

Access this article online

Quick Response Code:



Website:

http://www.braincirculation.org

DOI:

10.4103/bc.bc\_24\_20

# Strokes occurring in the hospital: Symptom recognition and eligibility for treatment in the intensive care units versus hospital wards

Haris Kamal, Muhammad K. Ahmed, Alicia Zha, Navdeep S. Lail<sup>1</sup>, Peyman Shirani<sup>2</sup>, Robert N. Sawyer<sup>1</sup>, Ashkan Mowla<sup>3</sup>

Department of Neurology,  
University of Texas Health

Sciences Center at

Houston, Houston, Texas,

<sup>1</sup>Department of Neurology,

University at Buffalo, State

University of New York,

Buffalo, New York,

<sup>2</sup>Department of Neurology

and Neurosurgery,

University of Cincinnati,

Medical Center, Cincinnati,

OH, <sup>3</sup>Department of

Neurological Surgery,

Division of Endovascular

Neurosurgery, Keck

School of Medicine,

University of Southern

California, Los Angeles,

CA, USA

**Address for  
correspondence:**

Dr. Ashkan Mowla,

Department of

Neurological Surgery,

Division of Endovascular

Neurosurgery,

Keck School of Medicine,

University of Southern

California, 1200 North

State Street, Suite 3300,

Los Angeles 90033,

CA, USA.

E-mail: mowla@usc.edu

Submission: 08-06-2020

Revised: 14-07-2020

Accepted: 04-09-2020

Published: 30-09-2020

## Abstract:

**BACKGROUND:** Studies have shown that 4%–17% of acute ischemic strokes (AISs) occur in patients hospitalized for another reason; scanty data are available about the care delivery and outcome of this patient population.

**MATERIALS AND METHODS:** All consecutive in-hospital AISs over a 10-year period at our comprehensive stroke center were included in the study. We compared the meantime from last known neurologically intact to symptom detection and also eligibility for acute treatment of patients based on their physical location in the hospital with respect to the level of care when they were found to have the stroke symptoms.

**RESULTS:** Fifty-three patients suffered in-hospital AIS during this period (28 in intensive care units/emergency department [ICUs/ED] vs. 25 in regular floors). Only in four patients (7.5%), initial brain imaging was done within 25 min from symptom recognition (as recommended by the American Heart Association/American Society of Anesthesiologists guidelines). Forty-two (79%) underwent brain imaging within 6 h of symptom recognition; of them, 11 (26%) received intravenous thrombolysis (IVT) within the first 4.5 h of symptom onset and 7 (17%) underwent endovascular treatment (EVT). The mean ( $\pm$ standard deviation) time in minutes from last known neurologically intact to symptom detection for floor patients was significantly longer compared to the ICU/ED patients (194 [ $\pm$ 149] vs. 74 [ $\pm$ 45],  $P = 0.0003$ ). Patients admitted to the ICU/ED had more chance of being recognized earlier and being eligible for IVT or/and EVT compared to the patients admitted to the regular floors (44% vs. 25%,  $P = 0.14$ ); however, the difference did not reach statistical significance.

**CONCLUSIONS:** ICU/ED patients had a significantly shorter time to stroke symptom detection from last known neurologically intact when compared to the regular floor patients. Furthermore, they had a trend toward a higher likelihood of being eligible for acute treatment compared to the regular floors, although the result did not reach statistical significance.

## Keywords:

In-hospital, quality of care, stroke

## Introduction

While acute ischemic stroke (AIS) management has made giant strides by increasing access, reducing contraindications to thrombolysis<sup>[1-4]</sup> as well as the advent of

mechanical thrombectomy,<sup>[5]</sup> the emphasis continues to be on timely and early detection and triage. A fairly large proportion of patients are hospitalized for another reason altogether, who subsequently suffered an AIS while being inpatient. Studies have shown this number to be between 4% and 17%<sup>[6-9]</sup> of all AISs.

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

For reprints contact: WKHLRPMedknow\_reprints@wolterskluwer.com

**How to cite this article:** Kamal H, Ahmed MK, Zha A, Lail NS, Shirani P, Sawyer RN, *et al.* Strokes occurring in the hospital: Symptom recognition and eligibility for treatment in the intensive care units versus hospital wards. *Brain Circ* 2020;6:196-9.

While prior studies have evaluated inpatient strokes among large multicenter cohorts,<sup>[10]</sup> limited data exist with granularity on etiologies, clinical signs, and specific reasons for the delay in stroke management.

This study is unique in that we compared the mean time from last known neurologically intact to symptom detection, eligibility for acute treatment, and outcomes between the intensive care units/emergency department (ICUs/ED) versus regular floor inpatient strokes.

