New Risk Score Improves Vasospasm Prediction Following Subarachnoid Hemorrhage Using Markers of Vascular Compliance

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Background and Objectives

Background: Current risk prediction scores for vasospasm after subarachnoid hemorrhage (SAH) use severity of hemorrhage as the only criterion. Intracranial vascular compliance may also influence the risk of vasospasm based on previous observations that older age is associated with lower vasospasm rates.

Objectives: This study aims to evaluate the association of age and vessel calcification, as indirect markers of intracranial vascular compliance, with vasospasm after SAH, and to evaluate whether risk models using these markers improve risk prediction for vasospasm.

Methods

- A retrospective study of 277 patients with aneurysmal SAH from two academic institutions.

- Non-contrast brain CT scan at admission was used to assess the severity of hemorrhage.

- Calcification in the intracranial internal carotid arteries (ICA) was identified using bone window and a magnification of 300-400%.

- An area >1 mm^2 and average density >130 Hounsfield units were used as a cut-off when identifying calcium.

- Severe vasospasm was identified by cerebral angiography and/or a mean flow velocity ≥200 cm/sec on Transcranial Doppler studies.

- Multivariate logistic regression was used to analyze independent association with vasospasm. Receiver operating characteristic curves were used to evaluate predictability of risk score for severe vasospasm.

Results

Table 1. Independent Predictors for Vasospasm after SAH

Variable	Odd's ratio	95% CI
Age <55 years	3.1	1.5-6.5
Thick SAH±IVH	3.0	1.6-5.9
Calcification in ICA	0.5	0.2-0.9

Model p-value <0.0001;
SAH= Subarachnoid Hemorrhage; IVH= Intraventricular Hemorrhage; ICA= Intracranial Internal Carotid Artery

Table 2. ABC Scores for Prediction of Vasospasm after SAH

A=Age	<55 years **or** <65 years	2 points **or** 1 point
B=Bleed severity	Thick SAH±IVH	2 points
C=Calcification	Absent calcium	2 points
Maximum points		6 points

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Results

Table 3. Prediction of Severe Vasospasm after SAH using ROC Curves

Variable	AUC (95% CI)	P-value
ABC score ≥ 4	0.72 (0.65-0.78)	< 0.0001
Modified Fisher grade ≥3 **or** Thick SAH±IVH	0.60 (0.52-0.68)	0.02
Age ≤55 years	0.64 (0.56-0.71)	0.001
Absence of calcification in intracranial ICA	0.63 (0.55-0.71)	0.002

ROC= Receiver Operating Characteristic; AUC= Area Under the Curve; SAH= Subarachnoid Hemorrhage; IVH= Intraventricular Hemorrhage; ICA= Intracranial Internal Carotid Artery

Conclusions

- A new risk-score, that combines indirect markers of intracranial vascular compliance with the severity of hemorrhage, improves prediction of severe vasospasm after SAH.

- Calcium scores of intracranial vasculature may be evaluated as a more quantitative marker of both intracranial vascular compliance and vasospasm.

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