UDC: 616.12-008.331.1:616.12-07

COMPARATIVE ANALYSIS OF SYSTOLIC BLOOD PRESSURE AND HEART RATE ORTHOSTATIC REACTIONS IN HEALTHY SUBJECTS AND ARTERIAL HYPERTENSION PATIENTS

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Age and gender difference of SBP orthostatic reaction types and HR in healthy subjects and AH patients were found. Rate of SBP hyper- and hypotensive reaction types decrease with age. Frequency of hypertensive type in AH is increased. HR increases in orthostasis disregarding SBP reaction type, the extent of growth increases from hyper- to hypotensive reaction. HR reactivity is higher in males.

KEY WORDS: arterial hypertension, orthostatic reactions, orthostatic hypotension, heart rate, systolic blood pressure

ПОРІВНЯЛЬНИЙ АНАЛІЗ ОРТОСТАТИЧНИХ РЕАКЦІЙ СИСТОЛІЧНОГО АРТЕРІАЛЬНОГО ТИСКУ ТА ЧАСТОТИ СЕРЦЕВИХ СКОРОЧЕНЬ У ЗДОРОВИХ ОСІБ І ПАЦІЄНТІВ З АРТЕРІАЛЬНОЮ ГІПЕРТЕНЗІЄЮ

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Виявлені вікові та статеві відмінності розподілу типів ортостатичних реакцій САТ та ЧСС у здорових осіб та у пацієнтів з АГ. Частота гіпер- та гіпотензивних типів реакції САТ знижуються з віком. Частота гіпертензивного типу при АГ підвищена. В ортостазі ЧСС зростає незалежно від типу реакції САТ, ступінь зростання збільшується від гіпер- до гіпотензивної реакції. Реактивність ЧСС вища у чоловіків.

КЛЮЧОВІ СЛОВА: артеріальна гіпертензія, ортостатична реакція, ортостатична гіпотензія, частота серцевих скорочень, систолічний артеріальний тиск

СРАВНИТЕЛЬНЫЙ АНАЛИЗ ОРТОСТАТИЧЕСКИХ РЕАКЦИЙ СИСТОЛИЧЕСКОГО АРТЕРИАЛЬНОГО ДАВЛЕНИЯ И ЧАСТОТЫ СЕРДЕЧНЫХ СОКРАЩЕНИЙ У ЗДОРОВЫХ ЛИЦ И ПАЦИЕНТОВ С АРТЕРИАЛЬНОЙ ГИПЕРТЕНЗИЕЙ

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Обнаружены возрастные и половые отличия распределения типов ортостатических реакций САД и ЧСС у здоровых лиц и у пациентов с АГ. Частота гипер- и гипотензивных типов реакции САД снижаются с возрастом. Частота гипертензивного типа при АГ повышена. В ортостазе ЧСС возрастает вне зависимости от типа реакции САД, степень прироста увеличивается от гипер- к гипотензивной реакции. Реактивность ЧСС выше у мужчин.

КЛЮЧЕВЫЕ СЛОВА: артериальная гипертензия, ортостатические реакции, ортостатическая гипотензия, частота сердечных сокращений, систолическое артериальное давление

Three main types of systolic blood pressure (SBP) and heart rate (HR) orthostatic reactions can be identified in both healthy subjects and in arterial hypertension (AH) patients: increase, no changes and decrease [1–3].

Persons in age 22–30 years are characterized with fast and high reactivity of SBP and HR, opposite to elderly people of age 65–75 years, in which lower reactivity, but longer duration of reaction is observed [3].

Normal and pathologic types of SBP and HR can be identified.

Normal type is characterized by average decrease of SBP on 6,5 mm (from –19 to 11 mm)

and by average increase of HR on 12,3 beats per minute (from –6 to +27 beats per minute. Pathologic type of SBP and HR orthostatic reactions include orthostatic systolic hypotension — decrease of SBP not less than per 20 mm; and orthostatic tachycardia — increase of HR for 30 beats per minute and more (or more than 108 beats per minute) [2].

