Aneurysm Inflow-Angle as a Discriminant for Rupture in Sidewall Cerebral Aneurysms Morphometric and Computational Fluid Dynamic Analysis

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Background and Purpose?The ability to discriminate between ruptured and unruptured cerebral aneurysms on a
morphological basis may be useful in clinical risk stratification. The objective was to evaluate the importance of
inflow-angle (IA), the angle separating parent vessel and aneurysm dome main axes.
Methods?IA, maximal dimension, height?width ratio, and dome?neck aspect ratio were evaluated in sidewall-type
aneurysms with respect to rupture status in a cohort of 116 aneurysms in 102 patients. Computational fluid dynamic
analysis was performed in an idealized model with variational analysis of the effect of IA on intra-aneurysmal
hemodynamics.
Results?Univariate analysis identified IA as significantly more obtuse in the ruptured subset (124.9°26.5° versus
105.8°18.5°, P0.0001); similarly, maximal dimension, height?width ratio, and dome?neck aspect ratio were
significantly greater in the ruptured subset; multivariate logistic regression identified only IA (P0.0158) and
height?width ratio (P0.0017), but not maximal dimension or dome?neck aspect ratio, as independent discriminants of
rupture status. Computational fluid dynamic analysis showed increasing IA leading to deeper migration of the flow
recirculation zone into the aneurysm with higher peak flow velocities and a greater transmission of kinetic energy into
the distal portion of the dome. Increasing IA resulted in higher inflow velocity and greater wall shear stress magnitude
and spatial gradients in both the inflow zone and dome.
Conclusions?Inflow-angle is a significant discriminant of rupture status in sidewall-type aneurysms and is associated with

higher energy transmission to the dome. These results support inclusion of IA in future prospective aneurysm rupture
risk assessment trials.

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