

# Rates of Cranial Computed Tomography before and during the COVID-19 Restrictions in Turkey

Türkiye’de COVID-19 Kısıtlamaları Sırasındaki ve Öncesindeki Kraniyal Bilgisayarlı Tomografi Oranları

## Abstract

**Aim:** In this study, we aimed to compare the admission and examination data of patients who presented to our emergency department with neurological symptoms in April 2019 (before) and April 2020 (during the COVID-19 pandemic).

**Methods:** The study included patients who underwent cranial computed tomography (CT), including patients who additionally underwent CT angiography for suspected stroke. Thus, the study sample consisted of a total of 960 patients, of whom 676 (Group I) presented before the COVID-19 pandemic and 284 (Group II) during the course of the pandemic. The data were reviewed retrospectively.

**Results:** The rates of the indications for cranial CT did not statistically significantly ( $p=0.143$ ) differ between Group I and II: suspected stroke, 76.2% vs. 72.9%; trauma, 22.5% vs. 23.6%; and tumors 1.3% vs. 3.5%, respectively. The rate of finding vessel obstruction on CT angiography was significantly ( $p<0.05$ ) higher in Group II (25% vs. 65%). The rate of confirmed cases of stroke was significantly ( $p<0.001$ ) higher in Group II (6.7% vs. 18.7%). Also, the rates of ischemic and hemorrhagic stroke were both significantly higher in Group II ( $p<0.001$  and  $p=0.043$ , respectively).

**Conclusion:** While measures for the prevention of the spread of COVID-19 infection have led to a decrease in hospital admissions, a conspicuous increase was observed in the rate of patients with stroke during the same period of time.

**Keywords:** computed tomography; coronavirus; COVID-19 pandemic

## Öz

**Amaç:** Bu çalışmada, Nisan 2019 ve Nisan 2020 aylarında (COVID-19 pandemisi öncesinde ve sırasında) nörolojik semptomlarla acil servisimize başvuran hastaların başvuru ve muayene verilerini karşılaştırmak amaçlanmıştır.

**Yöntem:** Çalışmamız, inme şüphesi nedeniyle ayrıca bilgisayarlı tomografik anjiyografi yapılanlar dahil, acil servisimize başvuran ve kraniyal bilgisayarlı tomografi (BT) çekilen hastalarla gerçekleştirildi. Böylece çalışma örneklemini 676’si (Grup I) COVID-19 pandemisinden önce, 284’ü (Grup II) COVID-19 döneminde başvuran hastalar olmak üzere, toplam 960 hasta içerdi. Veriler retrospektif olarak incelendi.

**Bulgular:** Grup I ve II arasında kraniyal BT endikasyon oranları bakımından istatistiksel olarak anlamlı ( $p=0.143$ ) fark görülmedi: inme şüphesi, (sırasıyla) %76,2’e karşı %72,9; travma, %22,5’e karşı %23,6; tümör, %1,3’e karşı %3,5. BT anjiyografide vasküler oklüzyon saptama oranı Grup II’de anlamlı biçimde ( $p<0,05$ ) daha yüksekti (%25’e karşı %65). Teyit edilmiş inme vakalarının oranı Grup II’de anlamlı biçimde ( $p<0,001$ ) daha yüksekti (%6,7’ye karşı %18,7). Ayrıca, hem iskemik hem hemorajik inme oranı yine Grup II’de anlamlı biçimde daha yüksekti (sırasıyla  $p<0,001$  ve  $p=0,043$ ).

**Sonuç:** COVID-19 enfeksiyonunun yayılımını önlemek için alınan önlemler hastane başvurularında azalmaya neden olurken, aynı dönemdeki inme oranlarında belirgin bir artış gözlenmiştir.

**Anahtar Sözcükler:** bilgisayarlı tomografi; COVID-19 pandemisi; koronavirüs

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## INTRODUCTION

Since it was first reported in China and subsequently declared a pandemic by the World Health Organization in March (1), the novel coronavirus disease-2019 (COVID-19) has been the most serious public health problem worldwide.

Most patients with COVID-19 have mild to moderate symptoms. Severe disease has been found to be associated with cardiovascular disease, diabetes mellitus, chronic respiratory disease, and cancer (2,3). The main route of transmission is close contact with infected people and infectivity tends to depend on the severity of the disease (4), rendering social distancing and isolation the main preventive measures. In Turkey, soon after the first confirmed case in the country (10 March 2020), all non-emergency surgical procedures were postponed by the national health authority in order to prevent COVID-19 transmission and preserve hospital capacity. State and private hospitals were designated as “pandemic hospitals”, and the working hours and shifts of healthcare workers were reorganized accordingly. Schools, including higher education institutions, were closed on 16 March 2020, and since then a distance education strategy has been adopted. Given the poorer prognosis and higher mortality in the elderly, official restrictions toward people aged  $\geq 65$  years were imposed on 21 March 2020, which, in April 2020, were expanded to include all age groups on weekends. People were asked not to visit hospitals during the course of the pandemic unless it was truly necessary. During the same period of time, a decrease was reported in the rate of stroke patients presenting to emergency departments (5–7). However, it remains unclear whether this decrease might have been because patients with minor stroke and transient ischemic attack accordingly postponed seeking medical care. Thus, in this study we aimed to compare the admission and examination data of patients who presented to our emergency department with neurological symptoms in April 2019 and April 2020.

