Higher Fasting Glucose Next Day after Intravenous Thrombolysis Is Independently Associated with Poor Outcome in Acute Ischemic Stroke

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Background: We aimed to test the outcome-predictive power of routine fasting glucose (FG) obtained at second day after onset in intravenous thrombolysis (IVT) acute ischemic stroke (AIS) patients. *Methods:* We identified AIS patients presenting to our institution between December 2011 and July 2013 within 4.5 hours of onset, who received admission glucose (AG) before IVT, FG, and glycated hemoglobin (HbA1c) the second day after admission, from our prospectively recorded stroke database. Multivariate logistic regression was used to assess the association of FG and 90-day modified Rankin Scale (mRS). *Results:* Between December 2011 and July 2013, a total of 166 AIS patients received intravenous plasminogen activator. Of those, 119 patients who have AG before IVT, FG, and HbA1c the second day were included in the study. FG independently predicted 90-day clinical unfavorable outcome (mRS, 3-6 with an odds ratio of 1.576; 95% confidence interval [CI], 1.053-2.358; $P = .027$). This association was not significant in AG ($P = .714$), HbA1c ($P = .655$), and history of diabetes ($P = .547$). In receiver operating characteristic analysis, increased FG was associated with 90-day mRS (3-6) with an area under curve of .72, (95% CI, .65-.9; $P = .001$). *Conclusions:* FG is a powerful predictor associated with the outcome in IVT-treated AIS patients independent of AG and HbA1c. **Key Words:** Admission glucose—fasting glucose—acute ischemic stroke—thrombolysis.

Introduction

Admission glucose (AG) level and history of diabetes mellitus (DM) are associated with poor clinical outcome after intravenous thrombolysis (IVT).[1,2] However, a recent study found that IVT-treated patients with post-stroke hyperglycemia (PSH) assessed with AG did not have significantly worse outcomes.[3] Various physiologic statuses, such as dietary intake or using insulin before onset, can impact AG level besides PSH and finally influence the association between PSH and outcome. Unfortunately, this issue was difficult to be controlled in clinical practice.

The purpose of our study was to test the outcome-predictive strength of routine fasting glucose (FG) the second day morning after admission in IVT-treated stroke patients. We hypothesized that FG in a similar physiologic status could be more reliable to evaluate the pathologic glucose metabolism in acute ischemic stroke (AIS) patients than AG and therefore predict the outcome.

Methods

Patients

We identified AIS patients presenting to our institution between December 2011 and July 2013 within 4.5 hours of

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Table 1. *Comparison of patient characteristics in those with good versus poor outcomes*

		90-day functional outcome		
	Total	mRS 0-2	mRS >2	*P* value
N	119	72	47	
Age, mean (SD), y	66 (57-74)	63 (55-72)	71 (61-77)	.027
Male, %	65.5 (78/119)	69.4 (50/72)	59.6 (28/47)	.325
Hypertension, %	65.5 (78/119)	66.7 (48/72)	63.8 (30/47)	.844
Diabetes, %	31.9 (38/119)	23.6 (17/72)	44.7 (21/47)	.026
Dyslipidemia, %	19.3 (23/119)	15.3 (11/72)	25.5 (12/47)	.235
Previous stroke, %	14.3 (17/119)	9.7 (7/72)	21.3 (10/47)	.108
Smoking, %	42 (50/119)	45.8 (33/72)	36.2 (17/47)	.345
OTT, mean (SD), min	180 (132-234)	184 (142-255)	155 (124-216)	.129
Baseline NIHSS, mean (SD)	10 (4-15)	6 (3-10)	15 (10-18)	<.001
SBP, mean (SD), mm Hg	150 (140-163)	147 (138-161)	157 (140-170)	.139
DBP, mean (SD), mm Hg	87 (80-92)	86 (80-91)	87 (80-92)	.696
TOAST, %				.005
Large vessel disease	34.7 (41/118)	38 (27/71)	29.8 (14/47)	
Small vessel disease	27.1 (32/118)	35.2 (25/71)	14.9 (7/47)	
Cardioembolism	34.7 (41/118)	22.5 (16/71)	53.2 (25/47)	
Other and undetermined	3.4 (4/118)	4.2 (3/71)	2.1 (1/47)	
AG, mean (SD), mmol/L	7 (5.9-8.3)	6.4 (5.7-7.6)	7.8 (6.3-11.1)	.001
FG, mean (SD), mmol/L	6.1 (5.2-7.7)	5.8 (5.5-6.4)	7.6 (5.5-11.1)	<.001
HbA1c, %	6 (5.5-6.7)	5.8 (5.5-6.4)	6.3 (5.8-7.8)	.002

Abbreviations: AG, admission glucose; DBP, diastolic blood pressure; FG, fasting glucose; HbA1c, glycated hemoglobin; mRS, modified Rankin Scale; NIHSS, National Institutes of Health Stroke Scale; OTT, onset to treatment time; SD, standard deviation; SBP, systolic blood pressure; TOAST, Trial of Org 10172 in Acute Stroke Treatment.

onset, who received AG before intravenous plasminogen activator (IV-tPA), FG, and glycated hemoglobin (HbA1c) the second day after admission. We supplied the meal according to the swallow test if the patients were admitted before 8 pm on the first day. All patients were limited on bed in the intensive care unit during the first 24 hours after IV-tPA. Thus, the situation of dietary intake and bed rest level were similar among patients. Baseline National Institutes of Health Stroke Scale (NIHSS), 90-days mRS (modified Rankin Scale), blood pressure, and onset to treatment time were obtained from the database. Histories of hypertension, dyslipidemia, DM, previous stroke, and smoking were recorded at the admission. Stroke etiology was classified according to the Stop Stroke Study Trial of Org 10172 in Acute Stroke Treatment based on the following magnetic resonance imaging and computer tomography angiography after admission. The study was performed with the informed consent of the patients or their next of kin and with ethical approval from the Institutional Review Board of Huashan Hospital.

Statistics Analysis

Statistical analyses were performed using SPSS, version 20 (SPSS Inc, Chicago, IL). *P* less than .05 was considered to indicate statistical significance. Patients were dichotomized by using the 90-day mRS score into good (mRS score 0-2) versus poor outcome (mRS score 3-6). Differences of patients' characteristics between outcomes were tested by the Fishers exact test for categorical and the Mann–Whiney test for continuous value. Multivariate binary logistic regression (including variables with *P* value <.2) was used to assess the association of AG, HbA1c, and FG with 90-day poor outcome (mRS 3-6). Receiver operating characteristic analysis was performed between FG and poor outcome.

Results

Between December 2011 and July 2013, a total of 166 AIS patients received IV-tPA. Of those, 119 patients have AG before IV-tPA, FG, and HbA1c the second day after admission. Patient characteristics (total and stratified by outcome) are listed in Table 1. As expected, increased age and higher baseline NIHSS, history of DM and atrial fibrillation, higher AG, FG, and HbA1c were significantly associated with worse functional outcome.

Multivariate logistic regression analysis between variables (*P* value <.2) and 90-day mRS was listed in Table 2. Previous stroke, onset to treatment time, baseline NIHSS, and FG was independently associated with outcome after adjust DM history, AG, HbA1c, systolic blood pressure, atrial fibrillation, and age. FG predicted favorable outcome with an odds ratio of 1.576 (95% confidence interval, 1.053-2.358; $P = .027$). This association was