

## RETROSPECTIVE ANALYSIS OF STROKE PATIENTS ADMITTED TO EMERGENCY DEPARTMENT BEFORE AND DURING COVID-19 PANDEMIC <sup>(1)</sup>

### COVID-19 PANDEMİSİ SIRASINDA VE ÖNCESİNDE ACİL SERVİSE BAŞVURAN İNME HASTALARININ RETROSPEKTİF ANALİZİ

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**Öz: Amaç:** Bu çalışmada, COVID-19 pandemisinde acil servise başvuran iskemik ve hemorajik inme hasta sayısındaki ve 30 günlük mortalitedeki değişimi saptamak amaçlanmıştır. **Yöntem:** Çalışma bir üniversite hastanesinin acil servisinde yapılmıştır. 11 Mart 2019 – 11 Mart 2021 tarihleri arasında başvuran inme hastaları retrospektif olarak incelendi. 11 Mart 2019– 11 Mart 2020 tarihleri arası pandemi öncesi, 11 Mart 2020 tarihi sonrası ise pandemi dönemi olarak kabul edilmiştir. Hastaların cinsiyet, inme tipi (iskemik/hemorajik), tedavi aldığı ünite ve 30 günlük mortalite durumunun pandemideki değişimi incelenmiştir. Çalışma için etik kurul onayı alınmıştır. **Bulgular:** Çalışmaya 586 inme hastası dahil edilmiştir. Pandemi öncesi iskemik inme oranı %72.4 (n:181) iken pandemi döneminde %92.3'e (n:310) yükselmiştir ve hemorajik inme oranı ise %27.6'dan (n:69) %7.7'ye (n:26) düşmüştür (p<0.001). Pandemi döneminde hastaların cinsiyet, 30 günlük mortalite ve tedavi aldığı ünite açısından istatistiksel olarak anlamlı değişim saptanmamıştır (sırasıyla, p=0.534; p=0.147; 0.905). **Sonuç:** Pandemi sırasında acil servise başvuran iskemik inme sayısında artış, hemorajik inme sayısında ise azalma olmuştur. Bu duruma COVID-19'un neden olduğu kanaatini taşımaktayız.

**Anahtar Kelimeler:** COVID-19, İnme, Mortalite, Başvuru Oranları, Acil Servis

**Abstract: Aim:** This study aims to determine the change in the number of ischemic and hemorrhagic stroke patients admitted to the emergency department and 30-days mortality in patients during the COVID-19 pandemic. **Method:** This study was conducted in the emergency department of a university hospital. The stroke patients admitted between March 11, 2019, and March 11, 2021, were retrospectively analyzed. The dates between March 11, 2019, and March 11, 2020, were considered as the pre-pandemic period, and the dates following March 11, 2020, as the pandemic period. The changes in the gender of the patients, stroke type (ischemic/hemorrhagic), the unit where the patients received treatment, and the 30-day mortality status in the pandemic period were examined. Ethics committee approval was obtained for the study. **Results:** 586 stroke patients were included in the study. While the rate of ischemic stroke in the pre-pandemic period was 72.4% (n:181), it increased to 92.3% (n:310) in the pandemic period, and the rate of hemorrhagic stroke decreased from 27.6% (n:69) to 7.7% (n:26) (p<0.001). It was found that there was no statistically significant change in terms of gender, 30-day mortality, and the unit in which the patients received treatment in the pandemic period, respectively p=0.534, p=0.147, p=0.905. **Conclusion:** There is an increase in the number of ischemic stroke cases admitted to the emergency department during the pandemic and a decrease in the number of hemorrhagic stroke cases. We believe that this is motivated by COVID-19.

**Keywords:** COVID-19, Stroke, Mortality, Admission Rates, Emergency Department

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## INTRODUCTION

Emergency departments are the units where stroke patients generally apply for the first time and receive initial treatment. Strokes are classified as ischemic and hemorrhagic strokes. Cardioembolic strokes are the most significant cause in the etiology of ischemic strokes. Risk factors such as hypertension, hypercholesterolemia, atrial fibrillation, smoking, obesity, diabetes mellitus play a role in ischemic and hemorrhagic strokes (Hankey, 2017: 641).

