

1111. Research of pathology degree and kind influence on the stress in damaged blood vessels areas

M. Mariūnas¹, Z. Kuzborska², A. Šešok³

Vilnius Gediminas Technical University, Department of Biomechanics, Vilnius, Lithuania

¹Corresponding author

E-mail: ¹mariunas@vgtu.lt, ²zyta.kuzborska@vgtu.lt, ³andezela.sesok@vgtu.lt

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Abstract. The aim of the work is to determine of the complex influence of pathology degree and type as well as blood flow turbulence on blood pressure and stress patterns and values in the pathology blood vessels and to find out of the most dangerous pathology cases. Atherosclerosis with single symmetric plated stenosis, symmetric double plated and asymmetric plated stenosis and aneurysm influence on the blood pressure, stresses and flow rate in the pathologic blood vessels were analyzed. Some blood vessels pathological contact points were obtained by ultrasonic double-scanning duplex method. The calculations show us that blood flow rate in damaged blood vessel areas depending on blood pressure could be 3.4 times bigger than in healthy blood vessels and stresses depending on the pathology type – up to 6.8 times bigger. The most dangerous pathology is double symmetric stenosis case. Turbulent blood flow increases blood pressure and stresses in pathology area up to 1.8 times, as compared to laminar flow. It was found out that blood vessel damage degree has the biggest influence on local blood pressure and stresses.

Keywords: pathology degree and kind, damaged blood vessels, turbulence, local blood pressure and stresses, blood flow velocity.

1. Introduction

Many people in the world die of cardiovascular dysfunction: atherosclerosis, aneurysms, arterial deflections and other irregularities. Such irregularities change blood vessel radius, wall thickness, strength properties and other parameters [1, 2, 3, 4]. Depending on formed damage degree and type, blood flow rate, blood pressure and stresses in damaged blood vessels areas are significantly increased and changes of blood flow patterns appear. Such changes affect blood vessel wall and cause critical stresses in damaged blood vessel areas that can cause blood vessels splits [5, 6]. Most of blood pressure and stresses research results are fragmentary because of a lack of: 1) an analysis of the complex influence of the pathology degree and kind on the distribution of stresses and pressure along the length of a blood vessel; 2) a comparative analysis of the influence of pathology of different degrees and kinds in damaged blood vessels and blood flow turbulence on blood pressure and stresses in pathology area [7, 8, 9, 3].

Many scientists use different diagnostic experimental ways, such as ultrasonic double-scanning duplex method, to determine vascular pathologies and some studies have been carried out by invasive method [10, 11]. On measuring blood pressure, general increase in blood pressure is set; however, it is difficult to determine blood pressure in damaged blood vessels areas, because it is local blood pressure and its value could vary even few times from total pressure [12, 13]. Using experimental measurement of blood pressure, only for certain patients with certain pathology, mentioned above blood pressure could be set, but to determine pressure, blood vessels walls tensions dependence on the size of pathology it is practically impossible. Besides, experimental diagnostic researches need sophisticated equipment [10, 11]. There are inaccuracies while determining experimental values. However, there are digital methods which allow to model these processes varying degrees of pathology in a wide range [14, 15, 16], and to obtain sufficiently accurate results. These digital methods could append obtained experimental results and let have much more detailed information about blood flow velocity variations, blood pressure and tensions in the damaged blood vessels areas.

Using numerical methods, we could wider evaluate the complex influence on blood flow