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Effectiveness of modified stroke scale in reducing door to CT scan time in patients presenting with acute ischemic stroke

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ABSTRACT

Introduction: Timely intervention in Acute Ischemic Stroke (AIS) can significantly improve the mortality and morbidity. In order to achieve a higher standard of care in AIS, a practical and economic stroke code to reduce door to brain imaging time is needed.

Objective: To determine the effect of modified stroke scale in reducing door to CT time in patients with Acute Ischemic Stroke (AIS).

Materials & Methods: This Interventional study was carried out in Rehman Medical Institute (RMI) over a period of 3 months, from 15th June 2021 to 15th September 2021. 50 Pre-interventional group data was retrieved from the hospital record system. In Post-interventional 50 patients of AIS underwent modified stroke code activation process. Door to CT time was presented as median and interquartile range in each group. Both groups were compared for demographics, clinical features and door to CT time. A $p \leq 0.05$ was considered statistically significant.

Results: The mean age of patients was 60.60 ± 13.389 and 62.90 ± 10.835 in pre and post interventional group. Male patients accounted for 50% (n=25 in pre and 56.0%(n=28) in post interventional groups. The mean door to CT time was 147.86 ± 225.424 minutes in pre- and 76.34 ± 47.886 was in post-interventional group. (P value 0.03). 24% of patients in postinterventional group achieved Door to CT time <25% that was significantly improved as compared to pre-interventional group i.e. 4%. (p=0.001)

Conclusion: Mean door to CT time was decreased significantly in the post interventional group by applying simplified stroke code according to our limited facilities.

Keywords: Acute ischemic stroke; Mean, Median, stroke code

The authors declared no conflict of interest. All authors contributed substantially to the planning of research, data collection, data analysis, and write-up of the article, and agreed to be accountable for all aspects of the work.

INTRODUCTION

The latest guidelines by American Heart Association recommend: "Because time from onset of symptoms to treatment has such a powerful impact on outcomes, treatment with IV alteplase should not be delayed to monitor for further improvement".[1] Time-dependent administration of intravenous tissue plasminogen activator (tPA) in patients with acute ischemic stroke has been very well supported by the American Heart Association (AHA) & the American Stroke Association (ASA). It has taken stroke as a 4th leading cause of death in the United States instead of third in the past. Therapeutic window for thrombolysis is narrow in Acute Ischemic Stroke (AIS) patients; administration of IV tPA within the therapeutic window (3-4.5 hours) has proven of benefit in reducing both mortality and morbidity.[1] Early treatment leads to greater proportional benefit as documented by different studies.[2] According to AHA/ASA, suspected acute ischemic stroke patients should be triaged with the same priority as acute myocardial infarction patients. An early brain imaging study is essential to exclude Intra Cerebral Hemorrhage (ICH) and it is recommended as part of initial evaluation of stroke patients who are eligible for IV tPA. Based on AHA/ASA guidelines, reducing the time interval from the Emergency Department (ED) presentation to initial brain imaging can help to reduce time to treatment initiation. AHA/ASA recommends door to CT time should be less than 25minutes.[1]

A multi-institutional Solitaire Flow Restoration Thrombectomy for Acute Revascularization (STAR) study described that the median time from hospital arrival to CT scan brain was 24 minutes; however it ranged from 2 minutes to 160 minutes with a 25th percentile of 12 minutes and a 75th percentile of 34 minutes.[3]

Several stroke-specific care processes have been introduced to improve the management timeline. Pre-notification to Emergency Medical Services, rapid triage protocols, single-call stroke team activation, toolkits, rapid laboratory testing, team-based approach, and prompt feedback of data are a

few such processes being practiced in centers offering thrombolysis.[4,5]

In our resource deficient system, we have to introduce the practical and economic Stroke Code Activation System that can reduce the door to brain imaging time in patients presenting with Acute Ischemic stroke. This intervention is an obligatory step towards IV tPA administration in AIS, in turn reducing morbidity and mortality.

In Pakistan, only a few centers are offering thrombolysis and revascularization therapy to AIS; however, there are none from the Khyber Pakhtunkhwa (KP) province. Therefore, this study was planned as a first step towards introducing thrombolysis therapy in this part of the country. KP is among the largest populated areas of the country, with Peshawar being a center of referrals from all the remote areas of the province. By introducing thrombolysis here, a huge chunk of the population is expected to benefit.

The study was conducted to determine the effect of Modified Stroke Code Activation Process on Door to CT Time in patients with AIS, based on the alternate hypothesis that a new Modified Stroke Code Activation Process is feasible to achieve intended Door-to-CT Time in patients with AIS.

MATERIALS & METHODS

This single center interventional study was carried out in Rehman Medical Institute (RMI), Peshawar, Khyber Pakhtunkhwa, over a period of 3 months, i.e., from June 15, 2021, to September 15, 2021, after getting ethical approval from Research Ethical Committee of Rehman Medical College, Peshawar. Written Informed consent was taken from study participants or their attendants, whichever was appropriate.

