

Neuroradiology

Associations of hemodynamics, morphology, and patient characteristics with aneurysm rupture stratified by aneurysm location – Supplementary Material

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Tab. 1 Computed hemodynamic and geometric parameters.

	Variable	Definition
Hemodynamics	ICI	Inflow concentration index
	Q [cm ³ /s]	Mean inflow rate into aneurysm
	KE [erg]	Mean kinetic energy
	SR [1/s]	Mean shear rate
	VE [cm/s]	Mean velocity
	VO [1/s]	Mean vorticity
	VD [erg/s]	Mean viscous dissipation
	WSSmax [dyne/cm ²]	Maximum wall shear stress
	WSSmin [dyne/cm ²]	Minimum wall shear stress
	WSSmean [dyne/cm ²]	Mean wall shear stress
	LSA (%)	Low shear area
	SCI	Shear concentration index
	OSImax	Maximum oscillatory shear index
	OSImean	Mean oscillatory shear index
	WSSves [dyne/cm ²]	Mean wall shear stress in parent vessel
	WSSnorm	Normalized WSS = WSSmean/WSSves
	MWSSnorm	Maximum normalized WSS = WSSmax/WSSves
	Corelen [cm]	Vortex core line length (flow complexity)
podent	Proper orthogonal decomposition (POD) entropy (flow stability)	
Vmax [cm/s]	Peak velocity	
Morphology	Avol [cm ³]	Aneurysm volume
	Asize [cm]	Max. distance between any two points on the aneurysm surface
	Nsize [cm]	Max. distance between any two points on the neck surface
	Narea [cm ²]	Area of the neck surface
	AR	Aspect ratio = aneurysm depth/neck diameter
	Aheight [cm]	Max. normal distance of all points on dome from aneurysm neck

Awidth [cm]	Max. diameter of aneurysm slices parallel to aneurysm neck
HWR	Height to width ratio = aneurysm height/ aneurysm width
BF	Bottle neck factor = aneurysm width/neck diameter
BL	Bulge location = Distance of plane with largest diameter from neck / height
Vdiam [cm]	Vessel diameter: Diameter of nearest vessel from aneurysm neck
SizeR	Size ratio = Aneurysm size/Vessel diameter
VOR	Volume to ostium ratio = Aneurysm volume/Area 2D of neck
CR	Convexity ratio = Aneurysm volume/Volume of convex hull
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
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
MLN	L2-Normof mean curvature

Tab. 2 Results of the univariate comparison of ruptured (R) and unruptured (U) aneurysms from all aneurysm locations combined. The p-value refers to the Wald test, the coefficient to the coefficient of the fitted univariate logistic regression model

	p-value	coefficient	Mean U	Mean R
ICI	0.0001	0.2451	0.6467	0.796
Q [cm ³ /s]	0.0040	0.1832	0.6129	0.7225
KE [erg]	<0.0001	6e-04	184.3329	275.0735
SR [1/s]	0.4245	2e-04	220.0604	228.5415
VE [cm/s]	0.0015	0.0224	8.7014	9.809
VO [1/s]	0.1769	2e-04	294.6923	313.7566
VD [erg]	0.0825	0	1325.7114	1987.4185
WSSmax [dyne/cm ²]	<0.0001	0.0021	214.9645	376.2737
WSSmin [dyne/cm ²]	<0.0001	-0.4224	0.7912	0.3432
WSSmean [dyne/cm ²]	0.0094	0.0058	19.9966	22.9593
LSA	0.4243	0.0012	50.7062	52.0456
SCI	<0.0001	0.0414	4.5397	6.2606

OSImax	<0.0001	3.8827	0.2523	0.3172
OSImean	<0.0001	16.7551	0.0128	0.0171
WSSves	<0.0001	0.0141	39.4009	49.1429
[dyne/cm ²]				
WSSnorm	<0.0001	-0.6468	0.5068	0.4427
MWSSnorm	<0.0001	0.0753	5.556	7.1606
Corelen	<0.0001	0.1433	1.4563	2.3363
[cm]				
podent	<0.0001	1.4844	0.1755	0.2066
Vmax	<0.0001	0.0113	62.5709	88.6712
[cm/s]				
Avol [cm ³]	0.3890	-0.0825	0.1802	0.1502
Asize [cm]	<0.0001	0.6411	0.6444	0.7699
Aarea [cm ²]	0.2902	0.0265	1.038	1.1403
Nsize [cm]	0.3626	-0.2115	0.4413	0.4311
Narea [cm ²]	0.0190	-0.7874	0.1647	0.1418
AR	<0.0001	0.9073	0.9117	1.2878
Aheight	<0.0001	0.797	0.4089	0.5084
[cm]				
Awidth	0.1303	0.2456	0.4658	0.4886
[cm]				
HWR	<0.0001	2.2427	0.8174	1.0215
BF	<0.0001	0.7511	1.1731	1.3136
BL	<0.0001	2.3648	0.2886	0.3558
Vdiam [cm]	<0.0001	-4.9211	0.3746	0.3258
SizeR	<0.0001	0.3805	1.7958	2.4797
VOR	0.0355	0.0674	0.6898	0.8705
CR	0.0003	1.5231	0.7615	0.7847
EI	0.0190	-3.5194	0.2766	0.2725
NSI	<0.0001	13.1368	0.2062	0.2456
MLN	<0.0001	7.1515	0.2908	0.3598

