## **Aneurysm Formation**

Intracranial aneurysms are pathological dilations of the cerebral arterial wall, typically occurring at **arterial bifurcations** where **hemodynamic stress** is concentrated.

## Hemodynamic Contributors

Computational fluid dynamics (CFD) studies suggest that the following factors may contribute to aneurysm initiation:

- High wall shear stress (WSS) → may damage endothelial cells
- Flow bifurcations → increase mechanical stress on vessel walls
- **Complex or unstable flow patterns** → lead to endothelial dysfunction
- Low WSS zones  $\rightarrow$  promote inflammation, wall remodeling and degeneration

## **Biological Mechanisms**

CFD findings are integrated with biological hypotheses:

- Endothelial injury triggers inflammatory cascades
- Smooth muscle cell apoptosis weakens wall structure
- Matrix degradation via MMPs (matrix metalloproteinases)
- Genetic predisposition may modulate vulnerability

## **Typical Locations**

- Anterior communicating artery (ACoA)
- Posterior communicating artery (PCoA)
- Middle cerebral artery (MCA) bifurcation
- Internal carotid artery (ICA) siphon

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