The study consisted of two groups: Pre-intervention and Post-intervention groups, each having 50 patients making the total sample size of 100 patients suffering from Acute Ischemic Stroke.

Data for the Pre-intervention group was retrieved retrospectively from the hospital medical record system. The time from ED presentation to CT scan was noted.

The Post-intervention group included patients presenting with suspected stroke in the Emergency Department prospectively over the period of 3 months. The Modified Stroke Code Activation Scale was applied on these patients, and the time from ED presentation to CT scan was noted.

All patients with acute ischemic stroke aged >18 years who had stroke symptoms up to 24 hours were included. The exclusion criteria consisted of pregnancy, venous sinus thrombosis, intracerebral hemorrhage, transient ischemic attack (TIA), malignant tumors, a history of recent surgery or trauma during the preceding 3 months, patients having stroke symptoms for more than 24 hours, and patients who could not undergo CT scan urgently.

Brain computed tomography (CT) was done using Toshiba Aquilian, 128 slices Computed Tomography scanner. Images were reported by a radiologist at radiology department, Rehman Medical Institute, Peshawar.

Stroke code was implemented for any patient presenting with signs of stroke to the emergency department within 24 hours of onset of symptoms. The following points were noted and implemented:

Timelines:

- Time of arrival
- Triage / registration time
- Stroke code activation time (stroke team notified)
- CT Time
- Admission time

Stroke code activation:

- Activation call to stroke team (phone)
- Call from ED to CT
- No patient intake till stroke patient has been scanned
- Designate one-bed “Pure Stroke” (meaning it will be vacated if any stroke patient comes)
- Stroke Swarm – vitals, finger test glucose, if on wheel chair shift to bed, if on stretcher do not shift but rapidly assess and shift to CT

Data Collection and Analysis

Data for the Pre-interventional group was retrieved retrospectively from the hospital record system. Arrival time and CT time were noted in a Performa. For Post-interventional group, patients demographics and stepwise time lines, history points like Hypertension, Diabetes Mellitus, baseline Modified Rankin Scale (mRS), the National Institute of Health Stroke Scale (NIHSS), stroke type (Bamford’s classification) were noted in a Performa. Door to CT Time was derived from the patient’s arrival time in the emergency department to CT time.

Data were entered and analyzed by SPSS 24. For quantitative variables like Age and Door to CT Time, the mean and standard deviation were calculated and for qualitative variables like gender, stroke territory, Hypertension, Diabetes Mellitus, etc., frequencies and percentages were calculated. Door to CT Time was presented as median and interquartile range in each group. For comparison of baseline variables between Pre- and Post-interventional groups, the Chi-square and Student’s T-test were used to test for significant differences, keeping $p \leq 0.05$ as significant.

RESULTS

A total of 100 patient were included in the study, 50 patients in the pre-interventional group and 50 in the post-interventional group.

In the pre-interventional group the mean age of patients was 60.60 ± 13.389 years; 50% (n=25) were males and 50% (n=25) were females. The mean door to CT time was 147.86 ± 225.424 minutes. Less than 25 minutes CT was achieved in 4.0% (n=2) patients only. In the post-interventional group, the mean age was 62.90±10.835 years; 28 (56.0%) were males and 22 (44.0%) were females (Table 1).

According to Bamford classification of ischemic stroke, in the pre-interventional group of the strokes, 18(36.0%) were Partial Anterior Circulation Strokes (PACS), 08(16.0%) were Total Anterior Circulation Strokes (TACS), 12(24.0%) were Lacunar Syndrome (LACS) and 02(4.0%) were Posterior Circulation Syndrome (POCS); 10(20.0%) of the CTs were unremarkable. In the post interventional group 24(48.0) CT scans showed PACS, 06(12.0%) showed TACS, 07(14.0%) were POCS, 09(18.0%) were LACS, and 04(8.0%) of the CT scans were unremarkable (Table 1).

In the post intervention group according to NIH Stroke scale for stroke severity 18% (n=9) had Minor stroke (1-4) , 20.0%, (n=10) patients had Moderate (5-15) stroke, 12.0%, (n=6) had Moderate to severe (15-20) stroke while Severe stroke (21-42) 16.0% (n=8) . In the post interventional group 94.0% (n=47) had premorbids , 86.0% (n=43) were hypertensive , 52 % (n=28) were diabetic. On mRs (modified ranking scale) scoring 30.0% (n=15) had a score less than 3 while 70.0% (n=35) had an mRs score of greater 3. Whereas NIHSS could not be calculated for 34% (n=17) patients .

Table 1: Features of pre and post interventional groups (n=50 each).

