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Hypertensive emergencies crisis and the choice of therapy in prehospital treatments

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Abstract

People with arterial blood pressure >140/90 mmHg (hypertension) have accelerated development of atherosclerosis and changes in blood vessels and other organs of the body, therefore, such arterial blood pressure must be treated. A hypertensive crisis is defined as an extreme increase in arterial blood pressure with a systolic blood pressure over 180 mmHg and diastolic blood pressure over 120 and 130 mmHg, respectively, and poses an immediate danger to the patient's life. At the heart of each hypertensive crisis is severe hypertension. In the Emergency medicine center Zivinice has been carried out a prospective study ehich include four study groups were formed as a sequential sample of 160 participants of both sexes. By administering a combination of furosemide amp. And diazepam amp. The mean systolic blood pressure in all observed groups decreased from 186.25 mmHg to 167.5 mmHg, and the mean diastolic blood pressure decreased from 120.53 mmHg to 97.5 mmHg. By prescribing a combination of nifedipine tab., furosemide amp. and diazepam amp., the average systolic blood pressure all observed groups was reduced from 186.25 mmHg to 152 mmH, and the average diastolic blood pressure was reduced from 120.53 mmHg to 91.2 mmHg.

Keywords: Hypertensive crisis; Nifedipine; Furosemid; Diazepam; Prehospital

1. Introduction

Thus, arterial blood pressure of 120/80 mmHg is considered optimal, while systolic blood pressure values of 121-129 mmHg and diastolic blood pressure values of 80-84 mmHg are considered normal arterial blood pressure. People with arterial blood pressure >140/90 mmHg (hypertension) have accelerated development of atherosclerosis and changes in blood vessels and other organs of the body, therefore, such arterial blood pressure must be treated. Elevated arterial blood pressure poses a risk of cardiovascular diseases, manifested by the damage to target organs [1].Hypertension is a hemodynamic disorder. Blood pressure is the product of the minute volume of the heart (the volume of blood that is eject from the heart in one minute) and the resistance of blood vessels. Therefore, factors that affect cardiac output and vascular resistance determine blood pressure. Narrowing of small arteries (arterioles) leads to an increase in blood pressure due to an increase in peripheral vascular resistance, and narrowing of small veins (venues) leads to a redistribution of blood from the periphery to the center, to the heart and an increase in blood flow to the heart, as well as the minute volume of the heart [2] About 65 million people in the United States suffer from hypertension. As many as 22% of people do not know that they suffer from hypertension, 32% of people with hypertension do not receive treatment, and 36% of patients with hypertension have blood pressure above 140/90 mmHg [3]. In 95% of people with hypertension, the cause is unknown. This condition is called primary (essential) hypertension.

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1.1. Increased arterial blood pressure

Long-lasting exposure to high arterial blood pressure leads to changes in the walls of the aorta and smaller vessels, changes in the heart, brain, kidneys and retina of the eye [4]. High blood arterial pressure accelerates the process of atherosclerosis in the walls of blood vessels. Narrowed arteries are less able to supply blood to tissues and organs, and over time, their damage and deterioration of their function occur [5]. The formed atherosclerotic plaques in the walls of the vessels burst, as they become inelastic, and a blood clot forms in that place, closing the blood vessel. Hypertension leads to excessive stretching of the blood vessel and the formation of "weak spots" at the walls of blood vessels that are prone to rupture. They are the cause of a heart attack. Excessive stretching leads to the formation of thin cracks in the walls of blood vessels, and in these places a blood clot can form and clog the blood vessel [6].

1.2. Hypertensive urgency and emergency care

Hypertensive crisis is registered in about 1% of hypertensive patients, that is, in about 3% of patients who go to the emergency, that is, 27% of all emergency cases [7]. Hypertensive crises are present in less than 1% of the adult population in the United States. Severe increases in blood arterial pressure may develop a new or progressive existing burden on vital organs (heart, brain, kidneys), that is, they can complicate existing essential or secondary hypertension [8].

As a part of a hypertensive crisis, two conditions are distinguished:

- Hypertensive urgency (state of hypertensive urgency) and
- Hypertensive emergence (critical hypertensive condition) [9].