Tab. 3 Results of the ANOVA analysis of the interaction tests for the hemodynamic and morphological parameters with aneurysm location

Variable	p-value
ICI	0.7612
Q	0.1741
KE	0.1089
SR	0.4833
VE	0.1523
VO	0.4664
VD	0.4314
WSSmax	0.1214
WSSmin	0.1086
WSSmean	0.2124
LSA	0.488
SCI	0.417
OSImax	0.2045
OSImean	0.159
WSSves	0.1922
WSSnorm	0.6202

MWSSnorm	0.5033
corelen	0.5319
podent	0.3196
Vmax	0.0178
Avol	0.9821
Asize	0.8148
Aarea	0.9927
Nsize	0.8125
Narea	0.8834
AR	0.2023
Aheight	0.9519
Awidth	0.9179
HWR	0.9463
BF	0.68
BL	0.0077
Vdiam	0.98
SizeR	0.9828
VOR	0.8395
CR	0.304
EI	0.2065
NSI	0.0024
MLN	0.027

Tab. 4 Results of the univariate comparison of ruptured (R) and unruptured (U) ACOM aneurysms (left) and ACOM aneurysms harbored by old vs. young patients (right). The p-value refers to the Wald test, the coefficient to the coefficient of the fitted univariate logistic regression model

	p-value	coefficient	Mean U	Mean R	p-value	coefficient	Mean old	Mean young
ICI	0.2343	0.2528	0.6232	0.7156	0.2833	-0.2569	0.6844	0.6037
Q [cm ³ /s]	0.4133	0.1997	0.5721	0.6238	0.5527	-0.1527	0.596	0.5561
KE [erg]	0.5169	2e-04	232.4929	274.1671	0.4448	-2e-04	272.3959	218.5205
SR [1/s]	0.7684	2e-04	221.6393	229.5976	0.2928	-7e-04	236.022	205.3531
VE [cm/s]	0.3272	0.0158	8.802	9.767	0.6254	-0.0081	9.2936	8.7838
VO [1/s]	0.6252	2e-04	299.217	317.8603	0.3474	-4e-04	320.8933	282.4555
VD [erg]	0.9617	0	1820.342	1849.301	0.405	0	2064.207	1494.501
			6	5			6	8
WSSmax [dyne/cm ²]	0.0262	8e-04	275.428	542.0168	0.4617	-1e-04	515.529	360.521
WSSmin [dyne/cm ²]	0.0041	-0.6674	0.5149	0.2141	0.0498	-0.4388	0.4689	0.2323
WSSmean [dyne/cm ²]	0.5786	0.0025	21.6977	23.6352	0.4898	-0.0033	23.4564	20.8515
LSA	0.9035	5e-04	42.2274	42.7097	0.2018	0.0051	40.464	45.9596
SCI	0.044	0.0677	4.4746	5.8133	0.307	0.0259	5.0128	5.7911
OSImax	0.0353	2.2825	0.2825	0.3122	0.9675	0.0466	0.2968	0.2974
OSImean	0.086	19.2741	0.0134	0.0161	0.5759	6.1532	0.0142	0.0151
WSSves [dyne/cm ²]	0.1169	0.0073	37.2077	43.2325	0.8121	-0.0012	39.3644	38.5198
WSSnorm	0.4994	-0.2573	0.5326	0.506	0.1261	-0.6092	0.5525	0.4846
MWSSnorm	0.0041	0.0843	6.791	10.0157	0.4088	-0.0115	9.6526	8.2024
Corelen [cm]	0.0198	0.1946	1.472	1.9516	0.8684	0.0139	1.6252	1.6592

