Admissions for Stroke and Strategies to Optimize Healthcare Delivery During the COVID-19 Pandemic - Experience from a Tertiary Care Hospital in South India

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ABSTRACT

BACKGROUND

COVID-19 is associated with a hypercoagulable state and stroke is one of its most common neurological complications. The current study is aimed at investigating the effect of the COVID-19 pandemic on hospital admissions for stroke.

METHODS

We conducted a retrospective observational study to determine if there was a significant difference in the number of hospital admissions for stroke during the 2 months of lockdown and the two preceding months, (starting on 24 March 2020). The numbers were also compared with the figures during the same months in the previous year. The numbers were also compared to the same months one year prior. The secondary objectives were to compare the time between the onset of stroke and presentation to the hospital, type of strokes that presented to the hospital, severity of stroke, number of code activations, number of thrombolysis conducted, and in-hospital mortality between the same time periods.

RESULTS

The total number of patients admitted for stroke during the time periods from 25th March 2019 to 24th May 2019, 25th January 2020 to 24th March 2020 and 25th March 2020 to 24th May 2020 were 82, 72 and 75 respectively, and there was no statistically significant difference between these numbers. However, there was a significant increase in the proportion of stroke cases when compared to total hospital admissions. This suggests that an increase in stroke incidence may have been masked by a reduction in the total number of patients presenting to the hospital. The National Institutes of Health Stroke Scale (NIHSS) score of the patients who presented during the lockdown were higher. There were no significant differences in the time between the onset of stroke and presentation to the hospital, type of strokes that presented to the hospital, severity of stroke, number of code activations, number of thrombolysis conducted, and in-hospital mortality between the periods under study.

CONCLUSIONS

The present study suggests that there may be a relative increase in the incidence of stroke in the community, as a result of the COVID-19 pandemic. The patients who presented with stroke during the lockdown period had a higher NIHSS score.

KEYWORDS

COVID-19, Stroke, Lockdown

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DOI: 10.18410/jebmh/2021/599

How to Cite This Article:
John KJ, Roy RA, Baby B, et al. Admissions for stroke and strategies to optimize healthcare delivery during the Covid-19 pandemic - experience from a tertiary care hospital in South India. J Evid Based Med Healthc 2021;8(36):3300-3305. DOI: 10.18410/jebmh/2021/599

Submission 27-04-2021,
Peer Review 05-05-2021,
Acceptance 10-08-2021,
Published 06-09-2021.

BACKGROUND

Stroke is a medical emergency and is one of the leading causes of disability and mortality worldwide. Ischemic stroke, which makes up 68% of all strokes, is treatable if thrombolysed during the 'window period' of 4.5 hours. Moreover, a subset of patients may also benefit from mechanical thrombectomy within 24 hours of symptom onset. Timely interventions such as decompressive craniectomy are beneficial in hemorrhagic stroke, which make up the remaining 32%.[1] Hence, the treatment of stroke is time-sensitive and is therefore essential that patients arrive at a health-care facility with as little delay as possible.

Different countries have adopted various measures to contain the spread of the severe acute respiratory syndrome coronavirus 2 (SARS – CoV - 2) virus. These measures range from voluntary social distancing guidelines to stringent travel restrictions. In India, a nationwide 'lockdown' was initiated on 24 March 2020 limiting movement of the entire 1.3 billion population of India. This lockdown was initially announced for a period of 21 days, and was extended till 31 May 2020 in four phases. This strategy was considered to be highly effective in slowing the spread of SARS–CoV-2. However, such travel restrictions could have had untoward consequences in the timely management of medical emergencies. It is known that COVID-19 is associated with a hypercoagulable state and stroke is one of the most common neurological complications associated with this disease.[2,3] Furthermore, the disability in stroke increases in proportion to the delay in seeking treatment.

This study compared the proportion of strokes who presented during the two-month lockdown period among in-patients to the same time period before the initiation of lockdown in India and to a similar period in the preceding year. We also describe the measures taken by our healthcare team to ensure that there was minimal disruption of healthcare delivery during this period.

