



# Decreased Stroke Applications During Pandemic: Collateral Effects of COVID-19

## *Pandemi Döneminde Azalmış İnme Başvuruları: COVID-19'un Kollateral Etkileri*

Erman Altunışık, Ali Arık

Adiyaman University Training and Research Hospital, Clinic of Neurology, Adiyaman, Turkey

### Abstract

**Objective:** Our study aimed to investigate the effects of the pandemic on human behavior and stroke management by comparing hospital admissions made due to stroke during the pandemic period with the same period of the previous year.

**Materials and Methods:** This retrospective study was conducted on patients with stroke admitted to our hospital between April 1<sup>st</sup>, 2020, and May 31<sup>st</sup>, 2020, and April 1<sup>st</sup>, 2019, and May 31<sup>st</sup>, 2019. Strokes were divided into three subgroups: ischemic stroke, hemorrhagic stroke, and transient ischemic attack (TIA). The total number of strokes, stroke subtypes, vascular risk factors, sociodemographic and clinical characteristics, National Institutes of Health Stroke Scale (NIHSS) scores, presence of large vessel occlusion, thrombolytic therapy use, intensive care unit requirement, and in-hospital mortality values were compared for both periods.

**Results:** A total of 133 patients, 75 males, 58 females, 44 during the pandemic period and 89 in the previous year, were included in the study. The mean age of the patients was 71.29±13.12 years. During the pandemic period, compared with the same period one year ago, there was a 50% decrease in the number of strokes, a 44% decrease in the number of ischemic strokes, a 62.5% decrease in the number of intracranial hemorrhages, and an 87.5% decrease in the number of TIA. During the pandemic period, the rate of patients who received intravenous thrombolytic therapy, the rate of patients with large vessel occlusion, the in-hospital mortality rate, and the mean NIHSS scores were found to be significantly higher during the pandemic, but the rate of patients who had a minor stroke was significantly lower.

**Conclusion:** The pandemic period has brought along many unknowns. It is a matter of curiosity how the effects of the pandemic on human behavior and functioning in health institutions will affect the diagnosis, treatment, and long-term follow-up of diseases other than coronavirus disease-2019.

**Keywords:** COVID-19, pandemic, stroke, transient ischemic attack, epidemiology

### Öz

**Amaç:** Çalışmamız, pandemi döneminde inme sebebiyle yapılan hastane başvurularını bir önceki yılın aynı dönemiyle kıyaslayarak pandeminin insan davranışları ve inme yönetimine olan etkilerini araştırmayı amaçlamaktadır.

**Gereç ve Yöntem:** Bu retrospektif çalışma, hastanemize 1 Nisan 2020 ve 31 Mayıs 2020 ile 1 Nisan 2019 ve 31 Mayıs 2019 tarihleri arasında kabul edilen inme geçiren hastalar üzerinde gerçekleştirildi. Hastalar inme tipine göre; iskemik inme, hemorajik inme ve geçici iskemik atak (GİA) olmak üzere üç alt gruba ayrıldı. Her iki döneme ait toplam inme sayıları, inme alt tipleri, vasküler risk faktörleri, sosyodemografik ve klinik özellikler, Ulusal Sağlık İnme Enstitüsü Ölçeği (NIHSS) değerleri, büyük damar oklüzyonu varlığı, trombolitik tedavi kullanımı, yoğun bakım yatışı gereksinimi ve hastane içi mortalite değerleri birbiriyle kıyaslandı.

**Bulgular:** Çalışmaya yaş ortalaması 71,29±13,12 olan 75 erkek, 58 kadın; pandemi döneminde 44, bir yıl önceki dönemde 89 olmak üzere toplamda 133 hasta alınmıştır. Pandemi döneminde bir yıl önceki aynı dönemle karşılaştırıldığında, hastaneye kabullerde tüm inme geçiren hasta sayılarında yüzde 50, iskemik inme sayılarında %44, intrakraniyal hemoraji sayılarında %62,5, GİA sayılarında %87,5 düşüş saptandı. Pandemi döneminde tedavisinde intravenöz trombolitik tedavi kullanılan hasta oranı, büyük damar oklüzyonu saptanan hasta oranı, hastane içi mortalite oranı ve ortalama NIHSS skorları pandemi döneminde anlamlı derecede daha yüksek saptanırken, minör inme geçiren hasta oranı anlamlı derecede düşük saptandı.