## Materials and Methods

We performed a cross-sectional study using the Get With The Guidelines-Stroke Database at our large high-volume comprehensive stroke center. All patients diagnosed with inhospital AIS over a 10-year period were included in the study. Exclusion criteria included age younger than 18 years, hemorrhagic strokes, and stroke mimics.

Variables studied included demographics and baseline characteristics, comorbid illnesses, clinical presentations and the National Institutes of Health Stroke Scale (NIHSS), bed location/level of care of the patient when AIS occurred, duration from last known neurologically intact to symptom recognition, duration from symptom recognition to brain imaging, location of infarction and vascular distribution on brain imaging, and treatment undertaken, namely, conservative management versus intravenous thrombolysis (IVT) versus endovascular treatment (EVT) or combinations. We further compared the mean time from last known neurologically intact to symptom detection and also eligibility for IVT/EVT based on the physical location of the patient and level of monitoring (ICU/ED vs. medical floors).

All statistical analyses were carried out using IBM SPSS Statistics for Windows version 23.0 (IBM Corp, Armonk, NY, USA). For comparison of means, independent *t*-test was used and Chi-square test was used for nominal variables.

Although this was a quality improvement project not necessitating institutional review board (IRB) approval, we had approval under an existing IRB to study stroke outcomes at our center.

## Results

Table 1 lists baseline characteristics of all patients found to have an inhospital AIS. We found 53 such patients who were admitted for other medical reasons/procedures and subsequently suffered an AIS. Of these, 26 (49%) were males, and the mean age was  $69.4 \pm 13.1$  years. Mean NIHSS on admission was 0 as expected.

**Table 1: Baseline characteristics of the patients**

Characteristics	
Number of inpatient strokes ( <i>n</i> )	53
Mean age $\pm$ SD	69 $\pm$ 13
Male sex, <i>n</i> (%)	26 (49)
Risk factors/medical comorbidities, <i>n</i> (%)	
Hypertension	40 (71)
Diabetes mellitus	20 (38)
Coronary artery disease	27 (51)
Atrial fibrillation	45 (84)
Location of patients, <i>n</i> (%)	
Emergency department	11 (21)
ICU	9 (17)
Postoperative/surgical ICU	5 (9)
Regular floors	28 (52)
Symptoms, <i>n</i> (%)	
Unilateral arm or leg weakness	11 (22)
Dysarthria	14 (28)
Aphasia	14 (28)
Decreased level of consciousness	15 (29)
Vertigo	5 (10)
NIHSS (mean $\pm$ SD)	10 (10)
Location of stroke, <i>n</i> (%)	
Anterior circulation	38 (72)
Posterior circulation	10 (19)
Both anterior and posterior circulations	5 (9)
Treatment, <i>n</i> (%)	
Intravenous tPA	11 (26)
Endovascular treatment	7 (17)

ICU: Intensive care unit, SD: Standard deviation, NIHSS: National Institutes of Health Stroke Scale, tPA: Tissue plasminogen activator

Clinically, aphasia (28%), dysarthria (28%), and left-sided hemiparesis (22%) were the most common neurological symptoms at the time of recognition. Mean NIHSS at the time of stroke symptom recognition was 10.1 ( $\pm 9.72$ ). Thirty-eight (72%) had acute infarction in the anterior circulation, ten (19%) had acute infarction in the posterior circulation, and five (9%) patients had acute infarcts in both anterior and posterior circulations.

Brain imaging (head computed tomography [CT] without contrast) was done within 25 min from symptom recognition (as recommended by the American Heart Association [AHA]/American Society of Anesthesiologists [ASA] guidelines) in only four patients (7.5%). Of the 53 patients, only 11 (26%) were eligible and received IVT within the first 4.5 h of symptom onset and 7 (17%) were eligible and underwent EVT. Fifteen patients (28%) had a delay in symptom recognition or treatment, as they were initially misdiagnosed. Mean Modified Rankin Scale at discharge was 2.37 ( $\pm 2.16$ ). Overall, 13% of the patients passed away during the hospital stay choosing to opt for comfort measures due to mounting medical complications, especially the extent of the infarcts.

Table 2 compares the patients admitted to the ICU/ED versus patients admitted to the regular floors with respect to demographics, comorbidities, severity of stroke based on NIHSS, mean time of stroke symptom detection from last seen neurologically intact, and also treatment undertaken. The mean ( $\pm$ standard deviation) time in minutes from last known neurologically intact to symptom detection was significantly longer for floor patients compared to ICU/ED patients (194 [ $\pm$ 149] min vs. 74 [ $\pm$ 45] min,  $P = 0.0003$ ). Patients admitted to the ICU/ED had more chance of being recognized earlier and being eligible for IVT or/and EVT compared to the patients admitted to the regular floors (44% vs. 25%,  $P = 0.14$ ); however, the difference did not reach statistical significance.