podent	0.5007	0.6196	0.1957	0.2071	0.6797	0.4176	0.19	0.1971
Vmax [cm/s]	0.0338	0.0047	74.5873	92.4203	0.6771	-8e-04	83.4281	79.8845
Avol [cm ³]	0.4148	-0.8325	0.093	0.0811	0.1446	-1.8691	0.0907	0.0693
Asize [cm]	0.0554	0.8578	0.6407	0.7085	0.6708	0.2012	0.6606	0.676
Aarea [cm ²]	0.7604	0.0511	0.8262	0.8539	0.4525	-0.1405	0.8432	0.7734
Nsize [cm]	0.4988	-0.5381	0.4251	0.4123	0.7519	-0.2787	0.4172	0.4111
Narea [cm ²]	0.1585	-1.8452	0.143	0.1261	0.6125	-0.7954	0.1327	0.1271
AR	3e-04	1.1038	1.0027	1.2063	0.1046	0.4934	1.0553	1.1491
Aheight [cm]	0.3037	0.572	0.4267	0.4552	0.7974	0.1517	0.4295	0.4369
Awidth [cm]	0.9271	-0.0612	0.4486	0.4466	0.5251	-0.4683	0.4462	0.4314
HWR	6e-04	1.7508	0.9045	1.0191	0.007	1.3878	0.9183	1.0158
BF	0.0144	1.2193	1.1973	1.2785	0.4512	-0.3623	1.2523	1.2251
BL	0.0733	1.519	0.3169	0.3492	0.8263	0.1942	0.325	0.3293
Vdiam [cm]	0.011	-5.2472	0.3007	0.2804	0.687	0.8598	0.2847	0.2879
SizeR	0.0032	0.3749	2.1877	2.6054	0.9923	-0.0011	2.4288	2.4273
VOR	0.1161	0.4129	0.539	0.637	0.3998	-0.2227	0.6063	0.5507
CR	0.4482	-0.962	0.7944	0.7853	0.7033	-0.4843	0.7827	0.7775
EI	0.1412	8.1047	0.2661	0.2703	0.8476	1.022	0.2692	0.2698
NSI	<0.000	21.9256	0.2073	0.2494	0.0039	7.9067	0.2252	0.2447
1								
MLN	<0.000	10.9645	0.3041	0.362	0.0281	3.6632	0.3302	0.3538
1								

Tab. 5 Results of the univariate comparison of ruptured (R) and unruptured (U) ACOM aneurysms harbored by young patients (left) and harbored by old patients (right). The p-value refers to the Wald test, the coefficient to the coefficient of the fitted univariate logistic regression model

	p-value	Coefficient	Mean young U	MEAN young R	p-value	Coefficient	Mean old U	Mean old R
ICI	0.4883	0.3434	0.5576	0.6241	0.1867	0.4313	0.5993	0.7689
Q [cm ³ /s]	0.7762	0.1348	0.5392	0.567	0.9758	-0.0102	0.6093	0.6061
KE [erg]	0.7777	2e-04	204.0542	225.7086	0.8339	1e-04	262.6595	288.5767
SR [1/s]	0.9843	0	205.3682	206.1532	0.9364	1e-04	235.1282	238.8652
VE [cm/s]	0.8336	0.0063	8.5801	8.9041	0.686	0.009	9.0392	9.698
VO [1/s]	0.9494	1e-04	280.6865	284.2629	0.7901	1e-04	312.6689	330.1895
VD [erg]	0.8827	0	1585.2084	1474.9611	0.9775	0	2079.4657	2112.792
WSSmax [dyne/cm ²]	0.9482	0	353.7587	360.4692	0.0306	0.0021	219.7857	761.4119
WSSmin [dyne/cm ²]	0.0172	-1.1447	0.4404	0.1594	0.1019	-0.4243	0.6534	0.2809
WSSmean [dyne/cm ²]	0.9293	-8e-04	21.2877	20.8292	0.7009	0.0023	22.3671	24.7275
LSA	0.3096	-0.0069	50.7298	43.791	0.778	-0.0016	41.6538	39.9107
SCI	0.3035	0.0597	4.7032	6.0778	0.2884	0.0465	4.5523	5.5682
OSImax	0.0452	4.1311	0.2639	0.3094	0.6201	0.763	0.2939	0.3053
OSImean	0.1433	36.1445	0.0123	0.0161	0.3762	14.8317	0.0133	0.0153
WSSves [dyne/cm ²]	0.9834	2e-04	38.4013	38.5221	0.0499	0.0172	34.1171	44.5341
WSSnorm	0.9674	-0.0296	0.4887	0.4861	0.2477	-0.61	0.5905	0.5117
MWSSnorm	0.5715	0.0251	7.6894	8.3219	0.0133	0.1459	6.2244	12.4047
Corelen [cm]	0.0196	0.4955	1.1395	1.8593	0.3421	0.1085	1.4853	1.7959

