ANALYSIS OF HAEMODYNAMICS IN ABDOMINAL AORTIC ANEURYSM (AAA) WITH FENESTRATED ANACONDA DEVICE

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Introduction

AAA is an abnormal and irreversible fusiform dilation of the terminal aorta, which can rupture, if left untreated. The treatment options include highly invasive open surgical repair or minimally invasive Endovascular Aneurysm Repair (EVAR). Despite being minimally invasive, EVAR is not suitable for some patients due to unfavourable AAA morphology. Fenestrated Stent Graft (FSG) was designed to address these limitations. The aim of this study is to evaluate the longitudinal drag force acting on the FSG by numerically computing the flow, pressure and stress fields in pre and post grafted AAA. This quantitative analysis will help to predict the risk of future complications such as endoleaks and migration.

Methods

Geometry: As shown in Fig. 1, 3D models of pre and post stented AAA were reconstructed from CT scans using Mimics.

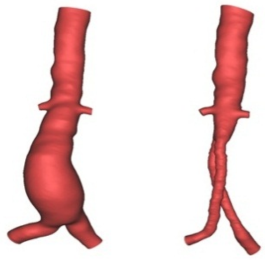

Figure 1: Pre and post stented AAA models reconstructed from CT scans.

Flow model and assumptions: The Navier-Stokes equations were used to describe the 3D, pulsatile blood flow in the lumen. Blood was assumed to be non-Newtonian, described by the Quemada model, the vessel wall and FSG were assumed to be rigid.

Boundary conditions: Physiologically realistic velocity and pressure waveforms were adopted and described using Fourier series [Taylor *et al*, 1998]. Velocity profiles, derived from the Womersley solution were imposed at the inlet, while volumetric flow rate and pressure waveforms were applied at the renal and iliac arteries respectively. No slip conditions were also specified at the wall. Numerical solutions were obtained by using ANSYS CFX.

Results

In pre-grafted AAA, there was a large recirculation zone in the sac as blood decelerates during transition from systole to diastole. However in post-grafted AAA, more organised flow was observed over the whole cardiac cycle. The longitudinal drag force acting on the FSG is shown in Fig. 2.

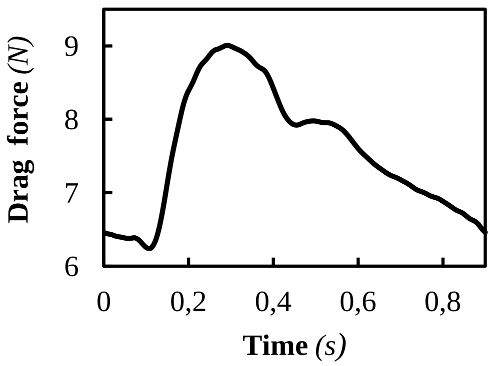

Figure 2: Longitudinal drag force acting on the FSG over one cardiac cycle.

Discussion

The longitudinal drag force acting on the FSG varied between 6.2N and 9N during a cardiac cycle. FSG placement also significantly reduced the sac pressure. Research is on-going to evaluate the drag force acting on the FSG for AAAs with different morphological features, e.g. angulated neck and/or angulated iliac bifurcations.

Acknowledgements

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References

Taylor *et al*, Annals of Biomedical Engineering, 26:975-987, 1998.