ORIGINAL RESEARCH

To determine the hypertension in COVID-19 patients

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Received: 12 February, 2023 Accepted: 15 March, 2023

ABSTRACT

Aim: To determine the hypertension in COVID-19 patients. **Material and Methods:** In the current retrospective cohort analysis, a total of one hundred COVID-19 patients who were hospitalised to the same hospital during the course of this study's duration were included. Patients those who were younger than 18 years old, steroid medication, history of systemic inflammatory illness,history of kidney or liver failure, hypertension, left the follow-up, and who had missing data were excluded.**Results:** One hundred COVID-19 patients, with an average age of 45.69 ±5.66 years, were included in the study; of those patients, 65 (or 65%) were female. On admission, the serum D-dimer level was 150.50 (99.50–298.50) ng/mL, which was significantly higher than the post-COVID-19 period level of 120.25 (98.65–191.25) ng/mL. The CRP level was 5.2 (2.24–9.55) mg/L, which was significantly higher than the post-COVID-19 period level of 3.3 (2.2–5.5) mg/L. Following COVID-19, there was a statistically significant drop in high sensitivity troponin-I (10.0±2.63 pg/mL compared to 4.1±1.2 pg/mL, P<0.001). Both the systolic blood pressure (119.88±6.39 vs. 127.53±7.61 mmHg, P<0.001) and the diastolic blood pressure (77.91±5.59 vs. 82.99±8.36 mmHg, P.001) were significantly higher in the post-COVID-19 period when compared with the readings taken on admission.**Conclusion:** In conclusion, the findings of the current investigation demonstrated that COVID-19 generates new cases of hypertension and leads to a rise in both systolic and diastolic blood pressure. The findings of this research have important implications for clinical practise.

Keywords: blood pressure, hypertension, COVID-19

INTRODUCTION

The World Health Organization estimates that more than one billion people are living with hypertension, making it one of the most common chronic diseases. [1] the top preventable risk factor for cardiovascular disease, but it is also a significant contributor to the development of early death. [2] Despite this, blood pressure (BP) management continues to be relatively poor, with only one in five hypertensive persons regularly attaining the prescribed BP objectives. [3] A new examination of data from the United States National Health and Nutrition Examination Survey indicated a pattern of rising blood pressure levels among persons diagnosed with hypertension over the previous two decades.

Concerns have been raised about the possibility that hypertension management may have been even more difficult during the COVID-19 epidemic.[3] The lockdown orders that were given in an effort to stop the further spread of the virus led in the closure of numerous businesses and institutions, including schools, restaurants, and gyms, as well as in the stringent restrictions that were placed on people's movements. These measures led to reduced physical activity, interrupted sleep, poor diets, increased alcohol use, and higher psychosocial stress, all of which are known to significantly effect blood pressure. Additionally, these measures led to increased alcohol intake. [4] Because of the epidemic, many medical offices went out of business, and their capacity to shift to telemedicine visits was inconsistent; as a result, patient access to basic medical treatment was severely restricted. [5] In addition, patients' concerns about being exposed to COVID-19 often dissuaded them from getting medical attention even when it was readily accessible. Patients may have had a harder time affording their hypertension drugs as a result of the economic burden of the pandemic, which led to a decline in their adherence to treatment.[6]

MATERIAL AND METHODS

In the current retrospective cohort analysis, a total of one hundred COVID-19 patients who were hospitalised to the same hospital during the course of this study's duration were included. Patients those who were younger than 18 years old, had steroid medication, history of systemic inflammatory illness, history of past kidney or liver failure, hypertension,

who had left the follow-up, and who had missing data were excluded.

The diagnosis of COVID-19 was confirmed by the detection of the presence of SARS-CoV-2 ribonucleic acid on an oropharyngeal and nasopharyngeal swab using reverse transcriptase polymerase chain reaction in the Public Health Microbiology Laboratory of the Ministry of Health in accordance with the recommendations provided by the World Health Organization.[5] At the time of the patient's admission to the outpatient facility, swabs from the oropharyngeal and nasopharyngeal cavities were taken.

