Values of central aortic blood pressure
in normotensive students, existing risk factors and possible approaches to create the preventive environment in the University

Evsevyeva M.E.*, Sergeeva O.V.
Stavropol State Medical University, Stavropol, Russia

Autors

Maria E. Evseeva, M.D., Doctor of sciences, Professor, Honored doctor of Russia, Head of the Department of Faculty Therapy, Head of the Center of Students' Health of Stavropol State Medical University, Russia.
Oksana V. Sergeeva, M.D., Ph.D., Associate Professor of the Department of Faculty Therapy, Center of Students' Health of Stavropol State Medical University, Russia.

Summary

Objective

To investigate the profile of cardiovascular risk factors (CVRF) in young students and to estimate the influence of these factors on central aortic blood pressure (CABP), to discuss possible ways of CVRF correction using university media for spreading information and motivation ideas.

Materials and methods

80 students underwent the estimation of aortic rigidity parameters and presence of CVRF with complex diagnostic software.

Results

Systemic and latent hypertension was diagnosed more frequently in risk factor carriers. Frequency of false hypertension occurrence didn't depend on risk factors (RF) presence. In case of normotension RF presence was associated with higher values of augmentation index. This study also presents data of the Center of Students' health about introduction of real and network forms of mass, group and personalized preventive work among young students using obtained information about possible health hazards.

*Corresponding author: Tel. +79283154687. E-mail: evsevieva@mail.ru

Conclusion

Despite the young age and short anamnesis of CVRF presence students demonstrate preclinical but distinct lesions of aortic wall as the one of the most important target organs. It is necessary to introduce more actively the CVRF screening together with CABP estimation into the work of the centers of students' health in order to start in time early preventive interventions.

Key words:

Screening, risk factors, students, premorbid diagnostic, preventive intervention.

Experience of several countries that managed to obtain real reduction of initially high cardiovascular (CV) mortality, demonstrates that CV risk factors (CVRF) correction has more significant impact on achieving such results comparing with coronary heart disease (CHD), arterial hypertension (AH) and their complications treatment [1, 2].

In clinical practice this approach is implemented through creation of mass diagnostics of the system of risk factors (RF) and preclinical lesions in population and particularly in its active part [3, 4]. Examination of young students in the centers of students' health (CSH) or in students' polyclinics [5,6] looks enough promising [7, 8].

Risk groups formation in young persons allows to start early correction of identified hazards with preventive interventions of different levels including the school of students' health [9]. This approach requires elaboration of reasonable screening aiming to estimate effectively the profile of significant RF and asymptomatic changes of target organs [10.11]. It has been identified that for successful screening it is necessary to take into account the age of examined persons [12], their social [8] and psychophysiological status [13, 14]. and also constitutional and anthropometric features [15].

Pathogenetic continuum of main cardiovascular diseases (CVD) in this age corresponds to very early prenosological changes of target organs [16]. Because of this young age gives a good chance to slow down the CVD development and prevent their unfavorable income. This preventive strategy seems to be the most effective one although its prospective results are delayed in time. But the diagnostic step of prophylaxis in young age group as the initial element of mass health examination is undoubtedly not elaborated enough [6]. Technologies of preventive interventions in organized groups of young people are also formed in noticeably low level [7, 8].

The aim of this study is to estimate the influence of CVRF on the central aortic blood pressure (CABP) and its augmentation index (Aix) and to design the approach of these factors correction according with the university informational and motivation resources.

Materials and methods

This study demonstrates the results of complex examination of 80 students of Stavropol State Medical University (SSMU) (39 males, 41 females), that was performed on the base of SSMU CSH during second stage of mass health examination of students. The age of students was 19-22 years.

Using questioning and anthropometry we performed screening of such RF like hereditary predisposition of diabetes mellitus (DM), cancer, early CVD, office AH/prehypertension (PH), excessive body weight (EBW), dyslipidemia and hyperglycemia (test-stripes for express-diagnostics), smoking (smoke detector "SmokeCheck"; "Micro Medical Ltd.", Great Britain), the presence of infection nidus, improper feeding according with the questionnaire of National Research Center for Preventive Medicine(NRCPM) [17], hypodynamia according with the World Health Organization (WHO) questionnaire [18] and low stress tolerability according with student questionnaire of U.V.Shcherbatykh [19].

