

Carotid Artery Stenting and Blood–Brain Barrier Permeability in Subjects with Chronic Carotid Artery Stenosis

Arkadiusz Szarmach, Grzegorz Halena, Mariusz Kaszubowski, Maciej Piskunowicz, Michal Studniarek, Piotr Lass, Edyta Szurowska and Pawel J. Winklewski

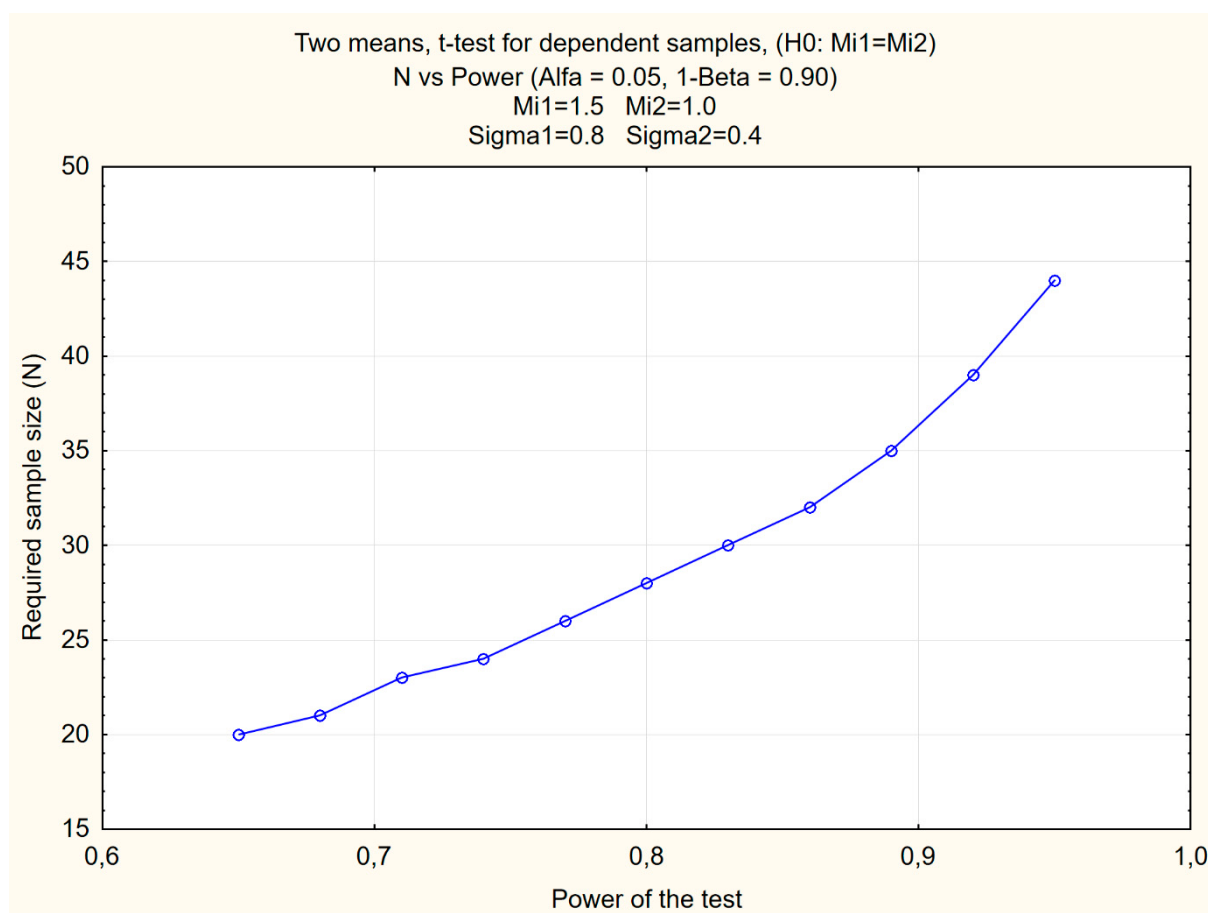


Figure S1. The sample size calculation. The minimum sample size for Alfa=0.05 and 1-Beta=0.9 is equal to 36 subjects.

Table S1. Inter-observer variability before (1) and after (2) surgery. The inter-rater variability presents the bias (mean of differences), lower and upper agreement limits designated according to the principle of Bland and Altman [23] and the standard deviation of the relative differences calculated as the difference between each pair of observations divided by their mean.

