Patient-Specific Biomechanics of Thoracic Endovascular Aortic Repair

Master 2 internship proposal

PRINCIPAL INVESTIGATOR:
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CO-INVESTIGATOR:
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CONTEXT:
Thoracic endovascular aortic repair (TEVAR) has become the gold standard treatment for the principal pathologies of the descending thoracic aorta including aneurysms, aortic dissections, and blunt trauma. TEVAR involves the endovascular deployment of an endoprosthesis within the descending thoracic aorta. However, recent studies suggest that the presence of the endoprosthesis might alter aortic biomechanics, heart function, and ventricular-arterial coupling. To date, the data confirming these findings remain very sparse. Therefore, there is a clear need for improved understanding of the impact of TEVAR on aortic biomechanics, most notably aortic blood flow patterns and resulting stresses in the arterial wall. Four-dimensional flow magnetic resonance imaging (4D MRI) is a fairly recent flow imaging modality that allows high resolution in vivo imaging of the three-dimensional flow field in blood vessels over time. In collaboration with vascular surgeons at Marie-Lannelongue Hospital, we have recently initiated a 4D-MRI clinical study that aims to establish the effect of TEVAR on aortic flow fields. Several imaging software packages are used to visualize flow data from 4D-MRI; however, these packages are limited in terms of secondary flow quantification (vortices, helicities, recirculation), which appear to be a key component of TEVAR's adverse effects. A recent pipeline for 4D-MRI flow analysis has been developed by a lab at Stanford University. This pipeline, initially developed for pulmonary artery's flow assessment, can be similarly adapted for aortic flow analysis.

INTERNSHIP GOAL:
The aim of this internship research project is to develop a semi-automated pipeline for 4D-MRI aortic flow analysis that will enable a unique quantification of aortic flow fields before and after TEVAR.

REQUIRED SKILLS:
An intermediate to advanced level in Python coding will be required to process the different steps of the targeted published pipeline.

MANAGEMENT AND SUPPORT:
The trainee will work closely with Alexandra Hauguel, vascular surgeon and PhD student at LadHyX (E4H medical fellow) who will provide strong medical and scientific support. LadHyX's engineering environment will also provide high expertise in cardiovascular fluid mechanics. Attendance of vascular surgery procedures at Hôpital Marie Lannelongue can also be arranged if interested.

HOW TO APPLY?
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