혈관내치료 스텐트그라프트 배치에 따른 유동특성 변화

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Flow characteristics comparison with variation of SG configurations for Endovascular Aneurysm Repair (EVAR)

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Abstract : In this study, three idealized geometries of stent graft (SG) configurations for endovascular aneurysm repair (EVAR) had been employed and the hemodynamic flow characteristics of conventional and cross-limb EVAR techniques were investigated numerically. As a result, the helical flow is generated in a cross-limb SG configuration making it sustainable for higher wall shear stresses.

1. Introduction

Cardiovascular diseases (CVDs) include various types of pathologies such as thrombus, stenosis, infarction, and aneurysms[1]. Aortic aneurysms are among leading causes of deaths in the US[2]. Endovascular aneurysm repair (EVAR) has been a topic of utmost importance since Juan Parodi introduced it in 1990. Cross-limb EVAR has been studied by many researchers[3,4], however, the anatomical configurations change patient to patient.

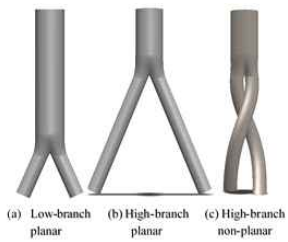

Fig. 1. SG configurations for EVAR

Hence, a comparison of conventional and cross-limb EVAR is investigated in this study and fluid flow hemodynamics have been observed in three ideally constructed SG configurations.

2. Results and Discussion

In the present study, three ideally designed three-dimensional SG configurations; namely low-branch planar, high-branch planar and high-branch non-planar have been utilized (Fig 1). The k-ω turbulence model with Reynolds Averaged Navier-Stokes equations is used along with the non-Newtonian Careau viscosity model. A computational fluid dynamics study has been employed to observe and compare the fluid flow characteristics and wall shear stresses of the three SG configurations.

The results show that the helical flow is generated in the cross-limb SG configuration making it sustainable for higher wall shear stresses when compared to other SG planar configurations. Fig 2 shows the contour plots of helical flow being generated in non-planar configuration. However, in the long-term, fatigue induced by high displacement forces renders it more prone to fatigue-induced-failure.

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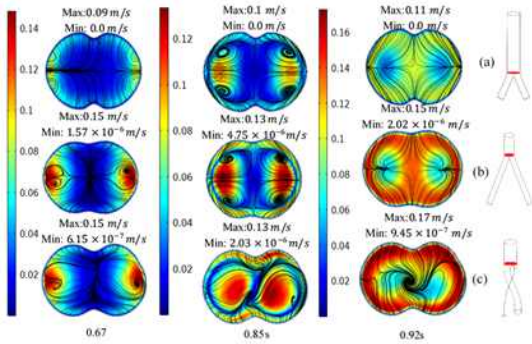

Fig. 2 velocity and streamline contours of three SG configurations at different time instances.

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