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Impact of COVID-19 pandemic on blood pressure management and antihypertensive medication use in hypertensive patients

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Ethics Committee Approval
The study was approved by the Istanbul Medeniyet University Goztepe Training and Research Hospital Clinical Research Ethics Committee (Date: June 24, 2020, No: 2020/0375). All procedures in this study involving human participants were performed in accordance with the 1964 Helsinki Declaration and its later amendments.

Conflict of Interest
No conflict of interest was declared by the authors.

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Abstract

Background/Aim: The interaction between angiotensin-converting enzyme inhibitors (ACEIs), angiotensin receptor blockers (ARBs), and the angiotensin-converting enzyme 2 (ACE-2) system became a focal point during the COrona VIrus Disease-19 (COVID-19) pandemic, as SARS-CoV-2 utilizes ACE-2 for cellular entry. Concerns arose that renin-angiotensin-aldosterone sytem (RAAS) inhibitors, which modulate the ACE-2 system, might enhance viral entry by increasing ACE-2 expression. Despite some proposing alternative antihypertensives, other studies indicated potential protective effects of RAAS inhibition in lung injury models, underscoring the need for clarity on ACEI and ARB use during viral infections. Consequently, the European Society of Cardiology issued a statement in March 2020, asserting no clinical or scientific evidence justified halting ACEI or ARB therapy due to COVID-19. The recommendation was for physicians and patients to maintain their antihypertensive treatment regimens. This study aimed to evaluate the impact of the COVID-19 pandemic on the systolic and diastolic blood pressure levels of hypertensive patients, as well as to investigate any antihypertensive treatment modifications made due to the perceived risk associated with the use of ACIs and ARBs during the COVID-19 outbreak.

Methods: A total of 500 hypertensive patients who had visited the Internal Medicine Clinic prior to March 2020 were surveyed by phone. The data collected from these patients included their age, the duration of their hypertension, the medications they were taking, their self-measured home blood pressure values both before and after the pandemic, their physician consultations, if any, and any changes that were made to their antihypertensive treatments during this time period.

Results: Of the participants, 58.8% were women, with a mean age of 63.16 (10.87) years and hypertension (HT) duration of 7.87 (3.58) years. During the pandemic, 20% of the patients consulted a physician who opted not to alter the patients' ACEI and ARB regimens. Prior to the pandemic, mean SBP and DBP were 131.38 (9.37) mmHg and 75.3 (6.07) mmHg, respectively. During the pandemic, mean SBP decreased significantly to 130.58 (9.04) mmHg (P=0.001), while DBP of 75.22 (6.05) mmHg remained statistically unchanged (P=0.853).

Conclusion: The findings indicate that clinicians adhered to the European Society of Cardiology statements, retaining ACEI and ARBs. The significant decrease in SBP post-pandemic may be attributed to lifestyle changes.

Keywords: COVID-19, hypertension, renin-angiotensin aldosteron system blockers

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Introduction

Hypertension (HT) remains a major global public health issue, affecting populations in both developed and developing countries due to its high prevalence and associated complications. Extensive evidence demonstrates that effective blood pressure reduction significantly lowers the risk of early morbidity and mortality [1-3]. Although lifestyle modifications and pharmacological interventions are effective in managing blood pressure, optimal control remains challenging worldwide [4-5]. Consequently, hypertension continues to be a leading, yet preventable, contributor to cardiovascular diseases and all-cause mortality. According to current clinical guidelines, hypertension in adults is defined as a systolic blood pressure ≥140 mmHg and/or a diastolic pressure ≥90 mmHg [6]. Even modest reductions in blood pressure—such as 10 mmHg systolic or 5 mmHg diastolic—can reduce the risk of major cardiovascular events by approximately 20% [1,3]. Management strategies involve both behavioral changes—such as reduced salt and alcohol intake, maintaining healthy body weight, adopting a Mediterranean diet, smoking cessation, and regular physical activity—and pharmacotherapy. The primary classes of antihypertensive drugs include angiotensin-converting enzyme inhibitors (ACEIs), angiotensin II receptor blockers (ARBs), beta-blockers, calcium channel blockers, and diuretics [6,7].