SBP in healthy subjects of young age were investigated during the orthostatic test [3, 4]. Frequency distribution of main BP reaction types were studied [2] and hypertensive type of SBP reaction was found in 54 %; isotensive in 3%, and hypotensive in 43 %.

According to existing scientific data [1] three types of SBP orthostatic reactions were identified in AH patients — hypertensive, isotensive and hypotensive with a frequency distribution 67 %; 12 % and 21 % correspondingly.

According to multicenter clinical trials data hypotensive type of SBP reaction in orthostatic test, in particular orthostatic hypotension (SBP decrease on more than 25 mm) is an independent predictor of vascular mortality, risk factor of stroke [5], coronary syndrome [6], factor with clear negative prognostic meaning [7].

Comparative analysis of SBP and HR orthostatic reactions frequency distribution peculiarities in healthy subjects and AH patients data are absent in world and native scientific literature.

Aim of Research: to compare the peculiarities of SBP and HR orthostatic reactions distribution features in healthy subjects of various age groups and in AH patients in order to identify their clinical meaning.

MATERIALS AND METHODS

Three follow up groups were identified: healthy subjects of young and elder age (256 persons in total) and elder AH patients (154 patients in total).

Group of healthy subjects consisted of 2 sub-groups: 1^{st} — 218 persons (93 males and 125 females, age 20,8 ± 2,1 years, and 2^{nd} — 38 persons (17 males and 21 females, age 60,8 ± 4,4 tears).

Group of AH patients consisted of 58 males and 96 females, age 63,0 ± 7,0 years. Average AH anamnesis duration was 10,4 ± 7,8 years. 83 patients had I grade AH, 36 had II grade AH, and in 35 patients — III grade AH.

Patients that had myocardial infarction, stroke, heart failure (IV functional class), obesity III–IV grade, secondary hypertension were not included into study [4, 6].

Examinations were done in the morning, coffee, alcohol, medications were prohibited for 24 hours period. Physical load restricted for 30 minutes before the test.

BP was measured with Korotkoff method with a Microlife BP AG1-20 tonometer in a supine position (clinostasis) after 5 minutes rest and in 3 minutes after transition into standing position (orthostasis).

HR was calculated according to 5 minutes ECGs traces performed with computer electrocardiograph Cardiolab 2000.

According to SBP changes in orthostatic test healthy subjects and AH patients were split into 3 groups: 1^{st} — hypertensive type; 2^{nd} — isotensive type; 3^{rd} — hypotensive type. Criteria of SBP increase and decrease were its changes in a volume not less than 5 mm. Gender of healthy subjects and AH patients were taken into account in SBP and HR orthostatic reaction evaluation.

Distribution peculiarities of SBP and HR orthostatic reactions in healthy young and old subjects and in AH patients were studied.

Parametric criteria were used for evaluation of statistical estimations (mean meaning — M and standard deviation — sd).

RESULTS AND DISCUSSION

Fig. 1, reflects the results of SBP orthostatic reactions distribution research in young and old healthy subjects, and gender dependence.

Hypertensive SBP reaction type was found in 54 % of healthy young (45 % males, 60 % females) and in 45 % of healthy old (42 % males, 49 % females); Isotensive type in 3 % of healthy young (6 % males, 0 % females) and in 18 % of healthy old (21 % males, 17 % females); Hypotensive type in 43 % of healthy young (49 % males, 40 % females) and in 37 % of healthy old (37 % males and 34 % females).

SBP hyper and hypo orthostatic reactions types are predominating in healthy persons, but the old age group demonstrates a tendency for isotensive type frequency increase. Hypertensive type frequency is markedly higher in young healthy females, if compared to males, but in the old age group this difference greatly diminishes.

Relative increase of isotensive orthostatic SBP reactions frequency together with hypertensive and hypotensive reactions decrease

that is seen in old healthy subjects can be explained with the age diminishing SBP reactivity [3, 8].

