

**Rupture Risk Assessment of Basilar-tip Aneurysms Using Computational Fluid Dynamics**

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**Introduction:** Rupture of cerebral aneurysm is believed to have relation to hemodynamic effect. Therefore, a lot of hemodynamic analysis using computational fluid dynamics (CFD) has been performed. Some hemodynamic parameters have been reported that they were able to predict the rupture, however, the rupture prediction with single parameter may be insufficient. In this study, we executed CFD simulations on basilar-tip aneurysms and calculated hemodynamic parameters. Then we estimated rupture risk using statistical multivariate analysis.

**Materials & Methods:** We identified 35 basilar-tip aneurysms, including 5 ruptured and 30 unruptured aneurysms. Patient-specific vessel geometries were re-constructed from CT angiography images. CT images of ruptured group were taken before the rupture. The latest CT images were used for unruptured group. Pulsatile flow conditions were assumed in CFD simulations using ANSYS CFX 16.0, and hemodynamic parameters were calculated. Each parameter was tested whether it had statistically significant difference or not. Next, we performed logistic regression as a multivariate analysis method to make an equation which evaluates rupture risk. Finally, a receiver operating characteristic (ROC) analysis was executed to evaluate a usability of obtained rupture risk.

**Results:** Regression equation contained three hemodynamic parameters; Energy Loss (EL), Energy Loss per Volume (ELV) and Wall Shear Stress (WSS). The average risk value of ruptured and unruptured groups were 0.48 and 0.09, and it had a statistically significant difference between the groups ( $P < 0.01$ ). A threshold value which divided the risk into rupture or unruptured was 0.13 by ROC analysis. Area under the ROC curve (AUC) was 0.87. Sensitivity and specificity of the threshold were 1.00 and 0.74, respectively. In comparison of the sensitivity among single hemodynamic parameters, the rupture risk had the highest sensitivity value.

**Conclusion:** In conclusion, we reveal that rupture risk of basilar-tip aneurysms can be assessed by ELV and WSS, and considering both parameters is important. It can predict the rupture, however, we must confirm the validity by larger sample size.