Association Between Vascular Anatomy and Posterior Communicating Artery Aneurysms

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Introduction

Hemodynamic stress, conditioned by the geometry and morphology of the vessel trees, plays an important role in the formation of intracranial aneurysms. The aim of this study was to identify image-based location-specific morphological parameters, which are associated with posterior communicating artery (PCoA) aneurysms.

Methods

Morphological parameters obtained from computed tomographic angiographies of 56 patients with PCoA aneurysms and 23 control patients were evaluated with Slicer, an open-source image analysis software, to generate 3-D models of the aneurysms and surrounding vasculature. Segment lengths, diameters, and vessel-to-vessel angles were examined. In order to control for genetic and clinical risk factors, the unaffected contralateral side of patients with unilateral PCoA aneurysms was used as a control group for ICA related parameters. A separate control group with visible PCoAs and aneurysms elsewhere was used as a control group for PCoA-related parameters.

Results

ICA related parameters were not statistically different between the PCoA aneurysm and control groups. Univariate and multivariate subgroup analysis for patients with visualized PCoAs demonstrated that a larger PCoA diameter was significantly associated with PCoA-aneurysm presence (OR 12.1, 95% CI 1.3-17.1, p = 0.04), after adjusting for other morphological parameters.

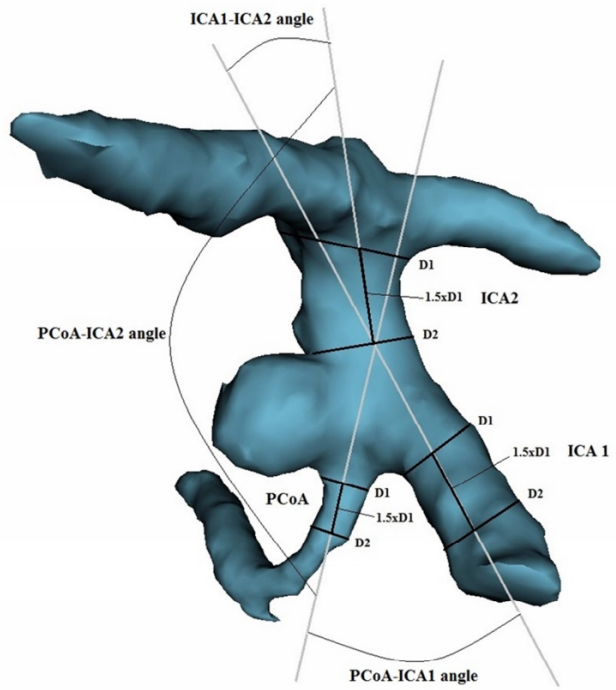
Conclusions:

Larger PCoA diameters are associated with the formation of PCoA aneurysms

Multivariate Logistic Regression for the Presence of ACoA aneurysms

	PCoA (n=23)	Control (n=23)	Multivariate Analysis		
	Mean (SD)	Mean (SD)	OR	95% CI	P
Mean age (years)	53.34 (13.8)	53.52 (11.9)	0.99	0.94-1.06	0.92
Female (%)	86.96 (34.4)	78.26 (42.2)	2.96	0.38-30.97	0.32
Hyper-tension %)	34.78 (48.7)	43.5 (50.7)	0.38	0.05-2.18	0.29
Smoking (%)	73.91 (44.9)	56.52 (50.7)	4.31	0.84-28.06	0.09
Family history (%)	8.69 (28.8)	8.69 (28.8)	0.76	0.05-11.94	0.84
Diam PCoA (mm)	1.83 (0.49)	1.48 (0.29)	12.1	1.31-17.14	**0.04 ***
PCoA-ICA bifurcation distance (mm)	8.79 (1.35)	8.29 (1.00)	1.25	0.62-2.67	0.55
ICA1-PCoA angle (◦)	106.71 (27.5)	101.75 (20.1)	1.01	0.97-1.06	0.58
ICA2-PCoA angle (◦)	124.3 (14.4)	116.9 (18.0)	1.01	0.95-1.07	0.81

3D model of a PCoA aneurysm depicting morphological and angular variables of the surrounding vasculature.



Composite diameters are obtained for the PCoA, ICA1, and ICA2, by averaging the initial diameter of the vessel (D1) at the aneurysm neck or branching point with the diameter of the vessel 1.5 away from the initial diameter (D2). There were three vessel-to-vessel angles measured. The ICA1 to ICA2 angle refers to the angle between the distal ICA (ICA2) and the proximal ICA (ICA1). In addition, the PCoA-ICA1 and PCoA-ICA2 angles were measured. (Figure modified from Ho et al., Plos One, 9:e94837, 2014.)