

Particle Image Velocimetry measurements in an abdominal aortic aneurysm model

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Abdominal aortic aneurysm (AAA) is an abnormal dilatation of the aortic wall which if left untreated may rupture. Although numerous experimental flow studies have been conducted in idealised AAA models [1], only few investigations in realistic AAA geometries are available [2]. Particle Image Velocimetry (PIV) was employed for the measurement of the flow field that develops inside a realistic model of an AAA. The detailed 3D AAA geometry was extracted from a patient *in vivo* with contrast enhanced spiral Computed Tomography (CT) angiography. The acquired CT images were

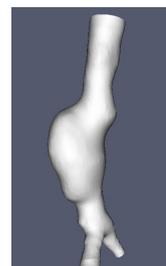


Fig.1: Replicate prototype of AAA

segmented and the 3D AAA surface was reconstructed (Fig.1) [3]. A 1:1 replicate prototype of the AAA was then manufactured by a rapid prototyping machine (3D printer). The manufactured transparent model includes the abdominal aorta bifurcation with a stenosis in the right common iliac artery. Velocity information was obtained with the aid of a PIV system (Oxford Lasers).

In this study unsteady flow inlet conditions were applied and velocity vectors were extracted from several planes in order to acquire a more integrated view of the flow regime. Further study has been conducted upon the variation of the flow rate ratio between the two branches of the AAA bifurcation. The following three cases were examined: (i) zero flow rate in the right common iliac artery (Fig.2a), (ii) zero flow rate in the left common iliac artery (Fig.2b) and (iii) flow in both branches (Fig.2c). The investigation of these cases revealed that flow patterns are significantly affected by the flow rate ratio during the cycle.

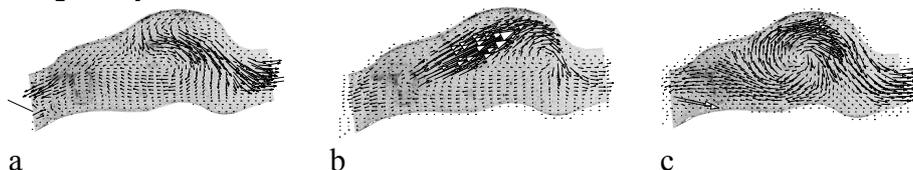


Fig.2 Measured intra-aneurysmal flow patterns with: zero flow rate in the right C. Iliac artery (a), zero flow rate in the left C. Iliac artery (b), flow in both branches (c)

[1] V. Deplano et al. (2007), *J. Biomech*, **40**, 11, 2406-2413

[2] S. K. Kim et al. (2007), 7th International Symposium PIV, Rome.

[3] S. Giordana et al. (2005), *J. Biomech.*, **38**, pp. 47-62.