COVID-19 outbreak started in Wuhan, China in 2019 and was declared a pandemic by the World Health Organization on March 11, 2020 (Aydemir et al., 2021; Cao et al., 2020: 748). Over time, it has been understood that COVID-19 not only causes pneumonia but also predisposes to thromboembolic events such as myocardial infarction, pulmonary thromboembolism, deep vein thrombosis and thus leading to thromboembolic diseases (Klok et al., 2020: 145). COVID-19 can cause morbidity and mortality in patients due to thromboembolic diseases (Vidale, 2021: 371). Strokes have been reported in 5.7% of severe patients treated for COVID-19 (Mao et al., 2020: 683). It is expected that there will be an increase in the incidence and mortality rate of ischemic stroke admitted to the emergency department due to the COVID-19 pandemic.

This study aims to determine whether the COVID-19 pandemic causes an increase in ischemic stroke patients admitted to the emergency department and whether there is an increase in the mortality of the patients.

## METHODS

### Study Population

Cerebrovascular disease, and especially ischemic stroke, has emerged as a serious complication of COVID-19. There has been a differentiation in stroke types after COVID-19. These types include large vessel occlusion, multi-territory stroke, and involvement of uncommonly affected vessels. The pathogenesis and optimal treatment strategy of ischemic stroke associated with COVID-19 are still unclear. Some hypotheses include coagulopathy and endotheliopathy induced by cytokine storm (Vogrig et al., 2021). Stroke was reported as an additional complication in 2.6% of patients hospitalized for COVID-19. It has been predicted to cause stroke as a complication of COVID-19 (Ellul et al., 2020: 767). This study was also designed to determine the change in stroke incidence and mortality during the COVID-19 pandemic. For the study, the stroke patients who applied to the Emergency Department of Ordu University Hospital between March 11, 2019, and March 11, 2021, with annual emergency service admissions in number over 100,000, were ret-



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respectively analyzed. Patients older than 18 without a history of trauma, pregnancy, immunosuppression, malignancy, or hematological disease were included in the study. The study involves the entire population, and no additional sample population was selected.

### Study Design

For the study, the gender of the patients, stroke type imaging methods (hemorrhagic, ischemic stroke), the unit the patients received treatment (outpatient unit, inpatient unit, intensive care unit), and 30-day mortality were recorded. The study was designed by including patients who applied for a one-year pandemic period and one-year pre-pandemic. The start date of the pandemic has been determined by the World Health Organization (WHO) as March 11, 2020, when the COVID-19 pandemic was declared<sup>1</sup>. Cases diagnosed with stroke according to the patient registry system were analyzed retrospectively by classifying them into two categories according to the periods as the pre-pandemic and pandemic. The patients were classified into two groups as ischemic stroke and hemorrhagic stroke according to the brain tomography and magnetic resonance imaging methods. The units in which the patients diagnosed with stroke and were hospitalized were classified as outpatient, inpatients, and intensive care units. In addition, the survival of the patients in the first 30 days after the di-

agnosis was analyzed via the patient registry system. Demographic and clinical characteristics of the cases were also analyzed along with the information given above.

### Ethics Consideration

Ethical approval was obtained for the study from the Clinical Research Ethics Committee of Ordu University (February 18, 2021, decision number 2021/46). Because the study was conducted retrospectively, informed consent was not obtained from the patients. The study was carried out in accordance with the Declaration of Helsinki.

### Statistical Analysis

All data analyses were conducted using SPSS v26 (IBM Inc., Chicago, IL, USA). Chi-square test was used to compare the frequency of diagnoses and 30-day mortality between the pre-pandemic and pandemic periods. All comparisons were two-tailed, and a p-value less than 5% was considered statistically significant.