Objectives

The primary objective of this study was to determine the number of hospital admissions for stroke during the 2 months of lockdown and the two preceding months, along with 2 corresponding months (March to May) in 2019, and to determine if there was any significant difference in the numbers between these time periods. The secondary objectives were to compare the time between onset of stroke and presentation to the hospital, type of strokes that presented to the hospital, severity of stroke, number of code activations, number of thrombolysis conducted and in-hospital mortality between the same time periods.

METHODS

Study Setting

This study was conducted at Believers Church Medical College Hospital, Kerala, which is a 500-bed tertiary-care, referral, teaching institute with a comprehensive stroke center and an efficient emergency department and critical care unit, in South India. This hospital receives patients from all socio-economic backgrounds, predominantly from central and southern districts of Kerala, India. Patients who present with stroke, are admitted to the emergency department. All patients are then evaluated by the on-call neurologist. Patients who are eligible for thrombolysis or mechanical thrombectomy are taken for the respective intervention and are then admitted to the intensive care unit (ICU) or the ward. Patients who do not fulfil eligibility criteria for emergent interventions are directly admitted to the ICU or ward, and managed by the neurology team.

Study Design

A retrospective observational study was conducted with patients presenting with stroke in three time periods, namely during the lockdown period (25th March 2020 to 24th May 2020), a similar time period just prior to the lockdown (from 25th January 2020 to 24th March 2020) and the same time period in the previous year (25th March 2019 to 24th May 2019). The results are reported in accordance with the STROBE guidelines.[4]

Study Participants

All patients admitted to the department of neurology with a diagnosis of stroke (ischemic stroke, haemorrhagic stroke and transient ischemic attack) during the study period were included in the study.

Study Variables

Patient information such as age, sex, time from onset of stroke to hospital admission, type of stroke, severity of stroke (NIHSS score), comorbidities, length of hospital stay and mortality were abstracted from the electronic medical records (EMR). Details of code activation and thrombolysis were also retrieved. Hospital statistics such as total number of in-patient and out-patient admissions in the department of neurology and the entire hospital were obtained from the medical records department

Statistical Methods

Descriptive measures such as median, mean and standard deviation (SD) were calculated for all continuous variables, whereas percentages were calculated for all categorical variables. Comparison between the time periods were done using the z-test for proportions, student t test for means and Mann-Whitney test for medians. All the analyses were performed using Statistical Package for Social Sciences (SPSS) software, version 23.0.

Ethical Considerations

The study was approved by the Institutional Review Board (IRB No. IEC / 2020 / 10 / 188) before its commencement.

RESULTS

Characteristics	Corresponding period in 2019	2020, Before Lockdown Period	2020, during Lockdown Period	P Value: Comparing Before and during Lockdown	P Value: Comparing Lockdown Period to Same Period in 2019
Number of strokes	82	72	75		
Stroke cases per neurology IP (%)	82/116 (70.7 %)	72/134 (53.7 %)	75/106 (70.8 %)	0.189	0.99
Stroke cases per hospital IP (%)	82/4184 (2.0 %)	72/3756 (1.9 %)	75/2587 (2.9 %)	0.013*	0.015*
Neurology OP cases per hospital OP (%)	2888/59779 (4.8 %)	2367/50930 (4.6 %)	1326/27146 (4.9 %)	0.16	0.74
Time to hospitalization, mean hours (SD)	21.7 (+/- 26.5)	25.7 (+/-32.1)	35.9 (+/-61.6)	0.21	0.07
Time to hospitalization (median hrs)	10.2	11	11		
Ischemic strokes (%)	77 (93.9 %)	64 (88.9 %)	69 (92 %)	0.88	0.92
Haemorrhagic stroke (%)	2 (2.4 %)	2 (2.8 %)	1 (1.3 %)	0.54	2
Transient ischemic attacks (%)	3 (3.7 %)	6 (8.3 %)	5 (6.7 %)	0.72	0.42
Code activation (%)	10 (12.2 %)	11 (15.3 %)	14 (18.7 %)	0.64	0.33
Thrombolysis (%)	8 (9.8 %)	10 (13.9 %)	11 (14.7 %)	0.91	0.41
NIHSS, mean (SD)	5.1 (4.9)	4.3 (3.3)	5.7 (3.8)	0.03*	0.38
Outcome					
Mean duration of hospitalization, days (SD)	6.5 (6.3)	5.4 (4.7)	6.6 (4.2)	0.13	0.92
Median duration of hospitalization (days)	5	5	5		
Mortality (%)	4 (4.9 %)	2 (2.8 %)	3 (4 %)	0.69	0.79

Table 1. Baseline Characteristics of Stroke In-Patients in Three Time Periods.

