

Rate of Stroke Mimics over Telestroke

Dong In Sinn,^a Sami Al Kasab,^b Chirantan Banerjee,^b Shelly Ozark^b

^aDepartment of Neurology and Neurological Science, Stanford University School of Medicine, Stanford, CA, USA

^bDepartment of Neurology, Medical University of South Carolina, Charleston, SC, USA

Dear Sir:

Intravenous thrombolysis (IVT) remains the cornerstone of acute ischemic stroke treatment.¹ However, use of IVT has remained low due to lacking access to emergency medicine care.² Successful implementation of a statewide telestroke network at the Medical University of South Carolina has increased post-IVT transfer (drip-and-ship) from 28 cases in 2008 to 336 in 2015.³ A major limitation that consulting neurologists may have during telestroke care is inability to perform first-hand examination before making critical decisions. We investigated whether telestroke is associated with increased frequency of stroke mimics (SM).

A retrospective study was conducted to compare patients who received IVT through telestroke between January 2013 and October 2014 (telestroke group) to those who had IVT directly during the same period (in-house group). Acute ischemic stroke was defined based on either radiological evidence or clinical evidence of symptoms persisting ≥ 24 hours or until death, and other etiologies excluded. SM was defined as a non-ischemic condition mimicking focal ischemic strokes without radiological evidence of acute localized cerebral ischemia relevant to presenting symptoms. To identify SM, we screened cases without acute stroke on 24 hour post-IVT images first. SM cases were identified based on primary discharge diagnoses. Then, a panel with two vascular and two board-certified neurologists reviewed the residual cases to determine them as SM or as neuroimaging-negative cerebral ischemia.

During the study period, 196 patients in the telestroke group and 90 patients in the in-house group received IVT. One case in each group was excluded due to insufficient medical records. Baseline clinical characteristics in each group are shown in Table 1. In the telestroke group, neurological deficit was more severe (me-

dian NIHSS, interquartile range: 11, 6–17 vs. 8, 4–13, $P=0.005$). The rate of post thrombolysis intracerebral hemorrhage was 24 (12.3%) vs. 10 (11.4%) ($P=0.977$) in the telestroke and in-house groups respectively (Table 1). There was no difference in the percentage of patients achieving good functional outcome (49% in the telestroke vs. 43% in the in-house group).

There were 53 cases (27.2%) and 13 cases (14.8%) of SM in the telestroke and in-house groups respectively ($P=0.033$) (Table 2). Seventy-eight (40.0%) out of 195 cases in the telestroke group and 30 (34.1%) out of 88 in the in-house did not have radiological evidence of acute stroke on 24 hours post-tPA scans ($P=0.415$). Logistic regression analysis revealed previous history of seizures, psychiatric conditions and migraine as risk factors of SM (data not shown). SM in both groups combined was associated lower risk of intracranial bleeding (3.0% vs. 18.4%, $P<0.0005$) and better functional outcomes at discharge (modified Rankin Scale of 0 and 1: 69.7% vs. 40.1%, $P<0.0005$).

Our study found that telestroke under drip-and-ship paradigm is associated with an increased frequency of SM among patients who undergo IVT, as compared to patients who received IVT after an in-person evaluation.

Telestroke neurologists can encounter the dilemma of "swift or sure"⁴ where one may lose chance of good outcome by delaying thrombolysis to gather additional information for diagnostic accuracy. Since it is well known that IVT is relatively safe and functional outcomes are favorable in SM,⁵ some neurologists may tend to treat a patient with IVT with an unclear clinical scenario. Our telestroke network serves the state of South Carolina, a part of the "stroke belt" of the USA with the highest stroke incidence, and morbidity. This fact may contribute to lower threshold of giving IVT when a diagnosis of acute stroke is unclear but still possible.