**Sonuç:** Pandemi dönemi birçok bilinmezi beraberinde getirmiştir. Pandeminin insan davranışları ve sağlık kuruluşlarındaki işleyişe olan etkilerinin koronavirüs hastalığı-2019 dışındaki hastalıkların tanı, tedavi ve uzun dönem takiplerini nasıl etkileyeceği merak konusudur.

**Anahtar Kelimeler:** COVID-19, pandemi, inme, geçici iskemik atak, epidemiyoloji

**Address for Correspondence/Yazışma Adresi:** Erman Altunışık MD, Adiyaman University Training and Research Hospital, Clinic of Neurology, Adiyaman, Turkey  
Phone: +90 505 467 46 69 E-mail: ermanaltunisik@gmail.com ORCID: orcid.org/0000-0002-5996-2090

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## Introduction

The coronavirus disease-2019 (COVID-19) pandemic caused by severe acute respiratory syndrome-coronavirus-2, which was first reported in China in December 2019, posed a critical threat to global public health (1). It is known that during the COVID-19 pandemic, emergency room admissions for non-COVID-19 conditions such as appendicitis, myocardial infarction, and stroke have been greatly reduced. The fear of catching the virus, which can be fatal, and the avoidance of seeking medical help as a result of the confusion in patients with stay-at-home directives, may have caused some problems (2). The possibility that problems in accessing medical assistance during the pandemic period may lead to an increase in morbidity and mortality values of diseases other than COVID-19 in the upcoming period is an issue that should be carefully considered. In this respect, the effects of diseases other than COVID-19 on the population in long-term follow-up can be at least as devastating as COVID-19.

Stroke refers to a suddenly occurring focal neurologic syndrome that develops due to cerebrovascular disease. Of all strokes, 80-85% are of ischemic origin and 15-20% of them are of hemorrhagic origin. Stroke is a major medical and economic problem that causes severe disability and ranks third among the causes of death after heart diseases and cancer (3). Although the incidence of stroke varies between regions, it also varies according to race and residential areas among people in the same country. In studies conducted in the last 20 years, it was found that the incidence of stroke was 1-3/1.000 and the prevalence was 6/1.000 (4). For patients with acute illnesses such as stroke, any disruption in diagnosis, treatment, and care can lead to increased mortality, disability, and care burden. The delay in hospital admissions of severe patients during the pandemic period brings the risk of patients not being able to benefit from acute stroke treatments, and the pandemic process itself creates a separate problem in stroke treatment. When it comes to stroke, both the sociologic effects of the pandemic and the COVID-19 process itself bring many unknowns and discussions. Our study aimed to investigate the effects of the pandemic on human behavior and stroke management by comparing hospital admissions made due to stroke during the pandemic period with the same period of the previous year.

## Materials and Methods

This retrospective study was conducted on patients with stroke admitted to the Adiyaman University Training and Research Hospital between April 1<sup>st</sup>, 2020, and May 31<sup>st</sup>, 2020, and April 1<sup>st</sup>, 2019, and May 31<sup>st</sup>, 2019. The study population consisted of patients of both sexes aged over 18 years with acute focal neurologic symptoms consistent with stroke. Subarachnoid, subdural, and epidural hemorrhages were not included in the study because the diagnosis, treatment, and follow-up were performed by neurosurgeons. Strokes were divided into three subgroups: ischemic stroke, hemorrhagic stroke, and transient ischemic attack (TIA). The total number of strokes for both periods were compared in terms of the number of stroke subtypes, vascular risk factors such as diabetes, hypertension, hyperlipidemia, atrial fibrillation and stroke history, sociodemographic and clinical characteristics, intensive care hospitalization requirement, and in-hospital mortality rates. Ischemic stroke severity was measured according to the National Institutes of Health Stroke Scale (NIHSS). The

patients were divided into three groups according to the NIHSS scores. NIHSS scores between 0-4 were classified as minor stroke, those between 5-15 as moderate stroke, and those with 16 or above as severe stroke. Patients with ischemic stroke were compared between the two periods in terms of clinical features such as NIHSS scores, presence of large vessel occlusion, and the use of thrombolytic therapy. Large vessel occlusion was defined as the radiographic confirmation of occlusion in the intracranial internal carotid artery, M1 and M2 segments of the middle cerebral artery, or the basilar artery. The etiologic classification of ischemic stroke was made according to the Trial of Org 10172 in Acute Stroke (TOAST) criteria. Short episodes of acute, focal cerebral or monocular dysfunction lasting less than 24 hours and not causing permanent parenchymal damage were evaluated as TIA. Due to the retrospective nature of the study, patient consent was not obtained. Approval was obtained from Adiyaman University Non-interventional Clinical Research Ethics Committee for the study (date: 22/09/2020, protocol number: 2020/8-22).