*NIHSS: National Institutes of Health Stroke Scale, IP: In patient, OP: Out patient

The total number of patients admitted with stroke during the time period from 25th March 2019 to 24th May 2019, 25th January 2020 to 24th March 2020 and 25th March 2020 to 24th May 2020 were 82, 72 and 75 respectively. [Table 1] The total number of in-patient admissions and out-patient visits to the department of neurology, and the entire hospital are given in table 1. The demographic details of patients are given in Table 2. There were significantly lesser diabetic patients in the 2019 group (p value 0.03). Other characteristics were similar between the groups.

There were statistically significant differences between the strokes per neurology in-patients (IP) before and after lockdown, as well as strokes per hospital IP before and during lockdown. Although absolute number of out-patients (OP) had reduced to almost 50 %, there was no statistical difference in the proportion of neurology OP per hospital OP. The mean time to hospitalization was higher during lockdown, but this difference was not statistically significant. This can be explained by skewed data as evidenced by the comparable median values. The types of strokes that presented were similar across the three time periods. [Figure 1] However, a significantly higher National Institutes of Health Stroke Scale (NIHSS) score among the patients presenting after lockdown was noted. There were significantly more ischemic strokes than hemorrhagic strokes in our study. Although there was a higher proportion of code activations and thrombolysis during lockdown, it was not statistically significant. No statistically significant difference in stroke mortality was found between these three groups.

Characteristics	Corresponding period in 2019	2020, Before Lockdown	2020, during Lockdown	P Value: Comparing Before and After lockdown	P Value: Comparing Post Lockdown to Same Period in 2019
Age, Mean (SD)	67.3 (+/-10.8)	67.5 (10.9)	66.9 (10.3)	0.77	0.86
Men (%)	44 (53.7 %)	48 (66.7 %)	54 (72 %)	0.76	0.25
Diabetes (%)	34 (41.5 %)	54 (75 %)	55 (73.3 %)	0.93	0.03*
Hypertension (%)	66 (80.5 %)	55 (76.4 %)	56 (74.7 %)	0.92	0.76
CVA/TIA (%)	5 (6.1 %)	5 (6.9 %)	8 (10.7 %)	0.46	0.33
Coronary artery disease (%)	16 (19.5 %)	17 (23.6 %)	18 (24 %)	0.96	0.58

Table 2. Demographic Features of the Patients Admitted with Stroke during Three Time Periods

*CVA: cerebrovascular attack, TIA: transient ischemic attack

DISCUSSION

As the pandemic and the various measures to contain it unfolded, the department of neurology realized that there would be significant disruption of healthcare delivery in the months ahead. We identified the following areas where disruptions were likely, and where we would focus our efforts to mitigate them. We were concerned that patients with neurological emergencies such as stroke would not be able to seek health-care in time. Secondly, we felt that the travel restrictions would make it difficult for patients with chronic neurological issues to come for OP visits and refill their medications. We also realized that there were psychological aspects associated with the pandemic such as concern of contracting COVID-19 during a hospital visit. The safety of our healthcare team was also a priority.

We wanted to minimize the possibility that patients and the healthcare team cross infect each other. The treating team was split into smaller groups. This ensured that even if one team was exposed to a patient and had to be quarantined, the remaining teams could take over their function and continue patient care. Furthermore, a telemedicine center was opened to facilitate online review of patients with chronic diseases. A junior doctor and clinical pharmacist collected all the relevant details from the patient and reviewed previous records. This information was sent to a consultant neurologist who would call the patient or caregiver over telephone or video call. If the neurologist felt that the patient had to come to the hospital for further

evaluation or admission, they were asked to do so. If the patient needed a refill of medication, the prescription was sent to the pharmacy. The hospital arranged for home-delivery of refill medications to the patient's home, within a 20 km radius of the hospital.

