Numerical analysis with FEM to improve the planning of Transcatheter Aortic Valve Replacement

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This research arises from a collaboration between the Applied Mathematics II department (DMA-II) of the University of Vigo and the Health Research Institute Galicia Sur (IISGS) with the scope of contributing to the field of cardiology with advanced techniques of numerical simulation in a relatively new procedure called Transcatheter Aortic Valve Replacement (TAVR). The planning of this intervention faces several difficulties such as optimal device selection [1] where numerical simulation is playing an increasingly important role [2]. Consequently, several TAVR devices are designed and patient-specific 3D reconstruction is obtained by processing CT scan images. Those geometries are processed to create a finite element mesh valid for numerical simulation where a solid mechanics problem involving a contact problem is configured. The deployment process of different valves is simulated for the patient and insightful information such as haemodynamics of the left coronary artery [3] or induced tension after the procedure [4] can be computed. Therefore, the inclusion of numerical simulation in the clinical pipeline of TAVR is a powerful tool which can increase the amount of information considered when decision making. Further validations need to be done to apply this methodology in a great scale. A position paper from the ISO Working Group regarding this issue was recently published [5]. This research has lead also to the development of Marcos Loureiro-Ga doctoral thesis, funded by Xunta de Galicia.

Keywords: finite elemet method, solid mechanics, contact problem, aortic stenosis, trasncatheter aortic valve replacement

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