The renin-angiotensin-aldosterone system (RAAS) plays a central role in the pathophysiology of hypertension by regulating blood pressure and fluid balance. Activation of this system leads to vasoconstriction and fluid retention through a cascade involving renin (from the kidneys), angiotensinogen (from the liver), and angiotensin II (Ang II), a potent vasoconstrictor generated via angiotensin-converting enzymes (ACE). Ang II stimulates aldosterone release, promoting sodium and water retention and raising blood pressure. Counteracting this pathway, angiotensin-converting enzyme 2 (ACE-2) degrades Ang II into angiotensin 1–7, a vasodilator that contributes to blood pressure homeostasis [8]. Importantly, ACEIs and ARBs—widely used antihypertensive agents—modulate this system and are known to upregulate ACE-2 expression [9].

This pharmacological interaction gained renewed attention during the COVID-19 pandemic, as SARS-CoV-2 was found to use ACE-2 as a receptor for cellular entry [10-12]. Concerns have been raised regarding the use of RAAS inhibitors, as they may elevate ACE-2 expression and potentially increase viral entry. While some researchers have proposed alternative antihypertensives like calcium channel blockers, others have provided evidence suggesting that RAAS inhibition may actually offer protective effects in lung injury models [13-18]. These contrasting findings underscore the need for further research and clinical consensus on the safe use of ACEIs and ARBs during viral infections such as COVID-19.

Consequently, in March 2020, the European Society of Cardiology published a statement clarifying that there was no clinical or scientific evidence to justify the cessation of ACEI or ARB therapy because of the COVID-19 infection, and that physicians and patients should be able to follow the antihypertensive therapy as usual [19].

With all the information provided above, this study aimed to evaluate the extent to which patients with hypertension sought consultation with healthcare providers during the COVID-19 pandemic. Specifically, the study examines whether clinicians modified antihypertensive treatment regimens in response to the perceived risks associated with COVID-19. Additionally, it explores whether any changes in blood pressure occurred between the pre-pandemic and post-pandemic periods and whether these changes can be attributed to adjustments in antihypertensive therapy.

Materials and methods

The study protocol was approved by Istanbul Medeniyet University Goztepe Training and Research Hospital, Clinical Research Ethics Committee (Date: June 24, 2020, No: 2020/0375). The principles outlined in the Helsinki Declaration were adhered to throughout the research process.

This cross-sectional study included 500 hypertensive patients aged 18 and above who had previously visited the Internal Medicine Outpatient Clinic of University Hospital before March 1, 2020. Patients under 18 years old and those who were pregnant or lactating were excluded from the study. Patients with cognitive impairment were assessed through interviews with their caregivers.

Participants were contacted by telephone by the physicians and nurses conducting the study and were provided with verbal information regarding the study's purpose, duration, and the questionnaire to be administered (Table 1). Verbal consent to participate was obtained from the patients or their caregivers after ensuring that they fully understood the study's objectives, procedures, and their right to withdraw at any time without any negative consequences. This consent was systematically documented by the research team using a standardized data collection form immediately following each interview.

In addition, strict measures were implemented to protect patient confidentiality. Prior to data analysis, all personal identifiers were removed, and the data were stored in a secure environment with access limited to authorized personnel, in compliance with institutional data protection regulations.

During the interviews, demographic data were collected on the participants, as well as their medical history, current medications, and self-monitored home blood pressure values from two specific time periods: the three months preceding the onset of the pandemic and the first three months following the identification of the first confirmed COVID-19 case and the implementation of lockdown measures in Türkiye. Although the study is cross-sectional, it includes a retrospective longitudinal element. This involves comparing self-reported blood pressure readings from the three months before the pandemic to those from the first three months after COVID-19 began in Türkiye and documenting average blood pressure values during this period.

Additional information was gathered regarding whether participants had consulted a physician during the pandemic and whether any changes had been made to their antihypertensive treatment regimen (Table 1).

The data collected were supported by previously requested laboratory tests and imaging studies during outpatient clinic visits.

Table 1: Evaluation survey on blood pressure control and anti-hypertensive usage in hypertension patients during the COVID-19 Pandemic

1. How long have you been diagnosed with Hypertension?
2. Do you have any additional medical conditions? If so, what are they?
3. What was your blood pressure measurement prior to the start of the COVID-19 pandemic?
4. What is your blood pressure measurement after the start of the COVID-19 pandemic?
5. Which anti-hypertensive medications were you taking?
6. Did you seek medical consultation during this period?
7. If you did seek consultation, did your physician make any medication changes?
8. If so, which anti-hypertensive medications are you currently taking?