Seating arrangements in areas such as the waiting area, near pharmacy counters and the laboratory were rearranged to ensure safe physical distancing. The use of a face mask by all patients and bystanders was made mandatory. OP timings were changed, such that OP waiting times would be reduced. The aim was to ensure that patients can return home early in view of the various travel restrictions. Patient discharges were planned in the morning hours so that the patient and caregivers could travel home in the morning, when travel restrictions were lighter. Contact details of the telemedicine centre and a liaison were given so that online review was possible.

As the number of COVID-19 patients continue to increase worldwide, secondary effects of the pandemic are being identified. As more healthcare resources are being diverted to handle this crisis, there are less resources to treat other conditions. Many countries have imposed travel restrictions both international and domestic, in an attempt to slow the spread of SARS–CoV-2. There is concern that these measures may have unintended consequences such as hampering the patient's ability to seek healthcare. Neurological complications of COVID-19 have been described and one of the most common appears to be large vessel stroke.[2] Moreover, cerebrovascular events are associated with severe disease and poor outcome in patients with COVID-19.[5,6] Given this association between stroke and COVID-19, we sought to examine the impact the current pandemic and the various measures taken to contain it had on admissions for stroke in our hospital.

In India, the 'lockdown' was announced on 25th March 2020. The 'lockdown' was implemented to slow down the spread of COVID-19 within the country and entailed strict and mandatory social-distancing guidelines and travel restrictions. These guidelines were enforced by law-enforcement agencies and essentially confined a population of over 1.3 billion to their homes, unless travel was necessary for emergent reasons. While the enforcement of the 'lockdown' meant a sudden change in various-socioeconomic factors, we hypothesized that there would have been changes in the behaviour of the population even prior to the 'lockdown' as COVID-19 began to spread in the community and social-distancing and reducing non-essential travel were encouraged, if not enforced. Therefore, we included a control group from 2019, well before the emergence of SARS-CoV-2, to compare our study population.

At first glance, it would appear that the admission rates of other diseases had reduced during the COVID-19 pandemic.[7,8] The maximum reduction occurred during the initial months of the pandemic, and these numbers have partly reversed thereafter. This phenomenon was observed in stroke admissions as well, with many centers reporting reductions in stroke admissions during the pandemic.[9-12] In our study, we observed a reduction in number of total IP and OP numbers, especially after the 'lockdown'. Although the total number of patients with stroke were fewer, it was not statistically significant. Interestingly, the proportion of strokes per neurology IP and hospital IP were significantly higher.

These observations suggest that the findings of the studies mentioned above are the net effect of a number of factors. Although, there are a number of unanswered questions regarding the incidence, management and long-term outcome of cardiovascular diseases during a crisis, some clarity is emerging. An increased incidence of stroke was observed following extreme weather events.[13] Humanitarian emergencies have been linked with an increase in cardiac morbidity and mortality, and the effects may persist for many years.[14] It is reasonable to assume that the same holds true for stroke during the COVID-19 pandemic.

Theoretically, COVID-19 may increase the risk of stroke by various mechanisms, the first among which is the hypercoagulable state induced by the infection.[3] Indeed, anticoagulant therapy is now widely considered to be part of the standard of care for COVID-19.[15] Other mechanisms by which COVID-19 may cause stroke are endothelial dysfunction, systemic inflammation and cardio-embolism as a result of myocarditis, arrhythmia or heart failure.[16,17] Hence, it would only be logical to conclude that the incidence of stroke, especially ischemic stroke, should increase during the COVID-19 pandemic. This may explain why we observed higher proportion of ischemic strokes.

There was a significantly higher NIHS score among the patients with stroke who presented after the lockdown. It is possible that the travel restrictions, enforcement of lockdown and disruption of public transport may have discouraged patients with minor stroke from visiting the hospital. There were no significant differences in the mean age, type of stroke, proportion of code activations and thrombolysis between the three groups.

