Prehospital notification reduced time delays but not neurological outcomes in acute ischemic stroke

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Research Article

Keywords: delay time, thrombolysis therapy, neurological outcome, prehospital notification, ischemic stroke

Posted Date: April 28th, 2021

DOI: https://doi.org/10.21203/rs.3.rs-440192/v1

Abstract

Introduction: Since timely thrombolytic therapy is a crucial variable in acute ischemic stroke recovery, health care systems are trying to find new interventions to reduce treatment delay in order to improve neurological function. In Iran, SAMA code as a prehospital notification plan has been developed to help emergent stroke treatment. This study aimed to compare time delay to thrombolysis therapy and neurological outcomes between prehospital notification (SAMA)-transported patients and self-transported patients in acute ischemic stroke.

Methods and materials: In this retrospective cohort study, the data of 185 stroke patients treated with intravenous thrombolysis were gathered. There were two groups including, SAMA-transported (n=110) patients and self-transported (n=75) patients. The treatment delays including, onset to needle time (ONT), onset to door time, (ODT), door to CT time (DCT) and door to needle time (DNT) as well the neurological scores measured using NIHSS and mRS were analyzed between two groups. p-value<0.05 was considered as significant.

Results: The results showed that delay times reduced in SAMA-transported patient compared to that in self-transported patients. The findings revealed a significant difference in ONT (150 (120-180) vs 180 (150-225) (p=0.001), DNT (80 (60-105) vs 100 (80-125) (p=0.0001), and DCT (27 (20-37) vs 36 (24-52) (p=0.001) between SAMA-transported patients and self-transported patients. The times are represented as minute (median and IQR). However, there was no significant difference *between two groups* in terms of neurologic deficit severity*. Also, there was no relationship between the delay time and* neurological outcomes.

Conclusion: Although SAMA prehospital notification could partially reduce treatment delay times in acute ischemic stroke, such reduction was not enough to impact on neurologic deficit recovery. It seems more reduction in delay time is needed to significant improvement of neurological dysfunctions.

Introduction

Stroke is still the second leading cause of death and a main cause of long-term disability around the world. That imposes serious economic and social problems on patient, family and public health (1). Approximately 80% of strokes are classified as ischemic stroke (2) and the intravenous thrombolysis is a well-known and widely-used therapy for this type of stroke. However, this treatment is time dependent and delay in thrombolysis injection reduces its effectiveness. Consequently timely intravenous thrombolysis for acute ischemic stroke is a main concern in health care system (3).

The phrase “time is brain” emphasizes on emergency treatment of stroke (4), Therefore, health care systems have been trying to plan and stabilize some interventions in order to reduce delay for thrombolytic therapy. One of these activities to reduce treatment delay is stabilization of prehospital notification. Prehospital notification for stroke in Iran, coded as SAMA, aims to reduce the treatment delay by rapidly identifying stroke-suspected patients who are positive in face, arm and speech tests

(FAST), and by quickly transporting that patients to the comprehensive stroke centers, as well as by increasing alertness and readiness of the stroke centers for immediate treatment (5).

The principal purpose in the treatment of stroke patients is to improve neurological deficits (6). Therefore, the success of any intervention and treatment in stroke, such as SAMA prehospital notification is mainly measured by its effect on neurological improvement. With regard to importance of reduction of delay in thrombolytic therapy and importance of neurological improvement as the main concern for stroke treatment, this study was done to assess whether SAMA prehospital notification has a proper performance to reduce treatment delay and, if so, whether that amount of time reduction could have significant effect on neurological outcomes. Therefore, this study aimed to compare time delay and neurological outcomes between prehospital notification (SAMA)-transported patients and self-transported patients in acute ischemic stroke.

Methods And Materials

In this retrospective cohort study, data were obtained from the files of the acute ischemic stroke patients treated with intravenous rtPA thrombolysis. This study was done in Shahid Beheshti hospital affiliated to Qom university of medical sciences, Iran. This hospital as a 724 code hospital has been equipped with a stroke center providing specific care for acute ischemic stroke patients. Also SAMA code as a prehospital notification service has been established in order to quick transport of patients with a suspected stroke to 724 code hospital (5). As a whole, 724 code hospital and prehospital notification (SAMA) code were developed to rapidly identify and treat patients suspected to acute ischemic stroke.

