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Clinical treatment outcomes of hypertensive emergency patients: Results from the hypertension registry program in Northeastern Thailand

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Abstract

Hypertensive emergency care is a challenge in clinical practices due to vital organ complications that may lead to unfavorable outcomes if left untreated. The objectives of this study were to determine the prevalence, clinical characters, treatment, and outcomes of hypertensive emergency patients. A retrospective cohort study was conducted at a university hospital in Northeast Thailand from January 2016 to December 2019. Hypertensive crises patients were consecutively registered to the Hypertension Registry Program. There were 263 674 patients who were admitted to the ER, 60,755 of whom had BP ≥ 140/90 mm Hg and 1,342 of whom were diagnosed with a hypertensive emergency (127 per 100 000 patient-year). The mean age was 66 years old, and 52.1% of the registered patients were men. The most common target organ damage was caused by stroke (49.8%), followed by acute heart failure (19.3%), and then by acute coronary syndrome (6.5%). Intravenous antihypertensive medication was given in 42.1% of the patients, and 80% were admitted to the hospital. The in-hospital mortality rate was 1.6%. In conclusion, hypertensive emergencies were not uncommon among the emergency patients. Strokes caused the most common target organ damage. Although there was a high hospital admission rate, the mortality rate was low.

1 | INTRODUCTION

Hypertension is a well-known modifiable risk factor of fatal and non-fatal cardiovascular events.[1] International practice guidelines and recommendations were recently published to encourage both physicians and patients to be aware of uncontrolled hypertension and achieve 24-hour blood pressure (BP) control.[2,3] However, despite the availability of antihypertensive medications, only a small improvement in the hypertension control rate has been reported in the Thai population.[4]

Patients with uncontrolled hypertension can develop hypertensive crises,[5] which can be classified under (a) Hypertensive emergency or (b) Hypertensive urgency. Patients in the former group must exhibit signs and symptoms of target organ damage in either the cardiovascular system, cerebrovascular system, and/or renal system.[2,6,7] Hypertensive emergencies are a challenge in clinical practice because of vital organ involvement which can lead to unfavorable outcomes if left untreated.[7] However, with rapid detection and timely treatment, the mortality rate of hypertensive emergencies remains low (in-hospital mortality, 2.5%).[6-8]

The prevalence of hypertensive emergencies has varied according to the population studied. It has been reported that around 1%-3% of hypertensive patients experience hypertensive emergencies.[9] However, there is insufficient information about the clinical presentation, treatment, and outcomes of hypertensive emergency patients, especially in the Southeast Asian region on account of the previously small study samples.[6,10-12] We

aimed to fill this gap in knowledge by using the patient registry program, which allowed us to examine larger numbers of patients over four years. The objective of this study was to determine the prevalence, clinical characteristics, treatment, and outcomes of hypertensive emergency patients.

2 | METHODS

2.1 | Setting and population

A retrospective cohort study was conducted at a tertiary care university hospital in Khon Kaen, Thailand from January 2016 to December 2019. Adult patients were registered to the Hypertension Registry Program if they were aged ≥18 years old, were admitted to the ER, and had SBP ≥ 140 mm Hg and/or DBP ≥ 90 mm Hg. Patients were then categorized into hypertensive urgency and hypertensive emergency groups. We excluded pregnant or lactating women, patients with secondary hypertension, and those whose medical records were incomplete. The Khon Kaen University Ethics Committee in Human Research approved the study protocol (HE591508).

2.2 | Hypertensive crises definition

The set of criteria used to define hypertensive crises in this study was derived from the European Society of Hypertension [10], which is the same as the criteria set by the 2017 hypertension guidelines of the American College of Cardiology/American Heart Association [4]. Hypertensive emergency was defined by SBP ≥ 180 and/or DBP ≥ 120 mm Hg with evidence of acute target organ damage, including acute coronary syndrome (ACS), acute heart failure (AHF), stroke, intracerebral hemorrhage (ICH), hypertensive encephalopathy, acute aortic disease (AAD), or acute kidney injury (AKI). The definitions of ACS, AHF, ICH, AAD, and AKI were provided in Appendix S1.