We performed also the comparative analysis of the parameters of central and peripheral blood pressure (PB), that have been obtained with particular programmed diagnostic complex using oscillometric way of BP measurement on the shoulder and consequent modeling of central pulse wave (CPW). BP levels was used as the investigated parameter in two groups of students that were formed according with the presence or absence of other CVRF: 1 group (n=26) – without RF (control group), 2 group (n=54) (main group) – with the presence of CVRF like burdened familiar history, smoking, EBW, improper feeding, hypodynamia and low stress tolerability with the average number of RF =2,7±0,6.

We used special operation system for automatic tubulation of all parameters of CPW measurement.

Apart of traditional brachial artery BP parameters such values like aortic systolic blood pressure (SYSao), aortic diastolic blood pressure (DIAao), aortic pulse BP (PPao), average aortic BP (ABPao), duration of left ventricle ejection period (ED), aortic Aix, pulse pressure amplification (PPA), subendocardial viability ratio (SEVR).

We investigated occurrence of hemodynamic variants of AH/PH based on comparative estimation of aortic and peripheral BP values. We identified the cases of latent hypertension- isolated elevation of aortic BP, false hypertension – isolated elevation of brachial artery BP, systemic AH/PH – elevated BP in aorta and in brachial artery and stable normal BP[20]. Preclinical changes of vascular wall were examined using Aix values of central BP in newly formatted groups (53 student with normal BP in total) taking into account homogeneity of main hemodynamic parameters to exclude the influence of BP levels on mentioned parameter of vascular rigidity. During formation of groups we took into account the age of young patients. For example, in the control group without RF mentioned above brachial artery systolic blood pressure (SBPba) in young females was between 100-120 mm Hg. and 110-130 mm Hg in young males respectively, and brachial artery diastolic blood pressure (DBPba) was around 65-75 mm Hg in both gender groups, because of this we included only persons with corresponding levels of BP into the main group with the presence of RF. According with this the persons with EBW were not included to the main group because in all cases it was associated with higher BP. Thus the study design at the last stage was initially performed taking into account the task of correct investigation of per se vascular rigidity parameters, so by intentional exclusion of possible BP influence on it. According with this, investigated groups were comparable in this last parameter.

The results of students' examination were analyzed with "Statistica 6.0" software ("StatSoft Inc"). Differences with $p<0,05$ were considered statistically significant.

Results and discussion

Analysis of biological and behavioral RF in examined students revealed burdened family history in 37 (46,3%) persons. Profile of modifiable RF was the following: EBW, smoking and elevated BP were registered in 17,5%, 18,5% and 16,3% of students respectively. focal chronic infection was found in one fifth of all examined students. Hypodynamia, improper feeding, low stress-tolerability were registered in 35,0%, 38,7% and 32,5% of students respectively.

Individual comparative analysis of the results of peripheral and central BP measurements in each examined person (Table 1) demonstrated, that in the group of people without RF systemic PH/AH was registered in less than 1% of people, and the same value in students with present RF 10 times bigger (p<0.01). In the last group one of ten students had latent PH/AH and this pathology was not present in the group of students without RF. These data prove reasonability of CVRF screening as a simple but diagnostically informative stage of mass health examination of students. The frequency of false PH/AH was almost the same in both groups: every one of twelve students had it. In the end the amount of students with stable normal BP was twice as more in the group without RF comparing with the group of RF carriers.

Table 1. **Occurrence of different types of AH/PH in students according with the results of comparative peripheral and aortal BP estimation**

AH types	All without RF n=26	All with RF n=54
False AH	2 (7,9 %)	4 (7,7 %)
Latent AH	—	5 (9,6 %)
Systemic AH	1 (3,8 %)	19 (36,5 %)**
Normotension	23 (88,3)	24 (46,2)

Comment: ** — p<0,01, comparing with the group without RF.

