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Numerical Simulation for the Impact of Various Abdominal Aortic Aneurysms Models

Taewon Seo[1], Sun-Young Choi[2]
[1]College of Engineering, Andong National University
1375 Kyungdongro, Andong, Korea
dongjin@anu.ac.kr
[2]School of Medicine, Ewha Womans University
1071 Anyangchunro, Yangchungu, Seoul, Korea
medmath@hanmail.net

Extended Abstract

Abdominal Aortic Aneurysm (AAA) is a disease with a balloon-shaped dilation of blood vessels occurring in the abdominal aorta. It has been known that the prevalence of AAA occurred about 6~8% in men over the age of 65. AAA usually occurs in the infrarenal abdominal aorta [1]. If blood vessels expand abnormally 3 times or more than normal abdominal aortic diameter, the risk of rupture of blood vessel will be increased [2].

The main purposes of the study are to investigate the impact of the risk factors of the abdominal aortic aneurysmal geometric models such as aneurysm size, asymmetry, and neck angle in the aorta proximal the aneurysm bulge using the computational fluid dynamics (CFD). Changes in the blood vessel shape due to AAA not only make alteration of the flow characteristic patterns but also will be varied with hemodynamic stresses acting on the vascular wall [3, 4]. Aneurysmal expansion and the risk of rupture are dependent on the hemodynamic stresses acting on the vessel wall and mechanical stresses. Therefore, it is important to examine the morphological changes of blood flow for the variation in the aneurysm shapes.

The parametric study in AAA models is carried out examining effects of the possible risk factors of rupture. The CFD simulations are conducted to analyse the impact of the geometrical shapes such as aneurysm size, asymmetry, and neck angle in the aorta proximal the aneurysm bulge as well as bifurcation angle into the iliac artery. Furthermore, the numerical simulation is performed to understand the impact of the Non-Newtonian effects.

The hemodynamic phenomena in AAA vessels are shown by comparing how different compared to the healthy artery. It is found that the neck angle has significant impact on the blood flow patterns and wall shear stress distribution on the surface of AAA. It is also found that the blood flow field in the aorta upstream of the aneurysm is strongly dependent on the AAA geometrical shape. The results show the peak shear stress and the peak pressure within the aneurysm as a function of neck angle, aneurysm size, and asymmetry, respectively. The results of this study provide useful parametric information for the additional diagnostic tool to help clinicians.

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