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## MATERIALS AND METHODS

### Study sample

The study included patients who presented to our emergency department with neurological complaints

and underwent cranial computed tomography (CT) with or without diffusion-weighted magnetic resonance imaging (DW-MRI) as indicated by suspected stroke, trauma, or tumors in April 2019 and April 2020. The study was conducted in one of the busiest city hospitals in Turkey during the lockdown period. During the study period, in line with the recommendations of the Turkish Ministry of Health, we performed a SARS-CoV-2 polymerase chain reaction (PCR) test only in case of suspected infection, and none of the patients included in our stroke group tested positive for COVID-19.

### CT imaging

CT imaging was performed using 16-slice Multidetector CT (GE Healthcare Optima CT520, USA). The scanning protocol included non-enhanced cranial CT in all cases. After the start of dye injection using the bolus-tracking technique, a contrast-enhanced CT scan was performed in patients in whom CT angiography was deemed necessary. The post-processing techniques included axial, sagittal, coronal, and curved multiplanar reconstruction and maximum and minimum intensity projection. The reconstructed images had a slice thickness of 2.5–3.0 mm and a reconstruction interval of 1.5–2 mm.

### DW-MRI

Cranial DW-MRI was performed with a 1.5 Tesla MRI device (General Electric, Signa Excite). The examination protocol for axial DW images was as follows: TR/TE: 5900/98 ms, field of view: 250×250 mm, section thickness: 5 mm, matrix: 128×128, and b value: 0 and 1000 s/mm<sup>2</sup>. Apparent diffusion coefficient (ADC) maps were generated automatically by the software used.

### Statistical analysis

Statistical analysis was performed with SPSS (v. 19.0). Normality of continuous variables was checked by the Shapiro–Wilk test. Descriptive statistics were presented as mean ( $\pm$ standard deviation) for normally distributed and median (quartile: 25<sup>th</sup>–75<sup>th</sup> percentile) for non-normally distributed continuous variables, and as frequency (percentages) for categorical variables. Independent two-group comparisons were made us-

ing the Mann–Whitney U test and unpaired *t*-test for non-normally distributed and other continuous variables, respectively. When the assumptions were met, intergroup proportion comparisons were made using Pearson’s chi-square test, while Fisher’s exact test was used whenever at least one expected count in the contingency table cells was less than 5.  $p < 0.05$  was considered statistically significant.

### Study ethics

After the initial permission of the Turkish Ministry of Health, the study protocol was approved and the requirement for obtaining informed consent was waived by the Clinical Research Ethics Committee of the Istanbul Medeniyet University Göztepe Training and Research Hospital (13.05.2020-0241).

### RESULTS

The study included a total of 960 patients (471 females, 489 males), with a median age of 62 (range: 43–77) years. Group I ( $n=676$ ) consisted of patients who presented in April 2019 (i.e., before the COVID-19 outbreak), and Group II ( $n=284$ ) consisted of patients who presented in April 2020 (during the course of the COVID-19 pandemic). We performed CT in all patients, of whom 203 (21.1%) underwent DW-MRI. Cerebral CT angiography was performed in 71 (7.4%) patients. The indication for medical imaging was suspected stroke in 722 (75.2%), trauma in 219 (22.8%), and tumors in 19 (2%) patients.

The median age did not statistically significantly ( $p=0.073$ ) differ between Group I and II (61 [range: 42–77] vs. 65 [47–78] years, respectively). The sex distribution did not significantly ( $p=0.081$ ) differ between the two groups (344 [50.9%] vs. 127 [44.7%] females). The rate of undergoing DW-MRI did not significantly ( $p=0.085$ ) differ between the two groups (19.7% vs. 24.6%).

On the other hand, the rate of undergoing cerebral CT angiography was significantly ( $p < 0.001$ ) higher in Group II (4.1% vs. 15.1%). The rate of finding vessel obstruction on CT angiography was also significantly ( $p < 0.05$ ) higher in Group II (25% vs. 65%).

The rates of the indications for cranial CT did not significantly ( $p=0.143$ ) differ between the two groups:

suspected stroke, 76.2% vs. 72.9%; trauma, 22.5% vs. 23.6%; and tumors 1.3% vs. 3.5%.