Table 1. Characteristics and functional outcomes of the telestroke and the in-house groups

	Telestroke group	In-house group	P
Number of cases	195	88	
Age	64.0±14.1	64.3±15.5	0.875
Female	104 (53.3)	49 (55.7)	0.812
Race			0.041*
White	68	55	
Non-white	32	45	
Past medical history			
Atrial fibrillation	31 (15.9)	20 (22.7)	0.224
Diabetes mellitus	61 (31.3)	27 (30.7)	1.000
Hypertension	148 (75.9)	72 (81.8)	0.340
Coronary artery disease	60 (30.8)	19 (21.6)	0.147
Peripheral artery disease	6 (3.1)	4 (4.5)	0.786
Congestive heart failure	20 (10.3)	15 (17.0)	0.158
Stroke/transient ischemic attack	60 (30.8)	23 (26.1)	0.515
Smoking (for the past 5 years)	70 (35.9)	23 (26.1)	0.197
Seizure/epilepsy	14 (7.2)	2 (2.3)	0.169
Migraine	11 (5.6)	7 (8.0)	0.635
Cognitive problems/dementia	15 (7.7)	5 (5.7)	0.719
Psychiatric diseases	34 (17.4)	16 (18.2)	1.000
Blood pressure (mmHg)			
Systolic blood pressure	151.5±24.3	149.3±28.7	0.489
Diastolic blood pressure	83.8±15.4	78.4±18.9	0.014*
NIHSS on presentation	11 (6–17)	8 (4–13)	0.005*
Acute neurovascular intervention	23 (11.8)	17 (19.3)	0.134
Image modality of 24 hours post-tPA scan			0.108
MRI:CT (%)	61:39	50:50	
Intracranial bleeding on post-tPA scan	24 (12.3)	10 (11.4)	0.977
Modified Rankin Scale (%)			
0–1	49	43	
2–4	38	47	
5–6	13	10	
Disposition			
Home	127 (65.1)	55 (62.5)	
Rehabilitation facility	43 (22.1)	24 (27.3)	
Deceased/hospice	24 (12.3)	8 (9.1)	
Others	1 (0.5)	1 (1.1)	

Values are presented as mean±standard deviation, number (%) or median (interquartile range) unless otherwise indicated. Analyzed with Student *t*-test or Mann-Whitney *U*-test for continuous variables or with Fisher's exact test for categorical variables. Intracranial bleeding defined any new bleeding seen on post-IVT brain images regardless of clinical symptoms.

NIHSS, National Institute of Health Stroke Scale; tPA, tissue plasminogen activator; MRI, magnetic resonance imaging; CT, computed tomography.

**P*<0.05.

The increased frequency of SM could be from the method for case identification. We used a multiple step process to identify SM whereas most studies used one of three methods or in combination including radiological evidence, alternative dis-

charge diagnoses and retrospective review.⁶ This difference might have contributed to the higher frequencies of SM in both groups of our study.

Our study also revealed safety and favorable outcome of IVT

Table 2. Risk of stroke mimics, NNCI and acute ischemic stroke

	SM*	Ischemic events		
		NNCI	Acute ischemic stroke [†]	NNCI+acute ischemic stroke
Telestroke group (n=195)	53 (27.2)*	25 (12.8)	117 (60.0)	142 (72.8)
In-house group (n=88)	13 (14.8)	17 (19.3)	58 (65.9)	75 (85.2)

Values are presented as number (%).

NNCI, neuro-image negative cerebral ischemia; SM, stroke mimics.

*Twenty seven SM cases identified based on discharge summary. The panel reviewed 80 cases. Twenty cases needed a third reviewed because initial two reviewers disagreed. Thirty nine SM cases decided by the panel; [†]One case has acute stroke on image on post-intravenous thrombolysis day 3; [†]Fisher's exact test for independence indicated increased association between stroke mimics with telestroke, $P=0.033$.

in SM at the time of discharge. Our study has some limitations, mainly resulting from its retrospective nature. In addition, our study is a single-center study and its result might not be generalizable.

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Correspondence: Shelly Ozark

Department of Neurology, Medical University of South Carolina, 96 Jonathan Lucas St, CSB, 301, Charleston, SC 29424-6160, USA

Tel: +1-843-792-3221

Fax: +1-843-792-8626

E-mail: ozark@musc.edu

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