Early Neurologic Deterioration after Mechanical Thrombectomy in Anterior Circulation Acute Ischemic Stroke Patients with Unfavourable Combination of Circle of Willis Configuration and Occlusion Localization

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Background

In acute ischemic stroke (AIS) patients, infarct growth rate depends on collateral circulation¹. We propose that configuration of circle of Willis (CoW) and intracranial occlusion localization may largely influence the overall collateral flow and early neurological deterioration, whether one or more arterial territories are affected.

The aim of this study was to analyze the influence of involvement of multiple vascular territories on patients' outcome.

Materials and Methods

Anterior circulation AIS (AC-AIS) patients who were treated in Republican Vilnius University hospital during 2014-2017 and underwent mechanical thrombectomy (MTE) were included. Target group was defined as having >1 arterial territory affected and control group as having single territory affected. Each patient from target group was matched with 2 control group patients regarding age and IVT status. Early neurologic deterioration was defined as NIHSS score ≥ 4 -point increase or death at 7 days.

Statistical analysis was performed using SPSS 15.0 statistical software (Chicago, IL). Groups were compared using Student-T, Mann-Whitney U, Pearson Chi-square and Fischer exact tests as appropriate. Univariate and multivariate logistic regression analysis was used to investigate influence of CoW variant in combination with occlusion site and other covariates on patients' outcome.

	Target group (N=16)	Control group (N=32)	P value
	No (%), mean $\pm$ SD or median (IQR)		
Age (years)	69 $\pm$ 8.5	71.7 $\pm$ 8.3	0.3
Sex (male)	7 (43.8)	13 (40.6)	0.84
Baseline NIHSS	19 (15-23)	16.5 (14-21)	0.18
ASPECTS score	6.5 (6-7)	8 (8-9)	<0.01
ASPECTS collaterals on CTA (poor)	10 (66.7)	1 (3.4)	<0.001
Clot length on CTA (mm)	19 $\pm$ 9.2	16.7 $\pm$ 10	0.52
Time from onset to recanalisation (min)	235 (197.5-280)	247.5 (213-287.5)	0.36
TICI score (grade 2b/3)	11 (73.3)	29 (90.6)	0.13
IVT (received)	9 (56.3)	18 (56.3)	0.62

Table 1. Patients' characteristics. NIHSS = National Institutes of Health Stroke Scale; ASPECTS = Alberta Stroke Program Early CT Score; CTA = Computed Tomography Angiography; TICI = Thrombolysis in Cerebral Infarction Scale; IVT = Intravenous Thrombolysis

References

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Results

From 142 patients 48 cases (16 patients in target group and 32 patients in control group) were included in the final analysis. Target group patients had lower ASPECTS and higher percentage of poor ASPECTS collateral circulation score compared to control group (table 1).

Target group patients had lower NIHSS score at 24 hours after MTE and more frequently experienced early neurological deterioration (table 2). Univariate logistic regression showed that early neurologic deterioration was associated with multiple territories affected (OR 12.69; 95% CI 2.19-73.42; p=0.005). Results remained significant after TICI score was added to the regression model (OR 11.22; 95% CI 1.89-66.52; p=0.008).

	Target group (N=16)	Control group (N=32)	P value
	No (%) or median (IQR)		
NIHSS score at 24 hrs after MTE	19.5 (17-25)	7.5 (3-16)	0.001
Death at 7 days	5 (33.3)	3 (10.3)	0.07
Early neurologic deterioration	7 (46.7)	2 (6.5)	0.003

Table 2. Patients' outcomes. NIHSS = National Institutes of Health Stroke Scale; MTE = Mechanical Thrombectomy.

Discussion and Conclusions

The extent of collateral flow may define the pace of infarct growth and differentiate slow progressors from fast progressors². Different anatomical variations of CoW given the same occlusion localisation and thrombus burden may impair collateral flow to a different number of territories affected (picture).

Our results suggest that the unfavourable combination of CoW configuration and occlusion localisation leading to >1 arterial territories being affected is associated with early neurologic deterioration of anterior circulation acute ischemic stroke patients after mechanical thrombectomy. That may be due to the impairment of LMC flow when nearby territories are being affected, leading to the fast growth of infarct core.

Picture. Examples of different Circle of Willis anatomical variant and clot localisation combinations. Top row - unfavourable CoW configuration with more than one vascular territory affected; bottom row - favourable CoW configuration, only one vascular territory is affected, leptomeningeal collateral blood supply from nearby territories. LMC = Leptomeningeal Collaterals; (*) = Clot. Arrows showing direction of blood flow. Segments colored in red - affected territories.