CT	Side	Bias	SD	Lower Agreement Limit	Upper Agreement Limit	rSDD	ICC(2,1)
MTT – 1	Ipsilateral side	0.003	0.257	-0.502	0.508	6.16%	0.985
MTT – 1	Contralateral side	-0,027	0.203	-0.425	0.409	5.05%	0.978
MTT – 2	Ipsilateral side	-0.008	0.180	-0.361	0.345	4.96%	0.988
MTT – 2	Contralateral side	0.001	0.182	-0.354	0.356	5.36%	0.978
CBV – 1	Ipsilateral side	-0.004	0.122	-0.244	0.235	7.12%	0.948
CBV – 1	Contralateral side	-0.005	0.121	-0.242	0.232	6.90%	0.942
CBV – 2	Ipsilateral side	-0.003	0.100	-0.199	0.194	5.18%	0.985
CBV – 2	Contralateral side	-0.011	0.107	-0.220	0.199	5.55%	0.982
CBF – 1	Ipsilateral side	0.150	1.260	-2.321	2.621	4.07%	0.994
CBF – 1	Contralateral side	-0.440	1.050	-2.498	1.818	2.74%	0.993
CBF – 2	Ipsilateral side	-0.187	1.149	-2.439	2.065	2.81%	0.996
CBF – 2	Contralateral side	-0.205	1.306	-2.766	2.355	2.75%	0.996
TTP – 1	Ipsilateral side	-0.306	0.676	-1.632	1.019	2.56%	0.977
TTP – 1	Contralateral side	-0.157	0.351	-0.846	0.531	1.42%	0.994
TTP – 2	Ipsilateral side	-0.133	0.502	-1.116	0.851	2.05%	0.987
TTP – 2	Contralateral side	-0.154	0.480	-1.094	0.786	2.01%	0.988
PS – 1	Ipsilateral side	-0.006	0.086	-0.175	0.163	6.67%	0.994
PS – 1	Contralateral side	-0.013	0.078	-0.166	0.140	6.48%	0.995
PS – 2	Ipsilateral side	0.011	0.061	-0.109	0.131	10.16%	0.986
PS – 2	Contralateral side	0.003	0.071	-0.136	0.143	11.38%	0.984

SDtd. Dev. – standard deviation, rSDD - standard deviation of the relative differences, ICC(2.1)

- intra-class correlation coefficient.

Table S2. Subgroup analysis for absolute CT perfusion parameter values (all slices) in two subgroups: 70–89% (21 subjects) and 90–99% (19 subjects) stenosis before (1) and after (2) stenting. Both groups benefited from the surgery.

Variable	t-test for dependent samples						
	Side	Stenosis	Mean	SD	No.	t	p-value
MTT – 1	Ipsilateral side	70-89%	4.906	1.699	168	9.999	<0.001
MTT – 2			3.962	1.213			
MTT – 1	Ipsilateral side	90-99%	4.536	1.141	152	9.525	<0.001
MTT – 2			3.976	1.103			
MTT – 1	Contralateral side	70-89%	4.444	1.081	168	11.768	<0.001
MTT – 2			3.759	0.890			
MTT – 1	Contralateral side	90-99%	4.115	0.809	152	11.251	<0.001
MTT – 2			3.551	0.820			
CBV – 1	Ipsilateral side	70-89%	1.738	0.326	168	-9.024	<0.001
CBV – 2			2.026	0.460			
CBV – 1	Ipsilateral side	90-99%	1.810	0.418	152	-10.074	<0.001
CBV – 2			2.196	0.666			
CBV – 1	Contralateral side	70-89%	1.723	0.313	168	-10.607	<0.001
CBV – 2			2.038	0.435			
CBV – 1	Contralateral side	90-99%	1.811	0.384	152	-9.644	<0.001
CBV – 2			2.195	0.664			
CBF – 1	Ipsilateral side	70-89%	36.836	10.913	168	-9.666	<0.001
CBF – 2			44.266	12.590			
CBF – 1	Ipsilateral side	90-99%	38.486	11.693	152	-11.426	<0.001
CBF – 2			48.217	12.840			
CBF – 1	Contralateral side	70-89%	38.396	8.142	168	-8.188	<0.001
CBF – 2			45.121	12.246			
CBF – 1	Contralateral side	90-99%	41.619	11.811	152	-9.766	<0.001
CBF – 2			52.904	17.315			
TTP – 1	Ipsilateral side	70-89%	26.185	2.594	168	17.899	<0.001
TTP – 2			24.002	2.219			
TTP – 1	Ipsilateral side	90-99%	25.982	4.119	152	11.093	<0.001
TTP – 2			24.209	3.956			
TTP – 1	Contralateral side	70-89%	25.939	2.527	168	16.328	<0.001
TTP – 2			23.905	2.128			
TTP – 1	Contralateral side	90-99%	25.559	4.217	152	12.888	<0.001
TTP – 2			23.762	4.090			
PS – 1	Ipsilateral side	70-89%	1.665	0.748	168	14.841	<0.001
PS – 2			0.912	0.358			
PS – 1	Ipsilateral side	90-99%	1.564	0.858	152	12.578	<0.001
PS – 2			0.759	0.366			
PS – 1	Contralateral side	70-89%	1.572	0.749	168	14.552	<0.001
PS – 2			0.888	0.358			
PS – 1	Contralateral side	90-99%	1.417	0.823	152	9.188	<0.001
PS – 2			0.746	0.423			

