High Mean Blood Flow Velocity and the Level of Peripheral Resistance in the Common Carotid Artery in Young Women with Low Blood Pressure

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Abstract: Aim of this study was to evaluate an extracranial blood flow in young women with low blood pressure. Two groups of subjects reported in this study were selected from 1,264 women aged from 18 to 35 years: 69 women with low systolic blood pressure - SBP (61-99 mmHg) and 35 women with normal SBP (120-129 mmHg). SBP was measured and Doppler sonography study of the right common carotid artery was performed. The study revealed a higher mean blood flow velocity and the level of peripheral resistance in the common carotid artery in young women with low SBP (= 99 mmHg) when compared with normotonic women (SBP 120-129 mmHg). These signs should be considered as a compensatory mechanism that preserves an adequate blood flow of the brain only at a young age.

Key words: Low systolic blood pressure • Young women • Extracranial circulation

INTRODUCTION

Chronic low blood pressure (LBP) occurs in 7.2% of young women being a risk factor for cardiovascular complications in overall population, but it is still poorly understood problem [1, 2]. LBP in women is accompanied by an abundance of complaints, which are difficult to confirm in the study [3]. Cognitive complaints are revealed in 38% and headaches – in 56% of women with SBP less than 100 mmHg [4]. However, there are few studies of cerebral blood flow in women with LBP, while their results are contradictory.

The purpose of the study - evaluation of extracranial blood flow in young women with low blood pressure.

MATERIALS AND METHODS

Aim of the study - chronic hypotension. Subject of the study - extracranial circulation.

Type of the study – cross-sectional study. It was conducted during medical examination of university students before looking to access sporting activities. Site of the study was medical clinic. Time of medical examination - from 3 p.m. to 7 p.m. 1264 women aged 18 to 35 years were examined followed by randomization into 2 groups – test group (69 women with LBP) and control one (35 women with normal systolic blood pressure). The median age of women in the control group and the test was 19 years old. There was no significant difference between groups. LBP was defined as blood pressure within the range 61-99 mmHg [5-7]. Normal SBP was defined as blood pressure within the range of 120-129 mmHg [2].

Women with the following conditions were excluded from the study: dysplasia of connective tissue, cancer, diabetes mellitus, hypothyroidism, adrenal insufficiency, connective tissue diseases, congenital heart and blood vessels disease, heart surgery, any stage of pregnancy, drug abuse and acute infectious diseases at the time of the study. Exclusion from the study was done on the basis of analysis of medical records and interviews. The study protocol met the requirements of Declaration of Helsinki (1975) and its revised version (1983). Design of the study, its protocol and informed consent were approved by the Ethics Committee of the Vagner Perm State Medical Academy of the Ministry of Health of Russian Federation. The included women gave their written informed consents in order to participate in this study.
Table 1: Indicators of cerebral blood flow of the right CCA Young women test and control groups

<table>
<thead>
<tr>
<th>Options</th>
<th>Testgroup(N = 69)</th>
<th>Controlgroup(N = 35)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vps, cm/s</td>
<td>96.3 (87.6-99.0)</td>
<td>93.1 (92.7-98.9)</td>
<td>0.718</td>
</tr>
<tr>
<td>Vd, cm/s</td>
<td>22.7 (20.0-24.5)</td>
<td>23.2 (20.3-25.4)</td>
<td>0.073</td>
</tr>
<tr>
<td>V mean, cm/s</td>
<td>34.3 (29.7-34.3)</td>
<td>30.3 (26.6-32.7)</td>
<td>0.022</td>
</tr>
<tr>
<td>S/D</td>
<td>4.5 (4.2-4.5)</td>
<td>4.3 (4.0-4.5)</td>
<td>0.04</td>
</tr>
<tr>
<td>RI, U</td>
<td>0.79 (0.76-0.79)</td>
<td>0.75 (0.75-0.78)</td>
<td>0.001</td>
</tr>
<tr>
<td>PI, U</td>
<td>2.0 (1.9-2.0)</td>
<td>1.9 (1.9-2.0)</td>
<td>0.142</td>
</tr>
</tbody>
</table>

Blood pressure was measured after 5 min rest on the right shoulder in the sitting position, the forearm on the table. There were two measurements with an interval of 3 minutes. Tonometer used was A&D UA-777 (AGD Company Ltd. Japan, 2012). Mean value of the two measurements was calculated based on the obtained results. Ultrasound examination of the extracranial vessels was performed using Doppler ultrasound of the right common carotid artery (CCA), as symmetric extracranial vessels have the same first blood flow [8]. Logic 7 scanner (General Electric, USA, 2008) was used to perform Doppler ultrasound. The following indicators were studied: peak systolic blood flow velocity (Vps); end diastolic blood flow velocity (Vd); mean blood flow velocity (V mean); pulsatility index (PI); peripheral resistance index of the CCA (RI) and systolic-diastolic index of CCA (S/D) [9]. The last three indicators reflect the level of peripheral resistance.

