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NUMERICAL MODELING OF ASCENDING AORTA ANEURYSMS: A SYSTEMATIC REVIEW ON COMPUTATIONAL APPROACHES AND CHALLENGES TOWARDS THE CLINICAL PRACTICES

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Summary: Ascending Thoracic Aortic Aneurysms (ATAA) are one of the most common causes of mortality in developed countries. According to the European and American Guidelines for ATAA, the surgical indication is supported by the maximum diameter criterion. However, there are several reported cases of acute complications in patients with normal aortic diameters. A hypothesis can be formulated proposing a digital twin representation of aneurysms to provide a suitable platform to support clinical guidelines. This patient-specific digital platform should be built on advanced computational tools and assisted by medical-imaging data. This article presents a review, following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) methodology, concerning computational modelling of ascending aorta aneurysms enhancing challenges towards the clinical practices. The election process was performed by analyzing both title and abstract and only articles that developed biomechanical based computational models on healthy and diseased aortas were selected. A comprehensive research was performed on two databases. An analysis was developed to synthesise and uniformise the data extraction process. Contemporary evidence proves that computational models are able to provide clinicians with additional hemodynamic and mechanical data such as Wall Shear Stress (WSS) and vessel wall properties. These approaches have the potential to identify ATAA patients that despite presenting normal aortic diameter may benefit from earlier treatment. Nevertheless, these tools are not widely implemented in clinical practices primarily due to high uncertainty on the numerical results, difficulties in reproducibility on patient-specific applications, high computational effort and the lack of randomized controlled trials to assess the efficacy of computational models.