**Introduction**

Large abdominal aortic aneurysm (AAA) diameter (>5.5 cm) and rapid growth (>1 cm/year) are currently used as the only parameters to determine the need for surgical intervention. However, they have been proven inadequate as some “small” AAAs do rupture while some “large” AAA remain intact. Peak wall stress (PWS) has been shown to be a better indicator of a high risk profile than AAA size alone [Fillinger, 2003]. Since wall stress estimation can be time consuming and not always practical for clinical use, several AAA geometric markers have been associated with PWS values to allow its indirect estimation. Among these, intraluminal thrombus (ILT) [Georgakarakos, 2009] has been shown to reduce wall stress. In the current study, we hypothesized that a non-uniform deposition of ILT during the course of AAA evolution may redistribute wall stress increasing mean stress at regions with low ILT thickness.

**Methods**

Two AAAs (Cases 1 and 2) with an initial (A) and a follow-up (B) examination were studied. CT image based 3D patient-specific AAA models were reconstructed including aortic wall and lumen surface with the interim space representing ILT. From each AAA model, cross-sections normal to the centreline were obtained. The non-uniform circumferential deposition of ILT was calculated as the ratio of minimum over maximum distance between the centreline of the lumen and the wall boundary at the cross-section of maximum diameter and was defined as Eccentricity Index.

For the wall stress analysis, a 3D mesh was generated using ANSYS ICEM CFD, and an in house developed FEA solver, based on the C++ libMesh library, was used. For the wall and ILT, neo-Hookean hyperelastic material models were adopted. The PWS (based on the von Misses criterion) was recorded. Surfaces of AAA models were patched by dividing them topologically in small rectangular subsets. Average ILT thickness and wall stress for each patch was calculated. To detect effects of ILT non-uniformity on wall stress distribution, the mean stress of the wall surface patches that enclosed the section of maximum AAA diameter was examined. Specifically, the mean stress of the patch with minimum ILT thickness was compared to that with maximum ILT thickness and their quotient was defined as StressRatio.

**Results**

In Case 1, the ILT circumferential distribution was relatively uniform with an Eccentricity Index of 0.88 for 1A and 0.90 for 1B. Wall stress distribution was also uniform for both initial and follow up examination with a Stress Ratio of 1.10 and 0.98 respectively. The PWS reduced from 11 to 6.2 N/cm². Case 2 had a non-uniform ILT deposition over time with an Eccentricity Index of 0.71 for 2A and 0.44 for 2B. Although PWS increased only slightly (from 10 to 11.7 N/cm²), there was a marked redistribution of wall stress with mean stress increasing at the posterior and decreasing at the anterior. This change was represented by an increase of StressRatio from 1.8 in 2A to 10.38 in 2B.

**Discussion**

A significant amount of ILT is present in AAAs and its deposition is usually eccentric [Hans, 2005]. Changes in ILT non-uniform distribution over time, even when not significantly affecting PWS, may lead to non-uniform re-distribution of stress negatively affecting regions of reduced ILT thickness. This information may have implications in AAA rupture risk and provide easily measurable indices for rupture risk assessment.

The authors gratefully acknowledge funding by the ESF-GSRT AAA Risk Assessment Project [LS7 (2224)].

**References**