CBF- Cerebral Blood Flow, CBV- Cerebral Blood Volume, MTT- Mean Transit Time, TTP- Time to Peak, PS- Permeability Surface Area-Product , SD- Standard Deviation.

Table S3. Subgroup analysis for absolute CT perfusion parameter values (mean per patient) in two subgroups: 70–89% (21 subjects) and 90–99% (19 subjects) stenosis before (1) and after (2) surgery. Both groups benefited from the surgery.

Variable	Tests for dependent samples						
	Side	Stenosis	Mean	SD	N	t/z	p-value
MTT – 1	Ipsilateral side	70-89%	4.906	1.616	21	4.015	<0.001
MTT – 2			3.962	1.142			
MTT – 1	Ipsilateral side	90-99%	4.536	1.039	19	4.320	<0.001
MTT – 2			3.976	1.041			
MTT – 1	Contralateral side	70-89%	4.444	0.954	21	4.015	<0.001
MTT – 2			3.759	0.787			
MTT – 1	Contralateral side	90-99%	4.115	0.642	19	3.823	<0.001
MTT – 2			3.551	0.721			
CBV – 1	Ipsilateral side	70-89%	1.737	0.216	21	4.015	<0.001
CBV – 2			2.026	0.381			
CBV – 1	Ipsilateral side	90-99%	1.810	0.359	19	3.743	<0.001
CBV – 2			2.196	0.624			
CBV – 1	Contralateral side	70-89%	1.723	0.221	21	3.945	<0.001
CBV – 2			2.038	0.360			
CBV – 1	Contralateral side	90-99%	1.811	0.318	19	3.783	<0.001
CBV – 2			2.195	0.615			
CBF – 1	Ipsilateral side	70-89%	36.836	8.360	21	4.015	<0.001
CBF – 2			44.266	9.416			
CBF – 1	Ipsilateral side	90-99%	38.486	9.428	19	3.823	<0.001
CBF – 2			48.217	10.471			
CBF – 1	Contralateral side	70-89%	38.396	4.356	21	3.980	<0.001
CBF – 2			45.121	9.050			
CBF – 1	Contralateral side	90-99%	41.619	8.965	19	3.783	<0.001
CBF – 2			52.904	15.175			
TTP – 1	Ipsilateral side	70-89%	26.185	2.595	21	4.015	<0.001
TTP – 2			24.002	2.213			
TTP – 1	Ipsilateral side	90-99%	25.982	4.172	19	4.012	<0.001
TTP – 2			24.209	4.009			
TTP – 1	Contralateral side	70-89%	25.939	2.443	21	4.015	<0.001
TTP – 2			23.905	2.102			
TTP – 1	Contralateral side	90-99%	25.559	4.287	19	3.823	<0.001
TTP – 2			23.762	4.145			
PS – 1	Ipsilateral side	70-89%	1.665	0.678	21	6.366	<0.001
PS – 2			0.912	0.302			
PS – 1	Ipsilateral side	90-99%	1.564	0.751	19	3.823	<0.001
PS – 2			0.759	0.313			
PS – 1	Contralateral side	70-89%	1.572	0.675	21	6.098	<0.001
PS – 2			0.888	0.292			
PS – 1	Contralateral side	90-99%	1.417	0.751	19	3.501	<0.001
PS – 2			0.746	0.322			

CBF- Cerebral Blood Flow, CBV- Cerebral Blood Volume, MTT- Mean Transit Time, TTP- Time to Peak, PS- Permeability Surface Area-Product , SD- Standard Deviation.