## Statistical Analysis

Statistical analyses were made using the SPSS version 17.0 program. The normality of distribution of the variables was examined using histogram graphics and the Kolmogorov-Smirnov test. Mean, standard deviation, and median values were used while presenting descriptive analyses. Pearson's chi-square test was used in 2x2 comparisons. The Mann-Whitney U test was used when comparing groups that did not show normal distribution (non-parametric). A p value less than 0.05 was evaluated as statistically significant.

## Results

A total of 133 patients, 75 men and 58 women, were included in the study. The average age was 71.29±13.12 years. Forty-four patients were diagnosed during the pandemic period. There was no significant difference in terms of age, sex, and vascular risk factors between the two periods. There was no significant difference between the periods in terms of ischemic stroke etiology classification made according to the TOAST criteria. The sociodemographic data of the patients are summarized in Table 1.

During the pandemic period, compared with the same period a year ago, a 50% decrease was found in the number of patients with stroke in hospital admissions. There was a 44% decrease in the number of ischemic strokes in the COVID-19 period compared with the same period of the previous year, but there was no significant change in terms of the rate of patients with ischemic stroke (p=0.136). In the COVID-19 period, there was an 87.5% decrease in the number of TIAs compared with the same period the previous year, but there was no significant change in terms of the proportion of patients with TIAs (p=0.107). Although there was a 62.5% decrease in terms of the number of patients with intracerebral hemorrhages between the two periods, there was no significant difference in terms of the rate of patients between the two periods (p=0.669). The rate of using intravenous thrombolytic therapy in treatment, the rate of patients with large vessel occlusion, and in-hospital mortality rates were significantly higher during the pandemic period (p=0.004, p=0.047, and p=0.024, respectively). Although the rate of patients requiring follow-up in the intensive care unit was higher during the pandemic period, it did not reach statistical significance (p=0.052). When the periods were compared in terms of stroke severity, a significant

decrease was found in terms of the rates of minor strokes during the pandemic period ( $p=0.001$ ), but no significant change was found in terms of severe and moderate strokes ( $p=0.083$  and  $p=0.084$ ). When patients with ischemic stroke were compared in

terms of mean NIHSS scores, the mean NIHSS scores during the pandemic period were significantly higher than in the previous year ( $p=0.005$ ). The comparison of the clinical results between the two periods is summarized in Table 2.

Table 1. Clinical results of patients in the pandemic period and the period one year ago

		Year				p
		2019		2020		
		n	%	n	%	
Sex	Male	48	(53.93)	27	(61.36)	0.416 <sup>1</sup>
	Female	41	(46.07)	17	(38.64)	
Artery territory	MCA	53	(73.61)	25	(62.50)	0.061 <sup>1</sup>
	ACA	1	(1.39)	2	(5.00)	
	Lacunar	2	(2.78)	6	(15.00)	
	VBA	16	(22.22)	7	(17.50)	
Etiology	Atherosclerosis	47	(57.32)	24	(57.14)	0.620 <sup>1</sup>
	Small vessel disease	6	(7.32)	5	(11.90)	
	Cardioembolic	16	(19.51)	5	(11.90)	
	Cryptogenic	13	(15.85)	8	(19.05)	
Risk factor	Hypertension	69	(77.53)	27	(61.36)	0.055 <sup>1</sup>
	Diabetes	31	(34.83)	11	(25.00)	0.251 <sup>1</sup>
	Atrial fibrillation	16	(17.89)	5	(11.36)	0.325 <sup>1</sup>
	Stroke	13	(14.61)	12	(27.27)	0.079 <sup>1</sup>
	Hyperlipidemia	25	(28.09)	10	(22.73)	0.509 <sup>1</sup>
Age (mean $\pm$ SD)		70.96 $\pm$ 13.52		71.95 $\pm$ 12.37		0.655 <sup>2</sup>

<sup>1</sup>Chi-square test, <sup>2</sup>Mann-Whitney U test, MCA: Middle cerebral artery, ACA: Anterior cerebral artery, VBA: Vertebrobasilar artery, SD: Standard deviation

Table 2. Clinical results of patients in the pandemic period and the period one year ago