In hypertensive urgency care there is no damage to target organs, unlike hypertensive emergence, where damage to target organs is recorded and where there is an immediate danger to the integrity of the cardiovascular system [10]. Arterial pressure in hypertensive urgency should be gradually reduced within 24-48 hours, and various oral antihypertensive agents are used for this purpose. In the treatment of patients with hypertension urgency, it should carefully observe the effect of an ordinated medicine and not rush to increase the dose, since this can lead to the accumulation of the drug in the body and lead to unwanted hypotension [11].

Hypertensive emergence is defined as an increase in arterial blood pressure combined with: malignant arterial hypertension, intracranial hemorrhage, atherothrombotic cerebral infarction, acute congestive decompensation of the heart, acute coronary insufficiency, acute renal failure, acute aortic dissection and adrenergic crisis. In hypertensive emergence, arterial blood pressure should be lowered rapidly within 1-4 hours and preferably within the first hour to prevent further damage to target organs [12].

Aim

- To determine the frequency of hypertensive crises in patients who go to the Emergency Medical Service (EMS).
- To develop a therapeutic protocol (algorithm) for the treatment of hypertensive emergency.

2. Material and methods

Research methods are largely determined by the object of study. Descriptive statistics methods will be used. In this paper, both qualitative and quantitative methods will be used and those are: basic, general methods and methods of data collection. Hypothetical-deductive, statistical and comparative methods will be used in the paper. In the end, testing and analyzing the contents of various documents will be the main method and technique of data collection.

In the EMS Zivinice has been carried out a prospective study during period between 1 January and 31 March 2022 about the frequency of patients with hypertension in the EMS as well as antihypertensive therapy that patients use. Four study groups were formed as a sequential sample of 160 participants of both sexes. All patients had symptoms such as: headache, chest pain, choking, nausea and / or vomiting, tinnitus, dizziness, with previously established damage to target organs (eye, heart, brain, and kidney) by hypertension. The participants were divided into 4 groups:

- The first study group was consisted of 40 participants of both sexes, over 18 years of age, admitted to the EMS due to hypertension.
- The second group was consisted of 40 participants of both sexes, over 18 years of age, hypertensive patients who did not receive treatment.

- The third group was consisted of 40 participants of both sexes over 18 years of age, who were randomly measured and determined a high arterial blood pressure.
- The fourth group is a control group consisting of 40 participants of both sexes over 18 years of age, who experienced health conditions related to an increase in arterial blood pressure, and during medical check-up in EMS their blood pressure was within the reference range (normotensive patients).

The drugs we used were: diazepam 10mg / 2ml ampoules iv., furosemide 20mg / 2ml ampoules iv., nitroglycerin lingual spray 0.4mg per dose, atenolol 50mg tablets, lisinopril 10mg tablets, nifedipine 20mg tablets, lisinopril 10mg tablets, captopril 25 mg. Nonparametric methods and tests were used to calculate statistical significance: a $\chi 2\chi$ test was used to calculate differences within groups, and beside test 2 it was also used Kruskall-Wallis test to account for differences between groups, and if there is a statistically significant difference between groups, additional testing was conducted between groups using Mann-Whitney test in the U test; for parametric data differences between groups were calculated using one-factor Analysis of Variance (ANOVA), followed by calculations of Tukey's HD tests, if there were differences between groups, and it was used a Student's "t" - test for dependent samples; for calculations of testing before and after administrated therapy using Wilcoxon's test rank; and to calculate the correlation, where necessary, the Pearson's and Spearman's correlation test were used. Statistical hypotheses were tested at the level $\alpha=0.05$, that is, the difference between the groups in the sample was considered significant if $p<0.05$. Statistical processing was performed with the support of biomedical application software called "MedCalc for Windows version 12.4.0", Copyright © 1993-2013, and mostly using the software "SPSS Statistics 17.0", Copyright © 1993-2007.

The study was approved by the Ethics Committees of Public Health Center, Emergency medicine center Zivinice according to the World Medical Association outlined in the Declaration of Helsinki (Ethical principles for medical research involving human subjects).

3. Results

The average life expectancy of the participants was 49.67 years of age with a standard deviation of 13.36 and is ranged from 18 to 83 years of age (Figure 1.).

