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Research Article

Investigation of the Increase in Cerebrovascular Disease and ST Elevation Myocardial Infarction Cases Before and During the Pandemic

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Abstract

Aim: In this study, we aimed to investigate the effects of Coronavirus Disease 2019 (COVID-19) on the incidences of acute ischemic stroke (AIS) and ST elevation myocardial infarction (STEMI).
Material and Method: Patients admitted to the emergency department during the pandemic and pre-pandemic periods and diagnosed with AIS and/or STEMI. Demographic variables, comorbidities, diagnoses and mortality rates were compared between the two periods.
Results: The mean age of the patients was 71.8±13 years and 48.3% were male. The number of 255 ischemic patients (STEMI and/or AIS) admitted in the pre-pandemic period decreased to 165 during the pandemic period ($p<0.05$). During the pandemic period, there was a 38.2% decrease in the AIS group and a 29.1% decrease in the STEMI group. While the frequency of chronic renal failure and hyperlipidemia was found to be high in patients with AIS admitted during the pandemic period ($p<0.05$), there was no difference in terms of comorbidities in patients with STEMI ($p>0.05$). When the pre-pandemic and post-pandemic periods were compared, mortality was higher in the group with STEMI ($p<0.05$). In the STEMI group, the frequency of HL was higher in COVID-19 positive patients compared to COVID-19 negative patients ($p<0.05$).
Conclusion: Compared to the pre-pandemic period, the number of patients admitted due to AIS and STEMI decreased and mortality rates increased during the pandemic period.

Keywords: COVID-19, ischemic stroke, ST elevation myocardial infarction

INTRODUCTION

Severe Acute Respiratory Syndrome-Coronaviridea-2 (SARS-CoV-2) infection emerged in Wuhan, China in December 2019 and was named Coronavirus Disease 2019 (COVID-19) (1,2). Endothelial damage, stasis and inflammatory response due to COVID-19 form the Virchow triad that increases the tendency to thrombosis (3,4), and the resulting hypoxia directly triggers thrombosis formation by stimulating transcription factors (5). According to the World Health Organisation (WHO) records, 773,119,173 infected cases and 6,990,067 deaths were reported worldwide as of December 2023. In Türkiye, a total of 17,004,677 cases and 101,419 deaths were reported (2).

Cerebrovasculer event (CVE) are an important cause of mortality and morbidity in our country as in the whole world (6). The main factors determining the clinical presentation of the patient are the localisation and extent of the area supplied by the occluded or ruptured artery and the primary/secondary damages it causes. The main mechanism of acute ischaemic stroke (AIS) is occlusion caused by thrombosis or embolism in the artery (7). Li et al. defined neurological symptoms in 6% (13 patients) of the patient group with COVID-19; they reported that 11 of these patients had AIS, one patient had sinus vein thrombosis and 1 patient had haemorrhagic stroke (8). In another study evaluating COVID-19-infected AIS cases under the age of 50, it was shown that vascular endothelial damage and coagulopathy may cause AIS (9).

Acute myocardial infarction (AMI) is one of the most important causes of morbidity and mortality worldwide, and its incidence approaches 3 million people per year

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worldwide (10). AMI are divided into two as ST segment elevation (STEMI) or non-ST segment elevation (NSTEMI). Hypoxia, which develops as a result of interruption of blood flow in the coronary arteries supplying the heart, leads to irreversible damage to the heart muscle. It has been reported that infection due to COVID-19 leads to AMI, mainly hypercoagulation and endothelial damage, and consequently causes cardiac damage (11). In studies, it was stated that cardiac biomarkers were positive in more than 50% of patients who died due to COVID-19 and that these can be used to predict mortality (12).

In this study, we aimed to compare the number and some other clinical characteristics of patients diagnosed with AIS and STEMI admitted to the emergency department in the same time periods of the year before and after the outbreak of COVID-19 infection, and thus to investigate whether there was any change in the number of admissions to the emergency department due to AIS and STEMI in the post-COVID-19 period compared to the pre-COVID- 19 period, and thus how the COVID-19 pandemic affected the incidence of AIS and STEMI.

