ORIGINAL PAPER

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The impact of the COVID-19 pandemic on critically ill patients with acute stroke and diabetic ketoacidosis

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ABSTRACT

Introduction and aim. This study aimed to compare the hospitalization rate, mortality rate and morbidity status of patients hospitalized with stroke and diabetic ketoacidosis (DKA) before and during the COVID-19 pandemic.

Material and methods. The data of 2522 patients who applied to the emergency department (ED) before and during the pandemic were evaluated. A Poisson regression analysis was used to examine the number of presentations between two different periods.

Results. Stroke cases during the pandemic era were compared to those during the pre-pandemic period, and it was shown that the mortality rate for stroke patients during the pandemic period was much higher. Treatment-related ED presentations decreased significantly during the pandemic period, particularly among patients aged 75–84 years. Rates of ED presentation decreased by 84 percent (IRR: 0.14, 95 percent CI: 0.03-0.59) in those with DKA and by 37 percent (IRR: 0.67, 95 percent CI: 0.53-0.75) in those with stroke during the pandemic period.

Conclusion. Conclusion: Stroke and DKA admissions decreased during the pandemic, but the rate of stroke mortality increased statistically 3.375 times. Getting emergency medical care increases their chances of survival. Even in a COVID-19 outbreak, treatment is critical.

Keywords. diabetic ketoacidosis, strokes, pandemics

Introduction

The first case of Coronavirus Disease-2019 (COVID-19) infection was discovered in Wuhan, China, in December of 2019. According to official sources, the World Health Organization (WHO) declared the illness a pandemic on March 11, 2020.[1] Because the early phases of the COVID-19 pandemic occurred during peak flu season, there was an increase in alert levels at ED throughout the world, which acted as the primary referral facilities for infected patients during this period.[2,3] As a consequence of the deployment of stringent measures to manage the pandemic, the number of visitors to the emergency room has dropped considerably in recent years.[4] There are a variety of probable explanations for this condition, including people's dread of infection and attempts to lessen the burden on the health-care delivery system.[5] Treatment that is delayed despite the development of symptoms may deteriorate the condition and increase the possibility of admission to an ED for more severe situations such as stroke or DKA to be treated.[6]

Following the revelation of the first COVID-19 case in Turkey on March 11, 2020, many steps were taken to contain the illness. These included halting foreign flights, closing schools and other meeting areas, and re-

stricting access to the old and fragile.[7] Although these limits reduced ED visits, they delayed treatment of life-threatening conditions, increasing community mortality and morbidity.[8] It was necessary to compare the hospitalization rate, mortality rate, and morbidity status of patients coming to the ED with stroke and DKA during the COVID-19 pandemic to those who presented during the pre-pandemic era in order to establish these conclusions.

Aim

This study aimed to compare the hospitalization rate, mortality rate and morbidity status of patients hospitalized with stroke and diabetic ketoacidosis (DKA) before and during the COVID-19 pandemic.

Material and methods

This research was designed as a retrospective, observational and single-centered study. It was approved by the institutional review board, and a waiver of authorization was given (Ethics Committee decision no. 2021/514/20/28, date: 28.04.2021), allowing the study to proceed. The "pandemic period" is defined as the time period commencing March 11, 2020, and ending December 31, 2020, the date on which the first COVID-19 case was discovered in Turkey, and includes all subsequent cases. The "pre-pandemic period" is defined as the time period between January 1, 2019 and March 11,

2020 during which no COVID-19 illnesses were documented in Turkey, according to the World Health Organization. After their electronic records indicated ICD codes for stroke or DKA, patients diagnosed with stroke or DKA were invited to participate in the research (International Classification of Diseases and Related Health Problems). The study included 223 patients with DKA and 2299 stroke who applied to the ED in both periods. The researchers looked at factors such as age, gender, in-hospital mortality, and duration of hospital stay. They found that patients having diagnoses other than stroke or DKA were excluded from the study, as were those whose data could not be accessed for any reason.

