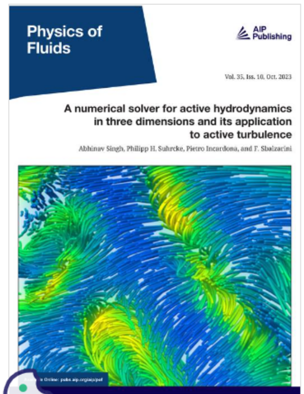
AIP Publishing Physics of Fluids



Volume 35, Issue 10
October 2023




RESEARCH ARTICLE | OCTOBER 10 2023

# Assessing the impact of aneurysm morphology on the risk of internal carotid artery aneurysm rupture: A statistical and computational analysis of endovascular coiling

**Special Collection:** Microscopic Channel Flows

Hongping Hu; Ping Luo; Dler Hussein Kadir; Amin Hassanvand



+ Author & Article Information
*Physics of Fluids* 35, 101904 (2023)
https://doi.org/10.1063/5.0165575 Article history



Computational modeling and investigation have become increasingly useful in assessing the hemodynamic and structural factors that contribute to aneurysm rupture, particularly when conventional clinical tools are inadequate. To this end, we conduct a study of a realistic internal carotid artery (ICA) under various working conditions using computational fluid dynamics. We analyze nine specific real ICA geometries in terms of coiling porosity and blood hematocrit, using a response surface model to evaluate 25 runs across selected geometrical parameters and treatment factors. The computational domain is created using computed tomography data from an actual patient, and we apply proposed boundary conditions to solve three-dimensional transient Navier–Stokes equations. By analyzing these cases, we try to understand how the sac section area, mean radius of the parent vessel, hematocrit, and coiling porosity interact and affect the risk of ICA rupture. We conduct an extensive study of the effects of sac section area and mean radius of the parent vessel on blood hemodynamics, examining several factors and comparing them at the peak systolic time instant, including wall shear stress (WSS), oscillatory shear index (OSI), pressure distributions, and velocity. Our results show that a 12% increase in the mean radius of the parent vessel reduced the maximum OSI value by approximately 50%, while a 120% increase in the sac section area decreases WSS on the aneurysm wall by up to 300%. These findings demonstrate the potential of computational modeling to provide valuable insight into the complex factors that influence aneurysm rupture, especially in cases where traditional clinical tools may be insufficient.