MATERIAL AND METHOD

This study was conducted with patients who were diagnosed with AIS and/or acute STEMI in the emergency department during the 6-month period before the outbreak of COVID-19 infection (1 July - 31 December 2019) and 6 months during the pandemic period (1 July - 31 December 2020). A total of 255 patients admitted in the pre-pandemic period and 161 patients admitted during the pandemic period were evaluated. The number, age, gender, comorbidity status, diagnosis and mortality status of the patients admitted in these periods were compared. In addition, patients with positive Polymerase Chain Reaction (PCR) results and/or 4-5 positive CO-RADS uptake on thorax CT during the pandemic period were considered COVID-19 positive. Age, gender, number of patients, comorbidity status, diagnosis and mortality status of COVID-19 positive and negative patients were compared. Patients over 18 years of age diagnosed with AIS and/or acute STEMI in the emergency department during the specified periods were included in the study. Patients under 18 years of age, pregnant and breastfeeding patients were excluded from the study.

Ethical Approval

It was performed retrospectively with the approval of the local ethics committee dated 20/06/2023 and numbered 2023-12/84 obtained from Kırşehir Ahi Evran University Faculty of Medicine Training and Research Hospital.

Statistics

All data obtained in the study were analysed in SPSS (Statitical Packages for Social Sciences) IBM statistics version 22. Mean and standard deviation (SD) were used to represent quantitative data, and number of cases (n) and percentages (%) were used to represent qualitative data. Kolmogrov Smirnov test was used to evaluate the distribution of quantitative data. Mann Whitney U test was used to analyse nonparametric data and chi-square test was used to analyse qualitative data. In this study, $p<0.05$ was considered significant.

RESULTS

In our study, while 255 patients admitted to the emergency department due to ischaemia (AIS or STEMI) in the pre-pandemic period, this number decreased to 161 during the pandemic period. Of the 255 patients admitted in the pre-pandemic period, 201 (78.8%) were diagnosed with AIS, 55 (21.6%) with STEMI and 1 (0.4%) with AIS+STEMI. During the pandemic period, a total of 161 patients were admitted due to AIS and/or STEMI, of which 123 (76.3%) were diagnosed with AIS, 39 (24.2%) with STEMI and 1 (0.6%) with AIS+STEMI. Compared to the pre-pandemic period, there was a 38.8% decrease in admissions in the group with all ischaemia (STEMI and/or AIS), 38.2% with AIS, and 29.1% with STEMI. In our study, we found that hypertension (HT) (57.7%) and cardiovascular disease (CVD) (43.5%) were the most common comorbidities in the total patient group (STEMI and/or AIS). In the post-pandemic period, the frequency of hyperlipidemia (HL) and chronic renal failure (CRF) was significantly higher compared to the pre-pandemic period ($p<0.05$) (Table 1).

When the pre-pandemic and post-pandemic periods were compared, no significant difference was found in terms of mean age and gender in all groups ($p>0.05$).

In our study, HT (63.6%) and CVD (45.7%) were the most common comorbidities in patients diagnosed with AIS. The frequency of hyperlipidaemia (HL) and CRF was significantly higher in patients diagnosed with AIS during the pandemic period compared to patients diagnosed with AIS before the pandemic ($p<0.05$) (Table 2). In our study, the most common comorbidities in 94 patients diagnosed with STEMI were HT (37.2%) and CVD (34%). No significant difference was found in the frequency of HT, CVD, diabetes mellitus (DM), HL, CVE, CRF and chronic obstructive pulmonary disease (COPD) in patients diagnosed with STEMI before and during the pandemic ($p>0.05$) (Table 3).

In our study, 69 (16.6%) of 415 ischaemic patients were excitus. It was determined that 42 (13%) of 323 patients diagnosed with AIS and 29 (30.9%) of 94 patients diagnosed with STEMI were excised. While there was no statistically significant increase in the mortality rate in patients diagnosed with AIS during the pandemic period, the mortality rate was significantly higher in patients diagnosed with STEMI during the pandemic period compared to the pre-pandemic period ($p<0.05$) (Table 4).

In our study, when all patients with AIS and STEMI diagnosed during the pandemic period were evaluated, no significant difference was found in terms of the presence of comorbidity in COVID-19 positive and COVID-19 negative patients ($p>0.05$). Similarly, similar results were obtained in the AIS and STEMI (except HL) groups ($p>0.05$). In the STEMI group, the frequency of HL was found to be significantly higher in patients who were COVID-19 positive compared to those who were COVID-19 negative ($p<0.05$) (Table 5).

