications [4,5]. Nevertheless, inappropriate prescribing practices, suboptimal drug combinations, incorrect dosing, and potential drug–drug interactions may compromise treatment effectiveness and patient safety [6]. These issues highlight the importance of rational drug use in hypertension management.

Rational use of medicines, as defined by the World Health Organization, requires that patients receive medications appropriate to their clinical needs, in doses that meet individual requirements, for an adequate duration, and at the lowest possible cost [7]. In the context of hypertension, rational prescribing is particularly important because treatment is long-term and often involves combination therapy, especially in patients with severe hypertension or multiple comorbidities [5,8]. Failure to adhere to rational prescribing principles may lead to poor blood pressure control, increased risk of adverse drug reactions, and higher healthcare costs [6,9].

In Vietnam, hypertension has become increasingly prevalent and represents a significant burden on the healthcare system. Although national and international guidelines for hypertension management are widely applied, several studies have reported variations in antihypertensive prescribing patterns and inconsistencies in treatment outcomes [10–12]. Most existing studies in Vietnam have focused on outpatient settings, while data on rational drug use and treatment outcomes among hospitalized hypertensive patients remain limited [11,13]. Hospitalized patients often present with more severe disease, multiple comorbidities, and complex drug regimens, making rational prescribing and effective blood pressure control even more challenging.

Therefore, evaluating antihypertensive drug use and treatment outcomes in hospitalized patients is essential to identify potential gaps in clinical practice and to improve hypertension management strategies. This study was conducted to evaluate the rational use of antihypertensive medications and treatment outcomes in hospitalized patients with hypertension, and to identify factors associated with achieving target blood pressure according to current clinical guidelines.

MATERIALS AND METHODS

Study design and setting

A cross-sectional descriptive study was conducted at a tertiary general hospital in Vietnam. This study design was chosen to evaluate real-world antihypertensive prescribing practices and treatment outcomes among hospitalized patients with hypertension, a population that often presents with more severe disease and multiple comorbidities compared with outpatients [14,15].

Study population

The study population consisted of adult patients aged 18 years or older who were diagnosed with hypertension and received antihypertensive treatment during hospitalization. Hypertension was defined as systolic blood pressure (SBP) ≥140 mmHg and/or diastolic blood pressure (DBP) ≥90 mmHg, or current use of antihypertensive medication, in accordance with international hypertension guidelines [14]. Patients were included if their medical records contained complete information on antihypertensive drug prescriptions and blood pressure measurements at both hospital admission and discharge. Patients with incomplete records, missing blood pressure data, or those discharged against medical advice were excluded.

Data collection

Data were retrospectively collected from patients' medical records using a standardized data extraction form. Collected variables included demographic characteristics (age and sex), clinical characteristics (hypertension grade, body mass index, and comorbidities), antihypertensive treatment regimens (drug classes, number of drugs, and drug combinations), and blood pressure values measured at admission and discharge. Blood pressure measurements were obtained using validated sphygmomanometers following standard clinical procedures as recommended by current guidelines [14].

Assessment of rational antihypertensive drug use

The rationality of antihypertensive drug use was assessed based on the World Health Organization definition of rational medicine use and guideline-based recommendations [16,17]. Each prescription was evaluated for appropriateness of indication, absence of contraindications, correctness of dosage, dosing frequency, appropriateness of drug combinations, and the presence of potential drug–drug interactions. Drug–drug interaction screening was performed based on established pharmacological evidence [18]. Antihypertensive regimens that fulfilled all assessment criteria were classified as rational, whereas those with at least one inappropriate component were classified as irrational.

Treatment outcome assessment

Treatment outcome was defined as achieving target blood pressure at the time of hospital discharge. Target blood pressure thresholds were determined according to current national and international hypertension management guidelines, with specific targets adjusted based on patient age and comorbid conditions such as diabetes mellitus and chronic kidney disease [14,19]. Patients were categorized into two groups: those who achieved target blood pressure and those who did not.

Definitions and classification criteria

Body mass index (BMI)

BMI was calculated using the standard formula [22].