Variables		Pre-interventional f (%)	Post-interventional f (%)	p value
Mean Age (years)		60.60 ± 13.389	62.90 ± 10.835	0.347
Gender	Male	25 (50.0)	28 (56.0)	0.548
	Female	25 (50.0)	22 (44.0)	
Door To CT time (min)	<25	02 (4.0)	12 (24.0)	0.001
	25-40	08 (16.0)	04 (8.0)	
	41-60	13 (26.0)	02 (4.0)	
	>60	27 (54.0)	32 (64.0)	
Stroke subtypes	PACS	18 (36.0)	24 (48.0)	0.14
	TACS	08 (16.0)	06 (12.0)	
	POCS	02 (4.0)	07 (14.0)	
	LACS	12 (24.0)	09 (18.0)	
	Multi territory	10 (20.0)	04 (8.0)	

The mean door to CT time was (76.34 ± 47.886). Less than 25 minutes of door to CT time was achieved in 12(24%) patients in post interventional group. It is significantly higher than pre interventional group (p=0.001). Overall, the average door to CT time was significantly reduced in post interventional group from 147 min to 76 min. The difference was statistically significant P value being 0.03. These results in the form of mean, 95% CI of mean, median, IQR are described in Table 2.

Table 2: Comparison of pre and post interventional groups in Door to CT time (n=50 each).

Groups	Mean ± SD	95% CI of Mean	Median	IQR	Minimum-Maximum
Pre-intervention	147.86 ± 225.424	83.80 ± 211.92	67	69	17-1315
Post-intervention	76.34 ± 47.886	62.73 ± 89.95	78.5	76	05-200

DISCUSSION

The current study applied the modified stroke code to determine its effect on the Door to CT time in patients with acute ischemic stroke. Although the door to CT time was significantly decreased, the benchmark of <25min was achieved in only 24% of patients.

In a resource-poor setup like ours, we are lagging behind in formulating a standard stroke code that comprises of either complicated or expensive interventions that were not feasible for our setting. However we tried to introduce modified stroke code utilizing the current resources of our hospital. We introduced less complicated, economical, and practical interventions which every hospital can implement in resource limited situations. With our stroke scale, mean DTC was 76min. William et al, described the mean DTC of 48 min.[7] Another study from India described reduction in DTC from 47min to 8 min by applying stroke code.[8] The difference in these results can be explained on the basis that their data are from the centers which are already offering thrombolysis and having standard stroke code team. On the other hand our study is the first effort in reducing DTC, and that also with a very limited resources.

In the literature, people have investigated diverse strategies as stroke codes in different setups.[9-11] Curran DTC was reduced from 120min to 11 min in 4 months by Successive PDSA (Plan, Do, Study, Act) cycles.[6] It was an easy but continuously supervised program, where step by step outcome, process measures and loop holes were identified and displayed on run charts as a reminder. Timely changes and modification strategies were also communicated to leading teams to assure continuously improving exercise. Tran et al, reduced DTC more by applying simple quality improvement that included hypertension control in ER, omitting blood test step from the chain and administrating thrombolysis in CT room.

The Emergency Department is a main pillar in this journey to thrombolysis. As reduction of door to imaging time is one of the most important factors towards timely thrombolysis. Barbour et al showed significant reduction in triage to CT scan time from 45

minutes to 22 minutes thus receiving thrombolysis within an hour.[12,13] This achievement was multifactorial. Staff education, training, limiting specific tasks before Imaging and simple documentation was points of emphasize. Staff was convinced to push patient towards scanner if porter is busy somewhere else.

Kalnins improved door to CT time by omitting NIHSS recording, IV line insertion, ECG and venesection before imaging.[5]

ED crowding is one of the factor delaying DTC.[14-16] Our Post interventional era was the time when hospitals were flooded with Covid related emergencies, this might have contributed in delay in DTC in our study.

Moreover, initiation of ambulance services for pre alert is vital as it is the well-established factor in reducing door to CT and door to needle time.[16-20] In our setup especially in KPK, introduction of pre alert ambulance service system should be considered. People awareness regarding stroke symptoms and early transport of patient to Hospital should also be taken under consideration.

LIMITATION OF STUDY

The front line staff was not formally trained or NIHSS certified. The NIHSS scoring was not accurate due to lack of trained staff. Moreover, the lapse in delay was not identified. We tried to extend the paper work to note the timings of notification to CT room and stroke team etc but couldn't documented that.

STRENGTHS OF STUDY

It is the 1st effort to start IV thrombolysis in a tertiary care center of a large province of Pakistan where no thrombolysis facility is available until now. We have simplified the stroke code according to our resources. With this economic and practical stroke code without omitting any important step in patients care, we managed to reduce DTC time significantly.

CONCLUSION

Mean door to CT time was decreased significantly in post interventional group by applying simplified stroke code according to our limited facilities. However, we could achieve bench mark of <25 min in only 24% of patients. The improvement in form of proper documentation, stroke coordinator, frequent reminders, audits and feedback to representative team can help in achieving the target.

RECOMMENDATIONS

Emergency Departments awareness workshops, refresher courses, periodic mock drills, a nominated stroke nurse/physician in every shift can bring further improvement in reducing Door to CT time in resource poor circumstances. Furthermore, Updates regarding performance of each shift staff, regular e-mails and audit based presentation on regular basis may be fruitful in future. The concept of Stroke code coordinator can be introduced to liaise between stroke team and Emergency department and to identify potential delays and communicate to the concern.

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