Table 1. Frequency of AIS and STEMI and comorbid conditions of patients before and after the pandemic

		Group		
		Before pandemic n (%)	Pandemic period n (%)	p
All ischaemias		255 (100)	161 (100)	<0.001
AIS		201 (78.8)	123 (76.4)	<0.001
STEMI		55 (21.6)	39 (24.2)	<0.001
HT	240 (57.7)	143 (56.1)	97 (60.2)	0.402
CVD	181 (43.5)	107(42)	74 (46)	0.423
DM	128 (30.8)	70 (27.5)	58 (36)	0.065
HL	105 (25.2)	54 (21.2)	51 (31.7)	**0.016**
CVE	93 (22.4)	56 (22)	37 (23)	0.808
CRF	42 (10.1)	19 (7.5)	23 (14.3)	**0.024**
COPD	39 (9.4)	27 (10.6)	12 (7.5)	0.285
Other	14 (3.4)	14 (5.5)	0 (0)	0.002

HT: hypertension, CVD: cardiovascular disease, DM: diabetes mellitus, HL: hyperlipidaemia, CVE: ischaemic/haemorrhagic cerebrovascular event, CRF: chronic renal failure, COPD: chronic obstructive pulmonary disease, AIS: Acut Ischemic Stroke, STMEI: ST Elevated Myocardial Ischemi

Table 2. Comparison of the distribution of comorbidities of patients diagnosed with AIS before and during the pandemic

	Patients diagnosed with AIS			
	Total n (%)	Before pandemic n (%)	Pandemic period n (%)	p
HT	206 (63.6)	125 (62.2)	81 (65.9)	0.506
CVD	148 (45.7)	91 (45.3)	57 (46.3)	0.851
DM	109 (33.6)	61 (30.3)	48 (39)	0.109
HL	86 (26.5)	44 (21.9)	42 (34.1)	**0.015**
CVE	86 (26.5)	55 (27.4)	31 (25.2)	0.669
CRF	33 (10.2)	15 (7.5)	18 (14.6)	**0.038**
CPOD	32 (9.9)	21 (10.4)	11 (8.9)	0.660
Other	13 (4)	13 (6.5)	0 (0)	0.004

HT: hypertension, CVD: cardiovascular disease, DM: diabetes mellitus, HL: hyperlipidaemia, CVE: ischaemic/haemorrhagic cerebrovascular event, CRF: chronic renal failure, COPD: chronic obstructive pulmonary disease

Table 3. Comparison of the distribution of comorbidities of patients diagnosed with STEMI before and during the pandemic

	Patients diagnosed with STEMI			
	Total n (%)	Before pandemic n (%)	Pandemic period n (%)	p
HT	35 (37.2)	19 (34.5)	16 (41)	0.522
CVD	34 (36.2)	17 (30.9)	17 (43.6)	0.207
DM	19 (20.2)	9 (16.4)	10 (25.6)	0.270
HL	20 (21.3)	10 (18.2)	10 (25.6)	0.384
CVE	7 (7.4)	2 (3.7)	5 (12.8)	0.092
CRF	9 (9.6)	4 (7.3)	5 (12.8)	0.368
CPOD	7 (7.4)	6 (10.9)	1 (2.6)	0.129
Other	1 (1.1)	1 (1.8)	0	0.397

HT: hypertension, CVD: cardiovascular disease, DM: diabetes mellitus, HL: hyperlipidaemia, CVE: ischaemic/haemorrhagic cerebrovascular event, CRF: chronic renal failure, COPD: chronic obstructive pulmonary disease

Table 4. Comparison of mortality rates of patients before and during the pandemic period

			Group		
		Total n (%)	Before pandemic n (%)	Pandemic period n (%)	p
All ischaemias	**Alive**	346 (83.4)	220 (86.6)	126 (78.3)	**0.026**
	Excitus	69 (16.6)	34 (13.4)	35 (21.7)	
AIS	**Alive**	281(87)	176 (88)	105 (85.4)	0.494
	Excitus	42 (13)	24 (12)	18 (14.6)	
STEMI	**Alive**	65 (69.1)	44 (80)	21 (53.8)	**0.007**
	Excitus	29 (30.9)	11 (20)	18 (46.2)	

AIS: Acut Ischemic Stroke, STMEI: ST Elevated Myocardial Ischemi

Table 5. Comparison of PCR results of all ischaemic patients and comorbidity status of patients during the pandemic period

