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AView- A streamlined clinical platform for intracranial aneurysm management

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Management of unruptured intracranial aneurysms (IAs) is difficult, since rupture rate is comparable to the risk associated with IA treatment. Although large IA size has been a clinical marker for high risk of rupture, many ruptured aneurysms are small. Therefore, improved biomarkers are required for rupture-risk assessment. Morphologic and hemodynamic parameters have been proposed as indicators of aneurysm rupture. However, since calculating complex morphological and hemodynamic parameters previously required different software platforms, using these indicators was not possible in a clinical setting. To this end, we have developed AView, an integrated platform to calculate complex morphological and hemodynamic parameters for rupture assessment of a newly presented IA. There are 4 modules in AView: clinical module, morphology module, flow simulation module and rupture resemblance score (RRS) report module. The clinical module takes the clinical information (age, sex, co-morbidities, etc.) and 3D imaging data of the patient as input. The morphology module implements a semi-automated segmentation on the image, and calculates complex 3D morphometrics such as size ratio, undulation index, etc. Flow simulation module performs CFD and qualitatively visualizes velocity flow streamlines, and calculates relevant parameters like WSS and OSI. The report module uses a statistical model built on a database from 413 ruptured and unruptured IAs, and provides RRS, the resemblance of the presented IA to existing ruptured IAs in the database based on the clinical, morphological and hemodynamic features. We have extensively validated our segmentation, morphology and flow simulation modules, to ascertain accurate computations from AView. Segmentation and morphology modules were validated by using spheres and patient-specific IAs of known dimensions. Flow simulation module was validated against experiments using PIV on a patient-specific IA. AView model error was quantified based on the rigorous ASME V&V 20 Standard. Compared to clinical measurements on 2D images, AView offers a robust means to calculate complex 3D morphometics. Likewise, as opposed to relying on 2D flow patterns in angiography, complex 3D streamlines can improve treatment efficacy. AView offers a significant improvement on current assessment of IAs based on morphometrics and hemodynamics, which can improve the current management of unruptured IAs.