The study was approved by Iran national committee for ethics in biomedical research (record no. IR.MUQ.REC.1398.022). All methods were performed in accordance with the relevant guidelines and regulations. Acute ischemic stroke patients between 18 to 80 years old who received thrombolytic drug and had complete hospital records, were included in the study from Mar 2016 to May 2020.

Excluded files were the file of patients diagnosed with hemorrhagic stroke or not treated with thrombolysis. Also, patients who died or had bleeding or severe complications were excluded. A total of 185 eligible patients who received thrombolytic therapy, 110 patients transported through SAMA code and 75 patients presented to hospital by themselves, were included in the study.

The collected data included the demographic and comorbidities data, neurological assessment using NIHSS and mRS at admission and discharge and the times including Onset to Door time (ODT), Onset to Needle time (ONT), Door to Needle Time (DNT) and Door to CT Time (DCT).

Statistical analysis

Quantitative data were presented as median (interquartile range, IQR) or mean ± standard deviation and qualitative data were presented as frequency and percentages. After testing for normality, the groups were compared using Mann-Whitney U test or $\chi 2$ tests. Also relationship between two groups in term of

neurological outcomes or time delay was tested using Spearman's test. Data were analyzed using SPSS software version 22. P value < 0.05 was considered statistically significant.

Results

Demographic characteristics and comorbidities are shown in table 1. Findings of the treatment times, presented in table. 2, showed that ODT in the SAMA-transported patients (60 (40-88)) was not significantly different in comparison with that in the self-transported patients (65 (40-115) (p=0.22). However, the results displayed the significant difference between SAMA-transported patients and self-transported patients in terms of DNT (80 (60-105) vs 100 (80-125) (p<0.0001) and DCT (27 (20-37) vs 36 (24-52) (p<0.001). Also ONT in SAMA-transported patients were significantly shortened in comparison with the self-transported patients (150 (120-180) vs 180 (150-225, p<0.001) (tab. 2).

The results of neurologic deficit severity scales are presented in table 3. The results showed that the admission neurologic deficit severity, assessed using NIHSS, was not different between two groups (15 (10-18) vs. 13 (10-16), p=0.17). Also, there was no significant NIHSS difference at discharge time between the SAMA-transported patients and the self-transported patients (1 (0-5) vs 1 (0-4.25), p=0.97). Analysis of data of mRS as another neurologic disability scale showed similar results. There was no significant difference between the SAMA-transported and the self-transported patients in mRS score at admission time (5 (4-5) vs 4 (3-5) p=0.07) and discharge time (1 (0-3) vs 1 (0-1) p = 0.30) (tab.3).

The Findings of the neurological deficit improvement in SAMA-transported patients and self-transported patients are shown in table 4. As shown in table 4 there was no significant difference in the amount of improvement between two groups. Table 5 and 6 presents the results of correlation between the delay times and the improvement in neurologic function in two groups. No relationship was shown between times (ONT, ODT, DCT, DNT) and improvement in HINSS or mRS (tab. 6).

Discussion

Stroke is still a main cause of long-term disability and mortality as well is one of the main challenges in health care systems around the world (1). Nowadays the known treatment for acute ischemic stroke is intravenous thrombolysis. However, this treatment is time dependent. Regarding to importance of early administration of thrombolysis as well as the importance of neurological recovery as the final purpose of stroke treatment, this study aimed to compare time delay and neurological outcomes between the prehospital notification (SAMA)-transported patients and self-transported patients in acute ischemic stroke.