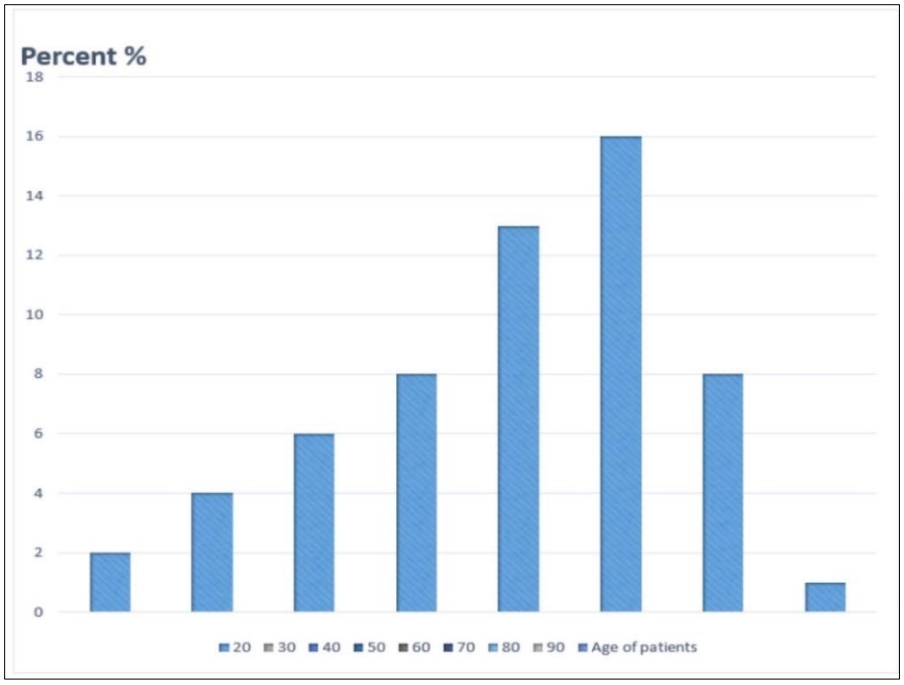

Figure 1 Participants age included in the study

The calculation of one-factor Analysis of Variance (ANOVA) revealed a statistically significant difference between the individual groups: F (3.156) =7.864; P<0.001; eta square=0.13. According to Cohen's criterion, the established difference has an average effect (eta square=0.13). Further testing using the HD Tukey's test shows that there is a statistically significant difference between normotensive patients and all other groups of patients, while there is no statistically significant difference between the other groups (Table 1.).

Table 1 BMI values in the studied groups of patients

Group of participants	Average value	Standard deviation	The lowest value	The highest value
Newly diagnosed patients	28.33	4.340	20	38
Inadequately treated patients	27.13	4.039	20	35
Untreated patients	28.05	4.420	20	38
Normotensive patients	24.40	3.272	19	30