The result of the investigation was the development of hypertension for the first time. According to the guidelines of the Eighth Joint National Committee (JNC 8) and the European Society of Cardiology, new onset hypertension was defined as having values of systolic blood pressure that was greater than 140 mmHg and/or diastolic blood pressure that was less than 90 mmHg in office measurements, and having values of systolic blood pressure that was greater than 135 mmHg and/or diastolic blood pressure that was less than 85 [6,7] After having the patient rest for twenty minutes in the COVID-19 unit, a qualified nurse used a sphygmomanometer to take the patient's blood pressure twice on the right upper arm while the patient was sitting. We utilised the average of the two different measurements. The correct size of the cuff was determined by measuring the circumference of the arm. The measurement was carried out in a calm and controlled environment inside an enclosed space.

The following blood tests were carried out: a complete blood count, C-reactive protein, lactate dehydrogenase (LDH), alanine aminotransferase (ALT), aspartate aminotransferase (AST), and creatinine, as well as high sensitivity troponin-I (HsTrop-I) and D-dimer. For the purpose of detecting COVID-19, Bio-Speedy® SARS-CoV-2 (2019-nCoV) qPCR Detection was used. At concentrations greater than the LOD, the repeatability of the kit is 100%, and the reproducibility achieved by combining it with robotic extraction achieves the same result (Limit of detection). The LOD for all sorts of samples is 20 genomes per millilitre. The Bio-Speedy® kit has a sensitivity of 99.4 percent and a specificity of 99.0 percent, respectively. [8]

AN EXAMINATION OF THE STATISTICS

The Kolmogorov–Smirnov test was used to check whether or not continuous variables followed a normal distribution. The variables are either reported as their means accompanied by standard deviations or their medians (interquartile range). When analysing dependent continuous variables, paired sample t-tests and/or Wilcoxon signed rank tests were used, depending on the circumstance. The McNemar test was used to make comparisons between dependent categorical variables. After doing a power analysis based on the changes in systolic and diastolic blood pressure over the follow-up period, we discovered that both variables had a power greater than 0.98 (P = 1- error probability). The results of the power analysis revealed a value of.88 for the dependent categorical variable of newly developed hypertension (P = 1- error probability). It was determined to be significant if the two-tailed P value was less than.05. The SPSS statistics software for Windows version 24.0 was used for all of the statistical studies that were carried out.

RESULTS

One hundred COVID-19 patients, with an average age of 45.69 ±5.66 years, were included in the study; of those patients, 65 (or 65%) were female. The characteristics of the study population at the beginning of the research are outlined in Table 1. It was 25.02±5.55 for the body mass index. Fever, cough, and exhaustion were the most prevalent manifestations of the illness (85%, 81%, and 75%, respectively). In the study population, 80% of patients reported having a sore throat, whereas 19% reported having difficulty breathing, and 44% reported having muscle pain. On admission, individuals diagnosed with COVID-19 very rarely had symptoms such as hyposmia, dysosmia, anosmia, headache, and diarrhoea. Favipiravir and chloroquine/hydroxychloroquine were the medications that were administered the most often (80% and 78%, respectively). Anti-coagulants were given to around forty percent of the patients. There were only seven individuals who required hospitalisation (7%). The average length of stay in the hospital was 6.51±1.36 days. The average amount of time spent following up was 31.6 ± 5.0 days.

Table 1: Basic profile of the patients

Gender	Number	Percentage
Male	35	35
Female	65	65
Age		
below 30	12	12
30-40	20	20
40-50	45	45
50-60	10	10
Above 60	13	13
Mean Age	45.69±5.66	
Body mass index, kg/m^2	25.02±5.55	
symptoms		

Fever	75	75
Cough	81	81
Sore throat	80	80
Fatigue,	85	85
Hyposmia, dysosmia, or anosmia	44	44
Myalgia	44	44
Headache,	35	35
Dyspnea	77	77
Diarrhea	19	19
Hospitalization days	6.5±1.36	

