Multivariable Prediction Model for Futile Recanalization Therapies in Patients With Acute Ischemic Stroke

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Study Question
Can a multivariable prognostic model identify patients with acute ischemic stroke who will have very poor 3-month outcomes despite treatment with IV thrombolysis and/or mechanical thrombectomy?

What Is Known and What This Paper Adds
Around a third of patients with acute ischemic stroke have a very poor clinical outcome despite treatment with thrombolysis or mechanical thrombectomy—a phenomenon termed futile recanalization. This investigation’s results identified clinical variables (stroke severity, age, active cancer, and prestroke disability), laboratory values (glucose, C-reactive protein [CRP], and creatinine), imaging biomarkers (white matter hyperintensities), and onset-to-admission time as important predictors of very poor clinical outcome at 3 months. Because decision curve analyses suggested a higher mean net benefit only at lower thresholds of treatment, the model might be particularly useful in low-resource health care settings.

Methods
This study reports the development of a multivariable prediction model for individual prognosis of very poor clinical outcome (modified Rankin Scale 5–6) in patients who were treated with mechanical thrombectomy and/or IV thrombolysis using data from 2,261 patients enrolled in a prospectively collected observational registry of a single academic stroke center (median [interquartile range] age 75 years [64–83], 46% female, median NIH Stroke Scale 9 [4–17], 34% IV thrombolysis alone, 41% mechanical thrombectomy alone, 25% bridging). The dataset was split into a training (N = 1,808, 80%) and internal validation (N = 453, 20%) cohort. We used gradient-boosted decision tree machine-learning models after k-nearest neighbor imputation of 32 variables available at admission to predict futile recanalization therapies.

Results and Study Limitations
Despite recanalization therapies, 1 in 4 patients had a very poor clinical outcome. This occurred more often in patients receiving mechanical thrombectomy alone (34%) as compared to IV thrombolysis alone (11%). The most relevant predictors of futile recanalization therapies included clinical variables (higher stroke severity, older age, active cancer, and higher prestroke disability), laboratory values (higher glucose, higher CRP, and higher creatinine), imaging biomarkers (more white matter hyperintensities), and longer onset-to-admission time (Figure). The final model was discriminatory for predicting 3-month futile recanalization therapies (area under the curve 0.87, 95% CI 0.87–0.88) and had good calibration (Brier 0.12, 0.11–0.12). Overall performance was moderate (F1-score 0.63 ± 0.004), and decision curve analyses suggested a higher mean net benefit at lower thresholds of treatment (up to 0.8). This study has the limitations of being a single-center, retrospective registry potentially limiting its generalizability to other settings.

Study Funding and Competing Interests
This study received targeted funding from the Swiss National Science Foundation, the Swiss Heart Foundation, and the University of Bern. The authors report no competing interests. Go to Neurology.org/N for full disclosures.
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