More frequently AH/PH occurred in students with EBW and burdened family history, and they were registered simultaneously in major part of students with elevated BP. It is necessary to mention also the high occurrence of low stress-tolerability in these students, that goes along with previously published works about personal features of young patients that were referred to cardiologist for examination and treatment due to the presence of evident primary AH [14].

In relation to the problem of CV health of young people it is relevant to study properties of vascular wall taking into account all present RF excluding AH/PH, so in all normotensive male and female students. The results of vascular rigidity characteristics in two groups of young males with presence/absence of CVRF and comparable initial levels of BP (Table 2a) demonstrate prominent differences of central pressure Aix.

This characteristic in students with favorable background correlates with its negative values, and it moves to more positive values of the scale in presence of RF. But these differences cannot be considered

Table 2a. **CABP characteristics in young males**

BP characteristics measured on brachial artery and aorta	Юноши без RF n=11				Юноши с RF n=12			
	M	Me	V_{25}	V75	M	Me	V_{25}	V75
SBPba	116	114	112	125	117,3	116,5	115	122
DBPba	68,9	69	66	72	70,6	71	68	74
ABPba	84,8	85	81	88	87,2	87,5	84	92
PPba	46,8	46	44	50	46,6	48	44	50
HR	73,8	73	67	78	75,2	74	68	79
SBPao	101,8	100	98	107	105,1	104	102	111
DBPao	70,2	70	65	73	71,5	71	68	78
ABPao	84,8	85	81	88	87,2	87,5	84	91
PPao	31,3	31	30	32	33,9	34,5	33	38
SBPba-SBPao	14,4	14	13	17	12,2	10,5	10	16
DBPba-DBPao	—1,3	—1	—1	0	—0,9	—1	—1	0
PP-PPao	15,2	16	14	18	13,3	12,5	11	15
Alxao, %	—4,9	—8	—12	2	3,9	0	—5	4
PPA, %	149,9	148	145	158	139	136,5	131	151
ED, mc	280,4	290	255	294	300,9	299,5	269	325
SEVR, %	165,1	160	148	167	165,5	168	135	194

Table 2b. **CABP characteristics in young females**

BP characteristics measured on brachial artery and aorta	Young females without RF n=12				Young females with RF n=18			
	M	Me	V_{25}	V_{75}	M	Me	V_{25}	V_{75}
SBPba	111,9	113,5	105	117	113,1	117,5	104	118
DBPba	69,8	69	66	74	72	71	69	74
ABPba	85,1	84	82	90,5	86,7	87	83	91
PPba	41,5	40	38	46	40,8	40,5	37	46
HR	71,8	72,5	66	78	74,3	75	67	80
SBPao	101,5	100,5	97	106	103,2	106,5	96	108,5
DBPao	71,4	70	66	77	73,4	72,5	71	79
ABPao	85,1	84	82	90,5	86,7	87	83	91
PPao	29,4	30	26	34	29,3	29	25	34
SBPba-SBPao	10,4	9,5	8	13	9,8	10	9	12
DBPba-DBPao	—1,6	—2	—2	—1	—1,38	—2	—2	—1
PPba-PPao	12,2	12,5	10	14	11,4	11,5	10	14
Alxao, %	1,5	1,5	—2	6	7,6*	8	4	12
PPA, %	142,9	140,5	134	153	139,7	139	132	144
ED, mc	305	319,5	282	328	316,6	328	291	341
SEVR, %	134,4	121	116	146	137,8	136,5	122	160

Comment: * — p< 0,05

significant (p=0,08). In young females of both groups (Table 2b) this characteristic has positive values, but at the same time the carriers of mentioned RF had Aix values 5 times bigger than young females without CVRF. The differences between the groups of female students were statistically significant (p=0,04). Thus, the presence of main RF in students promotes the loss of vascular wall elasticity in spite of young age and short history of presence of these factors.

