Title: Data-driven decision support for unruptured intracranial aneurysms

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Abstract
Unruptured intracranial aneurysms (UIA) which can be considered as “untimed bombs” have a prevalence of 3% around the past middle-aged population. Rupture is rare, there are about 10 cases per 100,000 people per year, roughly 300 times lower than prevalence. When rupture does occur, it causes subarachnoid hemorrhage, with about 50% mortality and high morbidity. This causes a clinical dilemma as prophylactic treatment carries a 5-7% risk of stroke, making early diagnosis essential for patient specific decisions making.

Previously, it had been seen that classical clinical and morphological factors such as irregular shape and smoking have a strong association with rupture. These features became the foundation of risk scoring systems such as ISUIA, PHASES, UIATS, UCAS, and ELAPSS, which combine multiple parameters to estimate rupture and growth risk. However, a limitation of these scoring systems is that aneurysms which later ruptured were not flagged as high-risk.

Recently, advancements have been made using convolutional neural networks and radiomics to predict rupture and unruptured cases. These models showed promising results having Area Under Curve (AUC) values ranging between 75% - 89%. But current models require improved accuracy and enhanced explainability to ensure clinical trust and usability.

Our method achieved an AUC of 88.7% ± 0.015 using AdaBoost to predict ruptured and unruptured cases with interpretability. While the models distinguished ruptured from unruptured aneurysms, their predictive power was inadequate for identifying which unruptured cases would later rupture. Future work will investigate whether incorporating novel patient-related biomarkers (dental infection) can improve rupture prediction.