Statistical analysis was performed using the software «Statistica 6.1» (serial number AXXR912E53722FA, StatSoft-Russia, 2009). Lilliefors H. criterion was used to estimate the data distribution (distribution considered normal at p <0.05). Mann-Whitney U-test was used in order to compare quantitative data of two independent groups [10].

**Main Part of the Study:** These results indicate that the extracranial blood flow in women with LBP are characterized by a considerably higher mean blood flow velocity and a high level of resistance in the peripheral CCA (Table 1). Peak systolic and end-diastolic blood flow velocity and pulsatility index did not differ between groups.

**CONCLUSION**

Reduction of cerebral hemodynamics was registered in most subjects of the study. Fonyakin A.V. *et al* studied extracranial and cerebral blood flow in 65 men and women aged from 18 to 60 years with LBP (BP 105-100/65-60 mmHg) [11]. In this report duplex scanning of the brachiocephalic, middle cerebral arteries in patients with LBP revealed a decrease in arterial inflow associated with compensatory decrease in vascular resistance in the carotid system. However such factors as age, sex and social status, level of education, nature and duration of their professional activities in these studies were not homogeneous.

Duschek S. and Schandry R. evaluated cerebral blood flow in 40 people with chronic LBP. On transcranial Doppler of both middle cerebral arteries the blood flow velocity was decreased in LBP patients compared to the group of healthy women with normal blood pressure [12]. Performing the Doppler of CCA Kalgin V.V. registered a decrease in blood flow velocity indices and reduction in the total peripheral resistance in 266 young people aged from 16-20 years in hypotonic group with an average systolic BP within the range of 87.5 ± 0.5 mmHg [13]. However blood flow in women and men was not analyzed and the total score was given to all members of the group being tested consisting of 20 men and 246 women.

Our findings contradict the above noted point of view on the decrease in extracerebral and cerebral blood flow. We studied heterogeneous groups of subjects with LBP different by sex and age. Our results can be regarded as new objective information about young women. We found confirmation of our results in the scientific works of I.Y Trinitatsky that registered an increase in an average blood flow velocity in CCA among 112 patients, increase in resistance index as well as systolic and diastolic index only in people under the age of 35 years [14]. The author didn’t study gender-specific characteristics of blood flow.

The study found an increase in the mean blood flow velocity and peripheral resistance in CCA regarded as an adaptive response to NAD in young women. We observe protective mechanism aimed at the compensation of cerebral hemodynamics and hypertension in the early stages of the disease when high vascular tone preserves brain function on the background of excess blood flow [15]. Perhaps a similar reaction during LBP is temporary being typical only for young women. Explanation of the increase in extracranial blood flow velocity, as a compensatory phenomenon in people with LBP, can be found in scientific works of Kérdő I. who showed that stimulation of sympathetic-adrenal system is accompanied by a reduction in blood pressure, increase in the heart rate and cerebral blood flow velocity, which can be often observed in young people [16]. Stimulation of the sympathetic system at LBP is associated with an activation of baroreflex due to hypoxia in all tissues and...
in particular in the brain tissues [17]. Confirmation of this opinion is shown in the study of Atayan A.S. who revealed 24-hour sympathetic activity and deficit of parasympathetic activity in 65 patients with LBP [18]. When examining 69 young women with LBP (SBP less than 99 mmHg), Baev V.M. also revealed signs of predomination of sympathetic activity [3].

Thus, we can say that the increase in the mean blood flow velocity and increase in peripheral resistance revealed during examination of CCA is a temporary compensatory element in maintaining of the optimal cerebral circulation in young women with LBP.

Summary: In young women with low SBP (≤ 99 mmHg) when compared to women with normal SBP (120-129 mmHg) we revealed a higher mean blood flow velocity and the level of peripheral resistance in the common carotid artery. These signs should be considered as a compensatory mechanism for the preservation of an adequate blood flow of the brain only at the young age.

REFERENCES