Hypertensive urgency was characterized by SBP ≥ 180 and/or DBP ≥ 120 mm Hg without evidence of acute target organ damage.

2.3 | Blood pressure measurement

The emergency care nurse measured BP at the emergency department using an upper arm cuff automatic BP device (DINAMAP Pro 300; GE Healthcare). Appropriate cuff size was used according to each individual's arm circumference. At least 2 BP readings were measures at 3-min intervals with the patient in a sitting or supine position (depending on their clinical need) after 5 minutes of rest. The average of these BP measurements was used for the analysis.

2.4 | Target organ damage detection and data collection

To detect target organ damage, specific investigations guided by the presenting symptomatology were ordered and evaluated by the doctor in charge. For stroke and ICH patients, the computerized tomography (CT) brain scan reports by diagnostic radiologists were reviewed and used for categorizing patients into the ischemic stroke, hemorrhagic stroke, or ICH group. The authors retrospectively collected the investigation data and results from the hospital's electronic database (Health Object Program).

2.5 | Statistical analysis

The prevalence rates of hypertensive crises', hypertensive emergencies, and hypertensive urgencies were calculated out of the total number of emergency patients who visited the ER during the study period. Baseline characteristic data is presented as mean ± standard deviation (SD) or percentage. Target organ damage is presented in total number and percentage. An independent sample t-test was used to compare the ischemic and hemorrhagic stroke groups in terms of continuous variables, including age, SBP, DBP, heart rate (HR), and laboratory measurements. The Chi-square test was used to compare categorical variables. A probability value of < 0.05 was considered statistically significant. All statistical analyses were performed with SPSS for Mac version 20.0, registered to Khon Kaen University.

3 | RESULTS

3.1 | Prevalence and baseline characteristics

There were 263,674 patients admitted to the ER during the 4-year study period. After repeated BP measurements, 60,755 patients were found to have BP ≥ 140/90 mm Hg and 9,833 patients were diagnosed with a hypertensive crisis (16.2% of emergency patients had hypertension). These patients were categorized as hypertensive emergency patients (n = 1,342) or as hypertensive urgency patients (n = 8,491) (2.2% and 14.0% of emergency patients with hypertension, respectively) (Figure 1).

The prevalence rate of admitted hypertensive emergency patients was 127/100000 patients-year. Of the total hypertensive emergency patients, 34 patients were excluded due to incomplete data and 1,308 patients were included for the final analyses. The average patient age in the sample was 65.9 ± 13.6 years old, and 52.1% were men. Most of the patients had previously known cases of hypertension (63.7%). Underlying diseases included diabetes mellitus (30.6%), old cerebrovascular disease (23.2%), and chronic kidney disease (CKD, 17.5%) (Table 1). The most commonly presented symptom of the patients was limb weakness (24.5%), and other complaints included dyspnea (10.8%), impaired consciousness (8.8%), dysarthria (7.6%), headache (5.4%), and generalized fatigue (5.1%). There were 19.8% of patients with non-specific symptoms. Initial SBP and DBP values were 199.4 ± 20.2 and 105.0 ± 20.1 mm Hg, respectively. Initial heart rate (HR) was 88.1 ± 17.0 beats per minute (bpm) (Table 1). Regarding laboratory parameters, the mean creatinine level was

