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Evaluation of flow changes in a giant fusiform aneurysm of the basilar artery after a complex stenting

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Introduction: Flow-diverter stents have shown their high efficiency for treatment of complex cerebral aneurysms where traditional methods are not applicable. Several multi-center studies have reported a treatment success in 80-90% of cases, especially for saccular intracranial aneurysms of the anterior circulation, e.g. [1]. However, the use of flow-diverter stents for non-saccular posterior circulation aneurysms requires complex deployment techniques and associated with high mortality and morbidity [2]. In this study, we evaluated flow alterations in a treated giant fusiform aneurysm of the basilar artery and correlated them with an available clinical outcome.

Materials & methods: The aneurysm was treated with three flow-diverter SILK stents (4.5x40, 5x40 and 5.5x40) deployed in series along the basilar and right vertebral arteries. The left vertebral artery was clinically occluded. A patient-specific aneurysm geometry was obtained by CT-Angio, whereas geometrical models of the clinically used stents were reconstructed according to specifications and deployed using a fast virtual stenting technique [3]. Transient CFD simulations before and after the treatment were performed under realistic pulsatile flow conditions, imposing zero velocity in the left vertebral artery for the treated case.

Results: The applied treatment strategy led to significant alterations of the flow pattern in the basilar artery and successful redirection of blood flow along the series of flow-diverters. The average intra-aneurysmal velocity at systolic peak and time-averaged wall shear stress were reduced by 76% and 92%, respectively, compared to pretreatment. Moreover, relative residence time increased 10.4 times, contributing to successful treatment outcome observed during the follow-up.

Conclusion: We found a correlation between the CFD-predicted flow alterations and the available treatment outcome showing a potential of CFD simulations to be used in a clinical practice for the treatment planning and estimation of possible risk factors associated with a complex stent deployment strategy.

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