BMI (kg/m^2) =

BMI classification followed the World Health Organization Asia–Pacific criteria: normal weight (BMI < 23.0 kg/m²), overweight (BMI 23.0–24.9 kg/m²), and obesity (BMI ≥ 25.0 kg/m²).

Classification of hypertension severity

Hypertension severity was classified as grade 1 (SBP 140–159 mmHg and/or DBP 90–99 mmHg), grade 2 (SBP 160–179 mmHg and/or DBP 100–109 mmHg), and grade 3 (SBP ≥180 mmHg and/or DBP ≥110 mmHg), in accordance with international guidelines [14].

Target blood pressure

Target blood pressure was defined as <140/90 mmHg for patients without high cardiovascular risk and <130/80 mmHg for patients with diabetes mellitus, chronic kidney disease, or high cardiovascular risk, provided the treatment was well tolerated [14,19].

Statistical analysis

Data were analyzed using appropriate statistical software. Descriptive statistics were used to summarize demographic characteristics, clinical features, prescribing patterns, and treatment outcomes. Categorical variables were presented as frequencies and percentages, while continuous variables were expressed as mean ± standard deviation. Logistic regression analysis was performed to identify factors associated with achieving target blood pressure. Odds ratios (ORs) with 95% confidence intervals (CIs) were calculated, and a p-value of less than 0.05 was considered statistically significant [20].

Ethical considerations

The study protocol was reviewed and approved by the institutional ethics committee of the study hospital. As this was a retrospective study using anonymized medical records, informed consent was waived. All procedures were conducted in accordance with the ethical principles outlined in the Declaration of Helsinki [21].

RESULTS

Antihypertensive drug utilization and rational prescribing (Objective 1)

Overall antihypertensive prescribing patterns

A total of 378 hospitalized patients with hypertension were included in the analysis. Elderly patients predominated, with those aged ≥60 years accounting for 75.4%, followed by patients aged 40–59 years (22.0%) and those under 40 years (2.6%). The mean age was 71.8 ± 12.4 years, ranging from 24 to 85 years. Female patients were more common than males (61.4% vs. 38.6%), corresponding to a male-to-female ratio of approximately 1:1.6. Most patients resided in rural areas (84.1%). Detailed demographic characteristics are presented in Table 1.

Clinical characteristics

Most patients had a hospital stay of 5–7 days (73.0%), while 23.8% stayed for more than 7 days. Regarding nutritional status, 86.5% of patients had normal BMI, 12.2% were overweight or obese, and 1.3% were underweight. Hypertension severity was predominantly grade 1 (58.7%), followed by grade 2 (22.0%) and grade 3 (19.3%). Cardiovascular comorbidities were common. These data are summarized in Tables 2 and 3.

Table 1: Demographic characteristics of the study population (n = 378)

Characteristic	n	%
Age group (years)		
18–<40	10	2.6
40–<60	83	22.0
≥60	285	75.4
Sex		
Male	146	38.6
Female	232	61.4
Residence		
Rural	318	84.1
Urban	60	15.9
Occupation		
Worker/Farmer	82	21.7
Officer/Employee	6	1.6
Retired	24	6.3
Elderly (not working)	266	70.4

Table 2: Length of hospital stay (n = 378)

Length of stay	n	%
< 5 days	12	3.2
5–7 days	276	73.0
> 7 days	90	23.8

Table 3: Clinical characteristics of patients (n = 378)

Variable	n	%
BMI classification		
Underweight (BMI < 18.5)	5	1.3
Normal (18.5–23.5)	327	86.5
Overweight/Obese (>23.5)	46	12.2
Hypertension grade		
Grade 1	222	58.7
Grade 2	83	22.0
Grade 3	73	19.3
Comorbidities		
Cardiovascular diseases	172	45.5
Diabetes mellitus	44	11.6
Respiratory diseases	6	1.6
No comorbidity	67	17.7

Antihypertensive drug utilization patterns

Angiotensin receptor blockers (ARBs) were the most frequently prescribed antihypertensive agents (48.4%), followed by fixed-dose or multi-component combinations (33.9%) and calcium channel blockers (30.2%). Combination therapy was common, with two-drug regimens accounting for 43.7%. Detailed prescribing patterns are shown in Tables 4 and 5.