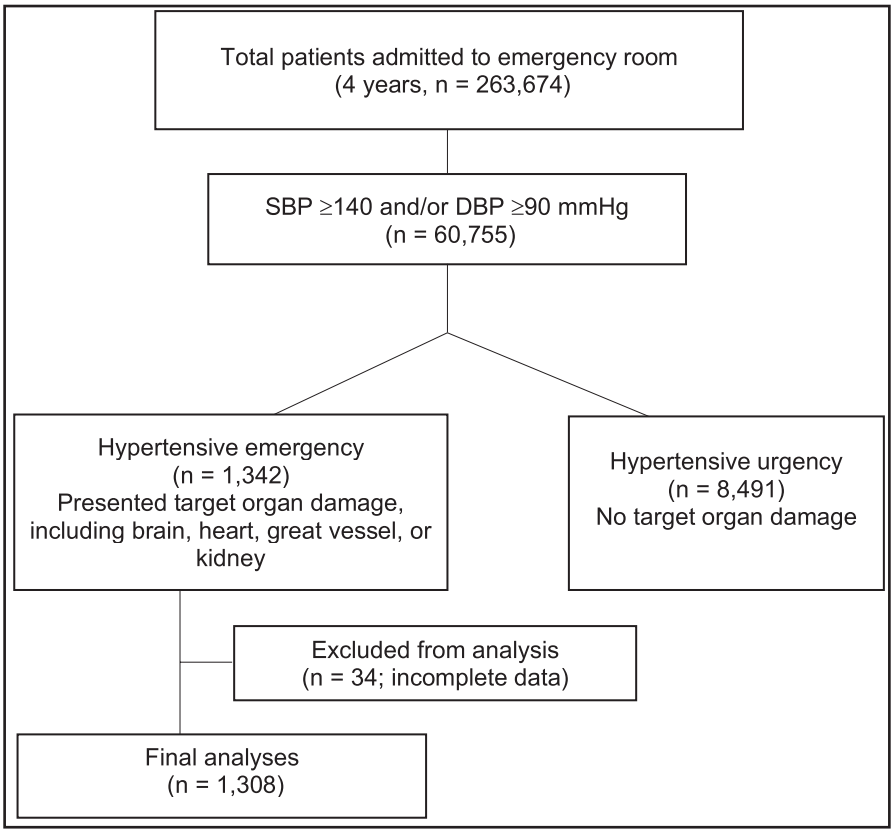

FIGURE 1 Patient flow diagram. There were 263,674 patients admitted to the ER during the 4-year study period. After repeated BP measurements, 60,755 patients were found to have BP ≥ 140/90 mmHg and 9,833 patients were diagnosed with hypertensive crises', categorized as hypertensive emergency (n = 1,342) or hypertensive urgency (n = 8,491). After excluding patients with incomplete data (n = 34), there were 1,308 patients used in the final analyses

2.0 ± 2.6 mg/dl and the mean hemoglobin level was 12.0 ± 2.4 g/dl (Table 1).

3.2 | Target organ damage

Most of the hypertensive emergency patients who were admitted to the ER in the present study suffered from stroke; 49.8% had an ischemic stroke and 13.2% had a hemorrhagic stroke. There were 7.2% of patients who had ICH. The second most common type of target organ damage was cardiovascular; 19.3%, 6.5%, and 2.5% presented with AHF, ACS, and AAD, respectively. A minority of patients (1.5%) had AKI (Table 2).

3.3 | Management in the ER

3.3.1 | Investigations

Blood tests were prescribed for most patients, including blood chemistry (95.3%) and complete blood count (94.1%) tests. Less than half of the patients were given a urine analysis test (46%). The most commonly prescribed imaging tests were chest X-rays (71.8%) and CT scans of the brain (59.6%). Electrocardiograms (ECG) were performed on 65.3% of patients.

3.3.2 | Treatment and outcomes

One fourth of the patients required oxygen supplementation (25.1%), and 16.7% needed ventilator support. Intravenous (IV) antihypertensive medication was given to 42.1% of patients (Nitroglycerine, 39.6%, Nicardipine, 36.5%, and Labetalol, 23.9%), while 46.4% were given IV fluid supplementation. Patients who were not given IV antihypertensive medication (57.9%) belonged to the strokes and ICH groups. Mean ER time was 5.6 ± 11.6 hours. (Table 3).

After being discharged from the ER, most patients were admitted to normal wards (70.2%), and around 9% of the patients were admitted to the intensive care unit (ICU) for close monitoring. Other cases included 13.6% of patients discharged to their homes, 6.7% referred to other hospitals, and one death (0.1%). (Table 3) Among the admitted patients, the average length of hospital stay (LOS) was 7.5 ± 13.5 days; 66.1% were discharged with an improved clinical status, while 4.2% had a worsening clinical status and 1.6% were deceased. (Table 3).

