

TYPOLICAL STRUCTURE OF HEMODYNAMICS IN AGE SCALE

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ABSTRACT — THE AIM OF THE STUDY was to clarify the features of adaptation of the cardiovascular system (by hemodynamic parameters) to the conditions of the earth's gravity in different periods of ontogenesis.

METHODS: The analysis was conducted for the number of age groups: up to 8 years (n=55), 9–14 years (n=68), 15–21 years (n=226), 22–35 years (n=326), 36–55 years for women and 36–60 years for men (n=658), up to 70 years (n=413) and over 70 years (n=198). The study of the cardiovascular system was carried out on the hardware and software complex "ANTHROPOS-CAVASCREEN" created by us on the basis of tetrapolar thoracic and regional rheography. Three orthostatic types of hemodynamics (hypokinetic, eukinetic and hyperkinetic) are determined by the ratio of minute blood volume standing/lying.

RESULTS: The age limit of transition to the increase in the severity of hyperkinetic organization of blood circulation (corresponding to the orthostatic type III of hemodynamics) is the first reproductive age (22–35 years). The age dynamics of the typological structure indicates that the orthostatic type of hemodynamics is a dynamic characteristic of the organization of blood circulation and it must be taken into account when assessing the circulatory state of the cardiovascular system.

KEYWORDS — age, hemodynamics, orthostatic type.

INTRODUCTION

In clinical practice, diagnostic studies of the cardiovascular system are carried out in the supine position, that is realizing in conditions of minimal manifestation of the gravitational effect on blood circulation [2, 3]. It can dramatically affect the reference values of the studied parameters [3]. At the same time, there are practically no standards and diagnostic approaches that take into account the typical human circadian rhythm of the natural positions of the body and the characteristic of blood circulation by the gravitational (hydrostatic) factor (orthostatic type of hemodynamics).

Interaction with the earth's gravity is a permanent factor of the environment, which has a systemic

gravitational effect on blood circulation. It manifests itself in a characteristic human stage adaptation to the conditions of upright walking throughout post-natal ontogenesis [1–3]. Accordingly, the relevant parameters for a person are standing and lying down, as well as their ratio *standing / lying* in the systemic characteristics of the functional state of the person by the main hemodynamic mechanisms. This creates the prerequisites for clarifying the features of adaptation of the cardiovascular system (by hemodynamic parameters) to the conditions of the earth's gravity in different periods of ontogenesis, which was the aim of the work.

METHODS

The analysis of the data on circulatory state of the cardiovascular system was carried out by age samples, which were formed in accordance with the proposed classification of the stages of ontogenetic adaptation to Earth gravity (*anthropogenetic model*) in the process of formation and activity in the human-specific conditions of walking. The analysis was conducted for the following age samples (total for men and women): up to 8 years (n=55), 9–14 years (n=68), 15–21 years (n=226), 22–35 years (n=326), 36–55 years for women and 36–60 years for men (n=658), up to 70 years (n=413) and over 70 years (n=198). The study of the cardiovascular system was carried out on the hardware-software complex "ANTHROPOS-CAVASCREEN" created by us on the basis of tetrapolar thoracic and regional rheography [1]. A complex of hemodynamic parameters for central and peripheral blood circulation in standing and lying positions was recorded. To do this, the following *orthostatic types of hemodynamics* are determined by the ratio of minute blood volume standing/lying:

– **Type I, or hypokinetic state**, with a decrease in cardiac output in the standing position compared to the lying position (less than 94%). it is considered the best option ;

– **Type II, or eukinetic state**, the magnitude of cardiac output lying and standing is not different (94–106%);

– **Type III, or hyperkinetic state**, in which the cardiac output in the standing position increases (more than 106%) compared to the lying position.

Calculations were performed by specially designed software on the basis of a statistical software package Microsoft Excel 2010.

RESULTS

We have considered the age representation of orthostatic types of hemodynamics. The dynamics of the typological structure of the organization of blood circulation was determined by the ratio of minute blood volume in standing/lying positions (Fig. 1).

