Collateral Grades of the Willis' Circle Predicts Clinical Outcomes in Acute Intracranial Carotid Artery Occlusion before Thrombectomy

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Objective

Endovascular mechanical thrombectomy (EMT) promised acute ischemia stroke (AIS) with proximal artery occlusion significant but variable improvement of outcomes. We investigated the clinical outcome of EVMT in intracranial carotid artery occlusion (ICAO) and predictors of a favorable outcome.

Methods

Consecutive patients with acute ICAO who received EMT were retrospectively analyzed the pre-operative catheter angiographic finding. We derived a collateral grading system (primary collateral grade, PCG) based on angiographic presentations, which categorized the collateral flow through Willis' circle into 3 grades: Grade I - anterior communicating artery (AcoA) was absent; Grade II - preserved AcoA with ipsilateral posterior communicating artery (iPcoA) absent; Grade III - both AcoA and iPcoA preserved (Figure 1). Logistic regression were used to assess the association of the PCG with the 90-day modified Rankin Scale (mRS) score.

Results

The favorable clinical outcome at 90 days ($mRS \leq 2$) rated 31.6% (12/38). The rate of successful reperfusion i.e. modified thrombolysis in cerebral infarction (mTICI) $\geq 2b$ was 65.8% (25 in 38). PCG was associated with clinical outcomes as 61.5% patients with PCG-3 achieved $mRS \leq 2$ at 90 days, while it was 37.5% and 5.6% in patients with PCG-2 and PCG-1 (Table 1). PCG predicted $mRS \leq 2$ at 90 days with an adjusted OR of 5.27, 95% CI 1.31-21.13, $p=0.019$).

Conclusion

PCG based on the integrity of Willis' Circle had strong power to predict prognosis of AIS patients with ICAO in EVMT, favorable functional outcome favored in patients with preserved both AcoA and ipsilateral PcoA.

Figure 1. row A - PCG1, anterior communicating artery (AcoA) was absent, no matter ipsilateral posterior communicating artery (iPcoA) preserved or not; row B - PCG2, preserved AcoA with iPcoA absent; row C - PCG3, both AcoA and iPcoA preserved. Black arrow - AcoA, white arrow - iPcoA.

Table 1. Univariate analysis between groups of different clinical outcomes

Clinical outcome	Total (n=38)	Favorable (n=12)	Unfavorable (n=26)	p value
Male, (%)	21 (53.30)	8 (66.67)	13 (50.00)	0.337
Age (yrs), median	77.5 (69.0-81.0)	68.5 (50.5-76.75)	79.5 (74-82)	0.015
Hypertension (%)	25 (65.80)	6 (50.00)	19 (73.08)	0.163
Diabetes (%)	5 (13.20)	0 (0.00)	5 (19.23)	0.103
Atrial Fibrillation (%)	22 (57.90)	8 (66.67)	14 (53.85)	0.457
Admission NIHSS	23.0 (18.0-29.25)	18 (15-22.50)	25.5 (21.75-31.75)	0.001
ASPECT	7.5 (6.0-9.0)	8 (6-9)	7 (6-8.25)	0.466
BG, mean $\pm$ SD	7.97 $\pm$ 2.27	7.28 $\pm$ 2.01	8.29 $\pm$ 2.34	0.206
SBP, mean $\pm$ SD	154.37 $\pm$ 29.53	148.83 $\pm$ 22.79	156.92 $\pm$ 32.25	0.440
DBP, mean $\pm$ SD	83.45 $\pm$ 16.26	83.00 $\pm$ 18.62	83.65 $\pm$ 15.45	0.910
IV-tPA (%)	16 (42.10)	6 (50.00)	10 (38.46)	0.503
OTP, mins, median	345 (236.75-391)	326 (213-451)	349 (245-388.50)	0.816
Primary collateral grade (%)				
I	17 (44.70)	1 (8.33)	16 (61.54)	0.005
II	8 (21.10)	3 (25.00)	5 (19.23)	
III	13 (34.20)	8 (66.67)	5 (19.23)	
mTICI $\geq 2b$ (%)	25 (65.80)	11 (91.67)	14 (53.85)	0.022