podent	0.237	2.5005	0.1743	0.2055	0.5845	0.7647	0.1844	0.1986
Vmax [cm/s]	0.3048	0.0043	70.0757	83.3841	0.0897	0.0062	71.1612	94.7683
Avol [cm ³]	0.2413	3.9243	0.0551	0.075	0.4648	-1.0321	0.1032	0.0846
Asize [cm]	0.0515	1.9854	0.6065	0.7035	0.4493	0.4561	0.6425	0.6877
Aarea [cm ²]	0.1171	0.7208	0.6356	0.8283	0.83	-0.0488	0.8777	0.8444
Nsize [cm]	0.5476	-0.989	0.4244	0.408	0.4093	-0.9331	0.4357	0.4098
Narea [cm ²]	0.6651	-1.2151	0.1329	0.1261	0.0857	-3.5887	0.1519	0.1216
AR	9e-04	2.2034	0.9282	1.2262	0.0218	1.0007	0.9471	1.1487
Aheight [cm]	0.0749	2.3447	0.3857	0.4564	0.9506	0.0459	0.4336	0.4365
Awidth [cm]	0.3095	1.4969	0.4084	0.4414	0.4176	-0.7579	0.4674	0.4365
HWR	0.0202	2.2046	0.9145	1.0493	0.032	1.6318	0.8652	0.9723
BF	0.0051	3.3192	1.1182	1.2635	0.1608	0.9242	1.2053	1.2861
BL	9e-04	5.256	0.2448	0.3568	0.6049	0.6869	0.3186	0.3324
Vdiam [cm]	0.2516	-3.7761	0.3004	0.2847	0.0025	-10.911	0.3046	0.2693
SizeR	0.0363	0.5794	2.1234	2.5352	0.0724	0.2815	2.1862	2.6652
VOR	0.021	1.7878	0.4021	0.6059	0.4074	0.2753	0.5604	0.6529
CR	0.944	0.1798	0.7757	0.777	0.9024	-0.2068	0.7861	0.7836
EI	0.6965	4.6207	0.2688	0.2703	0.2191	8.8898	0.2651	0.2716
NSI	3e-04	20.7491	0.2139	0.2561	0	25.4252	0.2006	0.2436
MLN	6e-04	13.114	0.3123	0.3694	9e-04	8.4292	0.3012	0.3575

Tab. 6 Results of the univariate comparison of ruptured (R) and unruptured (U) MCA-BIF aneurysms (left) and MCA-BIF aneurysms harbored by old vs. young patients (right). The p-value refers to the Wald test, the coefficient to the coefficient of the fitted univariate logistic regression model

	p-value	Coefficient	Mean U	Mean R	p-value	Coefficient	Mean old	Mean young
ICI	0.5888	0.0981	0.7312	0.7802	0.7519	-0.0592	0.7145	0.6871
Q [cm ³ /s]	0.3268	0.2005	0.6285	0.7068	0.4955	-0.1426	0.6472	0.5934
KE [erg]	0.1416	5e-04	233.0808	403.5371	0.381	2e-04	246.3972	331.1519
SR [1/s]	0.3285	4e-04	252.2168	292.4574	0.6478	2e-04	260.4378	278.4133
VE [cm/s]	0.2771	0.0173	9.9521	11.0758	0.9232	0.0015	10.1132	10.2097
VO [1/s]	0.3026	3e-04	340.9291	394.4172	0.6471	1e-04	350.3209	372.9479
VD [erg]	0.4799	0	1612.772	4432.1009	0.4154	0	1767.851	3686.4358
WSSmax [dyne/cm ²]	0.0035	0.0018	251.5355	342.4706	0.1948	7e-04	259.6591	296.7925
WSSmin [dyne/cm ²]	0.1383	-0.1831	0.9715	0.5358	0.4376	-0.0555	0.9599	0.7118
WSSmean [dyne/cm ²]	0.3221	0.0042	24.4611	28.4876	0.5891	0.0023	24.6513	26.7565
LSA	0.6214	0.002	50.1214	52.2105	0.6391	-0.0018	51.8102	49.8818
SCI	0.013	0.0724	4.016	5.5786	0.2406	0.0346	4.1095	4.7587
OSImax	0.0023	3.0578	0.2511	0.3063	0.2943	0.9651	0.2553	0.2737
OSImean	2e-04	36.0493	0.0108	0.0191	0.0421	17.4644	0.0116	0.0158
WSSves [dyne/cm ²]	0.0091	0.0106	44.9416	55.9354	0.0722	0.0073	45.6356	53.0239
WSSnorm	0.0174	-1.022	0.5572	0.4486	0.2967	-0.4135	0.531	0.4874
MWSSnorm	0.3551	0.0433	5.7961	6.12	0.1993	0.0616	5.5807	6.0137
Corelen [cm]	0.0336	0.1248	1.3817	1.9996	0.353	-0.0585	1.5922	1.3358
podent	0.1203	1.1806	0.168	0.2026	0.6268	0.3634	0.1703	0.1807
Vmax [cm/s]	0.0097	0.0058	78.7448	98.9205	0.6925	9e-04	80.8263	83.6803
Avol [cm ³]	0.9239	0.0454	0.1122	0.1155	0.3129	-0.6111	0.1158	0.0818
Asize [cm]	0.0278	0.7835	0.622	0.7245	0.5375	-0.229	0.6416	0.6145
Aarea [cm ²]	0.4824	0.0711	0.8605	0.9722	0.3021	-0.1249	0.8903	0.7362
Nsize [cm]	0.6613	-0.3644	0.4224	0.4135	0.0619	-1.5744	0.4273	0.389
Narea [cm ²]	0.455	-1.0944	0.1362	0.1273	0.0785	-2.6322	0.137	0.1163
AR	0.0033	0.5779	0.9502	1.2148	0.5205	0.1223	0.9815	1.0354
Aheight [cm]	0.1587	0.5657	0.4097	0.467	0.3484	-0.4016	0.4237	0.3873
Awidth [cm]	0.9707	-0.0201	0.4454	0.4443	0.1051	-0.9759	0.447	0.3998
HWR	1e-04	1.6044	0.8513	1.0157	0.2482	0.4471	0.8737	0.9218
BF	0.3848	0.2717	1.2029	1.2482	0.7645	-0.0976	1.1987	1.1838
BL	0.8547	0.1434	0.334	0.3379	0.7054	0.2874	0.3237	0.3317
Vdiam [cm]	0.1151	-3.1986	0.2986	0.285	0.0345	-4.3042	0.3012	0.2834
SizeR	0.007	0.2614	2.1436	2.6133	0.5759	0.0541	2.1783	2.2705
VOR	0.7202	0.0318	0.6871	0.7518	0.3743	-0.106	0.7232	0.5614
CR	0.6801	-0.3981	0.7653	0.7582	0.917	-0.0986	0.7566	0.7548
EI	0.1659	5.6617	0.268	0.2736	0.9627	-0.1799	0.272	0.2718
NSI	<0.0001	11.3047	0.208	0.2474	0.2603	2.3523	0.2172	0.2258
MLN	<0.0001	7.232	0.2991	0.3572	0.3224	1.3313	0.309	0.3208