TABLE 1 Baseline characteristics

Characteristic	N = 1308
Age, years	65.9 ± 13.6
Men, n (%)	682 (52.1)
Underlying disease, n (%)	
CVA	303 (23.2)
CKD	229 (17.5)
Hypertension	833 (63.7)
CAD	44 (3.4)
Diabetes mellitus	400 (30.6)
COPD	15 (1.1)
Cancer and palliative care	47 (3.6)
Chief complaint, n (%)	
Weakness	320 (24.5)
Dyspnea	141 (10.8)
Impaired consciousness	115 (8.8)
Dysarthria	100 (7.6)
Headache	71 (5.4)
Generalized fatigue	67 (5.1)
Found high BP during clinic visit	64 (4.9)
Dizziness	60 (4.6)
Chest pain	58 (4.4)
Numbness of extremities	54 (4.1)
No specific symptoms	259 (19.8)
Triage level*, n (%)	
Resuscitation	92 (7.0)
Emergency	976 (74.6)
Urgency	220 (16.8)
Lower urgency	19 (1.5)
No urgency	1 (0.1)
Body temperature, degree Celsius	36.8 ± 0.6
Respiratory rate, tpm	23.3 ± 5.5
Heart rate, bpm	88.1 ± 17.0
SBP, mm Hg	199.4 ± 20.2
DBP, mm Hg	105.0 ± 20.1
MAP, mm Hg	136.4 ± 16.7
Oxygen saturation, %	96.1 ± 5.9
Creatinine, mg/dl	2.0 ± 2.6
Hemoglobin, g/dl	12.0 ± 2.4

Note: Values indicate percent (%) or mean ± SD.

Abbreviations: CVA indicates cerebrovascular accident; CKD, Chronic kidney disease; CAD, Coronary artery disease; COPD, Chronic obstructive pulmonary disease; BP, Blood pressure; SBP, systolic blood pressure; DBP, diastolic blood pressure; MAP, mean arterial pressure; mmHg, millimeter of mercury; *mg/dl*, milligrams per deciliter; *g/dl*, grams per deciliter; tpm, time per minute; bpm, beat per minute.

*The triage system used in this study was described in Appendix S1.

3.4 | Acute strokes: differential characteristics between ischemic and hemorrhagic strokes

Patients in the ischemic stroke group were significantly older than those in the hemorrhagic stroke group (66.7 ± 12.7 vs 62.3 ± 14.7 years old, $P < .001$). There were higher numbers of women and higher rates of diabetes mellitus (DM) in the ischemic stroke group than in the hemorrhagic stroke group (49.8% vs 33.5% and 30.3% vs 17.9%, all $P < .01$). However, the hemorrhagic stroke group was more likely to have a history of hypertension (75.1% vs 63.1%, $P = .003$) (Table 4).

The initial Glasgow Coma Scale (GCS) scores of the hemorrhagic stroke group were significantly lower than the ischemic stroke group (10.2 ± 5.1 vs. 12.8 ± 4.6, $P < .001$). The initial SBP, DBP, and HR of the hemorrhagic stroke group were significantly higher than those of the ischemic stroke group (209.0 ± 24.1 vs 198.7 ± 19.4 mmHg, 113.4 ± 19.9 vs 103.5 ± 19.2 mmHg, and 91.6 ± 16.1 vs 97.7 ± 3.0 bpm, all $P < .001$, respectively). The hemorrhagic stroke group was more likely to require ventilator support (27.3% vs 5.6%, $P < .001$), more frequently received complex medical procedures in the ER (31.4% vs 8.0%, $P < .001$), and had longer LOS, (9.0 ± 17.0 vs 4.4 ± 8.8 days, $P < .001$) (Table 4).

4 | DISCUSSION

This study found a 127 per 100 000 patients per year prevalence of hypertensive emergency in Thai emergency patients. Strokes contributed to the most common target organ damage in hypertensive emergency patients, followed by AHF and ACS. Although most of the hypertensive emergency patients required hospital admission (80%), the mortality rate was less than 2%.