### RESULTS

A total of 586 stroke patients were included in the study. Of these stroke patients included in the study, 42.7% (n:250) applied in the pre-pandemic period, and 57.3% (n:336) in the pandemic period. 49.5% (290) of the patients were women and 50.5% (296) were men. It was found that the 30-day mortality

of all patients was 40.6%. While 83.8% of the cases were ischemic stroke, 16.2% of the cases were hemorrhagic stroke. While 8.5% of the patients received treatment in the outpatient unit, 59.2% received treatment in the inpatient unit, and 32.3% received treatment in the intensive care unit (ICU) (Table 1).

According to the comparison between the pre-pandemic and during pandemic stroke cases, there was no significant difference between female and male patients ( $p=0.534$ ). While the 30-day mortality rate of stroke patients in the pre-pandemic was 37.2%, it was 43.2% in the pandemic period, so there was no significant difference between these

( $p=0.147$ ). Comparisons between the hospitalization and intensive care needs of stroke patients in the pre-pandemic and the pandemic period indicated there was no significant difference ( $p=0.905$ ). However, the stroke types of the patients in the pre-pandemic and the pandemic period were analyzed, and it was found that there was a statistically significant difference. While the rate of ischemic stroke in the pre-pandemic period was 72.4% (n:181), it increased to 92.3% (n:310) in the pandemic period, and the rate of hemorrhagic stroke decreased from 27.6% (n:69) to 7.7% (n:26) ( $p<0.001$ ) (Table 1).

**Table 1. The Comparison of Distribution of Stroke Patients in Pre-Pandemic and Pandemic Period**

Variables		Pre-pandemic period % (n)	Pandemic period % (n)	Total % (n)	p
Gender	Female	48.0 (120)	50.6 (170)	49.5 (290)	0.534
	Male	52.0 (130)	49.4 (166)	50.5 (296)	
30-day mortality	Yes	37.2 (93)	43.2 (145)	40.6 (238)	0.147
	None	62.8 (157)	56.8 (191)	59.4 (348)	
Stroke type	Ischemic	72.4 (181)	92.3 (310)	83.8 (491)	<0.001
	Hemorrhagic	27.6 (69)	7.7 (26)	16.2 (95)	
Treatment unit	Outpatient unit	8.0 (20)	8.9 (30)	8.5 (50)	0.905
	Inpatient unit	60.0 (150)	58.6 (197)	59.2 (347)	
	ICU	32.0 (80)	32.4 (109)	32.3 (189)	

Chi square test, ICU; Intensive care unit

## DISCUSSION

The most important impact of COVID-19 is

on the respiratory system. However, it has been understood over time that COVID-19 is a more multi-systemic disease than it seems.



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It causes multi-organ failure due to cytokine storm. It has been seen in various case series that it affects many systems such as the cardiovascular system, central nervous system, and peripheral nervous system in addition to the respiratory system and progresses with many complications. The most common neurological symptoms associated with COVID-19 are headache and dizziness. Hypoxic and metabolic changes can lead to agitation, delirium, and coma. However, it causes acute encephalitis, acute disseminated encephalomyelitis, acute necrotizing encephalopathy, acute transverse myelitis, Guillain-Barré syndrome, ischemic or hemorrhagic stroke (Garg, 2020: 560; Ahmad and Rathore, 2020: 8).

This study aims to compare the first year of the pandemic period and a year in the pre-pandemic period in terms of the number of stroke patients who applied to the emergency department, hospitalization status, the need for intensive care, and the 30-day mortality. Our findings maintain that the incidence of ischemic stroke increased during the COVID-19 pandemic. Although the pathophysiology of ischemic stroke in COVID-19 cases remains unclear, endothelial dysfunction, predisposition to coagulation, arrhythmias after myocardial injury, and cardioembolic events are thought to cause strokes (Clerkin et al., 2020: 1648; Zhang et al., 2020: 586). In a study

conducted by Rothstein et al. (2020: e219) in patients hospitalized due to COVID-19, it was stated that the risk of stroke is low and that known stroke risk factors play a role in patients who have had a stroke.