			Group		
		Total n (%)	COVID19 (+) n (%)	COVID19 (-) n (%)	p
AIS+ STEMI	HT	97 (60.2)	7 (53.8)	90 (60.8)	0.623
	CVD	74 (46)	6 (46.2)	68 (45.9)	0.988
	DM	58 (36)	5 (38.5)	53 (35.8)	0.849
	HL	51 (31.7)	6 (46.2)	45 (30.4)	0.242
	CVE	37 (23)	1 (7.7)	36 (24.3)	0.172
	CRF	23 (14.3)	2 (15.4)	21 (14.2)	0.906
	COPD	12 (7.5)	1 (7.7)	11 (7.4)	0.973
AIS	HT	81 (65.9)	6 (54.5)	75 (67)	0.407
	CVD	57 (46.3)	5 (45.5)	52 (46.4)	0.951
	DM	48 (39)	4 (36.4)	44 (39.3)	0.850
	HL	42 (34.1)	4 (36.4)	38 (33.9)	0.871
	CVE	31 (25.2)	1 (9.1)	30 (26.8)	0.197
	CRF	18 (14.6)	2 (18.2)	16 (14.3)	0.727
	COPD	11 (8.9)	1 (9.1)	10 (8.9)	0.986
STEMI	HT	16 (41)	1 (33.3)	15 (41.7)	0.778
	CVD	17 (43.6)	1 (33.3)	16 (44.4)	0.709
	DM	10 (25.6)	1 (33.3)	9 (25)	0.751
	HL	10 (25.6)	3 (100)	7 (19.4)	**0.002**
	CVE	6 (15.4)	0	6 (16.7)	0.442
	CRF	5 (12.8)	0	5 (13.9)	0.489
	COPD	1 (2.6)	0	1 (2.8)	0.770

HT: hypertension, CVD: cardiovascular disease, DM: diabetes mellitus, CVE: ischaemic/haemorrhagic cerebrovascular event, CRF: chronic renal failure, COPD: chronic obstructive pulmonary disease, HL: hyperlipidaemia, AIS: Acut Ischemic Stroke, STMEI: ST Elevated Myocardial Ischemi

DISCUSSION

COVID-19 is a disease that kills millions of people worldwide and is a serious burden on healthcare systems. Although the majority of patients survive the acute illness period without any problems, they face long-term complications defined as 'post-acute COVID-19 syndrome'. COVID-19 leads to an increase in the frequency of ischaemic disease due to immobilisation and deterioration in coagulation factors (3,4,13).

In our study, no significant difference was found when the pre-pandemic and post-pandemic periods were compared in patients who were followed up due to AIS and STEMI. In some studies conducted in the world and in our country, no significant difference was found in the mean age of the patients when the pre-pandemic and post-pandemic periods were compared (14-17), while the mean age was found to be lower in some studies (18-20). Although we believe that the frequency of ischemia should also increase in young patients due to the increase in ischemic processes due to COVID-19, we believe that increased cytokines and mediators may have affected the elderly population more, so there was no difference in age between the pre-pandemic and post-pandemic periods. In addition, we believe that the younger population did not apply to the hospital even if they had some neurological and/or cardiac symptoms during the pandemic period, while the elderly population may have been diagnosed because they applied to emergency departments more frequently due to diseases independent of the pandemic.

In our study, the gender distribution of patients followed up for ischaemia between the pre-pandemic and post-pandemic periods was similar. Similarly, no relationship was found between COVID-19 positivity and gender. Similar to age, studies comparing the periods before and after the pandemic in terms of ischemic events have found significant differences in terms of gender (21-23). Although COVID-19 is frequently seen in the female population, we think that male patients are more predominant among the admitted patients due to its more severe course in the male population.

In our study, we found that the most common comorbidity in our total patient group (AIS+STEMI) was HT in accordance with the literature, but we found that CRF and HL were significantly higher during the pandemic period compared to the pre-pandemic period in the group diagnosed with AIS. In the group diagnosed with STEMI, no significant difference was found in terms of comorbidity between the pre and post-pandemic periods. In some studies comparing the pre-pandemic and post-pandemic periods, no significant differences were found in terms of comorbidities of patients who experienced thromboembolic events (15-17,24), while in some studies, some diseases were found at a higher rate. Görgülü et al. reported that HT, DM and CVD were the most common comorbidities in the group of patients with AIS who were PCR (+) for COVID-19 (25). In patients with AIS and COVID-19 (+), De havenon et

al. reported that DM (22) and Rinkel et al. found HL to be significantly higher (26). There are many studies reporting similar results in the literature (20,23). The reason for the increase in HL may be impaired liver function caused by hypoxia due to COVID-19, and sedentary life caused by social closure may also have contributed to this. We found that the frequency of CRF and HL started to increase in patients diagnosed with STEMI during the pandemic period, but it was not statistically significant. We think that this result may be related to the number of cases.