Tab 7 Results of the univariate comparison of ruptured (R) and unruptured (U) MCA-BIF aneurysms harbored by young patients (left) and harbored by old patients (right). The p-value refers to the Wald test, the coefficient to the coefficient of the fitted univariate logistic regression model

	p-value	Coefficient	Mean young U	Mean young R	p-value	Coefficient	Mean old U	Mean old R
ICI	0.8134	-0.0736	0.7123	0.6822	0.0903	0.4255	0.6657	0.9115
Q [cm ³ /s]	0.464	0.2229	0.5595	0.6572	0.1348	0.4688	0.6102	0.7869
KE [erg]	0.4111	3e-04	240.1346	449.5998	0.0258	0.0016	203.5029	395.5829
SR [1/s]	0.6143	3e-04	256.9341	299.7802	0.1253	0.0014	243.1217	306.5891
VE [cm/s]	0.6481	0.0096	9.8528	10.7238	0.042	0.0584	9.4822	12.2729
VO [1/s]	0.6336	2e-04	347.785	397.5604	0.0741	0.0012	325.5206	423.5878
VD [erg]	0.5025	0	1598.1338	6281.3427	0.0814	1e-04	1473.445	2602.1782
WSSmax [dyne/cm ²]	0.1659	0.0013	267.8463	336.1276	0.01	0.0026	233.5078	361.6137
WSSmin [dyne/cm ²]	0.1001	-0.3249	0.8811	0.4483	0.6138	-0.0619	0.963	0.6586
WSSmean [dyne/cm ²]	0.6096	0.0027	24.7869	28.9693	0.0961	0.0138	22.8495	30.317
LSA	0.1734	0.0084	46.2935	55.262	0.2662	-0.0069	53.8683	46.8883
SCI	0.0701	0.0776	3.874	5.9669	0.6825	0.0237	4.1335	4.4007
OSImax	0.0298	3.444	0.2506	0.3093	0.0772	2.6217	0.2474	0.297
OSImean	0.0264	31.2507	0.0116	0.0214	0.0208	33.9496	0.0105	0.0164
WSSves [dyne/cm ²]	0.2065	0.007	48.8055	58.3854	0.0555	0.0129	43.0271	53.7093
WSSnorm	0.0297	-1.4493	0.5524	0.402	0.8169	-0.1475	0.5319	0.5175
MWSSnorm	0.751	-0.0226	6.1299	5.9523	0.094	0.1199	5.4463	6.3117
Corelen [cm]	0.059	0.3036	0.9979	1.8003	0.1497	0.1103	1.4492	2.1327
podent	0.2377	1.4101	0.1594	0.2109	0.4901	0.9033	0.169	0.1884
Vmax [cm/s]	0.1357	0.0054	76.0261	94.2833	0.0193	0.0081	75.0541	104.1123
Avol [cm ³]	0.7337	0.3132	0.0766	0.0915	0.4421	-0.8459	0.1262	0.0816
Asize [cm]	0.0394	1.3817	0.5568	0.7019	0.3282	0.5177	0.6284	0.697
Aarea [cm ²]	0.3356	0.2025	0.6548	0.8646	0.751	-0.0545	0.9122	0.8347
Nsize [cm]	0.8174	-0.3069	0.3958	0.3888	0.8765	0.1922	0.4234	0.4283
Narea [cm ²]	0.7266	-0.8754	0.1205	0.1149	0.8191	-0.4863	0.1366	0.1323
AR	5e-04	1.5496	0.8241	1.3138	0.442	0.2068	0.9714	1.0763
Aheight [cm]	0.0505	1.6199	0.3406	0.4561	0.6922	0.2378	0.4207	0.4457
Awidth [cm]	0.4939	0.6819	0.392	0.4195	0.6052	-0.4474	0.4522	0.4274
HWR	2e-04	3.0941	0.8139	1.0633	0.0476	1.144	0.852	0.9855
BF	0.1002	0.9767	1.1378	1.2551	0.7261	-0.173	1.2079	1.1785
BL	0.1487	1.8053	0.3144	0.3621	0.194	-1.5846	0.3392	0.2969
Vdiam [cm]	0.3195	-3.0566	0.2889	0.2756	0.5332	-1.9545	0.302	0.294
SizeR	0.0471	0.3303	2.037	2.6226	0.2312	0.1781	2.1268	2.4224
VOR	0.0773	0.5455	0.4414	0.7292	0.5029	-0.1297	0.7893	0.5562
CR	0.6953	0.6371	0.7522	0.7618	0.445	-1.0829	0.7647	0.7443
EI	0.3188	7.9703	0.2687	0.2738	0.4957	3.6315	0.2698	0.2745
NSI	0.0146	8.4912	0.2124	0.2439	<0.0001	14.6457	0.2047	0.2556
MLN	0.0106	6.0188	0.3011	0.3509	3e-04	8.7344	0.2952	0.3651