The rate of confirmed cases of stroke was significantly ( $p < 0.001$ ) higher in Group II (6.7% vs. 18.7%). Also, the rates of patients with ischemic (5.2% vs. 14.4%) and hemorrhagic (1.5% vs. 3.5%) stroke were both significantly higher in Group II ( $p < 0.001$  and  $p=0.043$ , respectively). However, the numbers of the patients with ischemic and hemorrhagic stroke were quite similar in the two groups. The intergroup comparisons are summarized in Table 1.

### DISCUSSION AND CONCLUSION

In our study, we compared the admission and radiological examination data of patients who presented to our emergency department and underwent cranial CT before and during the COVID-19 pandemic. The university hospital at which our emergency department is located is one of the busiest city hospitals in Turkey and located in the most populous region of Turkey, where COVID-19 infection was prevalent during the study period. Accordingly, the present study results might be representative of the patient distributions at admission during the studied period of the COVID-19 pandemic.

We found that the number of cranial CT scans decreased from April 2019 to April 2020, probably due to the general decrease in admission to emergency departments during the pandemic. However, we observed a remarkable increase in the rate of stroke and signs of significant vascular occlusion. Among the indications for cranial CT, the most common were suspected stroke, trauma, and tumors in both years. The CT examinations in 2020 revealed significantly higher rates of ischemic and hemorrhagic stroke although the patient numbers were similar, and therefore it could be speculated that there were many unnecessary emergency visits before the COVID-19 pandemic. The total number of patients and rate of patients who underwent cranial CT with or without MRI were much lower in April 2020 than in April 2019. However, the rate of scans with abnormal findings (large vascular occlusions in most of the patients) increased. This would lead to significant neurological symptoms, increasing the rates of stroke and admission to the emergency department.

**Table 1.** Patient demographic and clinical characteristics

	Group I (n=676)	Group II (n=284)	<i>p</i>
Age (years)	61 (42–77)	65 (47–78)	0.073
Sex, n (%)			
Male	332 (49.1)	157 (55.3)	0.081
Female	344 (50.9)	127 (44.7)	
DWI, n (%)	133 (19.7)	70 (24.6)	0.085
CT-angiography, n (%)	28 (4.1)	43 (15.1)	<0.001
Stroke, n (%)			
Ischemic	35 (5.2)	41 (14.4)	<0.001
Hemorrhagic	10 (1.5)	10 (3.5)	0.043

CT: computed tomography; DWI: diffusion-weighted imaging

Our data on COVID-19 in Turkey were obtained from the website of the Turkish Ministry of Health. Most of the cases in Turkey were reported in major urban areas. The Ministry of Health and other governmental authorities took a series of measures, including the abovementioned restrictions, to prevent the spread of the infection, which resulted in a significant decrease in the number of patients who presented or were referred to hospitals, including those with trauma. Furthermore, fear of getting infected also contributed to the avoidance of nonvital visits to hospitals, particularly in the elderly population. For all these reasons, a decrease was reported in the number of emergency department admissions (8,9), including those of patients with transient ischemic attack (TIA)/acute stroke, which was explained by a similar avoidance in patients with TIA and mild stroke based on fear of infection at medical facilities during the pandemic (10). However, it was also maintained in rebuttal letters that the percentage of patients requiring immediate neurological consultation remained similar (11). All these hypotheses need to be tested with new studies on large series. A recent study by Altschul et al. reported a delay in patients presenting to hospitals and, consequently, worse outcomes (12). They used the term “collateral damage” for non-infected patients who had an acute stroke during the course of the pandemic and who ignored its mild symptoms, adopting a watch-and-wait strategy (13), to which Hoyer et al. also attributed the reduction in stroke rates during the pandemic (6). It appears that the COVID-19 pandemic will continue to have different effects on both admission distribu-

tions and non-infected patients. While studies on the relationship between stroke and COVID-19 infection accumulate, data on non-COVID-19-related stroke remain lacking.

It has currently been reported that ischemic stroke has been more common during the COVID-19 pandemic (14,15). The relationship between coagulopathy and thrombosis with COVID-19 has been a hot topic in the literature. Instead of the relationship between COVID-19 and stroke, in the present study we evaluated the stroke rates in non-COVID-19 patients. Comparing the same months of 2019 and 2020, we observed an increased stroke rate. However, considering that patients with more significant neurological findings might have been referred to emergency departments and that hospital visits were decreased due to fear and other factors, this can be interpreted as a relative increase.

Finally, the main limitations of our study are the single-center and retrospective design and the short study period despite the large sample size. In conclusion, while measures for the prevention of the spread of COVID-19 infection have led to a decrease in hospital admissions, a conspicuous increase was observed in the rate of patients with stroke during the same period of time.

#### Conflict of Interest and Financial Disclosure

The authors declare that they have no conflict of interest to disclose. The authors also declare that they did not receive any financial support for the study.

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