Reliable Identification of Benign Clinical Course in Aneurysmal Subarachnoid Hemorrhage: A Simple and Qualitative Clinical Algorithm

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Introduction

While a number of grading systems have been previously described to help guide clinical decision making in the setting of aneurysmal subarachnoid hemorrhage (aSAH), a method to reliably predict low vasospasm risk in aSAH patients has not been proposed. We developed a simple qualitative clinical algorithm that combines admission clinical severity, defined by Hunt Hess grade, and subarachnoid blood distribution, based on the Hijdra sum scoring system, to reliably identify patients at low risk of clinical vasospasm.

Objective

We developed a simple qualitative clinical algorithm that combines admission aSAH clinical severity, defined by Hunt Hess grade, and subarachnoid blood distribution, based on the Hijdra sum scoring system, to reliably identify patients at low risk of clinical vasospasm.

Hypothesis

We hypothesized that a simple to use qualitative clinical algorithm to reliably identify low risk of clinical vasospasm could be developed by analyzing clinical and systematically evaluating radiographic risk factors on admission.

Methods

Clinical severity, admission non-contrasted head computed tomography scans (CTH), and incidence of radiographic and clinical vasospasm among 214 aSAH patients treated at our institution were evaluated. Admission CTH's were systematically assessed for several different distributions of cisternal and ventricular blood. A final clinical algorithm was developed. Patients who satisfied all of the following 4 criteria experienced considerably lower risk of vasospasm. 1) Hunt Hess grade 1-2. 2) Lack of thick subarachnoid blood filling two adjacent cisterns. 3) Lack of thick interhemispheric blood. 4) Lack of biventricular IVH.

Results

Eighty-nine patients (41.6%) developed clinically silent vasospasm, seventy-one patients (33.2%) developed vasospasm with neurological deficit, and forty-five patients expired (21%). Adjacent cistern blood (OR 4.13, 95% confidence interval [CI] 2.1-8.09), interhemispheric thick blood (OR 6.39, 95% CI 3.17-12.87), and biventricular IVH (OR 2.05, 95% CI 1.04-4.04) were all statistically significant risk factors. Retrospective application of our proposed clinical algorithm yielded a sensitivity of 40% (95% CI 28.47-52.41%), specificity of 100% (95% CI 83.89-100%), positive predictive value of 100% (95% CI 87.66-100%), and negative predictive value of 33.3% (95% CI 21.95-46.34%). Inter-observer variability was substantial at k0.79.

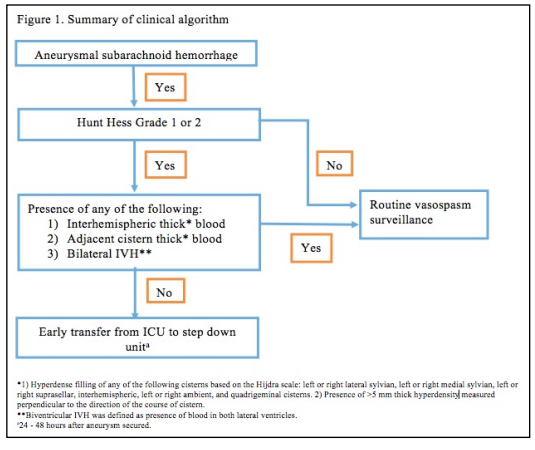

Table 1. Univariate Analysis
Hunt Hess Grade 1 through 5

Risk Factor:	Spasm	No spasm	Odds ratio (95% confidence interval)	P-value
Both suprasellar thick	22	27	1.9 (0.96-3.77)	0.066
Not both suprasellar thick	36	84		
Adjacent thick	38	35	4.13 (2.1-8.09)	<0.001
Not adjacent thick	20	76		
Interhemispheric thick	37	24	6.39 (3.17-12.87)	<0.001
Not interhemispheric thick	21	87		
Bilateral IVH	41	60	2.05 (1.04-4.04)	0.038
Not Bilateral IVH	17	51		
Either adjacent or interhemispheric thick	47	42	7.02 (3.28-15.01)	<0.001
Neither adjacent nor interhemispheric thick	11	69		
Either adjacent or interhemispheric or IVH	56	75	13.44 (3.1-58.18)	<0.001
Neither adjacent nor interhemispheric nor IVH	2	36		