According to present findings, time delays, including onset to needle time, door to CT time and door to needle time were shorter in SAMA-transported patients in comparison to that in self-transported patients. These findings were similar to Sadeghi-Hokmabadi and colleagues' study that showed the prehospital notification can significantly reduce treatment delays including door-to-CT and door-to-needle times in

acute ischemic stroke patients (7, 8) .Moreover, there are a number of studies in various countries with comparable results (9-13). In general, it is shown that the prehospital notification in different regions has had an acceptable performance in reducing time delay of thrombolytic therapy in acute ischemic stroke patients. Therefore, stabilization of SAMA code as a prehospital notification system succeeded to achieve goal of early transportation of ischemic stroke patient.

Although the reduction of delay time is a significant point in the stabilization of prehospital notifications for stroke, the final goal of implementation of any new intervention, such as prehospital notification is to improve neurologic deficit. Because of importance of neurologic outcomes in stroke treatment, current study aimed to assess the effect of SAMA prehospital notification on neurologic function measured using NIHSS and mRS in patients received thrombolytic drug. According to our results, there was no significant difference between the SAMA-transported and the Self-transported patients in neurological outcomes assessed by NIHSS and mRS at discharge time. Lack of a significant difference in neurological improvement between two groups in spite of reduction of delay time was an unexpected finding. However, Similar to current results, some studies didn't show the significant effect of reduction of delay time on neurological outcomes in ischemic stroke patients. For example, Kim and colleagues' study in Korea showed that prehospital notification, in spite of reduction in the in-hospital processing times, could not have a significant effect on neurological outcome improvement in acute ischemic stroke patients treated with thrombolysis. Same as our study, this study used NIHSS and mRS neurologic scales to measure neurological deficits (14). Also, there are some similar studies showed that the reduction of the interval time did not lead to better outcomes on mRS or NIHSS in acute stroke patients (9, 15, 16). In Sohn and colleagues' study, there were different findings on MRI and CT groups. In MRI- based thrombolysis group the reduction of time intervals coincided with significant improvement in favorable outcomes while in CT- based thrombolysis group in spite of reduction of delay, there was no significant increase in favorable outcomes (17).

There are some explanations or assumptions for lack of functional improvement in spite of a reduction in delay time. That may be due to the scale that is used to assess neurological improvement. It is probable that some scales are not able to assess slight improvement in neurological deficits. Also, assessment time might be a cause of diversity of results of functional improvement. For example, as studies of Mohamad and colleagues (18) and Candelaresi and colleagues showed (19), assessment of neurological function by the modified Rankin Scale (mRS) after a long term such as 90-day post stroke may show better finding, while assessment at a short time after stroke may show no difference between groups (16).

Although in our study, onset to needle time reduced by 32 min in the prehospital notification (SAMA) -transported patients in comparison to self-transported patients, it did not coincide with better neurological function. The authors presume that in order to make a statistically significant difference in neurological function between groups, more marked reduction in delay is needed to be made. Another assumption for diversity in results is that the real onset of stroke might be different from what is reported in patient documents. We thought that some patients might ignore mild signs for a while and call for a help when

signs are getting worse. Therefore, some patients might lose the golden time for receiving thrombolysis before transport to hospital.

There were some limitations to this study. Assessment of NIHSS and mRS by various assessors may result in measurement errors. Since just one hospital in Qom city is equipped to stroke center and number of admitted patients was partly small, sample size was another limitation. Larger sample size might increase the power of tests.

Conclusion

Finding of this study showed that performance of SAMA prehospital notification in reduction of treatment delay in acute ischemic strokes was acceptable to some extent. However, such amount of time reduction didn't have significant effect on neurological deficit improvement. According to evidences, time is a determining factor in the effectiveness of thrombolytic therapy in acute ischemic strokes therefore stabilization of prehospital notification plans, such as SAMA code, in order to reduce delay time could likely be advantageous to decrease ischemic stroke complications. However, it is probable that more markedly reduction in delay time is needed for improvement of neurological dysfunctions.

Declarations

Ethics approval and consent to participate

This work approved by Iran national committee for ethics in biomedical research (record no. IR.MUQ.REC.1398.022) was supported by Qom University of medical science, Qom, Iran. The article was extracted from the MSc. student thesis of Azra Sangari. The consent to participate was waived due to retrospective study

Consent for publication

Not applicable

Availability of data and materials' statement

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request

Competing interest

No potential conflict of interest was reported by the authors.

