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Time Metrics in Acute Ischemic Stroke Care During the Second and First Wave of COVID 19 Pandemic: A Tertiary Care Center Experience from South India

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Background: During the first wave of the pandemic, stroke care suffered globally and there were reduced stroke admissions and delays in time metrics. Stroke care was reorganized during the second wave learning from the experience of previous wave. This study shares our experience in stroke time metrics during the second wave of pandemic compared to the first wave. *Methods:* We did a single-center prospective study, where consecutive acute ischemic stroke patients within 24 hours of the onset of symptoms and aged more than 18 years, who presented to Stroke Unit, Department of Neurology, Government Medical College, Thiruvananthapuram from June 1st to 31st August, 2020 and June 1st to 31st August in 2021 were included. In-hospital time metrics (door to CT time and door to Needle time) were compared during the two time periods. We also compared functional outcomes at discharge and in-hospital mortality during the two periods. Functional outcome at discharge was assessed by modified Rankin scale (mRS). *Results:* From June to August 2021 (second wave of the COVID 19 pandemic), compared to the same months during the first wave (2020), our study demonstrated better in-hospital time metrics (door to CT time and door to needle time). We also found lower admission systolic blood pressure and higher baseline CT early ischemic changes during the second wave. There was no difference in functional outcome at discharge and in-hospital mortality. Intravenous thrombolysis rates also remained the same during the two periods. *Conclusion:* Our study has confirmed that time metrics in stroke care can be improved through system rearrangement even during the pandemic. Acute stroke treatments are time-dependent and hospital administrators must stick to the maxim "Time is Brain" while restructuring stroke workflows during future challenges.

Key Words: COVID-19 Pandemic—Workflow—Thrombolytic therapy—Hospital mortality—Treatment outcome

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Introduction

During the first wave of the pandemic, prime importance was on COVID 19 care and Stroke care suffered

Abbreviation: NCCT, Non-contrast CT; CTA, CT angiogram; ASPECTS, Alberta Stroke Program Early CT Score; ECASS, European Cooperative Acute Stroke Study; LVO, Large vessel occlusion; TOAST, Trial of ORG 10172 in Acute Stroke Treatment; MCA, Middle cerebral artery; ACA, Anterior cerebral artery; PCA, Posterior cerebral artery

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globally, which was contributed by the challenges faced in the hospital workflow and the impact of lockdown. Reduced stroke admissions and delay in time metrics were reported worldwide.^{1,2} However, there was no decline in stroke admissions in India, but a delay in time metrics was noted.³ Benefits from the acute treatment of ischemic stroke (both intravenous thrombolysis and mechanical thrombectomy) are time-dependent and time metrics are one of the significant quality indicators of stroke care.^{4,5}

Learning from the experiences from the first wave, administrators realized the fact that stroke causes significant morbidity and mortality, and strategies were planned to reorganize stroke care. This study shares our experience of time metrics in Government Medical

College, Thiruvananthapuram, during the second pandemic wave compared to the first wave. We also compared the in-hospital mortality and functional outcomes at the time of discharge.

Methods

Our study was a single-center prospective study, where consecutive COVID negative acute ischemic stroke patients (confirmed by either CT imaging or MRI), aged more than 18 years, presenting within 24 hours after onset of symptoms, to the Stroke Unit, Department of Neurology, Government Medical College, Thiruvananthapuram were included. They were recruited between June 1st 2020 and 31st August 2020 and between June 1st 2021 and 31st August 2021 after getting informed written consent. Stroke Unit at Government Medical College, Thiruvananthapuram is a tertiary care center that caters to treatment for patients from Southern Kerala and Southern districts of Tamil Nadu. Patients with premorbid mRS (modified Rankin scale) of >2 were excluded from the study. We selected the months of June, July, and August 2020 as the first wave and the same months in 2021 as the second wave because of the peaking of COVID cases during this period. The study was started after getting the approval of the Institutional Research Committee and Institutional Human ethics committee.