The prevalence rate of hypertensive emergencies in this study was higher than that found in European populations[13] and also higher than that found in a 2012 study on the Thai population, which reported a prevalence of 78.9/100 000 patients per year.[10] The present study was a longitudinal study that ran from 2016-2019. The difference in the prevalence rate might be explained by better access to emergency medical services as well as the monitoring of hypertensive patients over a longer period of time.[4,14] The average age of the patients in this study was higher than in studies from Western countries, which have reported average ages around 50 years old,[6,15,16] but was consistent with the aforementioned Thai study, which reported an average age of approximately 60 years old.[10] Regarding sex, the results of our study differed from previous studies. We found a slightly higher number of men with hypertensive crises, but other studies have reported a higher proportion of women than men.[10,15,16]

Around 64% of the patients were known hypertensive patients, and they still visited the ER with hypertensive emergencies. Furthermore, around one fifth of the patients were known to have prior cerebrovascular diseases. These findings were in line with

TABLE 2 Target organ damage associated with hypertensive emergencies

Target organ damage	n *(%)*
Ischemic stroke	651 *(49.8)*
Hemorrhagic stroke	173 *(13.2)*
Subdural, epidural, or subarachnoid hemorrhage	94 *(7.2)*
Acute heart failure	253 *(19.3)*
Acute coronary syndrome	85 *(6.5)*
Acute aortic disease	33 *(2.5)*
Acute kidney injury	19 *(1.5)*

TABLE 3 Emergency room treatment of hypertensive emergencies

Treatment	n (%)
Investigation, n (%)	1247 (95.3)
- Blood chemistry	1231 (94.1)
- Complete blood count	939 (71.8)
- CXR	854 (65.3)
- EKG	779 (59.6)
- CT brain scan	600 (45.9)
- Urine analysis	33 (2.5)
- Ultrasonography, any part of the body	
Oxygen supplementation, n (%)	328 (25.1)
Ventilator support, n (%)	218 (16.7)
IV antihypertensive medication, n (%)	551 (42.1)
- Nitroglycerine	218 (39.6)
- Nicardipine	201 (36.5)
- Labetalol	132 (23.9)
IV fluid supplementation, n (%)	607 (46.4)
Complex medical procedure	258 (19.7)
Time in ER, hour	5.6 ± 118.6
ER discharge status:	918 (70.2)
- Admitted to normal ward, n (%)	114 (8.7)
- Admitted to ICU, n (%)	178 (13.6)
- Discharged from ER, n (%)	88 (6.7)
- Referred to other hospitals, n (%)	1 (0.1)
- Deceased, n (%)	9 (0.7)
- Unidentified, n (%)	
Length of hospital stay, days	7.5 ± 13.5
Hospital discharge status*:	6 (0.6)
- Complete recovery, n (%)	682 (66.1)
- Clinically improved, n (%)	43 (4.2)
- Clinically declined, n (%)	17 (1.6)
- Deceased, n (%)	284 (27.5)
- Undetermined status, n (%)	

Note: Values indicate percent (%) or mean ± SD.

Abbreviations: EKG indicates electrocardiogram; CXR, chest X-ray; CT, computerized tomography; IV, intravenous; ER, emergency room; ICU, intensive care unit.

*The definition of each hospital discharge status was described in Appendix S1.

the previous Thai study but with a higher rate in the present study (23.2% vs 6.5%).[10] Previous studies have mentioned that one of the most important precipitating factors of a hypertensive crisis in known hypertensive patients is poor adherence and compliance to antihypertensive medication procedures.[2,15,17] The results of this study confirmed that it was not uncommon for treated hypertensive patients to arrive at the ER with a hypertensive emergency. However, we did not explore the precipitating factors.

The latest guidelines on the management of hypertensive emergencies show that IV antihypertensive medication for immediate BP control is required.[2] The present study found that in real-world ER practice, less than half of the patients were prescribed IV antihypertensive medication (42%). We found that the most common target organ damage was attributable to stroke (63%), and 13% of the patients had a hemorrhagic stroke. A higher BP target was generally accepted for patients with this condition in order to maintain the autoregulation of the intracerebral blood flow.[18] Therefore, IV antihypertensive medication may not be prescribed immediately in stroke patients but may instead be given after finishing and reporting on the CT scan of the brain. This could explain the lower rate of IV antihypertensive medication prescriptions given in the ER. The results of ER treatment were favorable with a lower than 1% mortality rate. While we found that the hospital admission rate was high (80%), it was lower than the admission rate in a study on American patients, which reported a hospital admission rate of 98% for 8 years in a row (2006-2013). [19] Most of the patients admitted to the hospital in the present study were discharged safely. The in-hospital mortality rate in our study was 1.6%, lower than that found in the American study (3%-4.5%).[19]