Tab. 8 Results of the univariate comparison of MCA-BIF aneurysms harbored by female (F) and male (M) patients. The p-value refers to the Wald test, the coefficient to the coefficient of the fitted univariate logistic regression model

	p-value	Coefficient	Mean F	Mean M
ICI	0.1498	0.287	0.6733	0.818
Q [cm ³ /s]	0.001	0.7525	0.5532	0.8729
KE [erg]	0.0053	0.0013	211.8363	524.5084
SR [1/s]	0.0603	0.0012	244.7384	352.6155
VE [cm/s]	0.0048	0.054	9.3914	13.0413
VO [1/s]	0.0391	0.001	328.9346	474.056
VD [erg]	0.0935	1e-04	1538.8709	5920.1965
WSSmax [dyne/cm ²]	0.0149	0.0015	256.5453	341.8491
WSSmin [dyne/cm ²]	0.5636	0.0297	0.8596	1.0767
WSSmean [dyne/cm ²]	0.0224	0.014	22.8873	35.4114
LSA	0.1023	-0.0073	52.6268	44.8792
SCI	0.5687	0.0184	4.2832	4.6404
OSImax	0.3555	0.9819	0.258	0.2767
OSImean	0.1786	11.4031	0.0125	0.0156
WSSves [dyne/cm ²]	0.0844	0.0073	46.9841	55.153
WSSnorm	0.0691	0.7665	0.4944	0.5825
MWSSnorm	0.4616	0.0392	5.6925	5.9749
Corelen [cm]	0.0388	0.1277	1.3246	2.007
podent	0.4073	0.6632	0.1694	0.1898
Vmax [cm/s]	0.0022	0.0076	76.0086	103.7639
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Avol [cm ³]	0.4697	0.3692	0.0956	0.1229
Asize [cm]	0.0431	0.7997	0.6059	0.7098
Aarea [cm ²]	0.2441	0.1324	0.7811	0.9814
Nsize [cm]	0.0255	1.9493	0.3991	0.4519
Narea [cm ²]	0.0058	4.1149	0.1195	0.1576
AR	0.6605	0.0942	0.9948	1.037
Aheight [cm]	0.2149	0.559	0.3965	0.452
Awidth [cm]	0.1593	0.8476	0.417	0.4641
HWR	0.5653	0.2531	0.8874	0.9147
BF	0.9057	-0.0444	1.1947	1.188
BL	0.388	0.7546	0.323	0.3439
Vdiam [cm]	0.1134	3.4497	0.2901	0.3054
SizeR	0.2696	0.1171	2.1657	2.3749
VOR	0.8992	-0.014	0.6645	0.6392
CR	0.0634	-1.9418	0.7654	0.7289
EI	0.2622	4.6655	0.2704	0.2758
NSI	0.0059	6.5213	0.2143	0.2391
MLN	0.0695	2.803	0.3075	0.3325

