

SUCCESS PREDICTION OF FLOW DIVERTER TREATMENT FOR INTRACRANIAL MEDIA BIFURCATION ANEURYSMS

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Introduction

The treatment of intracranial aneurysms (IA) using flow diverters (FD) is associated with high rates of complete aneurysm occlusion. Particularly for side wall aneurysms, this was proven in clinical and technical hemodynamic studies [1,2]. However, there is still an active debate regarding its value in the treatment of bifurcation IA [3]. Despite prior clinical indication, there are cases in which the IA with implanted FD remains almost unaffected long-term after treatment. The aim of the study is to examine possible hemodynamic causes for treatment failure on the basis of retrospective cases and thus to predict the success of FD treatment.

Methods

Eight bifurcation IA patients treated with a state-of-the-art FD device (p48 HPC, phenox GmbH, Bochum, Germany) are included. Four patients show successful treatment whereas four demonstrated no occlusion of the IA after follow-up. Patient-specific surface models are extracted based on pre-interventional 3D digital subtraction angiography. Utilizing an in-house fast virtual stenting approach [4], post-interventional treatment stages are virtually created. Image-based blood flow simulations are conducted allowing the comparison of pre- and post-interventional hemodynamics of both failed and successfully treated IA.

Results

The hemodynamics stresses in the IA sac are reduced for all cases despite of the treatment success. Inflowing blood causing higher wall shear stresses at the inflow zone are reduced (see Figure 1). The flow diversion effect indicated by the ostium inflow and the inflow concentration index is reduced almost similar in both cohorts. However, the clinically failed cases demonstrate lower shear rates caused by reduced flow velocities in the bifurcating branch without FD. Successful cases indicate higher shear stresses in the non-stented branch regardless of the treatment (see Figure 1).

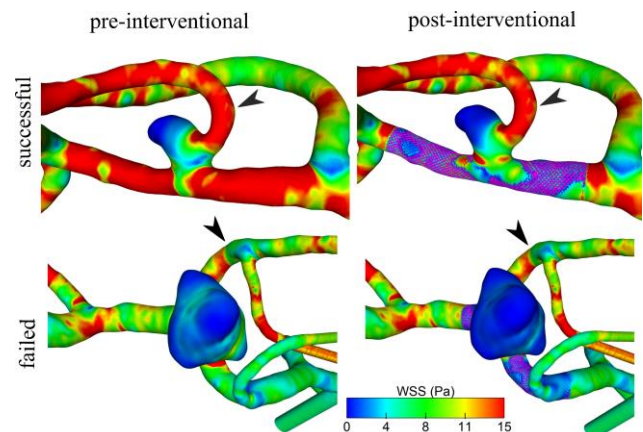


Figure 1: Qualitative hemodynamic comparison of pre- and post-interventional stages of an exemplary successful and failed case. The wall shear stress at the inflow zone is reduced due to the deployed FD (purple) for both cases. The arrows indicate lower shear stresses in the bifurcation branches without FD in the failed case.

Discussion

This study investigates hemodynamic changes in IA treated with FD devices. In a retrospective analysis clinically successful and failed cases are collected. Image-based blood flow simulations may indicate hemodynamic differences in the bifurcation branches, which are not captured in a clinical setting so far. This could support the predictability of clinically failed treatments for bifurcation IA using FD.

References

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