Because strokes caused the most common target organ damage in our study, we further categorized patients into hemorrhagic and ischemic stroke groups. Interesting findings were that the ischemic stroke group was older and had a higher rate of previous diabetes mellitus (DM), while the hemorrhagic stroke group had a higher number of men and known hypertensive patients. Andersen et al from Denmark also reported that DM was a predictive factor for ischemic stroke. However, age and sex were not found to affect the stroke type.[20] We found that the hemorrhagic stroke group had higher BP and HR and had lower GCS at baseline. Clinical complications in the hemorrhagic stroke group were more severe, and the patients needed more ventilator support, required more complex medical procedures, and had longer LOS. These results correlate well with a previous study by Andersen et al, which concluded that hemorrhagic stroke patients were generally more severe and had a higher mortality rate.[20]

This study had a larger number of patients and a longer study period than previous studies in the region. The results represented real-world practices and outcomes without any intervention. In the future, it may be possible to address the gaps that were observed in this study, specifically in emergency hospital settings at the tertiary level. However, we are aware that our study had some limitations. First, we did not collect data on the type of prescribed IV antihypertensive medications, which may affect outcomes. Furthermore, the study's retrospective design may have led to missing data, specifically that related to discharge status. Finally, this study was conducted in northeastern Thailand at a single tertiary care center and may not represent other regions or locations.

TABLE 4 Comparisons of clinical characteristics and laboratory parameters between ischemic stroke and hemorrhagic stroke patients

	Hemorrhagic stroke n = 651	Ischemic stroke n = 173	*P*
Age, years	62.3 ± 14.7	66.7 ± 12.7	<0.001
Men, n (%)	115 (66.5)	327 (50.2)	<0.001
DM, n (%)	31 (17.9)	197 (30.3)	0.001
HT, n (%)	130 (75.1)	411 (63.1)	0.003
CKD, n (%)	20 (11.6)	68 (10.4)	0.678
GCS	10.2 ± 5.1	12.8 ± 4.6	<0.001
BT, degrees Celsius	36.8 ± 0.7	36.7 ± 0.4	0.253
RR, tpm	22.9 ± 5.0	21.2 ± 3.4	<0.001
SBP, mmHg	209.0 ± 24.1	198.7 ± 19.4	<0.001
DBP, mmHg	113.4 ± 19.9	103.5 ± 19.2	<0.001
HR, bpm	91.6 ± 16.1	85.1 ± 15.6	<0.001
O_2 sat, %	97.5 ± 4.1	97.7 ± 3.0	0.405
PO_2	150.7 ± 96.1	107.0 ± 61.1	0.002
Ventilator support, n (%)	47 (27.3)	35 (5.6)	<0.001
Complex procedure, n (%)	54 (31.4)	50 (8.0)	<0.001
Sodium, mEq/L	138.5 ± 4.7	138.1 ± 4.3	0.206
Creatinine, mg/dl	1.6 ± 1.8	1.4 ± 1.7	0.230
Length of hospital stay, days	9.0 ± 17.0	4.4 ± 8.8	<0.001

Abbreviations: DM indicates diabetes mellitus; HT, hypertension; CKD, chronic kidney disease; GSC, Glasgow Coma Scale; BT, body temperature; RR, respiratory rate; SBP, systolic blood pressure; DBP, diastolic blood pressure; HR, heart rate; tpm, time per minute; bpm, beat per minute; mmHg, millimeter of mercury; PO_2, partial pressure of oxygen; *mEq/L*, milliequivalents per liter; *mg/dl*, milligrams per deciliter.

5 | CONCLUSION

Hypertensive emergencies were not an uncommon problem among emergency room patients. Strokes caused the most common target organ failure. Despite a high hospital admission rate, the overall mortality rate was low.

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CONFLICT OF INTEREST

The authors had no competing interests.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author, [PK]. The data are not publicly available due to their containing information that could compromise the privacy of research participants.