ANOVA: F(3.156) = 7.864; p<0.001

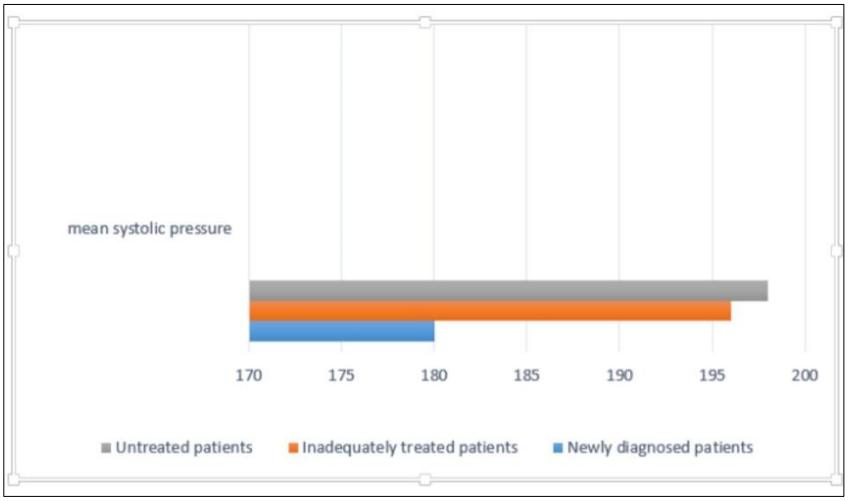

Figure 2 Mean systolic blood pressure by groups of patients

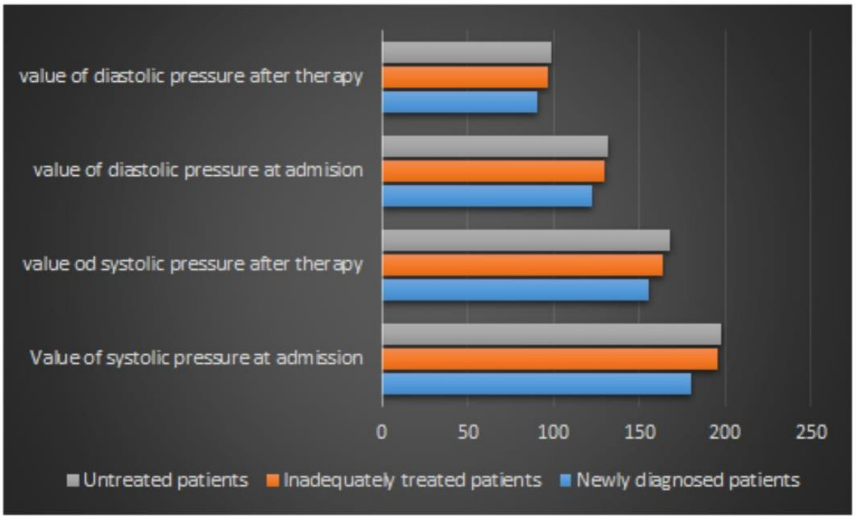

Figure 3 Arterial blood pressure values at admision and after therapy with diazepam amp. And atenolol tbl

The measured value of systolic blood pressure in the observed groups of patients shows certain deviations. The differences between the groups were statistically significant (□2 = 189.824; df = 12; p <0.001). However, the calculation of the Kruskall-Wallis test for other examined groups of patients also showed a statistically significant difference between the observed groups (□2 = 30.446; df = 2; p <0.001). The group of untreated patients has the highest mean value and the highest median, which indicates that this difference is most conditioned by the values of systolic blood pressure in this observed group (Figure 2.).

The combination of diazepam amp. And atenolol tab. had reduced the mean systolic blood pressure which was statistically significant (t = 7.2; df = 8; p <0.001), and the mean diastolic blood pressure also was reduced which is statistically significant (t = 9; df = 8; p <0.001) (Figure 3.).

By administering a combination of furosemide amp. And diazepam amp. The mean systolic blood pressurein all observed groups decreased from 186.25 mmHg to 167.5 mmHg which is statistically significant (t = 19.428; df = 31; p <0.001), and the mean diastolic blood pressure decreased from 120.53 mmHg to 91.5 mmHg, which is also statistically significant (t = 10.535; df = 31; p <0.001) (Table 2.)

Table 2 Values of systolic and diastolic blood pressure in mmHg after therapy with combinatition furosemid and diazepam amp

		N	Average value	Standard deviation	The highest value
The value of systolic pressure after therapy	Newly diagnosed patients	57	160	8.473	170
	Inadequately treated	53	168	7.503	176
	Untreated patients	60	175	17.927	180
	Total	90	167.5		175
The value of systolic pressure after therapy	Newly diagnosed patients	67	90.500	6.173	98
	Inadequately treated	63	90	4.802	100
	Untreated patients	30	94	10.728	105
	Total	160	91.500	9.468	101

F (2.87) = 15.543; p<0.001; eta square = 0.26 (systolic blood pressure); F (2.87) = 25.003; P<0.001; eta square = 0.36 (diastolic blood pressure)

In all observed groups:

A combination of atenolol tab., furosemide amp. And diazepam amp. Lowered the average systolic blood pressure from 186.25 mmHg to 133.75 mmHg, which is statistically significant (T=9.379; DF=7; p<0.001), and the average diastolic blood pressure was reduced from 120.53 mmHg to 89.38 mmHg, which is also statistically significant (T=7,519; DF=7; p<0.001).

By prescribing a combination of nifedipine tab., furosemide amp. and diazepam amp., the average systolic blood pressure was reduced from 186.25 mmHg to 152 mmHg, which is statistically significant (T=10.565; DF=7; p<0.001), and the average diastolic blood pressure was reduced from 120.53 mmHg to 91.2 mmHg, which is also statistically significant (T=5,227; DF=7; p=0.001).Testing revealed a statistically significant bidirectional correlation between prescribed medications and severe hypertension (hypertensive crisis) (Spearman ρ=-0.394; P<0.001. The most commonly prescribed drugs are Furosemide, diazepam, nifedipine and atenolol, regardless of whether they are prescribed as monotherapy or, more often, as polytherapy in combination of two or more drugs (Table 3.).

