

# Virtual endograft deployment in the thoracic aorta as predictor of TEVAR migration.

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## Abstract

Thoracic Endovascular Aortic Repair (TEVAR) is a consolidated procedure to treat thoracic aortic diseases such as aneurysms and dissections. The procedure is performed through a catheter-guided deployment of one or more stentgrafts, which are metallic tubular structures covered by a polymeric skirt. Complications after TEVAR are related both to the sub-optimal apposition of the device to the aortic wall [1] and to post-operative haemodynamics resulting in endoleaks, migration or collapse of the stent-graft and development of a false aneurysm [2]. Such clinical complications are linked to the mutual interactions between the aortic wall, the stentgraft, and the haemodynamics, which are unfortunately not yet taken into account during the pre-operative planning. Motivated by these considerations, we will present a computational framework which is able to predict the post-TEVAR haemodynamics by combining medical image analysis, structural finite element analysis (FEA) and Computational Fluid Dynamics (CFD). The motivation for this approach is a first finding on a subset of four patients from our iCardioCloud database treated for thoracic saccular disease (Figure 1). When drag force (DF) was calculated in the stented region, only the one with the highest covered area and DF presented stent migration in a 1 year follow up. In our proposed framework, we tackle the three main steps: realistic simulation of the stent-graft deployment by structural FEA, creation of a CFD-suitable domain based on FEA outcomes based on image distance and CFD analysis to compute post-TEVAR haemodynamics. Although such a framework is designed to be general, allowing to predict the implant of a given prothesis in a given position for a given patient, the present study proposes the analysis of a real clinical case, which allows us to compare the simulation and the post-operative reality to validate our approach.

## References

- [1] van Bogerijen, G. H., Auricchio, F., Conti, M., Lefieux, A., Reali, A., Veneziani, A., ... & Trimarchi, S. (2014). Aortic hemodynamics after thoracic endovascular aortic repair, with particular attention to the bird-beak configuration. *Journal of Endovascular Therapy*, 21(6), 791-80

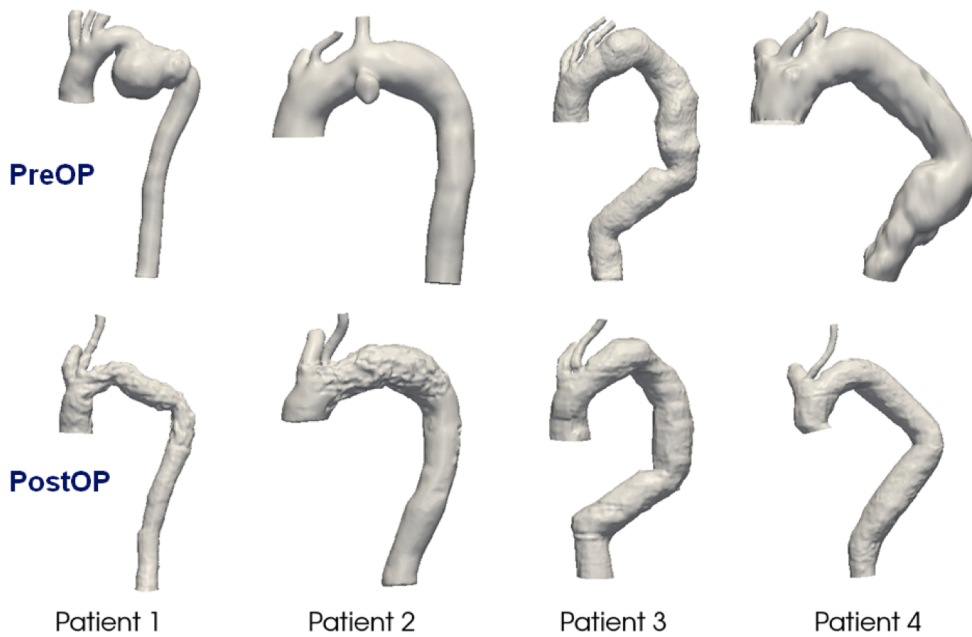


Figure 1: Four patients from the iCardioCloud database with thoracic aortic aneurysms.

- [2] Grabenwoger, M., Alfonso, F., Bachet, J., Bonser, R., Czerny, M., Eggebrecht, H., ... & Nienaber, C. A. (2012). Thoracic Endovascular Aortic Repair (TEVAR) for the treatment of aortic diseases: a position statement from the European Association for Cardio-Thoracic Surgery (EACTS) and the European Society of Cardiology (ESC), in collaboration with the European Association of Percutaneous Cardiovascular Interventions (EAPCI). *European Journal of Cardio-Thoracic Surgery*, ezs107