## Discussion

While overall in-hospital strokes in our study had high rates of mortality and morbidity, ICU/ED patients had a significantly shorter time to stroke symptom detection from last known neurologically intact when compared to the regular floor patients. Furthermore, they had a trend toward a higher likelihood of being eligible for acute treatment compared to the regular floors, although the result did not reach statistical significance. This may have also led to higher rates of eligibility for IVT and/or EVT with possibility of better clinical outcomes.

It is well established that having specialized stroke inpatient care units leads to reduced mortality and also reduced length of stay.<sup>[11-13]</sup> Our study also points along similar lines suggesting that units where nursing care is more critical care oriented with a better nurse-to-patient ratio such as ED and ICUs tend to lead to quicker stroke symptom recognition and higher eligibility for stroke treatment.<sup>[14,15]</sup> Our ICUs and ED are staffed with a 2:1 patient-to-nurse ratio, whereas the regular floors have a 4–6:1. Besides specialized nursing care, the better nurse-to-patient ratio, which is usual for most ICUs and EDs compared to the regular floors,<sup>[16]</sup> would lead to more frequent checks and would portend to higher chances of early recognition of stroke symptoms. While the overall functional outcome in patients with AIS is dependent on

a multitude of medical comorbidities and clinical factors, early symptom detection plays a significant role in the early initiation of treatment measures.

While sedation and various medical comorbid conditions<sup>[17]</sup> may have confounded an accurate neurological exam at times, thus leading to missed or late diagnosis of stroke, our data show significant delays in time of symptom recognition to head CT initiation in the majority of these patients (92.5%) which subsequently led to delays in appropriate treatment plans. This indicates continuing room for improving of overall systems of care for inpatient strokes.<sup>[18-20]</sup>

Our study being a relatively small cohort with inherent limitations should be interpreted with caution. First, the results of our single-center quality improvement study may naturally not be generalizable to the quality of care in other centers. Second, we cannot entirely keep out the confounding effect of other variables such as medical comorbidities, which likely also led to overall poor outcomes. Furthermore, decisions for not pursuing aggressive stroke treatments may also have stemmed from overall poor medical status and contraindications; thus, the outcomes cannot be reliably interpreted as solely being dependent on delayed treatments. Having no control group of patients with stroke occurring outside the hospital to compare the variables and quality of care was also a limitation to our study; however, the general standards of most comprehensive stroke centers can be considered benchmarks. The other major limitation of the study is the fact that no comparison can be done between the two groups in terms of the functional outcome, given the small sample size in each group, which makes multivariable regression analysis not feasible. Moreover, a low number of the total patients and patients per year make time trend analysis impractical.

Despite these limitations, our study demonstrated that better nurse-to-patient ratio and more knowledge about stroke symptoms among nursing staff may lead to quicker recognition of the neurological deficits among inpatient strokes. Further efforts toward higher quality neuro-specific nursing education for nurses

**Table 2: Comparison of patient variables based on location**

Measure	Regular floor (n=28)	ICU/ED (n=25)	P
Characteristics			
Age	69	64	0.62
HTN, n (%)	22 (80)	17 (71)	0.59
Diabetes mellitus, n (%)	8 (29)	12 (48)	0.72
Coronary artery disease, n (%)	13 (47)	14 (57)	0.57
NIHSS, mean $\pm$ SD	15 $\pm$ 7	13 $\pm$ 9.85	0.68
Mean time from last known normal to symptom detection (min), mean $\pm$ SD	194 $\pm$ 149	74 $\pm$ 45	0.0003
IVT/EVT treatment eligibility, n (%)	7 (25)	11 (44)	0.14

SD: Standard deviation, NIHSS: National Institutes of Health Stroke Scale, IVT: Intravenous thrombolysis, EVT: Endovascular treatment, ICU/ED: Intensive care unit/emergency department

on regular floors, encouraging a low threshold for initiating stroke alerts, and streamlining inpatient stroke alert algorithms<sup>[21]</sup> are among the measures that might improve the quality of care in this group of patients. Sustaining the improvements will depend on the commitment of educating the new nursing staff members on the importance of timely stroke symptom recognition and the entire stroke care.

## Conclusions

Significantly longer duration of the last known neurologically intact to symptom recognition among regular floor patients compared to the ICU/ED patients necessitates higher quality neuro-specific nursing education for the nursing staff. Only a small number of patients with in-hospital AIS received brain imaging within the time period suggested by the ASA/AHA guidelines (<25 min), which is a great opportunity for quality improvement efforts in the care of this group of patients.

## Acknowledgments

We would like to thank Ms. Deborah A. Steck, RN, MS, CNS, and SCRNP and Ms. Annemarie Crumlish, CCRC, for their valuable and constructive guidance for our data collection.

## Financial support and sponsorship

Nil.