		Year				p
		2019		2020		
		n	%	n	%	
Stroke type	Ischemic	72	(80.90)	40	(90.91)	0.136 <sup>1</sup>
	Hemorrhagic	8	(8.99)	3	(6.82)	0.669 <sup>1</sup>
	TIA	9	(10.11)	1	(2.27)	0.107 <sup>1</sup>
Stroke severity	Mild	34	(47.89)	7	(17.50)	0.001 <sup>1</sup>
	Moderate	27	(38.03)	22	(55.00)	0.084 <sup>1</sup>
	Severe	10	(14.08)	11	(27.50)	0.083 <sup>1</sup>
Thrombolytic therapy		3	(3.66)	8	(19.51)	0.004 <sup>1</sup>
Large vessel occlusion		24	(33.33)	21	(52.50)	0.047 <sup>1</sup>
In-hospital mortality		9	(10.11)	11	(25.00)	0.024 <sup>1</sup>
Intensive care hospitalization		29	(32.58)	22	(50.00)	0.052 <sup>1</sup>
NIHSS (mean $\pm$ SD)		7.75 $\pm$ 6.49		9.88 $\pm$ 5.59		0.005 <sup>2</sup>

<sup>1</sup>Chi-square test, <sup>2</sup>Mann-Whitney U test, TIA: Transient ischemic attack, NIHSS: National Institutes of Health Stroke Scale, SD: Standard deviation

## Discussion

In this study, we presented evidence that there was a significant decrease in stroke admissions in the province of Adiyaman after the onset of the COVID-19 pandemic. In studies conducted in many countries around the world, a decrease was reported in admissions of patients with stroke during the COVID-19 pandemic (5,6). A similar decrease has been shown in cardiovascular diseases (7). It is not clear to what extent the decrease in the number of healthcare center visits is related to population behavior or conditions in the health facility.

Considering the data of the last 5 years in Italy, it was observed that in a center where an average of 51 new patients with ischemic stroke was followed up per month, surprisingly, only six patients with ischemic stroke were admitted within a month of the onset of the pandemic; 21% of the strokes presenting in the pre-pandemic period were ischemic strokes due to large vessel occlusion, and only one patient with ischemic stroke presented with large vessel occlusion during the pandemic period (5). In a different study, it was observed that there was a 39% reduction in patients who underwent imaging with a pre-diagnosis of stroke (8). In a different study comparing the pandemic period with the same period of the previous year, a 36.4% decrease in stroke admissions was reported (9). In the study, although the number of TIAs and mild and moderate strokes decreased during the pandemic period, no significant change was found in the number of severe strokes and intraparenchymal hemorrhages. In another study conducted in Italy, it was found that the number of patients hospitalized in the stroke unit decreased by 45% compared with the previous year. In addition, it was observed that the average NIHSS scores were higher during the pandemic period (10). In a different study, it was observed that the rate of patients with large vessel occlusion was significantly higher during the COVID-19 period (11). The results obtained in the studies largely overlap with our study.

In our study, a decrease was found in the number of all strokes, ischemic strokes, hemorrhagic strokes, and TIAs. Although there was no significant change in the rates of severe and moderate stroke, there was a significant decrease in minor stroke rates during the pandemic period. In addition, in-hospital mortality, average NIHSS scores, and the rate of patients with large vessel occlusion were found to be higher during the pandemic period. Higher average NIHSS scores, higher in-hospital mortality rate, and a higher proportion of patients with large vessel occlusion among patients evaluated in the period of COVID-19 indicated that patients with severe ischemic stroke during this period tended to go to the hospital more often. The fact that the number of all strokes and minor stroke rates was decreased and there was no change in the number of severe and moderate ischemic strokes showed that the patients did not have less stroke than before. The lesser diagnosis of mild stroke and TIA is a point that needs to be addressed.

The first patient with COVID-19 in our country was seen on March 11<sup>th</sup>, 2020, and in our city on March 16<sup>th</sup>, 2020. In the following periods, a set of national isolation measures restricting the movement of the population except for need, working, and health conditions were taken. During this extraordinary period, the attention of healthcare providers primarily focused on infected patients. The tendency not to go to emergency departments, as a result of restrictions on free movement and encouragement of