Of the 586 patients included in the study, 50.5% (n:296) were men and 49.5% (n:290) were women. The percentage of women in the pre-pandemic and the pandemic period was 48.0% and 50.6%, respectively. In the study conducted by Siegler et al. (2020) examining stroke patients in the pre-pandemic and the pandemic period, 42% of 328 patients were women. Our study indicated that the 30-day mortality rate of all patients is 40.6% (n:238). The 30-day mortality rate in the pre-pandemic and the pandemic period was 37.2% and 43.2%, respectively. In the study by Kristoffersen et al. (2021: 791) in which 680 stroke patients were evaluated before and during the lockdown, the overall in-hospital mortality rate was found to be 6%. The study carried out by Siegler et al. (2020) indicated that the in-hospital mortality of stroke patients was 21% in the pre-pandemic and the pandemic period. Unlike the literature, the high mortality rate in our study may be because of the fact that we analyzed 30-day mortality, the mortality rate of all stroke patients (without separating ischemic and hemorrhagic), and our hospital operates as a regional hospital that accepts patients in need of intensive care.



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In this study, it was found that 83.8% of the patients have ischemic strokes, and 16.2% have hemorrhagic strokes. In the study conducted by Jasne et al. (2020: 2664) in which 378 suspected stroke patients were included, 42.3% of the patients were found to have an ischemic stroke, 6.1% to have a transient ischemic attack, and 4% to have a hemorrhagic stroke. In the study conducted by Hasan et al. (2021) in which 1394 stroke patients were analyzed in the pre-pandemic and pandemic period; it was found that there was a decrease of 45.5% in ischemic stroke patients and 37.2% in intracerebral hemorrhage in the pandemic period. In our study, ischemic stroke increased both numerically and proportionally in the pandemic period. However, hemorrhagic stroke decreased significantly both numerically and proportionally in our study, which is one of the most notable findings in our study. This result shows that patients admitted to the emergency department due to stroke during the COVID-19 pandemic are more prone to thromboembolic events rather than hemorrhagic events. We think that the incidence of ischemic stroke may have increased due to asymptomatic and undiagnosed or inadequately treated COVID-19 cases in this society. In the study conducted by Majidi et al. (2020: 2656), similar to our study, it was found that there was a significant increase in the incidence of ischemic stroke due to large cerebral artery occlusions

in the COVID-19 pandemic compared to before. In the same study, 79% of the patients were men, and the COVID-19 test was found positive in 53% (Majidi et al., 2020: 2656).

In our study, 8.5% of the patients received treatment in the outpatient unit, 59.2% in the inpatient unit, and 32.3% in the intensive care unit. In a study conducted by Richter et al. (2021: 716) in which ischemic and hemorrhagic stroke patients in 1463 hospitals were analyzed in Germany, it was found that hospitalizations due to both ischemic and hemorrhagic strokes decreased significantly in the pandemic period compared to the pre-pandemic period. Additionally, in the same study, it was found that in-hospital mortality rates of patients increased significantly in the pandemic period (Richter et al., 2021: 716). In the study, which examines emergency calls in the USA, it was found that during the COVID-19 pandemic, people hesitated to apply to emergency services and were late, and there was a 4.3% increase in deaths due to stroke (Sharma et al., 2021: 563). In our study, unlike the literature, we did not find a significant change in hospitalization and 30-day mortality rates.

### Study Limitations

Our study has some limitations. First, our study was retrospective and single-centered. Because the study was conducted in emer-



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gency department, follow-up data are missing, and only 30-day mortality and hospitalization requirements could be analyzed in terms of their prognosis. Whether the stroke patients had COVID-19 before the admission could not be evaluated due to the lack of data. Sub-diagnosis of ischemic and hemorrhagic stroke patients could not be found due to lack of data, and therefore sub-group analyzes could not be performed. Multicenter and prospective studies are required to evaluate how the COVID-19 affects stroke frequency and disease prognosis.

## CONCLUSION

In conclusion, the number of ischemic stroke patients admitted to the emergency department increased during the COVID-19 pandemic compared to the pre-pandemic period. On the other hand, the number of hemorrhagic stroke patients decreased. It was concluded that the increase in ischemic stroke patients admitted to the emergency department in the pandemic is associated with COVID-19.

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