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RELIABILITY OF CFD MODELS OF VASCULAR DISEASES: FROM RESEARCH TO CLINICAL APPLICATIONS

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MINI-SYMPOSIUM PROPOSAL

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1 SUMMARY

In intracranial aneurysm research [1], CFD has proposed theoretical foundation for the role of hemodynamics in macro-vascular remodeling and the Wall Shear Stress (WSS) has been identified as a key parameter, with some of its spatiotemporal derivatives, that affects aneurysm formation and growth [2]. In cardiac hemodynamics [3, 4], CFD has explained numerous aspects of the cardiac diseases and provided evidence for a number of hypothesis concerning the progression of such diseases. Moreover, CFD has been quite useful in examining the efficacy of stents and flow diverters used in endovascular therapy [5, 6].
Nevertheless, despite the escalated surge in using Computational Fluid Dynamics (CFD) in hemodynamics research, the clinical impact of such research has not been fruitful as expected. Wong and Poon [7] argued that CFD simulations of cerebral hemodynamics *lack the predictive values required for clinical practice*. Xiang et al [8] discussed the mechanistic heterogeneity that exist in CFD literature of intracranial aneurysm hemodynamics. They compared the roles of high and low WSS in contemporary literature and sought to propose a unifying hypothesis. Fiorella et al [9] proposed categorical criticism for some of the highly cited works in intracranial aneurysm CFD [10] in which the showed that CFD results contradicts fundamental aspects of their *supposedly* underlying mechanics as well as other complex clinical measures. On the other hand, Etminan et al [11], Morris et al [12], Slesnick [13] and Lawford et al [14] have shown significant role that CFD plays in current clinical hemodynamics practice.

2 SYMPOSIUM AIM & SCOPE

This symposium aims to focus on the challenges facing CFD in clinical hemodynamics applications and their relevance to the emerging relevant research topics. Verification, validation and multi-physics integration of CFD models are the main themes of this symposium. The symposium will discuss current controversies in the reliability of CFD models in representing the fluid dynamics of vascular disease, devices, endovascular planning and operation as well as bridging the gap between physics, medicine and biology. Researchers who are interested in CFD models that can better describe physiological hemodynamics, and correlate such description with pathological, physiological and biological

phenomena occur in human vasculature are invited to submit their work for poster and oral presentations at this symposium. The main topics of this symposium include, but are not limited to: CFD verification and validation, numerical methods, DNS, LES, LBM, aneurysm hemodynamics, endothelial dysfunction, FSI models for cardiac disease, blood rheology, multiphase models for blood, clinical applications of CFD, stent design, endovascular planning using CFD and CFD visualization and post-processing.

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