quarantine and isolation measures, may explain to some extent the fall in the number of recorded strokes. A series of unforeseen epidemiologic consequences are likely to occur, perhaps due to social anxiety and fear of transmission as a result of these efforts. It will not be surprising that non-COVID-19 diseases such as stroke are also affected by this epidemiologic change. However, it does not seem reasonable to avoid admission to the hospital and hospitalization in patients with large vessel occlusion who may progress and have the possibility of developing serious sequela. As a matter of fact, in this study, no decrease in the number of severe strokes was observed. We thought that the decrease in stroke admissions to the emergency department during the pandemic was related to the fact that patients with mild stroke and TIA were admitted to emergency departments less because of fear of going to the hospital. Patients with mild and transient symptoms may also be missed, as the focus of our healthcare system is to identify patients with COVID-19 and conserve healthcare resources. In addition, loss of social security as a result of economic factors such as dismissals and the anxiety of losing employment can also play a role in avoiding hospital admissions. Another factor that may have contributed to the lower stroke rates may be a decrease in the number of patients with silent infarction due to the decrease in the use of cranial imaging as a result of the concentration of radiodiagnostic facilities on pulmonary pathologies during the COVID-19 period. Future large population-based prospective studies may better shed light on the clinical consequences of overlooked stroke diagnoses and other social effects of the pandemic that could not be made due to contamination concerns.

Stroke symptoms are often noticed by another family member, friend, or anyone outside the home before they are noticed by the patient. During the pandemic period, especially the strict stay-at-home measures applied to the elderly population, and young individuals who continue to have relations with the outside, and reducing contact with the fear of infecting the elderly may have also contributed to the decrease or delay of stroke admissions. This, once again, demonstrates the importance of patient education and increasing awareness of the warning signs and symptoms of stroke.

The social effects of the pandemic on diagnosis, treatment, care and survival of patients with acute stroke should not be ignored. It is known that the risk of recurrent stroke, myocardial infarction or mortality is higher in patients who are diagnosed as having minor stroke or TIA and who receive suboptimal treatment compared with the normal population (12). It has also been reported that ischemic stroke can develop in 10-20% of untreated patients with TIA in 90 days (13). Considering that this risk can be reduced by 80% in early treated TIAs (14), it is undisputed how essential the diagnosis and treatment of these patients are for both the patient and the health system. Misconception or delay in the evaluation, diagnosis, and treatment of patients with mild stroke or TIA may cause stroke complications such as early recurrence of stroke, pneumonia, sepsis and seizures, and may increase the burden on intensive care units.

It is known that follow-up of patients with stroke in stroke units significantly improves the prognosis compared with normal wards or other hospital wards and units. This approach alone provides a 3-28% decrease in the mortality rate and an 8-11% reduction in the duration of hospital stay in patients with acute stroke, and most importantly, increases the rate of discharge of patients to home independently by 7-19% (15). It is known



that during the pandemic period, stroke units and patient beds in hospitals were used for pandemic patients in many cities. The effects of this handicap on survival and disability in patients with stroke should not be overlooked. Prospective studies in which long-term results are examined will be enlightening.

It has been previously reported that COVID-19 increases cerebrovascular and cardiovascular complications (16). Recently, Oxley et al. (17) shared remarkable observations regarding an increase in the number of young patients with ischemic stroke presenting with severe stroke symptoms in a center in New York. All of these young patients with stroke were diagnosed as having COVID-19. COVID-19 was not diagnosed in any of the patients included in our study. Polymerase chain reaction was not performed because the patients did not have clinical symptoms and contact history of COVID-19. During the study period, there were not many patients with COVID-19 and the patient peak number was not yet reached. In this respect, our study does not claim that there is a radical epidemiologic change.

#### Study Limitations

This study was a single-center, retrospective observational study of a short period in the early stage of the COVID-19 pandemic. It may not be generalized to the whole country and may not indicate major changes in stroke epidemiology. Although our results reflected the patients' possible reluctance to go to healthcare facilities, we were unable to confirm this with individual patients due to the retrospective nature of the study.

#### Conclusion

As a result, the pandemic period in which we remain has brought many unknowns. It is a matter of curiosity how the pandemic will affect human behavior and functioning in health institutions, and how that will affect the diagnosis, treatment, and long-term follow-up of diseases other than COVID-19. We believe that longitudinal, multi-center studies on large patient populations are needed to elucidate the collateral effects of the pandemic.

#### Ethics

**Ethics Committee Approval:** Approval was obtained from Adıyaman University Non-interventional Clinical Research Ethics Committee for the study (date: 22/09/2020, protocol number: 2020/8-22).

**Informed Consent:** Retrospective study.

**Peer-review:** Externally and internally peer reviewed.

#### Authorship Contributions

Surgical and Medical Practices: E.A., Concept: E.A., Design: E.A., Data Collection or Processing: A.A., Analysis or Interpretation: E.A., Literature Search: A.A., Writing: E.A.

**Conflict of Interest:** The authors have not declared any conflict of interest related to this article.

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