Research Article

Factors Affecting the Effective Management of Acute Stroke: A Prospective Observational Study

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Abstract

Background : Stroke, characterized by sudden loss of cerebral function, is among one of the leading cause of death and disability world over. The newer treatment modalities have changed the landscape of stroke treatment but are very much time bound. **Aim:** To characterize pre-hospital and in-hospital factors affecting acute stroke management thus defining lacunae in stroke management. **Subjects and Methods:** A prospective observational study, conducted at the emergency department of a tertiary care center in southern India from August 2015 to July 2016. All stroke patients presenting within first 24 hours of onset were included. A pre -defined Knowledge-Attitude-Practice (KAP) questionnaire was used. **Results:** Total of 133 patients were eligible out of which 28 were excluded for various reasons. Majority were >60 years age and male (61%). About 60% arrived within window. Distance from the hospital was one of the major factors for arrival within the window period. When compared by KAP questionnaire, bystanders of those arriving within window period had better awareness of stroke symptoms. **Conclusions:** Improving awareness of stroke symptoms and increasing availability of EMS is likely increase chances of stroke patients receiving appropriate acute management.

Keywords: Emergency, ischemic stroke, stroke, thrombolysis

Introduction

Stroke is characterized by rapidly developing clinical symptoms and signs of focal, and at times global, loss of cerebral function lasting more than 24 h, or leading to death with no apparent cause other than of vascular origin.[1] It forms the leading cause of death in developed nations and is indeed a global problem, wherein nearly 4.5 million stroke-related death occur from stroke each year.[2] Stroke is the third leading cause of deaths which is reflected by the data showing that an approximate 29% of people aged 65 years or older die within 1 year. Cerebral infarction constitutes about 80% of all acute ischemic strokes and 10% of them die within 30 days.[3]

The incidence of stroke in India is estimated to be 124–145/100,000 persons per year.[4] The Indian Council of Medical Research 2004 estimates indicated that stroke contributed 41% of deaths and 72% of disability-adjusted life years among the noncommunicable diseases.[5] The Indian National Commission on Macroeconomics and Health estimated that the number of strokes will increase from 1,081,480 in 2000 to 1,667,372 in 2015.[6] Stroke mortality rates are declining or stabilizing in developed countries but remain unchanged or even higher in developing countries.[7] The principal objective of therapeutic management in stroke is to rapidly restore and maintain adequate blood supply to the ischemic tissue and minimize brain damage, thereby reducing neurologic deficits, disability, and eventually improving the quality of life after stroke. Many countries now routinely thrombolyze all patients of acute ischemic stroke, who present within the time window and do not have any contraindications.[8]

The current study aimed to characterize prehospital and in-hospital factors affecting acute stroke management in the population presenting to our hospital. This will help to find lacunae in management and aid in correction of those lacunae to improve patient care, and thereby improve the patient outcomes in acute stroke management.

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This prospective observational study was designed with an objective to enumerate the prehospital factors affecting acute stroke management and also to identify the causative factors delaying effective stroke evaluation and management in the emergency department.

Subjects and Methods

This prospective observational study was conducted at the emergency department of a tertiary care center in Bengaluru from August 2015 to July 2016. Ethics committee approval was obtained from the hospital institutional ethics committee (No.: NHH/MEC-CL-2015-352(A) dated 19th August 2015). All suspected strokes who presented to the ED within 24 h of onset of first symptoms were included in this prospective study. Patients aged below 18 years, those presenting with in-hospital stroke and patients who did not want to be the part of the study (negative consent), were excluded from this study.

When a patient confirmed to be a candidate in our study inclusion criteria presents to the hospital, all standard procedures of patient management were followed. The prime investigator (the team leader/another physician not involved in managing the patient) took responsibility of taking consent, filling up the study pro forma, and interviewing the patient on a "YES" or "NO"-based Knowledge-Attitude-Practice questionnaire [Supplementary Materials 1 and 2].

The study pro forma took into account the demographic data of the patient and few questions that were to be answered by the bystander. Following the filling up of pro forma, the bystander was interviewed using a Knowledge, Attitude and Practices (KAP) questionnaire. The KAP questionnaire contained 22 core questions which mainly referred to factors found to delay effective management and are variables taken from review of various literature.[9-11] The KAP questionnaire was divided into three parts which assess the bystander knowledge about symptoms of stroke, knowledge of risk factors of stroke, attitude toward treatment, and practice of their knowledge. Causes for time delays were noted for both groups of patients: (1) who arrive in the window period and (2) out of the window period.