Table S4. Tests for independent subgroups of absolute CT perfusion parameter (mean per patient) in two subgroups: 70–89% (21 subjects) and 90–99% (19 subjects) stenosis before stenting. There were no differences between these subgroups.

Stenosis	Test for independent samples						
	Side	CT Value	Mean	SD	N	t	p-value
70-89%	Ipsilateral	CBF	36.836	8.360	21	-0.583	0.563
90-99%	Ipsilateral	CBF	38.486	9.428	19		
70-89%	Contralateral	CBF	38.396	4.356	21	-1.423	0.167
90-99%	Contralateral	CBF	41.619	8.965	19		
70-89%	Ipsilateral	CBV	1.737	0.216	21	-0.771	0.447
90-99%	Ipsilateral	CBV	1.810	0.359	19		
70-89%	Contralateral	CBV	1.723	0.221	21	-1.002	0.324
90-99%	Contralateral	CBV	1.811	0.318	19		
70-89%	Ipsilateral	MTT	4.906	1.616	21	0.871	0.390
90-99%	Ipsilateral	MTT	4.536	1.039	19		
70-89%	Contralateral	MTT	4.444	0.954	21	1.292	0.205
90-99%	Contralateral	MTT	4.115	0.642	19		
70-89%	Ipsilateral	PS	1.665	0.678	21	0.440	0.663
90-99%	Ipsilateral	PS	1.564	0.773	19		
70-89%	Contralateral	PS	1.572	0.675	21	0.682	0.500
90-99%	Contralateral	PS	1.417	0.751	19		
70-89%	Ipsilateral	TTP	26.185	2.595	21	0.182	0.857
90-99%	Ipsilateral	TTP	25.982	4.172	19		
70-89%	Contralateral	TTP	25.939	2.443	21	0.339	0.737
90-99%	Contralateral	TTP	25.559	4.287	19		

CBF- Cerebral Blood Flow, CBV- Cerebral Blood Volume, MTT- Mean Transit Time, TTP- Time to Peak, PS- Permeability Surface Area-Product , SD- Standard Deviation.

Table S5. Tests for independent subgroups of absolute CT perfusion parameter (mean per patient) in two subgroups: 70–89% (21 subjects) and 90–99% (19 subjects) stenosis after stenting. There were no differences between these subgroups.

Stenosis	Test for independent samples						
	Side	CT Value	Mean	SD	N	t	p-value
70-89%	Ipsilateral	CBF	44.266	9.416	21	-1.250	0.219
90-99%	Ipsilateral	CBF	48.217	10.471	19		
70-89%	Contralateral	CBF	45.121	9.050	21	-1.944	0.062
90-99%	Contralateral	CBF	41.619	15.175	19		
70-89%	Ipsilateral	CBV	2.026	0.381	21	-1.031	0.311
90-99%	Ipsilateral	CBV	2.196	0.624	19		
70-89%	Contralateral	CBV	2.038	0.360	21	-0.971	0.340
90-99%	Contralateral	CBV	2.195	0.615	19		
70-89%	Ipsilateral	MTT	3.962	1.142	21	-0.040	0.968
90-99%	Ipsilateral	MTT	3.976	1.041	19		
70-89%	Contralateral	MTT	3.759	0.787	21	0.871	0.389
90-99%	Contralateral	MTT	3.551	0.721	19		
70-89%	Ipsilateral	PS	0.912	0.302	21	1.575	0.124
90-99%	Ipsilateral	PS	0.759	0.313	19		
70-89%	Contralateral	PS	0.888	0.292	21	1.459	0.153
90-99%	Contralateral	PS	0.746	0.322	19		
70-89%	Ipsilateral	TTP	24.002	2.213	21	-0.199	0.843
90-99%	Ipsilateral	TTP	24.209	4.009	19		
70-89%	Contralateral	TTP	23.905	2.102	21	0.135	0.893
90-99%	Contralateral	TTP	23.762	4.147	19		

CBF- Cerebral Blood Flow, CBV- Cerebral Blood Volume, MTT- Mean Transit Time, TTP- Time to Peak, PS- Permeability Surface Area-Product , SD- Standard Deviation.