Fig. 2, reflects the results of SBP orthostatic reactions distribution research in old healthy subjects and old AH patients, and gender dependence.

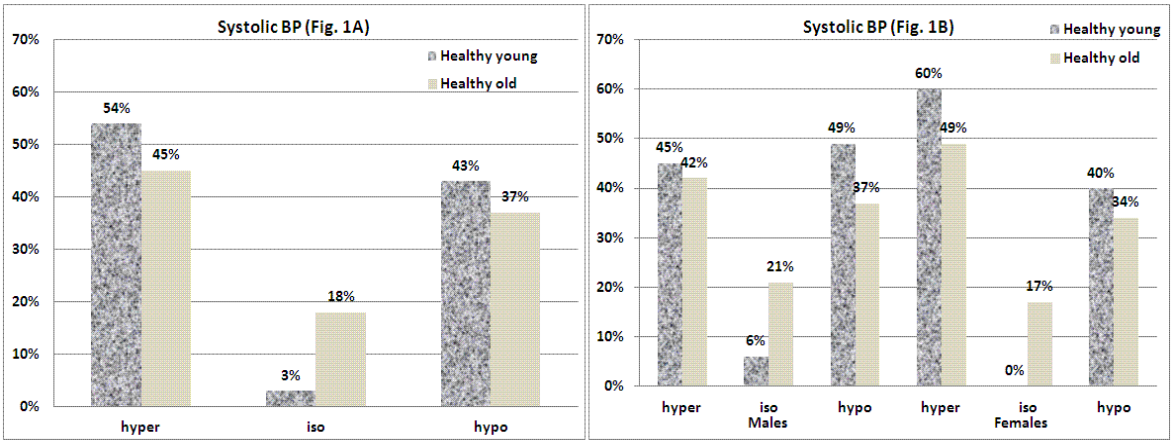

Fig. 1A. Distribution of SBP orthostatic reactions in young and old healthy subjects

Fig. 1B. Distribution of SBP orthostatic reactions in the same groups depending on gender

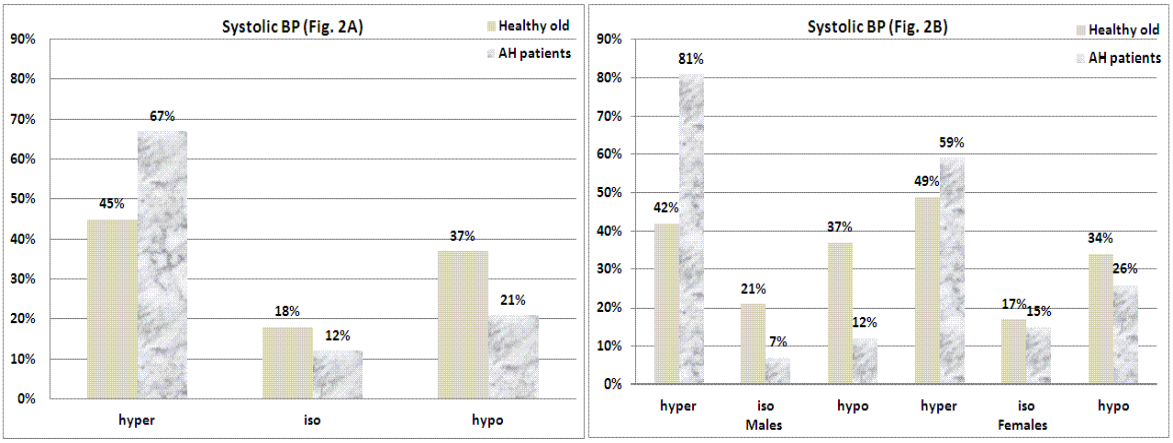

Fig. 2A. Distribution of SBP orthostatic reactions in old healthy and AH patients

Fig. 2B. Distribution of SBP orthostatic reactions in the same groups depending on gender

Hypertensive SBP reaction type was found in 45 % of healthy old (42 % males, 49 % females), and in 67 % of AH patients (81 % males, 59 % females); isotensive type in 18 % of healthy old (21 % males, 17 % females) and in 12 % of AH patients (7 % males, 15 % females); hypotensive type in 37 % of healthy old (37 % males, 34 % females) and in 21 % of AH patients (12 % males, 26 % females).