In window group

Those who presented to Emergency department within 4.5 hours of the onset of first symptoms in case of intra venous thrombolysis and within 6 hours in case of mechanical intervention and in some cases of posterior circulation stroke upto 24 hours

Out of window group

Those who presented to emergency department beyond the time specified.

The patients were divided into 2 groups as "in window" and "out of window" for better analysis and interpretation. Both, in-hospital and out-of-hospital variables were compared for patients who arrived within the time period and for patients who presented out-of-hospital period, only the out-of-hospital variables could be compared as the patient was beyond the time period for thrombolysis with rt-PA (>4.5 h from symptom onset). The data were statistically analyzed using the Student *t*-test, Chi-square or other analytical tools wherever applicable.

Results

A total number of 133 patients fulfi lled the inclusion criteria. However, after reviewing the exclusion criteria, 28 patients were excluded from the study. Nearly 16% were not willing for consent, 4% were below the age of 18, and 1% was an in-hospital stroke [As shown in Figure 1].

The study population was predominantly in the age group >60 years (47.25%) followed by 41–60 years (43.80%) and only 13.34% were between 18 and 40 years of age. However, there were a significant number of patients in the 18–40 years age group. About 67.8% of the patients were male. Out of the 105 patients included in the study, 61.90% arrived within the window period. Table 1 below gives a comparison between the out-of-hospital delays in the 2 groups, namely, (1) in-window and (2) out-of-window patients.

There was a statistically significant difference in the delay among mode of arrival among both the groups. Patients who had come in Emergency Medical Services (EMS) were found to have come faster. There was no statistical difference between the other variables.

Table 2 depicts a comparison of the distance (in km) travelled as a cause of out-of-hospital delays between the patients arriving within the window and those arriving out-of-window period. The table clearly shows that those living farther away from the hospital are significantly less likely to arrive to the hospital within the time window. The mean distance travelled in the "in-window" period was 54.9 km and in the "out-of-window period" was found to be 93.7 km.

Table 3 depicts the critical time goals that are recommended by the American Heart Association (AHA) in comparison with the mean time taken for each variable in our study.

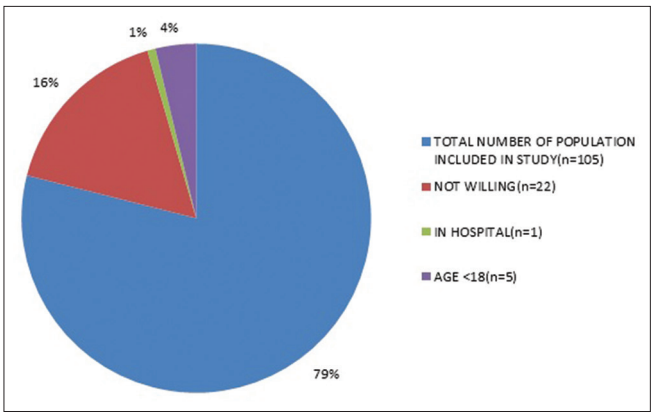

Figure 1: Total number of screened patients (n = 133)

Table 1: Comparison between causes of out-of-hospital delays between the in-window and out-of-window period groups (*n*=105)

Variables	In-window (*n*=65), *n* (%)	Out-of-window (*n*=40), *n* (%)	χ^2	*P*
Mode of arrival				
EMS	47 (72.31)	20 (50)	5.336	0.021*
Others	18 (27.69)	20 (50)		
Symptoms				
Aware	52 (80)	33 (82.5)	0.1004	0.751
Unaware	13 (20)	7 (17.5)		
Treatment awareness				
Aware	16 (24.61)	11 (27.5)	0.1079	0.742
Unaware	49 (75.39)	29 (72.5)		
Local hospital visit				
Yes	19 (29.23)	11 (27.5)	0.0363	0.848
No	46 (70.77)	29 (72.5)		
Financial issues				
Yes	4 (6.16)	5 (12.5)	1.272	0.259
No	61 (93.84)	35 (87.5)		

S: Significant; EMS: Emergency medical services

Table 2: Comparison between distance (km) as a cause of out-of-hospital delays between the in-window and out-of-window period groups (*n*=105)

Distance (km)	In-window, *n* (%)	Out-of-window, *n* (%)
0-50	42 (64.61)	22 (55)
51-100	16 (24.61)	6 (15)
101-150	5 (7.69)	5 (13)
151-200	1 (1.59)	2 (5)
201-250	0	2 (5)
251-300	0	2 (5)
301-350	0	0
351-400	1 (2)	1 (2)
Total	65 (100)	40 (100)
Mean distance travelled in both the groups		
	In-window	**Out-of-window**
Mean	54.95	93.74
SD	45.38	98.53
P (student *t*-test)	0.0076*	

*Significant. SD: Standard deviation

Table 3: Comparison of mean critical time periods in stroke management during window period between our study and American Stroke Association/American Heart Association/National Institute of Neurological Disorders and Stroke time goals (*n*=65)

Variable: Time (min)	AHA[9]	Present study
ED evaluation	10	4.67
Neuroevaluation + image acquisition	25	22.22
Interpretation of image	45	51.05
Door to needle	60	54

ED: Emergency department ; AHA: American Heart Association

All the time goals except interpretation of imaging time (mean – 51 min while recommended target was 45 min) were achieved. However, the mean door-to-needle (DTN) times were well within the recommended 60 min (mean DTN – 54 min).

