6th Ya.B. Lopatynsky International School-Workshop on Differential Equations and Applications

June 18-20, 2019
Vinnytsia, Ukraine

Book of Abstracts

Ministry of Education and Science of Ukraine
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Institute of Mathematics of the National Academy of Sciences of Ukraine
Institute of Applied Mathematics and Mechanics
of the National Academy of Sciences of Ukraine

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Accepted by the Academic Council of the Vasyl' Stus Donetsk National University, minutes N 11, 29.05.2019.

Supported by grant of Ministry of Education and Science of Ukraine, project number is 0118U003138.

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Mechanics of blood flow in the aorta

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The blood movement in vessels in terms of hydrodynamics is considered ([1], [2]).

We study the law of changes in blood pressure $p(t)$ in the human aorta during the complete cardiac cycle ([3]). It is shown that under some assumptions the pressure change is described by the equation

$$\frac{\partial p}{\partial t} = \frac{1}{k}\left[Q(t) - \frac{p(t)}{\omega}\right], \tag{1}$$

where $k > 0$ – aortic wall elasticity, $\omega > 0$ – hydraulic resistance of the microvascular system, $Q(t)$ – volumetric rate of blood flow from the heart to the aorta. We obtained explicit solutions of (1) in the following cases:

a) with parabolic change of $Q(t)$ in the systolic phase;

b) with $Q(t) \equiv 0$ in the diastolic phase.

We established that growth of the hydraulic resistance ω or growth of the elasticity k leads to the blood's pressure increasing in the aorta after closing of the aortic valve. In particular, the pressure is increasing at the end of the diastolic phase.

It was found that growth of the hydraulic resistance ω or growth of the elasticity k means the velocity decreasing of blood pressure in the aorta in diastolic phase.

The pulse wave propagation process was also studied. We have a condition of the pulse wave propagation without reflection. A normal functioning of the human circulatory system is difficult without this condition. In particular, an aneurysm can develop ([4]).

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Scientific edition

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Editors:

Kateryna Buryachenko
Maria Shan
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Віддруковано з оригіналів замовника.
ТОВ «ТВОРИ».
Свідоцтво про внесення суб'єкта видавничої справи до
Державного реєстру видавців, виготовлювачів і розповсюджувачів
видавничої продукції серія ДК № 6188 від 18.05.2018 р.
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