In the evaluation, demographic characteristics and chronic diseases of the patients' (diabetes mellitus / hyperlipidemia / coronary artery disease / other) and the duration of hypertension was inquired. Chronic diseases other than HT were divided into four categories: diabetes mellitus (DM), hyperlipidemia (HL), coronary artery disease (CAD), and others. The other chronic diseases category included diseases, such as chronic obstructive pulmonary disease (COPD), asthma, hypothyroidism, arrhythmia, cardiac failure, malignancies, and dementia. Detailed inquiries were made regarding the patients' medications. Chronic diseases and medications were further verified and recorded from the electronic health records system, called "E-nabız" in Türkiye.

Statistical analysis

Statistical analyses were performed using SPSS v17.0 software. In addition to descriptive statistical methods, the distribution of the study data was evaluated using the Shapiro-Wilk test. For comparisons of quantitative data that did not show a normal distribution between two groups, the Wilcoxon test was utilized. Significance was assessed at the P<0.05 level.

Results

Of the 500 individuals surveyed, 58.8% identified as female. Table 2 provides a comprehensive overview of additional demographic attributes.

In addition to HT, the study group had a significant burden of comorbidities, with 52.4% having DM, 46.4% having HL, and 21.2% having CAD. Furthermore, 49% of the participants had at least one additional chronic disease.

The findings related to the use of antihypertensive medications are presented in Table 2.

Interestingly, three patients were able to stop their antihypertensive medications after initiating sodium-glucose cotransporter-2 inhibitors (SGLT2i), as their blood pressure was adequately controlled.

During the pandemic, while 20% of the patients sought medical attention, changes in antihypertensive treatment were observed in only one individual, with the addition of a thiazide diuretic and spironolactone to the existing regimen. Prior to the pandemic, the patients' systolic blood pressure (SBP) ranged from 110 to 170 mmHg, with a mean of 131.38 (9.37) mmHg. Their diastolic blood pressure (DBP) ranged from 60 to 120 mmHg, with a mean of 75.3 (6.07) mmHg. After the outbreak of the pandemic, the patients' SBP continued to range from 110 to 170 mmHg, with a mean of 130.58 (9.04) mmHg, while their DBP remained between 60 and 120 mmHg, with a mean of 75.22 (6.05) mmHg.

Statistical analysis revealed a significant difference in the SBP measurements between the pre-pandemic and post-pandemic periods (P=0.001). Specifically, the SBP values were significantly higher in the pre-pandemic period compared to the post-pandemic period (P=0.001). However, DBP did not reveal any significant difference between the two periods (P=0.853) (Table 3).

Table 2: Characterization of patient population, comorbidities, and medication profiles

	Patient number (n:500)
Age; years	
Mean (SD)	63.16 (10.87)
Range (Median)	30-94 (64)
Sex; n (%)	
Female	294 (%58.8)
Male	206 (%41.2)
Hypertension Duration; Year	
Mean (SD)	7.87 (3.58)
Minimum-Maximum, (Median)	2-30 (7)
Co-morbidities; n (%)	
Diabetes Mellitus	262 (52.4%)
Hyperlipidemia	232 (46.4%)
Coronary Artery Disease	106 (21.2%)
Other	245 (49%)
Only Hypertension	108 (21.6%)
Antihypertensive Treatment; n (%)	
ACEI	179 (35.8%)
ARB	216 (43.2%)
Beta-Blockers	167 (33.4%)
CaCB	207 (41.4%)
Thiazids and Thiazid Like Diuretics	225 (45%)
Furosemid	15 (3%)
Alfa Blockers	47 (9.4%)
Spironolacton	7 (1.4%)
No-antihypertensive drug	3(0.6%)
Antidiabetic Treatment; n (%)	
Metformin	190 (72.52%)
DPP4i	122 (46.56%)
Thiazolidinediones (Pioglitasone)	23 (8.77%)
SGLT2i	68 (25.9%)
GLP-1a	4 (1.52%)
Alpha Glucosidase Inhibitors (Acarbose)	7 (2.67%)
Sulphonylureas	14 (5.34%)
Insulin	67 (25.57%)
Antiplatelet Treatment; n (%)	171 (34.2%)
Statin Treatment; n (%)	67 (13.4%)
Medical Consultation; n (%)	100(20%)

SD: Standard deviation. Other: cardiac failure, chronic obstructive pulmonary disease, hypothyroidism etc. ACEI: Angiotensin Converting Enzyme Inhibitors, ARB: Angiotensin Receptor Blockers, CaCB: Calcium Channel Blockers, DPP4-i: DiPeptidyl Peptidase-4 Inhibitors, SGLT2i: Sodium Glucose Transporter 2 Inhibitors, GLP-1a: Glucagon Like Peptide-1 Agonists. Data are expressed as mean (SD) or numbers and percentages, unless otherwise stated