Statistical analysis

The statistical analysis was carried out with the help of the StataCorp LLC (Texas, USA). In addition to the mean and standard deviation, the median and minimum-to-maximum values, and the percentage distribution, descriptive statistics were also provided for each variable. For the purpose of determining whether or not the data followed a normally distributed distribution, the Kolmogorov-Smirnov test was performed. To assess the number of patients with DKA and stroke who came to the ED before and throughout the pandemic, the LOWESS technique was employed before and during the pandemic period. The incidence rate ratio (IRR) was calculated by dividing the total number of ED visits be-

Table 1. Comparison of the distribution of the characteristics of patients who presented to the emergency department due to diabetic ketoacidosis and stroke before and during the pandemic

Variable	Diabetic ketoacidosis				Stroke			
	Pre-pandemic n (%)	Pandemic n (%)	Total n (%)	p	Pre-pandemic n (%)	Pandemic n (%)	Total n (%)	p
Gender								
Male	78 (45.3)	23 (45.1)	101 (45.3)	0.98	902 (57.9)	421 (56.9)	1323 (57.5)	0.66
Female	94 (54.7)	28 (54.9)	122 (54.7)		657 (42.1)	319 (43.1)	976 (42.5)	
Age group								
40-64 years	106 (61.6)	42 (82.4)	148 (66.4)		547 (35.1)	292 (39.5)	839 (36.5)	
65-74 years	38 (22.1)	5 (9.8)	43 (19.39	0.04	421 (27.0)	191 (25.8)	612 (26.6)	0.19
75-84 years	20 (11.6)	2 (3.9)	22 (9.9)		387 (24.8)	162 (21.9)	549 (23.9)	
85 years and above	8 (4.7)	2 (3.9)	10 (4.5)		204 (13.1)	95 (12.8)	299 (13)	
Survivor	170 (98.8)	50 (98)	220 (98.7)	0.66	1534 (98.4)	700 (94.6)	2234 (97.2)	0.001
Non-survivor	2 (1.2)	1 (2)	3 (1.3)		25 (1.6)	40 (5.4)	65 (2.8)	

chi-square analysis

Table 2. Comparison of the length of hospital stay of patients who presented to the emergency department due to diabetic ketoacidosis and stroke before and during the pandemic

Variable	Diabetic ketoacidosis			Stroke		
	Pre-pandemic Mean ± SD	Pandemic Mean ± SD	p	Pre-pandemic Mean ± SD	Pandemic Mean ± SD	P
Length of hospital stay (days)	6.9 ± 5.1	5.3 ± 5.5	0.05	5.4 ± 6.4	6.5 ± 10.6	0.002

SD, standard deviation

fore and during the pandemic by the total number of ED visits during the pandemic period. A Poisson regression analysis was used to examine the number of presentations between two different periods. The threshold of significance was set at 0.05, which was the lowest possible value that could be attained.

Results

The statistics below show the total mortality, gender, and age distribution of DKA and stroke patients admitted to the ED during pre- and post-pandemic periods. The study found no statistically significant change in DKA death rates between pre- and post-pandemic periods. The pandemic death rate for stroke patients rose considerably compared to pre-pandemic. The findings show that between pre- and post-pandemic periods, the mean duration of stay for patients with DKA and stroke dropped dramatically (Table 1).

A statistical analysis found that pre-pandemic DKA patients were hospitalized for substantially longer periods than pandemic patients, with some of the differences being statistically significant. When the time spent in hospitals for stroke presentations was compared between pre- and post-pandemic periods, the post-pandemic period was statistically significantly longer (Table 2).

