基于CTA影像数据的个体化颅内动脉瘤的流固耦合力学模型(点击查看pdf全文)

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Title: Individualized fluid-solid coupled model of intracranial aneurysms based on computed tomography angiography data

作者: 王芙昱; 许百男; 孙正辉; 刘磊; 武琛; 张小军

1中国人民解放军总医院神经外科，北京100853；2北京工业大学机械工程与应用电子技术学院，北京100124

Author(s): -

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摘要: 目的建立基于CTA影像数据的个体化颅内动脉瘤的流固耦合力学模型。方法用MIMICS软件读取1例患者颅内动脉瘤
影像CTA影像DICOM数据，进行三维实体重建。应用ANSYS+CFX软件进行流固耦合模型的数值仿真。分析了模型的敏感
性，并与刚性模型进行了比较。结果建立了个体化颅内动脉瘤血流动力学流固耦合模型，直观地模拟动脉瘤壁剪切力以及瘤壁
变形的变化过程，可以输出压力、剪切力、范-米斯氏应力和壁变形程度等结果。小杨氏模量可以导致壁较大的变形，壁厚则变形
程度小。与刚性模型比较，相对于壁剪切力和血流速度，压力变化不大。结论流固耦合模型比刚性模型更接近真实情况，模拟
的结果有利于进行动脉瘤发生、生长及破裂的研究。

Abstract: ObjectiveTo establish an individualized fluid-solid coupled model of intracranial aneurysms based on computed
tomography angiography (CTA) image data. MethodsThe original Dicom format image data from a patient with an
intracranial aneurysm were imported into Mimics software to construct the 3D model. The fluid-solid coupled model was
simulated with ANSYS and CFX software, and the sensitivity of the model was analyzed. The difference between the rigid
model and fluid-solid coupled model was also compared.ResultsThe fluid-solid coupled model of intracranial aneurysm was
established successfully, which allowed direct simulation of the blood flow of the intracranial aneurysm and the deformation
of the solid wall. The pressure field, stress field, and distribution of Von Mises stress and deformation of the aneurysm could
be exported from the model. A small Young’s modulus led to an obvious deformation of the vascular wall, and the walls with

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greater thicknesses had smaller deformations. The rigid model and the fluid-solid coupled model showed more differences in
the wall shear stress and blood flow velocity than in pressure. ConclusionThe fluid-solid coupled model more accurately
represents the actual condition of the intracranial aneurysm than the rigid model. The results of numerical simulation with the
model are reliable to study the origin, growth and rupture of the aneurysms.

参考文献/REFERENCES

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