4. Discussion

Data on the frequency of high blood pressure differ in different studies. In the well-known Framingham's study, almost 20% of the participants had a blood pressure value above 160/95 mmHg, and almost half of the participants had blood pressure above 140/90 mmHg. Most epidemiological studies in various countries have confirmed the prevalence of high arterial blood pressure in the range from 10% to 25% of the population[12]. In India, a study of hypertension was conducted on10, 463 patients, vary from 25 to 64 years of age, of whom 46.8% were men and 53.2% were women [13].

In the UK, about half of middle-aged people have high arterial blood pressure. In most patients, the blood pressure value is up to 160/100 mm Hg, but in 1 out of 20 patients with hypertension, blood pressure values exceed 160/100 mm Hg [14].

Hypertensive crisis is characterized by a very high arterial blood pressure (severe hypertension), which is often associated with acute organ damage. This can occur in the form of hypertensive encephalopathy, intracerebral hemorrhage, acute myocardial infarction, pulmonary edema, aortic dissection, unstable angina, eclampsia or reversible encephalopathy syndrome (a condition characterized by headache, altered mental state, and visual impairment).

Analysis of arterial hypertension complicated by the occurrence of hypertensive crisis was conducted in Moscow. It was revealed that hypertensive crises grows by 14%, in the period from 2015 to 2099. The number of hypertensive crises is increased among younger people (between 18 - 35 years of age). The incidence of cerebrovascular complications of hypertensive crises was age-dependent with maximum values among men ranging from 36 to 74 years of age and women older than 75 years of age [15].

In our study, one of the parameters that was observed was related to the frequency of hypertensive crisis in patients with hypertension. Hypertensive crises most often occurred in ineadequatly treated hypertensive patients (16.2%), whereas in newly diagnosed hypertensive patients, the occurrence of hypertensive crises was much less frequent (5.6%). It is important to draw attention on to the fact that inadequately treated hypertensive patients have suffered from hypertension for years, but their therapy was inadequate, which led to a more significant increase in arterial blood pressure values and more frequent occurrence of hypertensive crises. Hajjar in his study concluded, that in most patients, furosemide in combination with nifedipine led to a hypotensive effect, reducing arterial blood pressure below the critical limit within 3 hours. In this study, a combination of furosemide and nifedipine was recommended in the emergency treatment of hypertension [16].

The diuretic furosemide in the therapeutic effect in patients suffering from hypertensive disease, according to the results of our study, leads to a rapid decrease in elevated arterial blood pressure. In all three study groups, the most common drug used either as monotherapy or in combination with other drugs was furosemide administered parenterally intravenously at a dose of 20 mg. During the administration of furosemide, the value of high systolic blood pressure decreased by 35.88 mmHg and diastolic blood pressure by 27.14 mmHg. When a combination of furosemide and diazepam was prescribed, systolic blood pressure decreased by 40.6 mmHg, and diastolic blood pressure decreased by 21.6 mmHg. The combination of atenolol, furosemide and diazepam resulted in a decrease in systolic blood pressure by 63.75 mmHg and diastolic pressure by 18.9 mmHg. Nifedipine, furosemide and diazepam led to a decrease in systolic blood pressure by 56.25 mmHg and diastolic by 20.62 mmHg. Arterial blood pressure returned to normal after prescribed therapy in the group of newly diagnosed and untreated hypertensive patients, whereas in inadequately treated hypertensive patients it decreased significantly and was present in the majority of patients in the values of mild hypertension.

5. Conclusion

Analyzing four groups of patients who had symptoms and signs of hypertension, we come to the following conclusions:

- Hypertensive crises most often occur in long-standing, inadequately treated hypertensive patients.
- The age structure of patients shows that hypertension most often occurs at the age between 40 and 60 years of age.
- The choice of using antihypertensive monotherapy or combined therapy was significantly influenced by the arterial blood pressure value measured when the patient was admitted to the EMS, as well as the presence of a hypertensive crisis. The indicated antihypertensive monotherapy and combined therapy in most patients reduced elevated arterial blood pressure values for 3 hours. The therapy was aimed at a rapid and effective reduction of high arterial blood pressure with a single treatment and, thus, the elimination of patient health problems. It should be noted that diazepam, although it does not belong to the group of antihypertensive drugs, still exhibits an antihypertensive effect with its vasodilatory and sedative effects.