Although COVID-19 infection is thought to lead to an increase in AMI and AIS cases by creating a tendency to thrombosis, a sharp decrease in hospital admissions due to AMI and AIS has been observed in many studies (27-29). The fear of contracting the virus and the public recommendation to consult emergency services only in mandatory cases have caused people to avoid emergency services (30-33). In a study conducted in 22 centres in major cities of France, a decrease of up to 30% in the rate of patients diagnosed with AMI during the pandemic period was reported (34). Mafhan et al. reported a 40% decrease in the frequency of AMI and a decrease in the number of Percutaneous Coronary Intervention (PCI) performed in these patients and a shortening in the length of hospital stay (35).

In our study, it was found that 255 patients who presented with ischaemic diseases in the pre-pandemic period decreased to 161 during the pandemic period, and there was a 38.8% decrease in the entire ischaemic group, 38.2% in the AIS group and 29.1% in STEMI group. During the pandemic period, the number of applications to hospitals decreased due to reasons such as people not wanting to come to hospitals with complaints that they consider mild (dizziness, headache, etc.), not being able to go out due to isolation at home, and mistaking some symptoms for symptoms of COVID-19. Especially in COVID-19 patients, dizziness, headache, weakness, etc. Since complaints such as dizziness, headache, weakness, etc. are frequently seen, patients with such complaints may not have applied to the hospital, mistaking them for COVID-19 symptoms. In severe cases such as impaired consciousness and speech impairment due to AIS, the patient may not be diagnosed with AIS because the patient's current clinic is attributed to COVID-19 sepsis. The same applies to acut coronary syndrome (ACS). Existing chest pain and/or palpitations may be attributed to COVID-19 infection by the patient or clinician. It is possible to increase these examples. Cardiac ischaemia biomarkers may also be positive in COVID-19 infection or false positivity perception due to comorbidities such as CRF may have misled physicians. In addition to all these, antiaggregant and anticoagulant therapies initiated in moderate and severe COVID-19 patients may have reduced the incidence of AIS and/or AMI cases.

In our study, no significant difference was found between mortality rates in ischaemic patients when COVID-19 (+) and COVID-19 (-) patients were compared. Regardless of the treatment modality, it has been consistently identified that COVID-19 is an important determinant of mortality in patients with AIS (36-38). However, some studies contradict this data. Luca et al. found that COVID-19 was an independent risk factor for 30-day mortality in AMI cases, but there was no difference between COVID-19 positives and negatives in terms of 2-year mortality results (24). In our study, mortality was found to be significantly higher in patients with STEMI during the pandemic period compared to the pre-pandemic period and was 29.3%. No significant difference was found in patients diagnosed with AIS. The reason for the increase in mortality in patients with STEMI may be delays in diagnosis and treatment due to the attribution of symptoms to COVID-19, and complications due to inflammation and cytokine release caused by COVID-19. Administration of low molecular weight heparin and antiaggregants to patients with COVID-19 may have contributed to a lower mortality rate, especially in patients with AIS.

CONCLUSION

There was a significant decrease in the number of patients admitted with ischaemic diseases during the pandemic period compared to the pre-pandemic period. There was an increase in mortality in STEMI cases from the ischaemic diseases group during the pandemic period compared to the pre-pandemic period. In a situation such as COVID-19, which can cause thrombotic complications as a result of vascular damage, both central and cardiac ischaemic complications should be anticipated and prophylaxis of these complications should be performed quickly and appropriately. Early diagnosis and treatment of complications may contribute to the reduction of mortality and morbidity.

This study is based on the specialization thesis titled "Investigation of the Increase in Cerebrovascular Disease and ST Elevation Myocardial Infarction Cases After Covid-19" conducted at Kırşehir Ahi Evran University Faculty of Medicine Department of Emergency Medicine.

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