Baseline demographic data (age, sex), risk factor profile (diabetes, hypertension, dyslipidemia, smoking, rheumatic heart disease, atrial fibrillation), and onset to door time were noted. Time since last known well was noted in minutes. Clinical details at admission like baseline NIHSS (National Institute of Health Stroke Scale), GCS (Glasgow Coma Scale), systolic blood pressure (BP), and diastolic BP at time of admission were documented. NIHSS is a 15 item tool for assessing the neurological deficits in stroke patients.⁶

All patients underwent non-contrast CT(NCCT) brain with CT angiogram(CTA) on admission. Door to CT time was calculated in minutes. In the baseline NCCT, ASPECTS (Alberta Stroke Program Early CT Score) and in the CTA, the presence of large vessel occlusion(LVO) was noted. ASPECTS is a CT scan score that quantitatively assesses early ischemic changes in acute stroke cases, especially in middle cerebral artery strokes.⁷ Large vessel occlusion was defined as occlusion of the distal internal carotid artery, proximal M1 MCA(middle cerebral artery), A1 ACA (anterior cerebral artery), P1 PCA (posterior cerebral artery), vertebral or basilar artery.⁸ Patients eligible for intravenous thrombolysis were lysed with intravenous alteplase 0.9mg/kg. Door to needle time was noted in minutes. All patients underwent repeat CT imaging at 24 hours and the presence of hemorrhagic transformation was assessed according to ECASS criteria.⁹ Etiological evaluation of stroke, including transthoracic

echocardiogram, 24-hour Holter study, was done and classified according to TOAST criteria.¹⁰

The primary objective was to compare the in-hospital time metrics (door to CT time and door to needle time) in acute non-COVID ischemic stroke patients during June, July, and August in 2021(second wave of the pandemic) and June, July, and August in 2020 (first wave of the pandemic). The secondary objective was to compare functional outcomes at discharge and in-hospital mortality during the same periods. Functional outcome at discharge was assessed by mRS.¹¹ Modified Rankin Scale of 0-2 was taken as the good outcome and 3-6 as the poor outcome.

Data collection was done using Microsoft Excel and statistical analysis using IBM-SPSS v.27. The summary statistics of normally distributed continuous variables were expressed as mean (standard deviation), and non-normally distributed data as median (interquartile intervals). Continuous variables were analyzed with t-test and categorical variables with the Chi-square test. A p-value less than 0.05 was considered significant.

Results

Baseline demographic data, risk factor profile, and clinical features

Forty-eight patients satisfied the inclusion criteria during the first wave and forty-nine during the second wave. Comparison of baseline demographic data, risk factor profile, and clinical features of patients with acute ischemic stroke between second COVID wave and first COVID wave is shown in [Table.1](#). The basic demographic profile (age, sex) was similar during both waves. The severity of stroke documented by NIHSS did not differ between the two periods. Even though hypertension is a risk factor, systolic blood pressure at admission was lower during the second wave when compared with the first wave.

Imaging and investigation details

[Table 2](#) compares the radiological and investigation details of patients with acute ischemic stroke during the second COVID wave compared to the first wave. The volume of infarct on admission assessed by ASPECTS was lower in the first wave compared to the second wave. None of the other factors were different in the two groups. The most common etiology of stroke in both periods was the undetermined group, which was slightly more during the second wave.

Stroke metrics, treatment, and outcomes

The table depicts the comparison of stroke metrics, intravenous thrombolysis rates, and outcomes at the time of discharge of acute ischemic stroke patients during the second and first waves. Patients with acute stroke symptoms reached our emergency earlier during the second wave than the first wave but were not statistically

Table 1. Baseline Demographic, risk factor profile and clinical features of patients with acute ischemic stroke during second COVID wave compared to first COVID wave.

	Acute ischemic Stroke patients during second COVID wave (n=49)	Acute ischemic Stroke patients during first COVID wave(n=48)	p-value
Mean age in years(SD)	60(14.6)	58.8(12.9)	0.66
Male (n)	36	39	0.36
Wake up Stroke (n)	4	6	0.48
Median NIHSS	8	9.5	0.99
Median GCS	15	15	0.34
Mean SBP (SD)	152(28.7)	166(24.9)	0.01
Hypertension (n)	36	21	0.003
Diabetes (n)	38	35	0.59
Smoking (n)	19	12	0.15
Dyslipidaemia (n)	26	29	0.46
Alcohol (n)	4	3	0.71

SD- standard deviation, n-number of patients, NIHSS- National Institute of Health Stroke Scale, GCS- Glasgow Coma score, SBP -Systolic blood pressure, DBP- Diastolic blood pressure

significant. In-hospital time metrics were better during the second wave, evidenced by lesser door to CT time and door to needle time. Rates of intravenous thrombolysis were similar during the two periods. There was no significant difference in hospital-mortality rates and functional outcomes at discharge.

Discussion

Our study reveals better in-hospital time metrics, lower admission systolic blood pressure and higher baseline CT ASPECTS during the second wave of the COVID 19 pandemic than the first wave. We were able to reduce the door to CT time by twenty minutes.