Table 3: Comparison of blood pressure across time periods

	Before the Pandemic	**After the Pandemic**	***P*-value**
SBP(mmHg)			
Mean (SD)	131.38 (9.37)	130.58 (9.04	**0.001****
Range	110-170	110-170	
DBP(mmHg)			
Mean (SD)	75.3 (6.07)	75.22 (6.05)	0.853
Range	60-120	60-120	

SD: Standard deviation, SBP: Systolic Blood Pressure, DBP: Diastolic Blood Pressure. Data are expressed as mean (SD) or numbers and percentages, unless otherwise stated. **Wilcoxon Test,**P<0.01

Discussion

Our study found that physicians adhered to the recommendations of the European Society of Cardiology by not discontinuing RAAS inhibitors in hypertensive patients and continuing the current treatment according to the guidelines.

The COVID-19 pandemic prompted recommendations from the World Health Organization and government authorities for patients to remain at home as much as possible. In response, many healthcare systems have implemented telemedicine practices to facilitate remote monitoring and treatment of COVID-19 and other conditions [20]. Notably, a pre-pandemic study found that telemedicine-based hypertension management, particularly for high-risk patients, achieved statistically superior blood pressure reduction compared to in-person visits, while also being cost-effective [21]. Similarly, our research demonstrated that phone-based patient follow-up enabled most individuals to maintain their blood pressure within target ranges, reduce hospital visits, and enhance adherence to social distancing measures, thereby mitigating COVID-19 exposure risks.

Given the prominent role of elder family members in the traditional Turkish family structure, it can be postulated that during the pandemic period, when health-related concerns were heightened, the increased attention and monitoring by patients' family caregivers may have positively impacted patient outcomes. Studies by Matthew et al. [22] have demonstrated that family bonds and social support can enhance patient adherence to treatment. The increased communication between patients and their family members or close social circles during the pandemic may have favorably influenced medication compliance and treatment follow-up, potentially contributing to the statistically significant reduction in systolic blood pressure noted in our investigation.

The limited availability of certain essential food items during the lockdown may have influenced patients' dietary habits. The temporary closure of many food establishments, such as restaurants and cafes, could have potentially reduced salt and fat consumption. Reduced operating hours of grocery stores might have decreased the availability and intake of processed foods, possibly encouraging more home-cooked meals. Furthermore, a reduction in domestic and family visits within the country could have decreased the consumption of carbohydrate-rich foods typical of Turkish cuisine. Given that dietary habits and societal support systems were not evaluated in the current survey, additional studies are necessary to investigate these areas. Studies by Ruiz-Roso et al. [23] reported that in countries like Brazil, Colombia, Chile, Italy, and Spain, the pandemic led to alterations in dietary patterns, with an increased tendency toward home-prepared meals and a higher emphasis on vegetable and fruit intake. However, another study suggested that the stress and isolation caused by the pandemic may have led to binge eating and heightened intake of carbohydrate-rich foods [24]. Considering the potential challenges in food supply, the increased demand for shelf-stable processed foods could raise the risk of unhealthy eating habits and associated cardiovascular disease. Nevertheless, our study did not yield results that support this suggestion.

This study had several limitations. Reliance on patients' own home blood pressure monitoring devices without known validation or calibration may have led to measurement errors. Additionally, in some participants, arrhythmias, such as atrial fibrillation, could have compromised the accuracy of the home blood pressure readings. Furthermore, patients' self-reported blood pressure values may have reduced the objectivity of the study's findings. To enhance the generalizability of the findings, future prospective studies incorporating larger and more diverse participant samples, objective measurement methods, and broader sociocultural representation across multiple centers are warranted, as the current single-center, telephone-based design may limit the applicability of the results to other populations and healthcare systems.

Conclusion

In conclusion, this study demonstrates that the management of hypertension remained stable during the COVID-19 pandemic, with most patients maintaining consistent blood pressure levels and only one case of medication adjustment. The significant reduction in systolic blood pressure observed suggests that changes in lifestyle, improved medication adherence, and enhanced social support during the pandemic may have contributed to improved blood pressure control. Physicians adhered to guidelines by continuing RAAS inhibitors, reflecting evidence-based care despite initial concerns about potential risks.

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