## Conflicts of interest

There are no conflicts of interest.

## References

- Mowla A, Singh K, Mehla S, Ahmed MK, Shirani P, Kamal H, *et al.* Is acute reperfusion therapy safe in acute ischemic stroke patients who harbor unruptured intracranial aneurysm? *Int J Stroke* 2015;10 Suppl A100:113-8.
- Singh K, Mowla A, Mehla S, Ahmed MK, Shirani P, Zimmer WE, *et al.* Safety of intravenous thrombolysis for acute ischemic stroke in patients with preexisting intracranial neoplasms: a case series. *Int J Stroke* 2015;10:E29-30.
- Mowla A, Kamal H, Lail NS, Vaughn C, Shirani P, Mehla S, *et al.* Intravenous Thrombolysis for Acute Ischemic Stroke in Patients with Thrombocytopenia. *J Stroke Cerebrovasc Dis* 2017;26:1414-8.
- Kamal H, Mowla A, Farooq S, Shirani P. Recurrent ischemic stroke can happen in stroke patients very early after intravenous thrombolysis. *J Neurol Sci* 2015;358:496-7.
- AbdelRazek MA, Mowla A, Hojnacki D, Zimmer W, Elsadek R, Abdelhamid N, *et al.* Prior asymptomatic parenchymal hemorrhage does not increase the risk for intracranial hemorrhage after intravenous thrombolysis. *Cerebrovasc Dis* 2015;40:201-4.
- Powers WJ, Derdeyn CP, Biller J, Coffey CS, Hoh BL, Jauch EC, *et al.* 2015 American Heart Association/American Stroke Association Focused Update of the 2013 Guidelines for the early management of patients with acute ischemic stroke regarding endovascular treatment: A guideline for healthcare professionals from the American Heart Association/American Stroke Association. *Stroke* 2015;46:3020-35.
- Blacker DJ. In-hospital stroke. *Lancet Neurol* 2003;2:741-6.
- Kelley RE, Kovacs AG. Mechanism of in-hospital cerebral ischemia. *Stroke* 1986;17:430-3.
- Kimura K, Minematsu K, Yamaguchi T. Characteristics of in-hospital onset ischemic stroke. *Eur Neurol* 2006;55:155-9.
- Cumbler E, Murphy P, Jones WJ, Wald HL, Kutner JS, Smith DB. Quality of care for in-hospital stroke: analysis of a statewide registry. *Stroke* 2011;42:207-10.
- Jørgensen HS, Nakayama H, Raaschou HO, Larsen K, Hübbe P, Olsen TS. The effect of a stroke unit: reductions in mortality, discharge rate to nursing home, length of hospital stay, and cost. A community-based study. *Stroke* 1995;26:1178-82.
- Strand T, Asplund K, Eriksson S, Hägg E, Lithner F, Wester PO. A non-intensive stroke unit reduces functional disability and the need for long-term hospitalization. *Stroke* 1985;16:29-34.
- Indredavik B, Bakke F, Solberg R, Rokseth R, Haaheim LL, Holme I. Benefit of a stroke unit: A randomized controlled trial. *Stroke* 1991;22:1026-31.
- Shortell SM, Zimmerman JE, Rousseau DM, Gillies RR, Wagner DP, Draper EA, *et al.* The performance of intensive care units: does good management make a difference? *Med Care* 1994;32:508-25.
- Penoyer DA. Nurse staffing and patient outcomes in critical care: a concise review. *Crit Care Med* 2010;38:1521-8.
- Institute of Medicine (US) Committee on the Work Environment for Nurses and Patient Safety. In: Page A, editor. *Keeping Patients Safe: Transforming the Work Environment of Nurses*. Washington (DC): National Academies Press (US); 2004.
- Namazi MR, Mowla A. Massive right-sided hemorrhagic pleural effusion due to pancreatitis; a case report. *BMC Pulm Med* 2004;4:1.
- Mowla A, Doyle J, Lail NS, Rajabzadeh-Oghaz H, Deline C, Shirani P, *et al.* Delays in door-to-needle time for acute ischemic stroke in the emergency department: A comprehensive stroke center experience. *J Neurol Sci* 2017;376:102-5.
- Shahjouei S, Tsivgoulis G, Goyal N, Sadighi A, Mowla A, Wang M, *et al.* Safety of intravenous thrombolysis among patients taking direct oral anticoagulants: A systematic review and meta-analysis. *Stroke* 2020;51:533-41.
- Nabavizadeh SA, Mowla A, Mamourian AC. Wallerian degeneration of the bilateral middle cerebellar peduncles. *J Neurol Sci* 2015;349:256-7.
- Alberts MJ, Brass LM, Perry A, Webb D, Dawson DV. Evaluation times for patients with in-hospital strokes. *Stroke* 1993;24:1817-22.