We did not observe a significant difference between the absolute numbers of stroke admissions between these three periods. However, there was a significant increase in the proportion of stroke cases per neurology and total hospital IP before and after lockdown. At the same time, there was no change in the proportion of neurology OP visits between the three groups, in spite of an almost 50 % reduction in the total number of OP visits before and after lockdown. Therefore, we hypothesize that the number of strokes has indeed increased during the pandemic. The increase in proportion of stroke cases after lockdown may be a reflection of the general increase in stroke cases in parallel to the growing number of COVID-19 cases, combined with a lesser number of hospital admissions for other, less serious conditions.

Considering how common coagulopathic complications are in COVID-19, and the additional mechanisms by which COVID-19 may result in stroke, the increase in proportion of stroke cases seems lower than expected. Moreover, other studies have reported a decrease in the incidence of stroke.[9-11] One possibility is that patients with stroke are unable to reach the hospital in time, due to the restrictions in place and reduced availability of public transport. The counter-argument would be that almost all travel restrictions, provide

sufficient exemptions for medical emergencies. Moreover, reduced traffic on the roads would have meant that patients who used private transport or ambulance services may have found it easier to reach the hospital. This probably explains why the time to hospitalization was lower in the group of patients who presented during lockdown. Another explanation would be that people chose not to go to a hospital due to fear of getting infected with SARS–CoV-2 and therefore, patients with minor strokes did not present to the hospital during the pandemic.[18] Our observations are also congruent with other studies.[9-11] Patients may also defer hospital visits to avoid health-care expenditure, at a time when unemployment rates have increased substantially.[19] Since most strokes are minor and occur at home, it is also possible that an increase in stroke incidence is not reflected in the data derived from hospital records.[9,20] Possibilities such as minor stroke not being recognized by others as a consequence of social distancing and patients with severe stroke dying at home cannot be ruled out.[9] Reassuringly, there was no difference in stroke mortality during the three groups in our study.

It would seem that it is difficult to generalize the effect of COVID-19 and the lockdown. There appears to be two opposing groups of factors. On one hand, there may be an increase in the incidence of stroke due to the pandemic itself and other factors. On the other hand, patients may choose not to, or may be unable to access healthcare due to various reasons. The actual number of strokes that we witness in the hospital may be a complex interaction that is difficult to predict. They seem to be dependent on the specific community, state or country and the time period under study. It may also be too early to fully appreciate the effect of COVID-19 and travel restrictions on stroke. For almost a year, people have been confined to their homes, were socially isolated and had to deal with the emotional stress of a global pandemic. It can be presumed that at least some of them have not been able to exercise and visit their doctor for control of hypertension and blood sugar. Hence, it is plausible that the pandemic has led to an increase in their overall stroke risk, which may manifest in the coming years. We would like to point out that we observed more diabetics among our stroke patients in the two groups who presented in 2020, when compared to those in 2019. However, it may be too premature to draw conclusions from this observation.

We acknowledge that our study had some limitations. This was a retrospective study from a single center. A multicentre prospective study would have given more validity to our observations. The generalizability of our findings is also unknown, as the findings seem to be greatly dependent on the study site and multiple external factors. Nevertheless, we feel that this study is useful in better understanding on how the COVID-19 pandemic impacts other diseases.

CONCLUSIONS

The COVID-19 pandemic has resulted in significant disruption of healthcare services around the globe. The measures taken to slow the spread of COVID-19 may have also contributed to this. In our study, we did not observe a significant difference in the total number of patients with stroke who presented to our hospital before and after lockdown, when compared to the pre-COVID period. However, there was an increase in the proportion of stroke cases, indicating that the incidence of stroke may have increased. This increase may have been masked by a reduction in the total number of patients presenting to the hospital.

Ethics Approval and Consent to Participate

The study was approved by the Institutional Review Board (IRB No. IEC / 2020 / 10 / 188) before its commencement.

Data sharing statement provided by the authors is available with the full text of this article at jebmh.com.
Financial or other competing interests: None.
Disclosure forms provided by the authors are available with the full text of this article at jebmh.com.