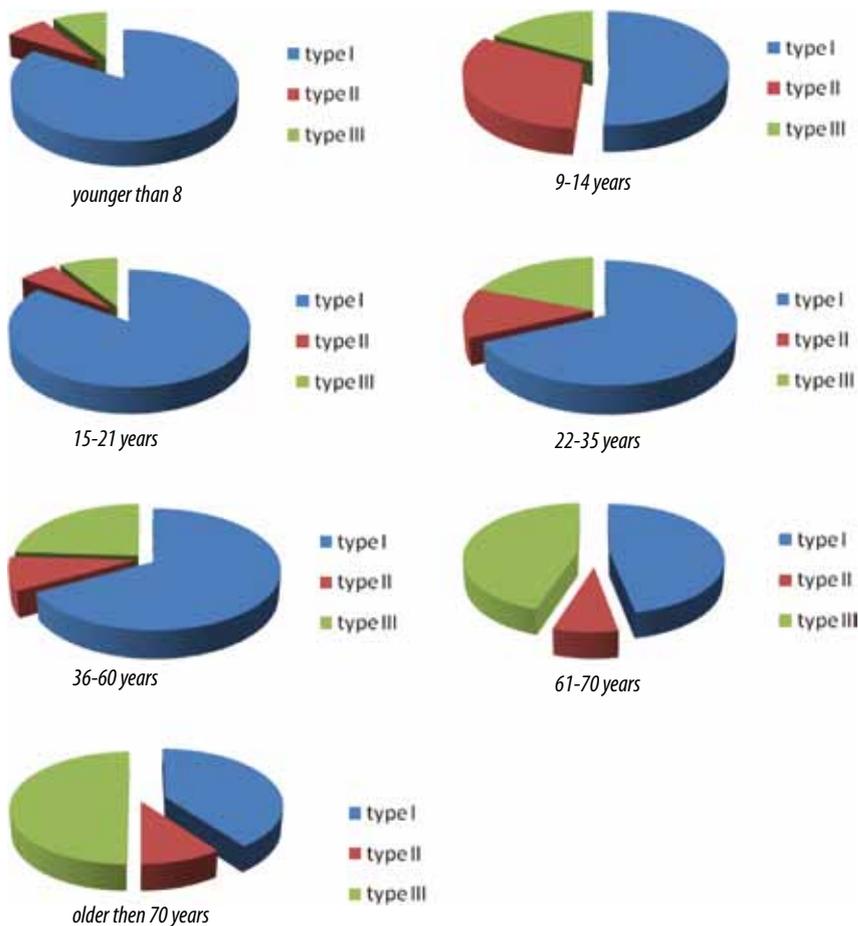


Fig. 1. Typological structure of hemodynamics state in different age groups

It was found that in children under 8 years the structure of orthostatic types of blood circulation is mainly present by I type (84%, $p < 0.05$), or hypokinetic state. The instability of the typological structure of hemodynamics in adolescents compared to younger children was noted as they grew up (in the puberty period). A significant increase in the representation of type II (eukinetic) of hemodynamics in comparison with children up to 8 years was determined (up to 32%; $p < 0.05$). Also, the proportion of persons with type I of hemodynamics (from 84% to 51%) significantly decreases ($p < 0.05$), whereas type III showed almost double growth (9% to 17%). At the same time, the proportion of people classified by type I remains prevalent compared to type II ($p < 0.05$) and, especially, with type III ($p < 0.01$). The state of hemodynamics in children aged 9–14 years can be assessed as a transitional nature of the dynam-

ics of the typological organization of blood circulation, where there was no significant predominance of any type in the sample.

At the end of the growth (15–21 years) and physical maturity (22–35 years old and 36–60) of the typological organization of the blood circulation is getting stable. At these age stages, the share of type I reaches 85%, 68% and 67%, respectively, significantly different from the representation of this type in younger people (9–14 years; $p < 0.01$). In the older age groups (60–70 years and older than 70 years), the proportion of type I decreases to 47% and 40%, along with a parallel increase in the proportion of persons with type III to 45–50%, which is considered as a manifestation of the non-optimality of the typological structure of blood circulation. It should be noted that, unlike the sample of adolescents (9–14 years) with a transitional typological structure of the organization of blood circulation, there were no significant differences between the representation of I (40–47%) and III (45–50%) types at the postdefinitive stage (older than 60 years). However, here is a significant ($P < 0.01$) increase in the proportion of type III compared with the first (22–35 years) and second (up to 60 years) reproductive age.

CONCLUSION

The age limit of transition to the increase in the severity of hyperkinetic organization of blood circulation (corresponding to the orthostatic type III of hemodynamics) is the first reproductive age (22–35 years). The age

dynamics of the typological structure indicates that the orthostatic type of hemodynamics is a dynamic characteristic of the organization of blood circulation and it must be taken into account when assessing the circulatory state of the cardiovascular system.

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