Profiling post-EVAR morphometry and hemodynamics through image-based computational analysis: comparison among endovascular devices

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Anastasios Raptis[1], Paola Tasso[2], Michalis Xenos[3, 1], Maurizio Lodi Rizzini[2], Diego Gallo[2], Umberto Morbiducci[2], Miltiadis Matsagkas[1, 4]

[1]*Institute of Vascular Diseases, Laboratory for Vascular Simulations, Ioannina, Greece*
[2]*Department of Mechanical and Aerospace Engineering, Politecnico di Torino, Torino, Italy*
[3]*Department of Mathematics, University of Ioannina, Ioannina, Greece*
[4]*Department of Vascular Surgery, Medical School, University of Thessalia, Larissa, Greece*

Abstract

Background. Endovascular aneurysm repair (EVAR) results in redirection of blood through the deployed endograft (EG). The possibility of an adverse post-EVAR event leading to reintervention or even to a fatal scenario, is real. Our objective was to identify possible unique post-implantation morphological and hemodynamic EG characteristics.

Methods. We reconstructed the pre- and post-EVAR CT scans of AAA subjects treated either with Endurant or Excluder EGs (N=10 per EG). Hemodynamic descriptors such as time- and surface-averaged wall shear-stress (TAWSS, AWSS), along with helicity-based indexes, are quantitatively assessed and compared with the hemodynamics in healthy vascular models (N=10). A complementary centerline-based geometrical analysis of the post-EVAR infrarenal vascular region, was carried out.

Results. Regarding hemodynamics, regions with higher TAWSS are larger in Excluder and healthy subjects than in Endurant subjects. Patients treated with Endurant presented the lowest AWSS, while the highest value is found for Excluder patients. Regarding morphometry, treated subjects present a higher number of torsion peak values than healthy subjects, located close to the bifurcation in Excluder group, and in the limbs in Endurant group. As an average, patients treated with Endurant presented the highest values of curvature and torsion in the limbs.

Conclusion. The findings indicate that the clinically observed propensity to thrombogenicity in EG devices can be explained in terms of local hemodynamics while reportedly pro-thrombotic hemodynamic structures correlate with the postoperative aortoiliac geometry. In perspective, our study suggests that future clinical follow-up studies could incorporate geometrical analyses, monitoring shape variations that can cause clinically significant hemodynamic disturbances.