Funding.

No funding to declare

Authors' contributions

KA wrote the main manuscript text, AS gathered data and drafted the manuscript, and MV analyzed the data. All authors reviewed the manuscript.

Acknowledgment

The *authors would like* to express their deepest gratitude to Dr. Sharifipour and Dr. Momenian for their helpful advices and supports. We would like to thank the staffs on Shahid beheshti hospital of Qom University of Medical Sciences for providing facilities for this work.

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Tables

Tab. 1 Demographics characteristics and comorbidities between SAMA-transported and self-transported patients

Variable	SAMA-transported N=110	self-transported N=75	P value
Age (Mean±SD)	65	64	0.50
Gender %	53% men	56% men	0.79
Marital status%	98% married	98% married	1*
past history of stroke %	8	19	0.03
past history of TIA %	6	7	0.99
Past History of Heart Disease %	27	21	0.39
Smoking %	2	3	1*
Addiction %	0.009	0	1*
Hypertensions %	45	52	0.38
Diabetes %	24	35	0.11
Dyslipidemia %	11	12	0.78

Tab. 2 Comparison of delay times between SAMA-transported and self-transported patients

Variable	Group	(IQR) minMedian	P value
ONT	Self –transported	180 (150-225)	0.001
	SAMA-transported	150 (120-180)	
ODT	Self –transported	65 (40-115)	0.22
	SAMA-transported	60 (40-88)	
DNT	Self –transported	100 (80-125)	0.0001
	SAMA-transported	80 (60-105)	
DCT	Self –transported	36 (24-52)	0.001
	SAMA-transported	27 (20-37)	

Tab. 3 Comparison of neurological deficit improvement between SAMA-transported and self-transported patients

Variable	Group	(IQR)Median (	P value
Admission NIHSS	Self –transported	13 (10-16)	0.17
	SAMA-transported	15 (10-18)	
Discharge NIHSS	Self –transported	1 (0-4.25)	0.97
	SAMA-transported	1 (0-5)	
Admission mRS	Self –transported	4 (3-5)	0.07
	SAMA-transported	5 (4-5)	
Discharge mRS	Self –transported	1 (0-1)	0.30
	SAMA-transported	1 (0-3)	

Tab. 4 Comparison of neurological deficit improvement in SAMA-transported and self-transported patients

Variable	Group	(IQR) minMedian	P value
neurological deficit improvement on NIHSS	Self –transported	10 (8-13)	0.22
	SAMA-transported	11 (7-15)	
mRSneurological deficit improvement on	Self –transported	3 (2-4)	0.89
	SAMA-transported	3 (2-4)	

Tab. 5 Correlation between neurological deficit severity measured by NIHSS and delay times

Variable	Group	correlation coefficient r	P value
ONT	Self –transported	0.08	0.53
	SAMA-transported	-0.03	0.80
	All patients	0.025	0.74
ODT	Self –transported	0.24	0.05
	SAMA-transported	-0.04	0.72
	All patients	0.08	0.30
DNT	Self –transported	-0.11	0.35
	SAMA-transported	-0.07	0.50
	All patients	0.013	0.11
DCT	Self –transported	-0.19	0.14
	SAMA-transported	0.15	0.14
	All patients	0.010	0.90

Tab. 6 Correlation between neurological deficit improvement measured by mRS and delay times

Variable	Group	correlation coefficient r	P value
ONT	Self –transported	0.06	0.63
	SAMA-transported	-0.14	0.89
	All patients	0.05	0.95
ODT	Self –transported	0.14	0.26
	SAMA-transported	-0.02	0.86
	All patients	0.04	0.56
DNT	Self –transported	-0.10	0.41
	SAMA-transported	0.04	0.68
	All patients	-0.01	0.90
DCT	Self –transported	-0.13	0.32
	SAMA-transported	0.10	0.30
	All patients	-0.01	0.89