Table 2. Multivariate Logistic Regression

Parameter	Coefficient	Odds Ratio	95% Confidence Interval	p-value
Intercept	-0.798			
Adjacent thick	0.832	2.29	1.07-4.94	0.03
Interhemispheric thick	1.436	4.2	1.94-9.1	<0.01
Bilateral IVH	0.476	1.61	0.75-3.41	0.21

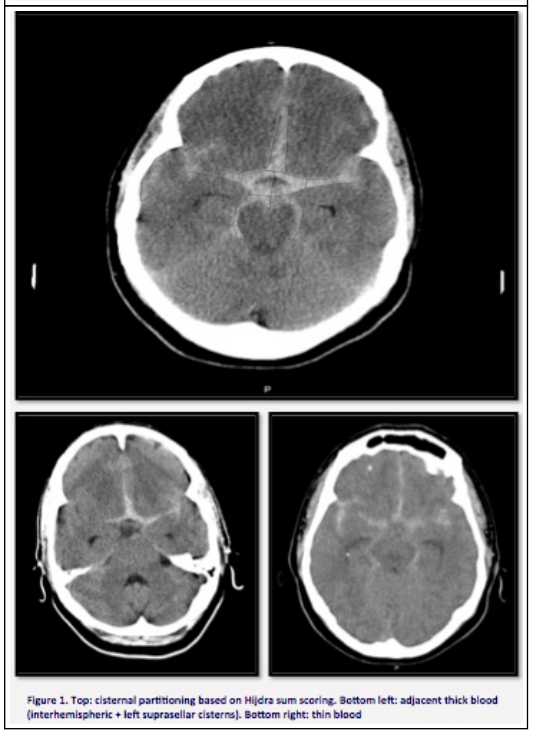

Figure 1. Top: cisternal partitioning based on Hijdra sum scoring. Bottom left: adjacent thick blood (interhemispheric + left suprasellar cisterns). Bottom right: thin blood

Table 3. Patient Demographics and Aneurysm Distributions

Aneurysm Location:	N (%)
Anterior communicating artery	71 (33.2)
Posterior communicating artery	35 (16.4)
Middle cerebral artery	28 (13.1)
Internal carotid artery, carotid terminus	13 (6.5)
Basilar artery	15 (7)
Posterior cerebral artery	6 (2.8)
Distal anterior cerebral artery	21 (9.8)
Vertebro-basilar or posterior inferior cerebellar artery	10 (4.7)
Anterior choroidal artery	8 (3.7)

Admission Grade:	N (%)	Vasospasm (%)	Mortality (%)
Hunt Hess 1	36 (16.8)	19.44	0
Hunt Hess 2	63 (29.4)	30.16	12.7
Hunt Hess 3	52 (24.3)	44.23	13
Hunt Hess 4	34 (15.9)	44.12	29.4
Hunt Hess 5	29 (13.6)	24.13	69

Total N = 214	N (%)
Female	143 (66.8)
Average age	55.8
Endovascular coiling	129 (60.3)
Microsurgical clipping	85 (39.7)
Overall mortality	45 (21)
Radiographic spasm	89 (41.59)
Clinical spasm	71 (33.18)

Conclusions

Application of the final clinical algorithm produced successful identification of aSAH patients who experience effectively zero risk of clinical vasospasm. Our algorithm is simple to apply with high reliability. Prospective application of our algorithm has considerable clinical and economic implications.

Learning Objectives

By the conclusion of this session, participants should be able to 1) Understand the derivation of the proposed clinical algorithm and 2) Apply the proposed clinical algorithm at home institutions for identification of subgroups of low-risk vasospasm patients.