Figure 2 depicts percentage-wise distribution of patients who were taken for an intervention among the patients in the in-window group. About 20% were taken for IV thrombolysis and 7.7% were taken for mechanical interventions. Nearly 72.3% of the patients were treated conservatively.

Figure 3 depicts the time taken for IV thrombolysis from entry into the hospital. The mean was found to be 54 min (range: 18–80 min).

The mean time taken for mechanical interventions from entry into hospital was found to be 79 min (range: 70–85 min).

The knowledge of patient bystanders (as described in the supplementary KAP questionnaire) in the in-window group was statistically better compared to the other group in the symptoms – blurring of vision, giddiness, loss of consciousness, and speech disturbance. Awareness among the in-window group by standers was better, although the difference was not statistically significant.

There was no significant difference between the attitude and practice of the bystanders between the in-window and out-of-window group either.

Discussion

This study was conducted over 1 year from August 2015 to July 2016. It was a prospective, observational study conducted in the emergency department of a tertiary care center in Bengaluru.

Cumbler *et al*. had conducted a study which looked at epidemiology of in-hospital stroke and found that in-hospital

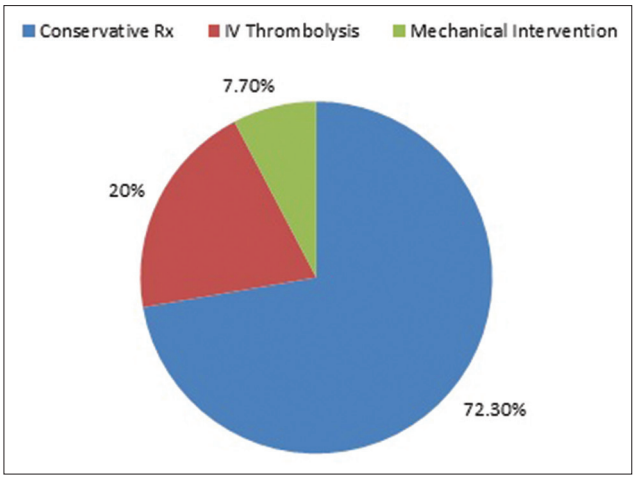

Figure 2: Percentage-wise distribution of patients who were taken for IV thrombolysis or mechanical intervention (n = 65)

stroke rate was 2.2%–17%.[12] A study done by Eeg-Olofsson and Ringheim which was conducted on stroke in children in regard to their characteristics and prognosis found that the average annual incidence of childhood stroke is 2.1/100,000 children per year.[13]

In our study, we found a predominance of stroke in the >60 years age group. However, 13.34% of our stroke patients were in the age group of 18–40 years. Although this may be a small percentage, this age groups comprises the breadwinners of the family and stroke in this age group could have devastating complications to the patient and family. Mozaffarian *et al*. had conducted a study on the prevalence of stroke and found similar results of stroke being higher in the age group >60 years[14] In ischemic stroke in the young, Maaijwee *et al*. had done a review article, in which it is stated that the long-term risks are not favorable with respect to inability to perform the responsibilities required at that particular stage of life.[15] In a prospective and long-term follow-up study done by Musolino *et al*. on ischemic stroke in young people, general handicap was severe in 11% and moderate in 59%. About 38% of the patients had become partially dependent and 11% were completely dependent. Nearly 32% of the patients were unable to return to work.[16]

The male:female ratio was found to be 2.09:1 in our study. Peter *et al*. conducted a review on epidemiology of stroke and had similar findings of a male predominance. The incidence was found to be 33% higher in males, but the fatality was found to be higher in women.[17]

In our data, we had found that 61.90% of the patients had come in the window period and 38.10% had arrived out-of-window period. This is contrary to a study done by Gurav *et al*. on a population of 695 patients where it was found that 78.7% of the patients had come out of the window period.[11] Another study conducted at New Jersey, USA, by Lacy *et al*. on delay in stroke presentation to the emergency department (n = 553) showed that 61% had presented in the window period.[18]