Table 4: Antihypertensive drug classes used (n = 378)

Drug class	n	%
Angiotensin receptor blockers (ARBs)	183	48.4
Fixed-dose/multi-component products	128	33.9
Calcium channel blockers	114	30.2
Beta-blockers	40	10.6
Diuretics	32	8.5
ACE inhibitors	24	6.3

Table 5: Antihypertensive treatment regimens (n = 378)

Regimen	n	%
Monotherapy	163	43.1
Two-drug combination	165	43.7
Three-drug combination	40	10.6
Four-drug combination	10	2.6

Table 6: Antihypertensive drug groups used in monotherapy (n = 163)

Drug group	n	%
Beta-blockers	84	51.5
ARBs	41	25.2
ACE inhibitors	15	9.2
Calcium channel blockers	14	8.6
Diuretics	9	5.5

Drug–drug interactions and rational use

Drug–drug interactions were identified in 7.1% of medical records, mainly involving antihypertensive drugs combined with potassium-containing agents. Overall, 85.7% of prescriptions were classified as rational and safe. Detailed results are shown in Tables 7 and 8.

Table 7: Drug - drug interactions and overall rational use (n = 378)

Type of interaction	n	%
Interaction between antihypertensive drugs	3	0.8
Interaction between antihypertensives and other drugs	26	6.9
Any interaction	27	7.1

Table 8: Overall rationality and safety of antihypertensive prescriptions (n = 378)

Classification	n	%
Rational prescriptions	324	85.7
Irrational prescriptions	54	14.3

Treatment outcomes and blood pressure changes

At discharge, 97.1% of patients achieved target blood pressure, while 2.9% did not. Mean systolic, diastolic, and mean arterial pressures decreased significantly during hospitalization (Table 9).

Table 9: Blood pressure changes from admission to discharge (n = 378)

Parameter (mmHg)	Admission	Discharge	p-value
Systolic BP	171.4 ± 15.9	124.1 ± 16.4	0.004
Diastolic BP	91.5 ± 11.6	81.9 ± 12.9	0.001
Mean arterial pressure	121.4 ± 14.1	104.6 ± 13.5	0.03

Factors associated with failure to achieve the target blood pressure

Multivariable logistic regression identified age ≥60 years, elevated creatinine, higher hypertension grade, irrational drug use, and drug–drug interactions as factors associated with failure to achieve target blood pressure.

Table 10: Association between treatment outcome and age (n = 378)

Age group	Not achieved target BP n (%)	Achieved target BP n (%)	p-value
< 60 years	1 (1.1)	92 (98.9)	0.041
≥ 60 years	10 (3.5)	275 (96.5)	

Table 11: Association between treatment outcome and sex (n = 378)

Sex	Not achieved target BP n (%)	Achieved target BP n (%)	p-value
Male	5 (3.4)	141 (96.6)	0.762
Female	6 (2.6)	226 (97.4)	

Table 12: Association between treatment outcome and comorbidities (n = 378)

Comorbidity	Not achieved target BP n (%)	Achieved target BP n (%)	p-value
Present	8 (4.2)	183 (95.8)	0.028
Absent	3 (1.6)	184 (98.4)	

Table 13: Association between treatment outcome and serum creatinine (n = 378)

Creatinine level	Not achieved target BP n (%)	Achieved target BP n (%)	p-value
Elevated	6 (6.1)	92 (93.9)	0.019
Normal	5 (1.8)	275 (98.2)	

Table 14: Association between treatment outcome and overall rational drug use (n = 378)

Creatinine level	Not achieved target BP n (%)	Achieved target BP n (%)	p-value
Elevated	6 (6.1)	92 (93.9)	0.019
Normal	5 (1.8)	275 (98.2)	