Hypertensive type is much frequently and hypotensive type is less frequently seen in AH patients, on the opposite to healthy old age. Hypertensive type is almost two times higher in male AH patients, while iso- and hypotensive types are almost three times lower in male AH patients, if compared to old healthy males. That makes hypertensive type absolutely dominating in AH male patients.

In female AH patients hypertensive type is somewhat higher, while isotensive is almost equal and hypertensive is slightly lower, if compared to old healthy females. Thus, hypertensive type is predominating in AH female patients, but the other two types can also be seen quite often.

Higher frequency of hypertensive orthostatic SBP reactions, that is seen in AH patients, is present mainly in males, and probably connected with the peculiarities of male and female organism aging [5, 7]. It also can be a reason of different frequency of more severe current and more aggressive complications of AH in males and females of older age [5].

Fig. 3, reflects the HR increase in identified types of SBP orthostatic reactions in young and old healthy subjects, and gender dependence.

In SBP orthostatic reaction hypertensive type, HR increased per 15 % in young healthy (16 % in males, 14 % in females) and per 12 % in old healthy (13 % in males, 11 % in females); In isotensive type, HR increased per 18 % in young healthy (19 % in males, 16 % in females) and per 15 % in old healthy (16 % in males, 14 % in females); In hypotensive type, HR increased per 20 % in young healthy (22 % in males, 19 % in females) and per 18 % in old healthy (19 % in males, 17 % in females).

HR increase is higher in young healthy, in all types of orthostatic reactions, if compared to old healthy subjects. Disregarding age, males demonstrate slightly higher rate of HR increase in all types of orthostatic reactions. Data obtained cannot be compared as no similar data was found available in world literature.

Fig. 4, reflects the HR increase in identified types of SBP orthostatic reactions in old healthy subjects and AH patients.

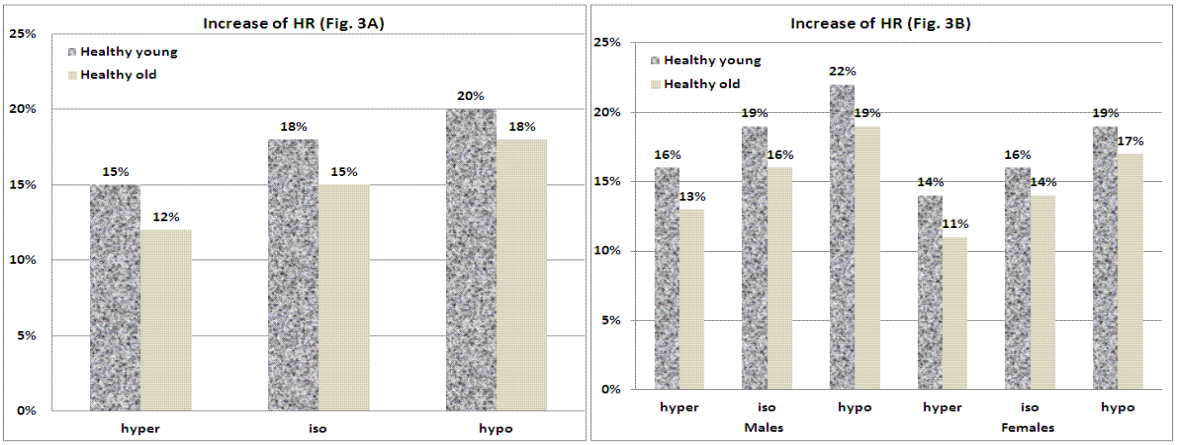

Fig. 3A. HR orthostatic increase peculiarities in the identified types of SBP orthostatic reactions in young and old healthy subjects

Fig. 3B. HR orthostatic increase gender dependence in the orthostatic types in young and old healthy subjects