Acute stroke patients reached our emergency room earlier during the second wave compared to the first wave (assessed by time of last seen normal to door), but this difference was not statistically significant. During the second wave, lockdown measures were milder and fear of contracting COVID Infection may have been reduced due to

better vaccination coverage. The continued education of the public through campaigns by Neurology Associations regarding the 'golden hours' of acute stroke care may have also helped progressively reduce onset-to-door time.

Our hospital is a major tertiary referral center that caters care to COVID and Non-COVID patients. The main hindrance we faced during the first wave was the delay in getting the acute CT imaging. Creating a red channel for imaging for patients with COVID created the delay. During the second wave, we overcame this hurdle by earmarking a separate 128 slices CT angiogram machine for acute stroke imaging, a significant step taken by State Government and Hospital administration. The effect in the door to CT time was also reflected in the door to needle time reduction. It may not be easy to earmark a CT machine entirely for stroke imaging in all hospitals, but such steps will help in reducing the delays in stroke care, especially in high volume centers.

Studies have identified delay in time metrics of treatment during the first pandemic wave compared to pre-

Table 2. Imaging and investigation details of patients with acute ischemic stroke during second COVID wave compared to first wave.

	Acute ischemic Stroke patients during second COVID wave (n=49)	Acute ischemic Stroke patients during first COVID wave (n=48)	P value
Median RBS at admission (IQI)	141(122)	158(79.5)	0.61
Median TLC at admission (IQI)	9800 (3650)	9100 (1050)	0.12
Mean CT ASPECTS at admission (SD)	8.9 (1.4)	8 (2.1)	0.02
CTA Large vessel occlusion(n)	13	16	0.22
Hemorrhagic transformation in repeat CT(n)	14	12	0.64
Etiology of Stroke (in percentages)- TOAST LAAD:SVD:CE:UD:OD	12:12:14:59:2	25:25:15:35:0	0.46

RBS- Random blood sugar, TLC- Total leucocyte count, IQI -interquartile interval, ASPECTS- Alberta Stroke Programme Early CT Score, SD -standard deviation, CTA- CT angiogram, TOAST- Trial of ORG 10172 in Acute Stroke Treatment, LAAD- Large artery atherosclerotic disease, SVD- Small vessel disease, CE-Cardioembolic stroke, UD-Undetermined, OD- Other determined.

Table 3. Stroke Metrics, treatment and outcomes of acute ischemic stroke patients during second COVID wave compared to first COVID wave.

	Acute ischemic Stroke patients during second COVID wave (n=49)	Acute ischemic Stroke patients during first COVID wave (n=48)	P value
Median Onset to door time in minutes (IQI)	180 (165)	203 (192)	0.60
Door to CT time in minutes (median) (IQI)	20 (5)	40 (35)	<0.01
Median Door to Needle time in minutes (IQI)	60 (20)	80 (22.5)	<0.01
Intra venous thrombolysis(n)	24	21	0.60
Median mRS at discharge (IQI)	3 (2)	3 (2)	0.46
In hospital mortality(n)	1	4	0.16
Median Duration of hospital stay in days (IQI)	6 (4)	7 (4)	0.119

CT- computerized tomogram, mRS- modified Rankin scale, n=Number of patients

pandemic period time.^{3,12} Higher systolic blood pressure on admission in the first COVID wave may be due to the lack of BP monitoring and poor access to health care facilities contributed by strict lockdown measures and the fear of getting COVID. The infarct volume on admission assessed by ASPECTS was more in the first wave than the second wave. This would have been due to relatively more prolonged onset to door time and more large vessel occlusions during that period.

The most common etiology of stroke in both periods was the undetermined group, which was marginally more during the second wave with a corresponding decrease in the number of large-artery atherosclerotic and small-vessel diseases during the second wave. Associations between SARS-CoV-2 infection and an increase in cryptogenic stroke have been reported in the literature.¹³ Rates of intravenous thrombolysis were similar during the two periods, similar to the scenario reported from Germany.¹⁴ However, there was an increase in the thrombolysis rate in Poland during the second wave.¹⁵ There was no difference in hospital-mortality rates and functional outcomes at discharge, similar to the German data.¹⁴

The main limitation of our study was the limited number of patients.

Conclusion

Our study has shown that though the COVID pandemic adversely affected the acute stroke care pathway in the initial phase, the metrics (Table 3) improved during the second phase, probably through system change. During challenging times, stroke care workflow must be appropriately modified, keeping time metrics in mind.

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Supplementary materials

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