



COLLATERAL CIRCULATION IN ACUTE ISCHEMIC STROKE

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BACKGROUND

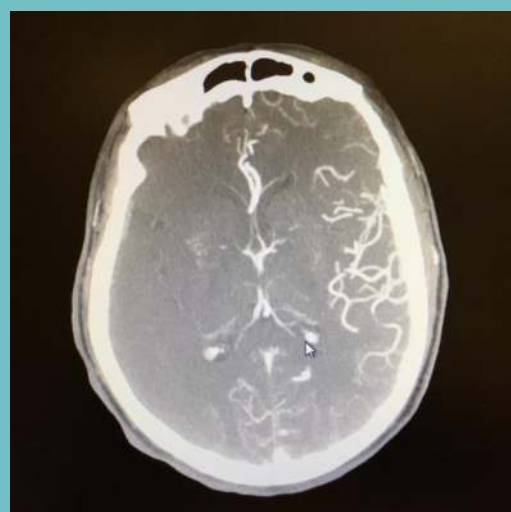
After acute ischemic stroke (AIS), older adults tend to have worse outcomes compared to young adults. One potential explanation is differences in cerebral collateral circulation (CCC). Multiple studies have shown that a robust CCC is associated with smaller infarcts, improved clinical outcomes, and lower rates of hemorrhagic transformation. We undertook this study to examine CCC status and the role it plays in determining infarct size and outcome in young and older adults with AIS.

METHODS

We studied 142 consecutive patients presenting with AIS secondary to occlusion of the proximal MCA. We measured final infarct volumes on DWI MRI and graded the CCC on CTA. We also assessed thrombus extent and location on CTA using the clot burden score (CBS). Patients were divided into 2 groups based on age; <55 and ≥55 years. Univariate and multivariate analyses were performed to test the relationship between age, CCC, and various clinical outcome measures. We also performed multivariate analyses stratified by age group.

RESULTS

In the univariate analysis, there were multiple predictors of good functional outcome (mRS 0-2). An adjusted multivariate analysis revealed that DWI lesion size was the most important predictor of functional outcome, followed by age. An adjusted multivariate analysis of DWI lesion size revealed that CCC was by far the most important predictor. This was apparent in both age groups, though with a higher standardized coefficient in the older age group. Despite there being a significant association between age and CCC in the univariate analysis, this did not hold for the multivariate analysis. Instead, overall clot burden was the most significant predictor of CCC, driven largely by the older patient cohort.



72Y MALE
R M1 OCCLUSION
TAN SCORE 0



77Y MALE
L M1 OCCLUSION
TAN SCORE 3

	Age <55 (n=46)	Age ≥ 55 (n=96)	p value
Demographics			
Age, mean (SD)	44 (9)	74 (10)	<0.0001
Sex - Female, % (n)	52 (24)	46 (44)	0.59
Race - White, % (n)	61 (28)	74 (71)	0.12
Medical History			
HTN, % (n)	59 (27)	74 (71)	0.08
HLD, % (n)	46 (21)	55 (53)	0.37
Statin Use, % (n)	28 (13)	47 (45)	0.05
DM, % (n)	33 (15)	25 (24)	0.42
Tobacco Use, % (n)	26 (12)	11 (11)	0.04
Clinical Variables			
Admission NIHSS, mean (SD)	13 (6)	16.5 (6.7)	0.01
Admission glucose, mean (SD)	145 (60)	134 (48)	0.30
Admission sBP, mean (SD)	135 (25)	145 (25)	0.03
Symptom Onset to CTA (min), mean (SD)	516 (446)	448 (427)	0.37
Imaging Variables			
Collateral Score, mean (SD)	1.96 (0.79)	1.68 (0.64)	0.04
Clot Burden Score, mean (SD)	5.5 (2.5)	5 (2.0)	0.18
Outcomes			
% getting Thrombectomy (n)	43 (19)	36 (35)	0.59
% with TICI 2b-3 (n)	22 (10)	19 (18)	0.99
Infarct Volume (cc), mean (SD)	59 (55)	61 (62.5)	0.84
Discharge NIHSS, mean (SD)	10.5 (7.1)	13.6 (9.6)	0.05
mRS 0-2, % (n)	35 (16)	32 (31)	0.03
Hemorrhage (>HI 1), % (n)	22 (10)	27 (26)	0.32

Variable	Age < 55			Age ≥ 55			
	Estimate	Std Error	P value	Estimate	Std Error	P value	
Rsqu = 0.23, P value = 0.01							
Diabetes	1.05	0.36	0.006	Clot burden	0.29	0.09	0.002
HTN	-0.86	0.35	0.02	HTN	-0.30	0.22	0.17
Clot burden	0.21	0.13	0.12	Diabetes	0.22	0.22	0.31

Variable	Age < 55			Age ≥ 55			
	Estimate	Std Error	P value	Estimate	Std Error	P value	
Rsqu = 0.46, P value = <0.0001							
CCC	-13.88	2.78	0.00001	CCC	-17.22	2.79	<0.00001
Time to CTA	2.12	0.92	0.03	Time to CTA	0.74	0.75	0.01
TICI IIB-III	-0.46	8.16	0.44	TICI IIB-III	-17.62	6.73	0.28
Clot burden	2.05	2.65	0.95	Clot burden	-2.92	2.68	0.33

Variable	Age < 55			Age ≥ 55			
	Estimate	Std Error	P value	Estimate	Std Error	P value	
Rsqu = 0.36, P value = 0.08							
Infarct size	0.009	0.005	0.06	Infarct size	0.01	0.003	0.002
TOAST			0.12	Admission NIHSS	0.07	0.03	0.01
Tobacco Use	-0.34	0.26	0.19	Tobacco Use	0.27	0.5	0.04
TICI IIB-III	-0.26	0.25	0.30	TOAST			0.05
Statin Use	0.17	0.24	0.48	Statin Use	0.28	0.17	0.09
CCC	0.07	0.77	0.51	TICI IIB-III	-0.31	0.22	0.17
				CCC	0.03	0.11	0.78

DISCUSSION

In this cohort, we are able to replicate the findings of prior studies showing better functional outcomes associated with better CCC. Our analysis suggests that this effect is mediated through smaller infarct sizes. Interestingly, after adjusting for a variety of clinical factors, we find that young adults do not have a significantly better CCC than older adults. This suggests that the association between younger adults and better collaterals is likely due to better general medical health and in turn, vascular health. Our stratified analysis seems to indicate that infarct size in older adults is more dependent on the status of their collateral circulation. This suggests that young adults may have alternative mechanisms to preserve brain parenchyma in AIS.

