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Development of a Statistical Model for Discrimination of Rupture Status in Posterior Communicating Artery Aneurysms – Supplementary Material

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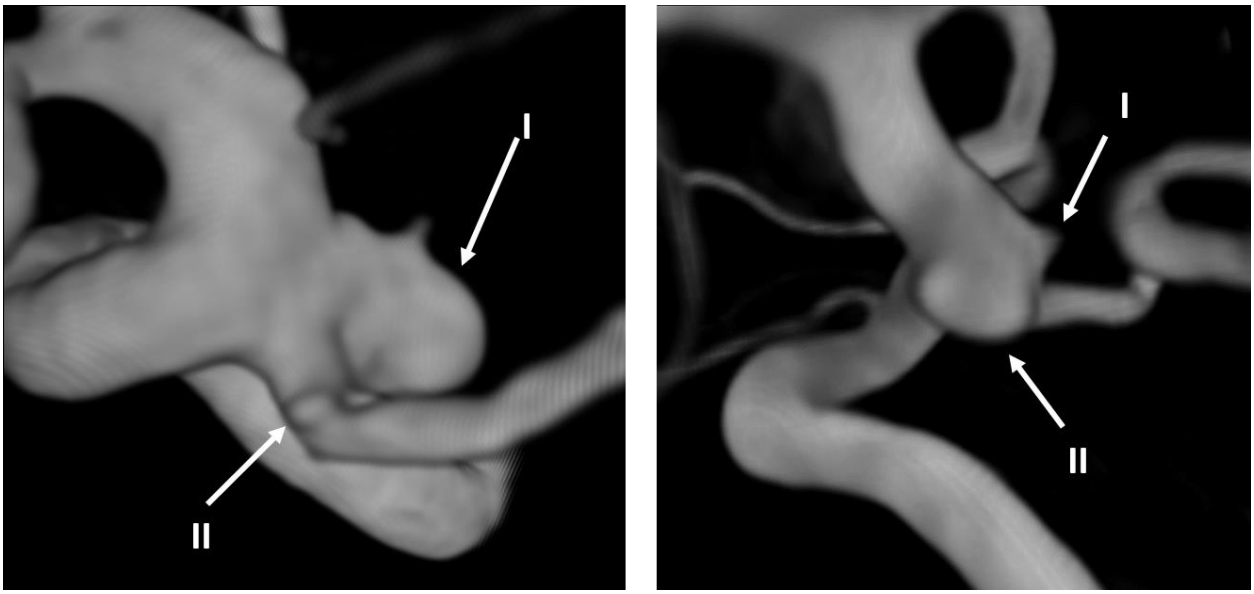


Fig. 1 Angiographic images of the two cases with two ipsilateral PCOM aneurysms

Tab. 1 Patient-related and categorical variables

Variable	**Definition**
Age [years]	Patient age
Female [0/1]	Patient gender
Male [0/1]	Patient gender
Angio-architecture [2]	
type_1 [0/1]	True PCOM
type_2 [0/1]	At ICA-PICOM bifurcation
type_3 [0/1]	PCOM from fundus
type_4 [0/1]	PCOM proximal/detached
type_5 [0/1]	PCOM proximal/attached
type_6 [0/1]	No PCOM visible in 3DRA
type_7 [0/1]	PCOM distal/distached

Tab. 2 Morphological variables with the corresponding ranges in our data

Variable	**Definition**	**Range**
Avol [cm^3]	Aneurysm volume	[0, 6.46]
Asize [cm]	Max. distance between any two points on the aneurysm surface	[0.17, 2.66]