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REFERENCES

1. Kearney PM, Whelton M, Reynolds K, Muntner P, Whelton PK, He J. Global burden of hypertension: analysis of worldwide data. *Lancet*. 2005;365:217-223.
2. Whelton PK, Carey RM, Aronow WS, et al. 2017 ACC/AHA/AAPA/ABC/ACPM/AGS/APhA/ASH/ASPC/NMA/PCNA Guideline for the Prevention, Detection, Evaluation, and Management of High Blood Pressure in Adults: A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines. *J Am Coll Cardiol*. 2018;71:e127-e248.
3. Kario K, Park S, Chia YC, et al. 2020 Consensus summary on the management of hypertension in Asia from the HOPE Asia Network. *J Clin Hypertens (Greenwich)*. 2020;22:351-362.
4. Aekplakorn W, Sangthong R, Kessomboon P, et al. Changes in prevalence, awareness, treatment and control of hypertension in Thai population, 2004–2009: Thai National Health Examination Survey III-IV. *J Hypertens*. 2012;30:1734-1742.
5. Marik PE, Varon J. Hypertensive crises: challenges and management. *Chest*. 2007;131:1949-1962.
6. Almas A, Ghouse A, Iftikhar AR, Khursheed M. Hypertensive crisis, burden, management, and outcome at a tertiary care center in Karachi. *Int J Chronic Dis*. 2014;2014:413071. https://doi.org/10.1155/2014/413071
7. Cherney D, Straus S. Management of patients with hypertensive urgencies and emergencies: a systematic review of the literature. *J Gen Intern Med*. 2002;17:937-945.

8. Brathwaite L, Reif M. Hypertensive emergencies: a review of common presentations and treatment options. *Cardiol Clin*. 2019;37:275-286.
9. Deshmukh A, Kumar G, Kumar N, et al. Effect of joint national committee VII report on hospitalizations for hypertensive emergencies in the United States. *Am J Cardiol*. 2011;108:1277-1282.
10. Piyanuttapull S. Prevalence of hypertensive emergency in emergency room of Rajavithi hospital. *J Hypertens Manag*. 2016;2(1):2-10.
11. Sruamsiri K, Chenthanakij B, Wittayachamnankul B. Management of patients with severe hypertension in emergency department, Maharaj Nakorn Chiang Mai Hospital. *J Med Assoc Thai*. 2014;97:917-922.
12. Kotruchin P, Mitsungnern T, Ruangsaisong R, Imoun S, Pongchaiyakul C. Hypertensive urgency treatment and outcomes in a Northeast Thai population: the results from the hypertension registry program. *High Blood Pres Cardiovasc Prev*. 2018;25(3):309-315.
13. Zampaglione B, Pascale C, Marchisio M, Cavallo-Perin P. Hypertensive urgencies and emergencies. prevalence and clinical presentation. *Hypertension*. 1996;27:144-147.
14. Apiratwarakul K, Ienghong K, Mitsungnern T, Kotruchin P, Phungoen P, Bhudhisawasdi V. Use of a motorlance to deliver emergency medical services; a prospective cross sectional study. *Arch Acad Emerg Med*. 2019;7(1):e48.
15. Bender SR, Fong MW, Heitz S, Bisognano JD. Characteristics and management of patients presenting to the emergency department with hypertensive urgency. *J Clin Hypertens Greenwich*. 2006;8:12-18.
16. Vilela-Martin JF, Vaz-de-Melo RO, Kuniyoshi CH, Abdo ANR, Yugar-Toledo JC. Hypertensive crisis: clinical-epidemiological profile. *Hypertens Res*. 2011;34:367-371.
17. 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;311:507-520.
18. Link MS, Berkow LC, Kudenchuk PJ, et al. Part 7: Adult Advanced Cardiovascular Life Support. *Circulation*. 2015;132:S444-S464.
19. Janke AT, McNaughton CD, Brody AM, Welch RD, Levy PD. Trends in the Incidence of Hypertensive Emergencies in US Emergency Departments From 2006 to 2013. *J Am Heart Assoc*. 2016;5:e004511.
20. Andersen KK, Olsen TS, Dehlendorff C, Kammersgaard LP. Hemorrhagic and Ischemic Strokes Compared. *Stroke*. 2009;40:2068-2072.

SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.

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