Tab. 9 Results of the univariate comparison of ruptured (R) and unruptured (U) MCA-BIF aneurysms harbored by female patients (left) and harbored by male patients (right). The p-value refers to the Wald test, the coefficient to the coefficient of the fitted univariate logistic regression model

	p-value	Coefficient	Mean F U	Mean F R	p-value	Coefficient	Mean M U	Mean M R
ICI	0.7846	0.0644	0.6683	0.6979	0.3553	0.3389	0.7663	0.9412
Q [cm ³ /s]	0.773	-0.0953	0.5587	0.5357	0.1929	0.4142	0.7671	1.0694
KE [erg]	0.7837	-2e-04	212.847	202.5802	0.1183	0.001	273.4968	884.5797
SR [1/s]	0.4965	-6e-04	247.009	226.3893	0.296	0.001	272.1006	458.0267
VE [cm/s]	0.5009	-0.0181	9.5277	8.8619	0.0925	0.0489	10.7618	16.4854
VO [1/s]	0.504	-5e-04	331.923	305.4006	0.2372	9e-04	368.5365	618.4595
VD [erg]	0.6716	0	1533.763	1377.715	0.29	1e-04	1810.864	11607.488
			4	8			8	7
WSSmax [dyne/cm ²]	0.4601	7e-04	251.6551	272.3473	0.0085	0.0046	234.9459	498.4892
WSSmin [dyne/cm ²]	0.2687	-0.181	0.9507	0.5199	0.2738	-0.2139	1.2637	0.5693
WSSmean [dyne/cm ²]	0.2958	-0.0099	23.5166	20.3729	0.1859	0.0123	26.2578	48.2033
LSA	0.4914	0.0035	52.1499	55.7358	0.7397	-0.0028	46.3861	43.6681
SCI	0.241	0.0468	4.1388	4.877	0.1216	0.1068	3.6823	6.2009
OSImax	0.09	2.1018	0.2507	0.2877	0.0133	5.0628	0.238	0.3378
OSImean	0.0162	27.7852	0.0109	0.0174	0.0203	45.9089	0.0106	0.0231
WSSves [dyne/cm ²]	0.4249	0.0042	45.6113	49.3638	0.0194	0.0209	44.7057	70.8407
WSSnorm	0.017	-1.4514	0.5295	0.4043	0.613	-0.3939	0.5887	0.5438
MWSSnorm	0.7497	-0.0194	5.7831	5.644	0.0127	0.4029	5.2422	7.0369
Corelen [cm]	0.3039	0.078	1.2296	1.5646	0.1233	0.1861	1.5929	2.7027
podent	0.3471	0.892	0.1644	0.1893	0.2907	1.4952	0.1708	0.2264
Vmax [cm/s]	0.8256	8e-04	75.7536	77.3652	0.0119	0.012	79.0137	141.2455
Avol [cm ³]	0.5436	-0.4944	0.1023	0.0772	0.6537	-0.469	0.1412	0.1083
Asize [cm]	0.2806	0.505	0.5918	0.6497	0.1646	1.0068	0.6604	0.802
Aarea [cm ²]	0.953	-0.0086	0.7848	0.7741	0.9983	4e-04	1.0102	1.0109
Nsize [cm]	0.6305	-0.5662	0.4006	0.3897	0.5226	-0.8911	0.469	0.4371
Narea [cm ²]	0.4138	-1.8328	0.1213	0.1111	0.373	-2.0859	0.1719	0.1448
AR	0.0345	0.5091	0.9375	1.1716	0.0281	1.0023	0.8834	1.3022
Aheight [cm]	0.4195	0.4225	0.3869	0.4256	0.3931	0.7031	0.432	0.505
Awidth [cm]	0.5458	-0.4651	0.4233	0.4017	0.9304	-0.0947	0.4714	0.4659
HWR	0.0028	1.5832	0.8471	1.0043	0.0069	2.3596	0.8186	1.0849
BF	0.6778	0.1578	1.1913	1.2189	0.4406	0.5946	1.163	1.2317
BL	0.9998	-2e-04	0.3265	0.3265	0.8825	-0.2467	0.358	0.352
Vdiam [cm]	0.2809	-2.7641	0.2925	0.2811	0.1065	-6.7009	0.3171	0.2879
SizeR	0.1223	0.185	2.0908	2.4138	0.0802	0.3912	2.1326	2.7941
VOR	0.8977	-0.0142	0.6823	0.6508	0.9336	0.0257	0.6513	0.6696
CR	0.4811	-0.8864	0.7701	0.7558	0.5146	1.2238	0.7276	0.7517
EI	0.2879	5.1111	0.2682	0.2738	0.806	2.1823	0.2729	0.2748
NSI	5e-04	9.6914	0.2048	0.2398	0.0018	17.3643	0.2146	0.2671
MLN	0.0035	5.5893	0.297	0.3396	0.0018	10.23	0.2963	0.3921