Aarea [cm^2]	Aneurysm area	[0.03, 16.63]
Nsize [cm]	Max. distance between any two points on the neck surface	[0.15, 1.58]
Narea [cm^2]	Area of the neck surface	[0.02, 2.86]
Depth [cm]	Max. distance of all points on aneurysm dome from aneurysm neck	[0.04, 2.25]
AR	Aspect ratio = aneurysm depth/neck diameter	[0.18, 4.17]
Aheight [cm]	Max. normal distance of all points on dome from aneurysm neck	[0.05, 2.12]
Awidth [cm]	Max. diameter of aneurysm slices parallel to aneurysm neck	[0.13, 2.35]
HWR	Height to width ratio = aneurysm height/ aneurysm width	[0.28, 2.28]
Ndiam [cm]	Equivalent diameter of 2D neck = 4 x area/perimeter	[0.14, 0.9]
Aspect	Aspect ratio 2 = aneurysm height/neck diameter	[0.24, 4.43]
BF	Bottle neck factor = aneurysm width/neck diameter [5]	[0.64, 3.73]
BL	Bulge location = Distance of plane with largest diameter from neck / height [5]	[0, 0.85]
Vdiam [cm]	Vessel diameter: Diameter of nearest vessel from aneurysm neck	[0.18, 0.68]
SizeR	Size ratio = Aneurysm size/Vessel diameter	[0.4, 8.54]
VOR	Volume to ostium ratio = Aneurysm volume/Area 2D of neck	[0.01, 10.02]
CR	Convexity ratio = Aneurysm volume/Volume of convex hull [3]	[0.43, 0.98]
IPR	Isoperimetric ratio = Aneurysm area/(Aneurysm volume$^{2/3}$) [3]	[4.27, 6.41]
EI	Ellipticity index = 1-$(18\pi)^{1/3}$ ($V^{2/3}$/ S), with V and S referring to the volume and area of the aneurysm convex hull, respectively [5]	[0.22, 0.45]
NSI	Non-sphericity index = 1-$(18\pi)^{1/3}$ ($V^{2/3}$/ S), with V and S referring to the aneurysm volume and area, respectively [5]	[0.1, 0.4]
GAA [cm^{-2}]	Area weighted average of Gaussian curvature [3]	[-2.68, 96.72]
MAA [cm^{-1}]	Area weighted average of mean curvature [3]	[1.2, 10.92]
GLN	L2-Norm of Gaussian curvature [3]	[0.23, 12.7]
MLN	L2-Norm of mean curvature [3]	[0.13, 0.68]

Tab. 3 Hemodynamic variables with corresponding ranges in our data.

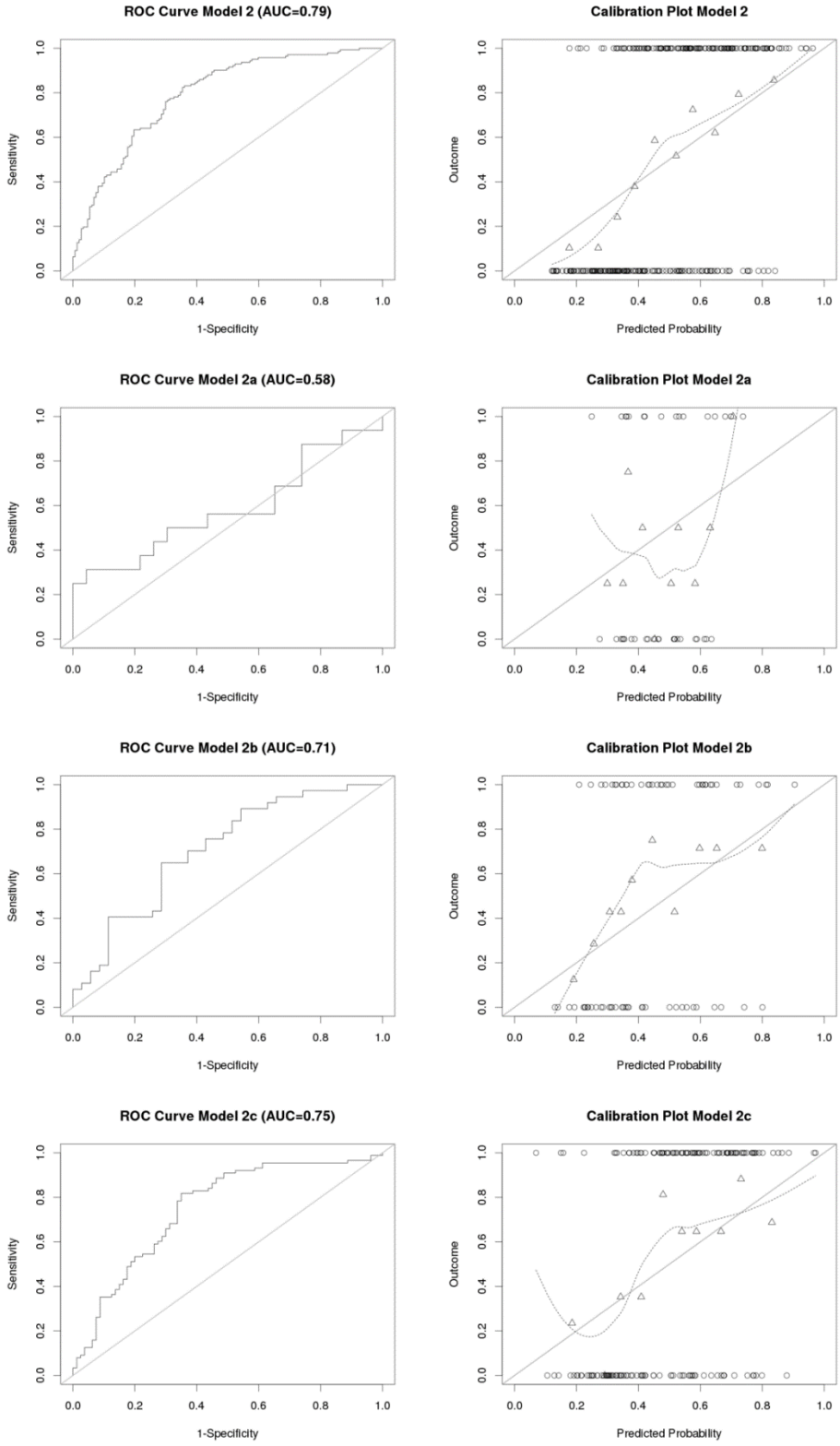
Variable	**Definition**	**Range**
ICI	Inflow concentration index [4]	[0, 6.64]