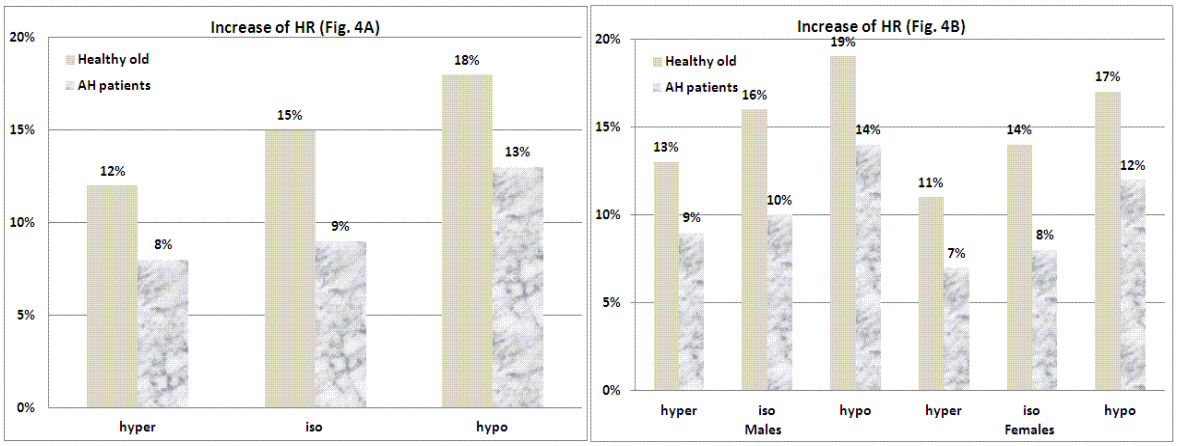

Fig. 4A. HR orthostatic increase peculiarities in the identified types of SBP orthostatic reactions in old healthy subjects and AH patients

Fig. 4B. HR orthostatic increase gender dependence in the orthostatic types in old healthy subjects and AH patients

In hypertensive type, HR increased per 12 % in old healthy (13 % in males, 11 % in females) and per 8 % in AH patients (per 9 % in males and 7 % in females); In isotensive type, HR increased per 15 % in old healthy (16 % in males, 14 % in females) and per 9 % in AH patients (10 % in males, 8 % in females); In hypotensive type, HR increased per 18 % in old healthy (19 % in males, 17 % in females) and per 13 % in AH patients (14 % in males, 12 % in females).

HR increases less in AH patients, in all types of orthostatic reactions, if compared to old healthy subjects. Both old healthy subjects and AH patients of male gender demonstrate slightly higher HR increase in all orthostatic reactions types.

HR changes are tightly connected with SBP orthostatic reactions. In all types of SBP orthostatic reactions HR increases during orthostatic tests both in young and old healthy subjects and AH patients. The extent of orthostatic HR increase raises from hypertensive to hypotensive SBP orthostatic reaction types. These data correspond to results obtained earlier [7]. The extent of HR increase in tilt tests diminishes not only with age but also in AH patients, and can be another additional sign of cardiovascular system reduced reactivity in AH. In males reactivity of HR in orthostasis is higher than in females per 2 % on average, that correspond to data obtained [7].

CONCLUSIONS

In healthy subjects SBP hyper- and hypotensive orthostatic reaction rates drops with age, while isotensive orthostatic reaction rate markedly grows. Gender difference in young and old healthy subjects has no significant importance.

In AH patients SBP hypertensive orthostatic reaction type predominates and is seen in 67 % of cases. In AH male patients, hypertensive type is markedly dominating.

In young and old healthy subjects and in AH patients HR increases in the tilt test in all types of SBP orthostatic reaction, but in AH patients the extent of increase is seen to be lower. The extent of HR increase drops from hypotensive to hypertensive type of SBP reactions. HR increase extent in tilt test diminishes with age. In males, HR reactivity is slightly higher in all age groups and reaction types.

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