Table 15: Association between treatment outcome and drug–drug interactions among antihypertensive drugs (n = 378)

Drug interaction	Not achieved target BP n (%)	Achieved target BP n (%)	OR (95% CI)	p-value
Present	1 (33.3)	2 (66.7)	18.25 (5.94–25.64)	0.021
Absent	10 (2.9)	365 (97.1)	Reference	

Summary of multivariable logistic regression analysis

Multivariable logistic regression analysis identified age ≥60 years, elevated serum creatinine, grade 2 and grade 3 hypertension, irrational antihypertensive drug use, and drug–drug interactions as independent factors associated with failure to achieve target blood pressure at discharge.

DISCUSSION

This study provides a comprehensive assessment of antihypertensive drug utilization, rational prescribing practices, and treatment outcomes among hospitalized patients with hypertension in a tertiary general hospital in Vietnam. The findings contribute important real-world evidence from an inpatient setting, which has been underrepresented in previous Vietnamese studies focusing mainly on outpatient populations.

Antihypertensive prescribing patterns and guideline adherence

The predominance of angiotensin receptor blockers (ARBs) and calcium channel blockers observed in this study is consistent with current international hypertension management guidelines, which recommend these drug classes as first-line therapy, particularly in elderly patients and those with comorbidities. The frequent use of combination therapy, especially two-drug regimens, reflects appropriate clinical decision-making for patients with moderate to severe hypertension or inadequate blood pressure control on monotherapy. These findings suggest a generally high level of adherence to evidence-based guidelines in the hospital setting.

Compared with previous studies conducted in outpatient clinics in Vietnam, the proportion of patients receiving combination therapy in this study was higher. This difference is expected, as hospitalized patients often present with more severe disease, acute complications, or uncontrolled hypertension requiring rapid blood pressure reduction and closer monitoring.

Rational drug use and drug - drug interactions

The high proportion of rational antihypertensive prescriptions (85.7%) indicates that most treatment regimens were appropriate in terms of indication, dosage, dosing frequency, and drug combinations. This finding underscores the positive role of hospital-based clinical protocols and specialist oversight in promoting rational drug use.

Nevertheless, a non-negligible proportion of prescriptions were classified as irrational, mainly due to inappropriate combinations or potential drug–drug interactions. Interactions involving potassium-containing agents were the most frequently identified, raising concerns about the risk of hyperkalemia, especially in elderly patients and those with impaired renal function. These results highlight the importance of systematic medication review and drug–drug interaction screening as integral components of inpatient hypertension management.

Treatment outcomes and associated factors

The rate of target blood pressure achievement at discharge (97.1%) was notably high compared with rates reported in community-based and outpatient studies. This favourable outcome likely reflects the advantages of inpatient care, including frequent blood pressure monitoring, timely medication adjustments, and improved short-term adherence under direct medical supervision.

Despite the overall success, several factors were independently associated with failure to achieve target blood pressure. Advanced age (≥60 years), elevated serum creatinine, higher hypertension grade, irrational drug use, and drug–drug interactions were all significant predictors of poor treatment outcomes. These findings are consistent with previous research demonstrating that elderly patients and those with renal impairment or severe hypertension are more difficult to control and require individualized treatment strategies.

Importantly, irrational prescribing and drug–drug interactions showed strong associations with treatment failure, reinforcing the critical role of rational drug use in achieving optimal blood pressure control. This emphasizes that appropriate medication selection and safety considerations are as important as the choice of drug class itself.

CONCLUSION

This study demonstrates that antihypertensive drug use among hospitalized patients with hypertension was largely rational and aligned with current clinical guidelines, resulting in a high rate of target blood pressure achievement at discharge. Combination therapy, particularly ARB-based regimens, was commonly and appropriately utilized. However, advanced age, renal impairment, higher hypertension severity, irrational drug use, and drug–drug interactions were significantly associated with failure to achieve treatment goals.

These findings highlight the importance of continuous evaluation of prescribing practices and the need for individualized treatment approaches, particularly for high-risk patient groups, to further improve blood pressure control in hospital settings.

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