Q [cm^3/s]	Mean inflow rate into aneurysm [4]	[0, 6.21]
KE [erg]	Mean kinetic energy [4]	[0, 2398.94]
SR [1/s]	Mean shear rate [4]	[0.23, 1056.98]
VE [cm/s]	Mean velocity [4]	[0.01, 40.14]
VO [1/s]	Mean vorticity [4]	[0.19, 1301.85]
VD [erg/s]	Mean viscous dissipation [4]	[0.03, 15187.2]
WSSmax [$dyne/cm^2$]	Maximum wall shear stress [4]	[13.56, 2779.56]
WSSmin [$dyne/cm^2$]	Mínimum wall shear stress [4]	[0, 12.11]
WSSmean [$dyne/cm^2$]	Mean wall shear stress [4]	[0.02, 130.74]
LSA (%)	Low shear area [4]	[0, 100]
SCI	Shear concentration index [4]	[0, 80.93]
OSImax	Maximum oscillatory shear index [4]	[0, 0.48]
OSImean	Mean oscillatory shear index [4]	[0, 0.13]
WSSves [$dyne/cm^2$]	Mean wall shear stress in parent vessel (within vessel region with distance to the aneurysm neck of less than 1 cm) [4]	[9.84, 148.04]
WSSnorm	Normalized WSS = WSSmean/WSSves	[0, 1.88]
MWSSnorm	Maximum normalized WSS = WSSmax/WSSves	[0.6, 32.32]
Corelen [cm]	Vortex core line length (flow complexity) [1]	[0, 16.72]
podent	Proper orthogonal decomposition (POD) entropy (flow stability) [1]	[0.02, 0.99]
podenum	Proper orthogonal decomposition – number of modes to account for 95% of total energy (flow stability) [1]	[1, 6]
Vmax [cm/s]	Peak velocity	[3.4, 440.8]
VmaxMean [cm/s]	Time average of maximum velocity in space	[0.87, 241.09]

Tab. 4 Coefficients of variables retained in the different statistical models (variables that were not retained in any model have been omitted)

Variable	Model 1	Model 2	Model 2a	Model 2b	Model 2c
Intercept	-4.4558	-3.4617	-2.8326	-2.6788	-3.6006
WSSmax	0.0001	0	0	0	0.0005
WSSmin	-0.2267	-0.1697	-0.0043	-0.1968	0
WSSves	0.0146	0.0056	0.0028	0.0027	0
SCI	-0.0281	-0.001	0	-0.0042	0.0012
OSImax	4.2304	1.6469	2.1332	0.7726	0.5498
OSImean	-15.4188	0	0	0	0
podent	0	-0.2332	0	0	0
Vmax	0.0028	0.007	0.0033	0	0.0075
VmaxMean	0	0	0	0.0127	0
Nsize	0	-0.3493	0	0	-1.1805
Aheight	-1.277	0	0	0	0
Awidth	-0.0637	-0.1587	0	0	-0.2443
HWR	0	0	0	0	0.7671
BL	1.4595	0.6137	0.522	0.3388	0
Vdiam	0	0	0	-1.8971	2.1722
VOR	0	-0.1327	0	-0.0509	-0.0419
NSI	9.5943	7.8988	6.6416	10.2484	3.3943
MLN	2.486	1.3671	0.0496	0	2.2573
type_1	1.1094	0.2841	0	0.1369	-0.8003
type_2	0.2595	0.0702	0	-0.0094	0.2338
type_3	0.3528	0.143	0	0.0188	0.6406
type_4	-0.3777	0.0393	0	0.0994	-0.0078
type_5	0.1099	0.0677	0	0.024	0.231
type_6	-0.481	-0.2091	0	-0.09	-0.2973
type_7	-0.9729	-0.3952	0	-0.1798	
age	-0.004	N/A	N/A	N/A	N/A

Fig. 2 ROC Curves (left) and calibration plots (right) for models 2, 2a, 2b, and 2c evaluated with the corresponding left-out data



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