Figure 1 illustrates smoothed data for ED presentations owing to DKA by age group before and during the pandemic period, as well as the total number of ED presentations.
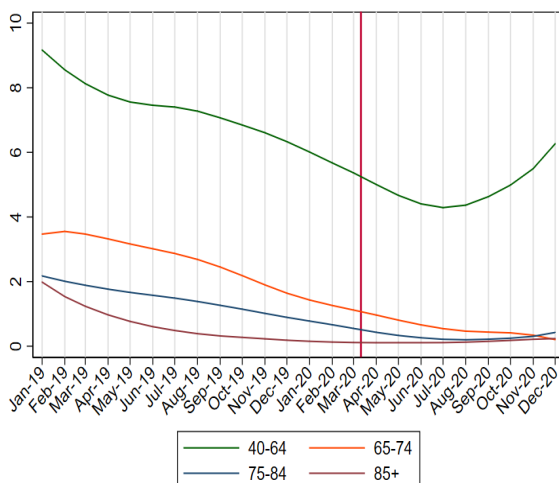

Fig. 1. Distribution of patients presenting to the emergency department with diabetic ketoacidosis according to age groups before and during the pandemic

After a thorough study, it was observed that the incidence of DKA presentations in the ED decreased progressively from pre-to pandemic levels during the course of the inquiry. The IRRs for changes in the number of diabetes-related ED presentations from the pre-to pandemic periods are shown in Figure 2.
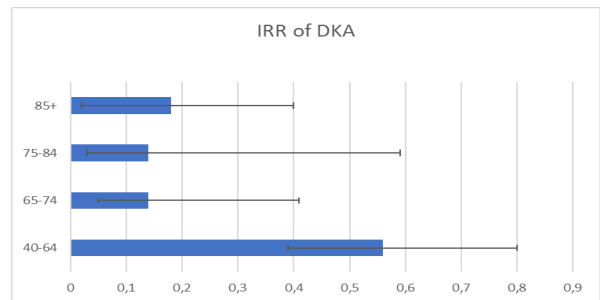

Fig. 2. IRR of DKA presentations before and during the pandemic

DKA presentations were 44% lower in the 40-64 age group [incidence rate ratio: 0.56, 95% confidence interval: 0.39-0.8], 84% lower in the 65-74 age group (incidence rate ratio: 0.14, 95% confidence interval: 0.05-0.41), 84% lower in the 75-84 age group [incidence rate ratio: 0.14, 95% confidence interval: 0.05-0.41], and 84% lower in the (IRR = 0.18; 95% confidence interval:

Figure 3 depicts the number of stroke-related ED presentations by age group before and during the pandemic, with smoothed data for each age group in each time period.
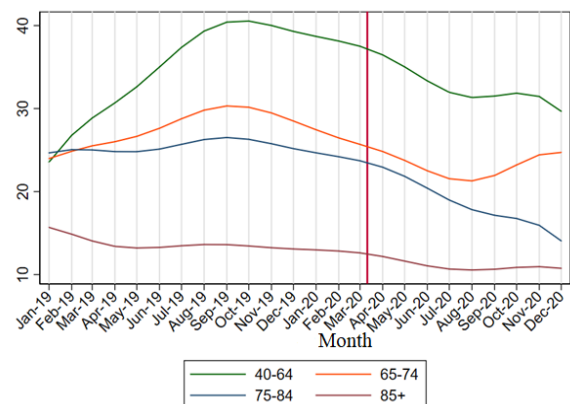

Fig. 3. Distribution of patients presenting to the emergency department with stroke according to age groups before and during the pandemic

