# The Difference of autonomic function in acute phase between right and left middle cerebral artery stroke.

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## Introduction

Cardiac complications such as arrhythmias, ischemic heart injury, or sudden death resulting from cardio-autonomic dysfunction is frequently observed following acute stroke. However, previous studies mainly investigate the role of right or left hemispheres involving insular cortex and cardiovascular function affecting sympathetic-parasympathetic tone by using heart rate variability (HRV) of 24-hour holter electrocardiography. However, we do not fully understand brain mechanisms and role affecting autonomic function system including cardio-autonomic system. We evaluated whether right or left middle cerebral artery (MCA) ischemic stroke affect autonomic function differently in acute phase of ischemic stroke using HRV analysis and other autonomic function tests.

## Methods

Patients with acute ischemic stroke involving MCA territory were included. Patients with no prior history of stroke were enrolled within 1 month after their initial event. Exclusion criteria from the study were patients with diabetes, a history of arrhythmia, cardiac disease, and renal and/or hepatic insufficiency. Medications which are known to influence ECG readings and cardiac rhythm on holter monitoring, were also excluded. HRV, autonomic function test [quantitative sudomotor axon reflex test (QSART), head-up tilt test (HUTT), sympathetic skin response (SSR), heart rate variation with deep breathing and valsalva ratio (VR)] were performed during admission after acute stroke onset. HRV measurements include time and frequency domain parameters. Statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS 18.0). Chi-squared test or Fisher's exact test was used for analyzing categorical variables. P value less than 0.05 was considered statistically significant. We analyzed the differences of autonomic function between patients with right and left MCA territory stroke.

## Results

A total of 35 patients were diagnosed with acute ischemic stroke. Among them, there were 16 with right MCA infarction and 19 with left MCA infarction. NIHSS score were not different between patients with right and left MCA infarction (3.75 ± 3.9 vs 2.84 ± 2.7, $p = 0.430$) [Table 1]. Insular involvement was found in 4 patients in each group and there were no differences between the two groups in terms of HRV and autonomic function test. Compared to patients with left MCA infarction (918.8 ± 103.2 ms), those with right MCA infarction (806.8 ± 102.5 ms, $p = 0.003$) had shorter RR interval in 24-hour holter electrocardiography. In patients with right MCA infarction, frequency domain parameters including very low frequency (VLF) and high frequency (HF) were significantly lower than in those with left MCA infarction.

Decrease in time domain parameters including square root of the mean of the sum of the squares of differences between adjacent NN intervals (RMSSD), standard deviation of all NN intervals (SDNN), and standard deviation of the averages of NN intervals in all 5-minute segments of the entire ECG recording (SDANN) was shown in patients with right MCA infarction compared to those with left MCA infarction. However, there were no difference in QSART, HUTT, SSR, heart rate variation with respiration, and VR between two groups (Table 2).

**Table 1. Comparison of clinical characteristics between right and Left MCA infarction.**

| | Rt MCA (n=16) | Lt MCA (n=19) | *p*-value |
|---|---|---|---|
| Age (mean ± SD), y | 63.2 ± 11.6 | 64.8 ± 11.7 | 0.688 |
| Gender, n(%) | | | 0.929 |
| Male | 12 (75%) | 14 (73.7%) | |
| Female | 4 (25%) | 5 (26.3%) | |
| HTN, n(%) | 12 (75%) | 13 (68.4%) | 0.723 |
| Hyperlipidemia, n(%) | 1 (6.3%) | 7 (36.8%) | **0.047** |
| Smoking, n(%) | 8 (50%) | 8 (42.1%) | 0.640 |
| NIHSS | | | |
| Day 1 | 3.75 ± 3.9 | 2.84 ± 2.7 | 0.430 |
| Day 7 | 2.8 ± 3.0 | 2.3 ± 2.8 | 0.586 |
| mRS (day 1) | | | 0.091 |
| Mild (0~2) | 5 (31.3%) | 11 (57.9%) | |
| Moderate (3~6) | 11 (68.7%) | 8 (42.1%) | |
| CASS, n (%) | | | |
| Sudomotor (mild) | 9 (56.3%) | 14 (73.7%) | 0.279 |
| Sudomotor (≥moderate) | 7 (43.8%) | 5 (26.3%) | |
| Cardiovagal (mild) | 15 (93.8%) | 18 (94.7%) | 0.713 |
| Cardiovagal (≥moderate) | 1 (6.4%) | 1 (5.3%) | |

**Table 2. Autonomic function test results in patients with right and left MCA infarction.**

| | Rt MCA (n=16) | Lt MCA (n=19) | *p*-value |
|---|---|---|---|
| RR interval (ms) | 806.8 ± 102.5 | 918.8 ± 103.2 | **0.003** |
| VLF | 22.7 ± 6.4 | 28.8 ± 9.1 | **0.031** |
| LF | 12.5 ± 5.7 | 16.3 ± 7.2 | 0.104 |
| HF | 7.5 ± 2.9 | 10.3 ± 4.7 | **0.040** |
| LFHF ratio (%) | 1.7 ± 0.5 | 1.6 ± 0.5 | 0.663 |
| pNN50 | 2.9 ± 4.5 | 6.3 ± 6.8 | 0.095 |
| SDNN | 92.5 ± 15.9 | 112.6 ± 26.1 | **0.009** |
| SDANN | 80.0 ± 16.2 | 97.0 ± 25.1 | **0.026** |
| RMSSD | 19.6 ± 7.3 | 26.8 ± 11.1 | **0.033** |
| HRV with respiration (mean ± SD) | 14.3 ± 6.2 | 13.3 ± 5.9 | 0.628 |
| Valsalva ratio (mean ± SD) | 1.4 ± 0.2 | 0.5 ± 0.2 | 0.081 |
| QSART1(mean ± SD) (volume Rt proximal arm) | 0.4 ± 0.4 | 0.7 ± 0.6 | 0.073 |
| QSART2 (volume Lt proximal arm) | 0.5 ± 0.4 | 0.7 ± 0.7 | 0.236 |
| QSART3 (volume Rt proximal leg) | 0.7 ± 0.6 | 0.7 ± 0.5 | 0.937 |
| QSART4 (volume Lt proximal leg) | 0.4 ± 0.4 | 0.6 ± 0.4 | 0.299 |

## Discussion

Decreases in VLF, HF of frequency-domain and SDNN, RMSSD of time-domain recordings of HRV that indicate changes in parasympathetic activity. Decreases in SDANN indicating greater levels of sympathetic activity, especially in patients with right MCA territory lesions. These results suggest that during the acute stroke period cardio-autonomic function is increased by an increase in sympathetic activity or a decrease in parasympathetic activity.

## Conclusions

Laterality of MCA infarction in acute phase of stroke may affect autonomic function differently. Except HRV, there were no difference in autonomic function test between right and left MCA infarction in acute stroke phase. Only HRV showed difference according to laterality of MCA infarction.