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Intracranial Aneurysm Geometry and Incidence Angle Predicts Rupture Rate in Very Small (<4mm) Aneurysms

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Introduction

Prediction of rupture risk for intracranial aneurysms remains inconsistent. Our ability to identify patients at risk for subarachnoid hemorrhage relies on an imprecise set of "predictive" factors, such as aneurysm size, location, and family history. We use a geometric approach to explore the risk factors associated with rupture of very small aneurysms (< 4mm), which are routinely observed when found incidentally.

Methods

Patients with ruptured or unruptured intracranial aneurysms treated at North Shore University Hospital (NSUH) in Manhasset, New York, from 2010 to 2013 were identified. Aneurysms measuring less than 4mm from neck to dome (height) were analyzed with a focus on aneurysm dimensions, incidence angle, and parent vessel geometry. Measurements were conducted using DSA, CTA, or MRA, and parameters were analyzed for significance using multivariate logistic regression analyses.

Learning Objectives

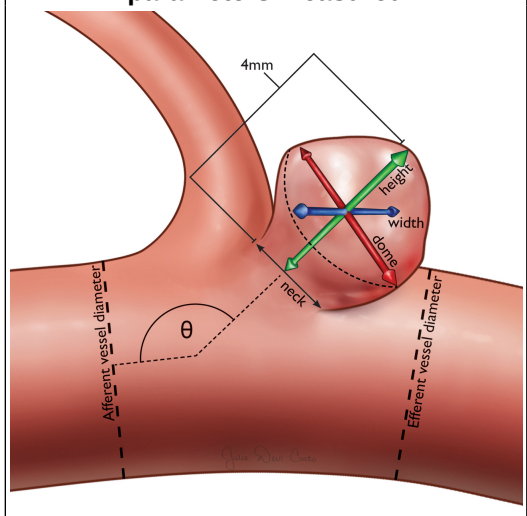
By the conclusion of this session, participants should be able to: 1) understand the importance of small aneurysm rupture risk; 2) identify key morphologic parameters that may predict risk of rupture in small aneurysms; 3) appropriately triage patients with unruptured very small aneurysms based on morphologic parameters suggested in this study

Results

A total of 113 aneurysms in 86 patients were identified and analyzed, with 57 of them ruptured (50.4%). Average age was 55 in ruptured and unruptured groups. 68% of patients with ruptured aneurysms were female, as were 86% of those with unruptured aneurysms (p =). Acom and Pcom artery aneurysms were most likely to rupture (OR 7.1 and 4.3, p = 0.01 and 0.003, respectively). Significant geometric and morphologic findings were as follows: Dome size (3.3 compared to 2.9 mm, p = 0.04); DNR (1.4/1.1 p = 0.003); AR (1.3/1.1 p = 0.01); SR (1.4/1.2 p 0.05); and AER (1.2/1.3 p = 0.02). Incidence angle was not found to be significantly different between the groups

Total: 113	Rupture, n=57	Unruptured, n=55	p-value	test
Patients (86)	50	36		
Age	55.3±16.8	55.4±12.4	NS	
Female	34	31	NS	
Pcomm	12	2	0.01**	OR=7.1
Acomm	22	7	0.003**	OR=4.3
Height	2.9±1.0	2.9±0.8	NS	One-sided 2 sample t-test
Width	2.6±1.2	2.6±0.9	NS	
Neck	2.5±0.9	2.6±0.8	NS	
Dome	3.3±1.3	2.9±1.1	0.04*	
AER	1.2±0.3	1.3±0.4	0.02*	Two-sided 2 sample t-test
Aspect ratio	1.3±0.6	1.1±0.3	0.01**	One-sided 2 sample t-test
DNR	1.4±0.7	1.1±0.4	0.003**	One-sided 2 sample t-test
Incident angle	118.8±34.6	126.7±33.4	NS	
Size ratio	1.4±0.9	1.2±0.5	0.05*	One-sided 2 sample t-test

Schematic drawing of the morphologic parameters measured



Dome-to-Neck Ratio (DNR): dome/neck; Aspect Ratio (AR): height/neck; Size Ratio (SR): height/(avg. parent diameter); Afferent to Efferent Ratio (AER): afferent vessel diam/efferent vessel diam

Conclusions

Measurement of aneurysm geometry represents a promising method for better characterizing intracranial aneurysms and stratifying their risk of rupture. This approach may be particularly useful for very small (<4mm) aneurysms, which have historically eluded reliable risk stratification. Patients who present with aneurysms smaller than 4mm with large DNR, AR, SR, and AER should be considered for prophylactic intervention.

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