These results indicate evident influence of RF on the characteristics of peripheral and central hemodynamics of young people. The information about association of several AH/PH types with RF supplement significantly the existing data about this problem in young patients [21]. Quite frequently they demonstrate sufficiently frequent diagnostics of isolated CBP abnormalities, and it makes it necessary to detect it during mass health examination together with traditional measurement of peripheral BP on brachial artery. AIx as one of rigidity characteristics increases being influenced with other RF in normal BP conditions. Until recently these aspects of vascular status in young patients estimated using oscillometric method of BP measurement on brachial

artery with consequent CBP modeling appeared only in few studies. And mentioned above studies investigated these CBP characteristics in young normotensive volunteers not considering RF [22]. This affordable approach is particularly relevant for mass health examination of Russian students, because one recent international study [23] demonstrated more high values of cardio-ankle vascular index (CAVI) obtained using volume sphygmograph comparing with Japanese students of the same age. The authors consider that more prominent positive linkage between CAVI and age of students in Russia comparing with Japan can be explained with larger amount of RF influencing vascular wall. Taken altogether, these data prove the necessity of angiologic screening introduction considering main CVRF during mass health examination of students.

It is necessary to develop immediately the system of prophylactic interventions in organized groups of young people. The existing experience indicates that mass health examination of students differs significantly from the one of laboring population [5, 24]. for example, ECG registration is more reasonable to perform in older population comparing with BP monitoring and CBP and Aix measurement. At the same tame lipid and carbohydrate metabolism estimations has the same importance in both populations. It is also necessary to consider that some characteristics have age-related properties. Screening data are the basis for the distribution of students into three health groups that predetermine passing through particular diagnostic, therapeutical and preventive interventions [17, 25]. We organize several motivating and educating events aiming to form stable positive behavioral stereotypes among the students of all health groups in the Health Center of SSMU. To achieve success in this work it is important to reach effective interaction between different departments of the same university. We perform short preventive consulting about the basics of healthy lifestyle with every student of the first year during initial screening. Advanced personal consulting by the interdisciplinary specialists of the Center is provided anonymously and in the real mode on the base of network technologies and hot-line service (phone number is available on the web-page of the Center). Special classes for young people of risk groups that also use network technologies are organized on the base of Health School. Students and specialists of CSH that are involved in the creative process of health-preservation created the platform for mass health examination surveys according with the CMS

Lime Survey software (informational system of personalized examination) and with the help of CSH doctors they adapted electronic online-questionnaires that include questions about physical and mental health of respondents. We created a website of young followers of HLS. Students fill the questionnaires about HLS and make a test of their adaptation status before the start of classes at the School and after finishing academic year. This dynamic control of preventive interventions efficacy in the beginning and in the end of academic year proved the increased knowledge of CVRF self-control and improved psychophysiological health resources of the School participants. Positive dynamics was more evident in young females comparing with young males. This complex of interventions, that forms health-oriented environment in university, not only demonstrates good results on the stage of health-oriented consciousness formation but also helps to practice the skill of mass preventive health examination in medical students. This experience is undoubtedly useful for self-protection and future clinical practice of medical students.

Conclusions

Reasonableness of main CVRF screening in young people is proved with instrumental evaluation of CBP and its Aix. If these factors are present, occurrence of systemic AH/PH is 10 times as more. Latent form of isolated aortic BP elevation was registered only in RF carriers. And false AH/PH is registered almost in one out of twelve students independently from RF presence.

CVRF presence in normotensive students is associated with central pressure Aix elevation, and it is particularly evident in young females. Thus, in spite of the young age and short history of damaging factors presence, students have preclinical but enough distinct lesions of aortic wall, that is one of the most prognostically significant target organs.

It is necessary to introduce more actively the technique of CBP evaluation into the work of CSH in office format for early detection of vascular remodeling in mass preventive examination in order to make risk group formation more differentiated, to provide well-timed beginning of preventive interventions and objective control of their efficiency.

From organization point of view students' medical prophylaxis should be performed in close cooperation of CSH, deans, departments, educational and social work professionals, active students, mass media workers and other structures of university. Doctors

of CSH specializing in different clinical disciplines should be initiators and catalysts of such activity.

Conflict of interest: None declared

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