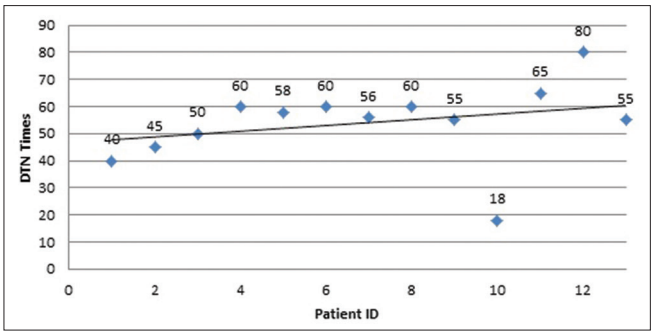

Figure 3: Duration (in minutes) for door-to-needle time for intravenous thrombolysis (n = 13)

In the present study, the main causes for out-of-hospital delays were found to be unawareness of treatment modalities and use of personal vehicle. In similar studies, causes of out-of-hospital delays were been found to be unawareness of symptoms and lack of EMS.[11] Lacy *et al*. found similar findings of out-of-hospital delays caused due to travel in vehicles other than EMS.[18] A review performed by Banerjee and Das showed that poor availability of transport in rural areas and congestion in urban areas were considered constraints or barriers to immediate hospitalization and treatment initiation.[19]

A significant cause of delay found in our study was distance to the hospital. A study done by Ashraf *et al*. conducted at MIMS, Kerala, found statistically significant correlation between the distance travelled and arriving within the time window for treatment. In his study, a distance of 15 km or less from the hospital was associated with an early arrival.[20]

In our study, we had compared the critical time goals set by AHA/American Stroke Association and National Institute of Neurological Disorders and Stroke on stroke management to those achieved in this study group. It is a well-established fact that lower DTN times lead to lesser complications of thrombolysis and better outcomes for the patient (achievement of mRS <1 at 90 days poststroke).[9,21] Except for our door to image interpretation time (which could be attributed to the use of magnetic resonance imaging for imaging in stroke patients), all other critical time goals in stroke treatment were within the prescribed limits. A study published recently by Heikkilä *et al*. in Finland found that their median DTN time in 2012 was 54 min (our current mean time) which was reduced to 28 min to 2013.[22] Thus, we still have scope for more improvement and efforts are on to further reduce DTN times at our hospital. The mean duration of DTN time in our study was found to be 54 min. However, the fastest DTN achieved in our center was 18 min. The current record holder for fastest DTN time for stroke in India is held by Jehangir Hospital in Pune which claims to have thrombolyzed a patient in a DTN time of 13 min and 37 s.[23]

Out of the 65 patients who had come to our center in the window period, 20% were taken for IV thrombolysis and 7.7%

were taken for mechanical intervention. 72.3% were treated conservatively. A study done by Fonarow *et al*. performed IV thrombolysis on 29.6% of the in-window patients.[10] The reasons for this were personal neurophysician decision and/or presence of contraindications to fibrinolysis. In a study published by Meyers *et al*. had conducted a study on endovascular stroke treatment and found that only 1%–7% of stroke victims arrive at hospital in time for mechanical interventions.[24]

The mean duration of door-to-mechanical intervention in our study group was 79 min. A study done by Roth *et al*. on mechanical recanalization with flow restoration in acute ischemic stroke found a 66% better outcome in patients taken for intervention within 100 min of arrival.[25] However, this study was not designed to look at outcomes of stroke treatments. The data collected in this study suggest significant delays in stroke management in the out-of-hospital and in-hospital period. Emergency physicians play a great role in the management of acute stroke, especially by formulating protocols to quicken the process of hyperacute stroke management in the hospital. It is also necessary to conduct in hospital drills and audits to create awareness among our colleagues and staff. We strongly suggest that we bear the responsibility of spreading the awareness of signs and symptoms of stroke among general public which will help in reducing out-of-hospital delays.

It is also necessary to have a regular EMS training about stroke management and importance of prenotification to the hospital should be emphasized.

Conclusion

This study found that patients who arrived in vehicles other than EMS and those who were unaware of treatment modalities had significant delay in arrival to hospital. Distance from the hospital was another important factor which caused significant out-of-hospital delay. In our study, there were no significant in-hospital delays in achieving optimal DTN time of <60 min. However, door-to-imaging interpretation time can be improved in an effort to further reduce the DTN times.

Limitations

This study did not correlate the delays with patient outcomes. The KAP questionnaire is subject to "investigator" and "recall" bias. However, efforts were made to reduce bias by getting a person unrelated to treatment to administer and record the questionnaire.

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Conflicts of interest

There are no conflicts of interest.

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