After doing research, it was observed that the number of stroke presentations to ED decreased dramatically between the pre-and pandemic periods. During the period from 2019 to 2021, the IRRs for fluctuations in the number of stroke admissions were calculated for the pre-and pandemic periods. The rate of stroke cases presented to the ED decreased by 24 percent in the 40-64 year age group (IRR: 0.76, 95 percent CI: 0.67-0.89), 33 percent in the 65-74 year age group (IRR: 0.67, 95 percent CI: 0.57-0.79), 37 percent in the 75-84 year age group (IRR: 0.67, 95 percent CI: 0.57-0.75), and 31 percent in the 85-plus year age group. The IRR of stroke presentations before and during the pandemic is shown in Figure 4.
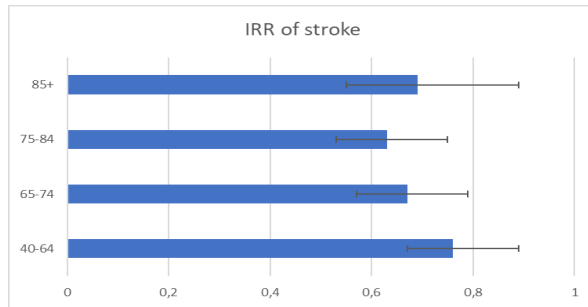
Fig. 4. IRR of stroke presentations before and during the pandemic

Discussion

Compared to the pre-pandemic period, the admissions to the ED of patients diagnosed with DKA and stroke decreased significantly during the pandemic period. This decrease was most observed among the elderly. The study also found that whereas DKA-related in-hospital mortality remained steady throughout the pandemic, stroke-related in-hospital mortality and length of stay rose. In addition to putting an enormous strain on the world's medical system, the fast spread of the COVID-19 pandemic has caused substantial disruption. As a consequence of the fast and extensive spread of viral pandemics, there has been an imbalance in the supply and demand of medical resources in many countries' healthcare systems. People have been afraid as a consequence of the uncertainty surrounding the situation and the possibility of a pandemic, resulting in medical visits being postponed even when serious diseases are present.[4,9,10] An Italian study conducted during the first 40 days of the pandemic revealed a large increase in out-of-hospital cardiac arrests when compared to the previous year's study conducted during the same time period, which indicated a panic situation.[11]

Untreated stroke and DKA may lead to increased mortality and morbidity. During the pandemic season, we saw a drop in both patient groups ED visits. A study that used neuroimaging data from over 850 institutions across the United States discovered that the number of patients tested for stroke-related symptoms decreased by 39% between 2005 and 2010.[12] According to statistics from China's Big Data Observatory Platform for Stroke, the overall number of instances of thrombolysis and thrombectomy was reduced by 26.7 percent and 25.3 percent, respectively, following the pandemic, according to Big Data Observatory Platform for Stroke data.[13] According to Canadian research, the number of code strokes that occur in ED is predicted to fall by 20 percent by the year 2020. In addition to other reasons, the authors mention a significant explanation for the decline in numbers as concerns about exposure to SARS-CoV-2.[14] Another study revealed that the number of patients coming to ED with ischemic stroke was reduced by 64 percent in 2020 when compared to the previous year, according to the researchers.[15] Diabetes mellitus (DM) is a chronic disease that affects around 34 million individuals in the United States. You may experience unusual blood sugar spikes if you have DKA or hyperosmolar hyperglycemia (HOH), two potentially life-threatening but treatable metabolic complications of diabetes.[16] Several weeks after COVID-19 was declared a national emergency in the United States on March 13, 2020, there was a 10% decrease in ED visits for hyperglycemic episodes.[18] When we analyzed the DKA-related death rates between the pre-and pandemic periods, we discovered that there was no statistically significant change. In light of the fact that patients with diabetes can frequently predict a DKA crisis using home glucose monitoring, this conclusion was not surprising.

A number of legal limitations apply to our inquiry. First, since this was a retrospective study at one institution, there is a possibility of selection bias. Second, the experiment only lasted a few months, and the participant fatality rate was modest considering the tiny sample size. As a result, future study should examine the pandemic's impact on stroke and DKA mortality.

Conclusion

While the research found that ED visits for life-threatening diseases including stroke and DKA reduced during the pandemic, stroke-related mortality increased. Getting them immediate medical attention increases their chances of survival. Even in a COVID-19 epidemic, prompt emergency treatment is crucial.

Declarations

Ethics approval
Study was approved by the institutional review board, and a waiver of authorization was given (Ethics Committee decision no. 2021/514/20/28, date: 28.04.2021).

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