Based on our research, it can be assumed that as a one-time therapy in EMS:

- in cases of mild or moderate hypertension, furosemide is used alone or in combination with dizepam
- In cases of hypertensive crisis a combination of atenolol with dizepam is used and/or furosemide.

Compliance with ethical standards

Disclosure of conflict of interest

All authors of the manuscript have no conflict of interests to declare.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

References

[1] Skoglund PH, Svensson P. Asking the patient or measuring blood pressure in the emergency department: which one is best? Curr Hypertens Rep. 2016; 18(10): 53.

[2] Lonn E, Shaikholeslami R, Yi Q, Bosch J, Sullivan B, Tanser P, Magi A et al. Effects of ramipril on left ventricular mass and function in cardiovascular patients with controlled blood pressure and with preserved left ventricular ejection fraction: a substudy of the Heart Outcomes Prevention Evaluation (HOPE) Trial. J Am Coll Cardiol. 2004; 43(12): 2200-6.

[3] Elliott WJ. Systemic hypertension. Curr Probl Cardiol. 2007; 32(4): 201-59.

[4] Cutler JA, Sorlie PD, Wolz M, Thom T, Fields LE, Roccella EJ. Trends in hypertension prevalence, awareness, treatment, and control rates in United States adults between 1988-1994 and 1999-2004. Hypertension. 2008; 52(5): 818-27.

[5] Vallelonga F, Carbone F, Benedetto F, Airale L, Totaro S, Leone D, Astarita A, Avenatti E, Maule S, Veglio F, Lupia E, Milan A. Accuracy of a Symptom-Based Approach to Identify Hypertensive Emergencies in the Emergency Department. J Clin Med. 2020; 9(7): 2201.

[6] Astarita A, Covella M, Vallelonga F, Cesareo M, Totaro S, Ventre L, Aprà F, Veglio F, Milan A. Hypertensive emergencies and urgencies in emergency departments: a systematic review and meta-analysis. J Hypertens. 2020; 38(7): 1203-1210.

[7] Seeman T, Hamdani G, Mitsnefes M. Hypertensive crisis in children and adolescents. Pediatr Nephrol. 2019; 34(12): 2523-2537.

[8] Rodriguez MA, Kumar SK, De Caro M. Hypertensive Crisis. Cardiol Rev. 2010; 18(2): 102–7.

[9] Lazaridis AA, Sarafidis PA, Ruilope LM. Ambulatory Blood Pressure Monitoring in the Diagnosis, Prognosis, and Management of Resistant Hypertension: Still a Matter of our Resistance? Curr Hypertens Rep. 2015; 17(10): 78.

[10] Mahmood S, Shah KU, Khan TM, Nawaz S, Rashid H, Baqar SWA, Kamran S. Non-pharmacological management of hypertension: in the light of current research. Ir J Med Sci. 2019; 188(2): 437-452.

[11] Raji YR, Abiona T, Gureje O. Awareness of hypertension and its impact on blood pressure control among elderly Nigerians: report from the Ibadan study of aging. Pan Afr Med J. 2017; 27(3): 190.

[12] Oras P, Häbel H, Skoglund PH, Svensson P. Elevated blood pres sure in the emergency department: a risk factor for incident cardiovascular disease. Hypertension. 2020; 75(8): 229–236.

[13] Shao, P.J., Sawe, H.R., Murray, B.L. et al. Profile of patients with hypertensive urgency and emergency presenting to an urban emergency department of a tertiary referral hospital in Tanzania. BMC Cardiovasc Disord. 2018; 12(4): 158.

[14] Ghazi L, Li F, Chen X, Simonov M, Yamamoto Y, Biswas A, Hanna J, Shah T, Peixoto AJ, Wilson FP. Blood pressure response to commonly administered antihypertensives for severe inpatient hypertension. PLoS One. 2022; 17(4): e0265497.

[15] Wang C, Yuan Y, Zheng M, Pan A, Wang M, Zhao M, Li Y, Yao S, Chen S, Wu S, Xue H. Association of Age of Onset of Hypertension With Cardiovascular Diseases and Mortality. J Am Coll Cardiology. 2020; 75(23): 2921-2930.

[16] Hajjar I, Kotchen TA Trends in prevalence, awareness, treatment, and control of hypertension in the United States. JAMA. 2019; 290(9): 190–193.