REFERENCES

[1] Krishnamurthi RV, Feigin VL, Forouzanfar MH, et al. Global and regional burden of first-ever ischaemic and haemorrhagic stroke during 1990–2010: findings from the Global Burden of Disease Study 2010. Lancet Glob Health 2013;1(5):e259-e281.
[2] Ghannam M, Alshaer Q, Al-Chalabi M, et al. Neurological involvement of coronavirus disease 2019: a systematic review. J Neurol 2020;267(11):3135-3153.
[3] Klok FA, Kruip MJHA, van der Meer NJM, et al. Incidence of thrombotic complications in critically ill ICU patients with Covid-19. Thromb Res 2020;191:145-147.
[4] von Elm E, Altman DG, Egger M, et al. The strengthening the reporting of observational studies in epidemiology (STROBE) statement: guidelines for reporting observational studies. J Clin Epidemiol 2008;61(4):344-349.
[5] Pranata R, Huang I, Lim MA, et al. Impact of cerebrovascular and cardiovascular diseases on mortality and severity of Covid-19–systematic review, meta-analysis, and meta-regression. J Stroke Cerebrovasc Dis 2020;29(8):104949.
[6] Aggarwal G, Lippi G, Henry BM. Cerebrovascular disease is associated with an increased disease severity in patients with Coronavirus Disease 2019 (Covid-19): a pooled analysis of published literature. Int J Stroke 2020;15(4):385-389.
[7] Mafham MM, Spata E, Goldacre R, et al. Covid-19 pandemic and admission rates for and management of acute coronary syndromes in England. The Lancet 2020;396(10248):381-389.
[8] Garcia S, Albaghdadi MS, Meraj PM, et al. Reduction in ST-Segment elevation cardiac catheterization laboratory activations in the united states during Covid-19 pandemic. J Am Coll Cardiol 2020;75(22):2871-2872.
[9] Jasne AS, Chojecka P, Maran I, et al. Stroke code presentations, interventions, and outcomes before and

during the Covid-19 pandemic. Stroke 2020;51(9):2664-2673.
[10] Siegler JE, Heslin ME, Thau L, et al. Falling stroke rates during Covid-19 pandemic at a comprehensive stroke center. J Stroke Cerebrovasc Dis 2020;29(8):104953.
[11] Tejada Meza H, Lambea Gil Á, Sancho Saldaña A, et al. Ischaemic stroke in the time of coronavirus disease 2019. Eur J Neurol 2020;27(9):1788–1792.
[12] Thornton J. Stroke: "striking reductions" are seen in number of people with symptoms seeking help. BMJ 2020;369:m1406.
[13] Swerdel JN, Janevic TM, Cosgrove NM, et al. The effect of hurricane sandy on cardiovascular events in New Jersey. J Am Heart Assoc 2014;3(6):e001354.
[14] Hayman KG, Sharma D, Wardlow RD, et al. Burden of cardiovascular morbidity and mortality following humanitarian emergencies: a systematic literature review. Prehospital Disaster Med 2015;30(1):80-88.
[15] Thachil J, Tang N, Gando S, et al. ISTH interim guidance on recognition and management of coagulopathy in Covid-19. J Thromb Haemost 2020;18(5):1023-1026.
[16] Varga Z, Flammer AJ, Steiger P, et al. Endothelial cell infection and endotheliitis in Covid-19. Lancet 2020;395(10234):1417-1418.
[17] Long B, Brady WJ, Koyfman A, et al. Cardiovascular complications in COVID-19. Am J Emerg Med 2020;38(7):1504-1507.
[18] Lazzerini M, Barbi E, Apicella A, et al. Delayed access or provision of care in Italy resulting from fear of COVID-19. Lancet Child Adolesc Health 2020;4(5):e10-e11.
[19] Witters D. Inc G. In U.S., 14% with likely Covid-19 to avoid care due to cost. Gallup.com. 2020 https://news.gallup.com/poll/309224/avoid-care-likely-covid-due-cost.aspx
[20] Feng EJ, Orencia AJ, Whisnant JP. Outcome and pathogenesis of stroke is conditioned by place of stroke occurrence. J Stroke Cerebrovasc Dis 1993;3(1):3-8.