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Quantifying Turbulent Kinetic Energy in an Aortic Coarctation with Large Eddy Simulation and Magnetic Resonance Imaging JONAS LANTZ, Department of Management and Engineering, Linkoping University, TINO EBBERS, Department of Medical and Health Sciences, Linkoping University, MATTS KARLSSON, Department of Management and Engineering, Linkoping University — In this study, turbulent kinetic energy (TKE) in an aortic coarctation was studied using both a numerical technique (large eddy simulation, LES) and in vivo measurements using magnetic resonance imaging (MRI). High levels of TKE are undesirable, as kinetic energy is extracted from the mean flow to feed the turbulent fluctuations. The patient underwent surgery to widen the coarctation, and the flow before and after surgery was computed and compared to MRI measurements. The resolution of the MRI was about 7x7 voxels in axial cross-section while 50x50 mesh cells with increased resolution near the walls was used in the LES simulation. In general, the numerical simulations and MRI measurements showed that the aortic arch had no or very low levels of TKE, while elevated values were found downstream the coarctation. It was also found that TKE levels after surgery were lowered, indicating that the diameter of the constriction was increased enough to decrease turbulence effects. In conclusion, both the numerical simulation and MRI measurements gave very similar results, thereby validating the simulations and suggesting that MRI measured TKE can be used as an initial estimation in clinical practice, while LES results can be used for detailed quantification and further research of aortic flows.

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