Tab. 10 Results of the univariate comparison of sidewall (S) and bifurcation (B) MCA aneurysms (left) and PCOM aneurysms (right). The p-value refers to the Wald test, the coefficient to the coefficient of the fitted univariate logistic regression model

	p-value	Coefficient	Mean S	Mean B	P-value	Coefficient	Mean S	Mean B
ICI	0.0214	2.0647	0.2646	0.6725	0.1815	0.2507	0.6509	0.7762
Q [cm ³ /s]	0.0274	2.0541	0.2458	0.5871	0.3232	0.1423	0.7325	0.8478
KE [erg]	0.0502	0.0044	89.1139	268.8926	0.4597	-0.0002	272.0627	237.4847
SR [1/s]	0.2532	0.0019	189.9832	261.6738	0.1723	-0.0009	245.864	214.5273
VE [cm/s]	0.0166	0.1375	5.3488	9.8881	0.5199	-0.0108	10.3339	9.7553
VO [1/s]	0.2261	0.0015	251.7304	350.8844	0.1297	-0.0007	340.4493	292.2398
VD [erg]	0.8006	2.5292	1517.3022	2378.7881	0.2972	-5.0234	1687.9486	1366.561
WSSmax [dyne/cm ²]	0.0866	0.0036	179.2397	267.7947	0.2291	0.0008	257.6968	293.5638
WSSmin [dyne/cm ²]	0.7281	0.0542	0.6904	0.9194	0.3564	-0.1070	0.478	0.3558
WSSmean [dyne/cm ²]	0.2041	0.0215	16.9147	24.9823	0.2763	-0.0062	24.2017	21.3337
LSA	0.0414	-0.019	70.3673	52.1143	0.9012	-0.0005	58.0693	57.5959
SCI	0.1442	0.1386	2.71	4.3255	0.0231	0.0546	5.0606	7.3944
OSImax	0.292	1.9292	0.2162	0.2544	0.003	3.0117	0.2748	0.3204
OSImean	0.6698	8.1235	0.0115	0.0134	0.0867	18.2295	0.0133	0.0164
WSSves [dyne/cm ²]	0.7292	-0.0027	49.6029	46.9261	0.4341	-0.0038	50.4703	48.0258
WSSnorm	0.1534	1.3264	0.3832	0.514	0.1823	-0.5664	0.4785	0.4309
MWSSnorm	0.0076	0.3460	3.8849	5.7264	0.0099	0.1815	5.0907	6.063
Corelen [cm]	0.1444	0.4291	0.6431	1.3794	0.0591	0.09584	2.1108	2.7845
podent	0.6566	0.9289	0.1527	0.1701	0.0309	2.4265	0.1739	0.2098
Vmax [cm/s]	0.0114	0.0209	46.7945	80.3322	0.2557	0.0032	77.0368	84.0786
Avol [cm ³]	0.2427	5.3343	0.0349	0.0989	0.6843	0.1128	0.1657	0.1907
Asize [cm]	0.0334	2.5442	0.423	0.611	0.0112	0.8614	0.6968	0.8299
Nsize [cm]	0.0037	7.2535	0.2841	0.4015	0.0758	1.2623	0.4142	0.4576
Narea [cm ²]	0.0307	10.714	0.0752	0.1244	0.7821	0.1758	0.1576	0.1647
AR	0.8748	-0.0616	1.0086	0.9831	0.0724	0.3076	1.1939	1.3668
Aheight [cm]	0.1399	1.8788	0.2831	0.3967	0.0107	1.0855	0.4516	0.5579
Awidth [cm]	0.0736	3.0540	0.3154	0.4194	0.1659	0.6577	0.4781	0.5278
HWR	0.5317	0.5321	0.8369	0.8879	8e-04	1.3723	0.9005	1.0435
BF	0.7252	0.2605	1.1496	1.1838	0.5626	0.1576	1.2785	1.312
BL	0.0799	2.7416	0.2437	0.3216	0.004	1.9654	0.2955	0.3625
Vdiam [cm]	0.2538	4.3941	0.2691	0.2894	0.0579	3.2135	0.3858	0.4037
SizeR	0.0835	0.5607	1.6078	2.1717	0.186	0.1539	1.8982	2.087
VOR	0.5237	0.2699	0.4331	0.6281	0.4146	0.0851	0.8445	0.9743
CR	0.8365	0.3961	0.7535	0.7604	0.7758	0.3156	0.7733	0.7772
EI	0.2382	-9.0825	0.2783	0.2695	0.1278	-6.1579	0.2812	0.2754
NSI	0.2078	6.2357	0.1947	0.2137	0.0032	6.5107	0.2244	0.2464
MLN	0.0419	6.6938	0.2578	0.3059	<0.001	6.2396	0.304	0.3602