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Large Eddy Simulation of turbulent-like flow in intracranial aneurysms MUHAMMAD OWAIS KHAN, CHRISTOPHE CHNAFA, DAVID A. STEINMAN, University of Toronto, SIMON MENDEZ, FRANCK NICOUD, IMAG, University of Montpellier — Hemodynamic forces are thought to contribute to pathogenesis and rupture of intracranial aneurysms (IA). Recent high-resolution patient-specific computational fluid dynamics (CFD) simulations have highlighted the presence of turbulent-like flow features, characterized by transient high-frequency flow instabilities. In-vitro studies have shown that such turbulent-like flows can lead to lack of endothelial cell orientation and cell depletion, and thus, may also have relevance to IA rupture risk assessment. From a modelling perspective, previous studies have relied on DNS to resolve the small-scale structures in these flows. While accurate, DNS is clinically infeasible due to high computational cost and long simulation times. In this study, we present the applicability of LES for IAs using a LES/blood flow dedicated solver (YALES2BIO) and compare against respective DNS. As a qualitative analysis, we compute time-averaged WSS and OSI maps, as well as, novel frequency-based WSS indices. As a quantitative analysis, we show the differences in POD eigenspectra for LES vs. DNS and wavelet analysis of intra-saccular velocity traces. Differences in two SGS models (i.e. Dynamic Smagorinsky vs. Sigma) are also compared against DNS, and computational gains of LES are discussed.

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