Table 2: Clinical characteristics and laboratory findings

	On admission of COVID-19	**Post COVID-19**	***P***
Laboratory findings			
C-reactive protein, mg/L	5.2 (2.24–9.55)	3.3 (2.2–5.5)	<0.001
High sensitive troponin-I, pg/mL	10.0 ± 2.63	4.1 ± 1.2	<0.001
D-Dimer, ng/mL	150.50 (99.50–298.50)	120.25 (98.65–191.25)	<0.001
Hemoglobin, g/dL	13.7 ± 2.0	13.8 ± 1.8	0.51
White blood cells, 10^3/μL	5.2 ± 1.8	5.5 ± 1.7	0.36
Lymphocytes, 10^3/μL	1.7 ± 0.8	1.7 ± 0.7	0.27
Ferritin, ng/mL	50.50 (17.52–95.52)	50 (22.52–95.82)	0.06
Alanine aminotransferase, U/L	31.52 ± 5.63	30.58 ± 6.33	0.45
Aspartate aminotransferase, U/L	31.02 ± 4.85	28.63 ± 4.69	0.32
Lactate dehydrogenase, U/L	165.58 ± 12.52	155.52 ± 22.36	0.25
Creatinine, mg/dL	0.89 ± .11	0.89 ± .12	0.33
Systolic blood pressure, mmHg	119.88 ± 6.39	127.53 ± 7.61	<0.001
Diastolic blood pressure, mmHg	77.91 ± 5.59	82.99 ± 8.36	<0.001
Previous medical history			
Coronary artery disease, n (%)	5(5)	6 (6)	0.61
Chronic obstructive pulmonary disease, n (%)	8 (8)	10 (10)	0.22
Hypertension, n (%)	0 (0)	13 (13)	<0.001
Diabetes mellitus, n (%)	12(12)	13(13)	0.41

Table 2 outlines the clinical features as well as the results of the laboratory tests. There was not a significant change in the count of white blood cells, lymphocytes, or haemoglobin at admission compared to the count after receiving COVID-19 (P =0.51, P =0.36, and P =0.27, respectively). On admission, the serum D-dimer level was 150.50 (99.50–298.50) ng/mL, which was significantly higher than the post-COVID-19 period level of 120.25 (98.65–191.25) ng/mL. The CRP level was 5.2 (2.24–9.55) mg/L, which was significantly higher than the post-COVID-19 period level of 3.3 (2.2–5.5) mg/L. Following COVID-19, there was a statistically significant drop in high sensitivity troponin-I (10.0±2.63 pg/mL compared to 4.1±1.2 pg/mL, P<0.001). Ferritin, lactate dehydrogenase, creatinine, and transaminase levels were not significantly changed between the time of admission and the time after COVID-19 was administered. During the post COVID-19 period, new onset hypertension was found in 13 patients (13%) (P<0.001); however, diabetes mellitus, coronary artery disease, and chronic obstructive pulmonary disease did not significantly change between admission and the post COVID-19 period (P = 0.41, P = 0.61, and P = 0.22, respectively). Both the systolic blood pressure (119.88±6.39 vs. 127.53±7.61 mmHg, P<0.001) and the diastolic blood pressure (77.91±5.59 vs. 82.99±8.36 mmHg, P<0.001) were significantly higher in the post-COVID-19 period when compared with the readings taken on admission (Table 2).

DISCUSSION

Since it was discovered that COVID-19 was spreading, the World Health Organization (WHO) has received reports of more than 4,000,000 fatalities and 188,650,179 confirmed cases of the disease. [2] Research that has been published since the beginning of the pandemic has focused on determining the most effective therapy to lower the death rate caused by COVID-19. Recent research has concentrated on determining independent mortality factors in patients diagnosed with COVID-19 in order to better understand the disease. [9] However, there is a paucity of evidence about outcomes in the short- and long-term follow-up periods after COVID-19. Because of this, the purpose of the current research was to investigate the impact of COVID-19 on hypertension in the period of time immediately after COVID-19 treatment. The current research included 100 COVID-19 patients who were eligible to participate, and these patients were monitored for an average of 31.7 days. At the conclusion of this time, both systolic and

diastolic blood pressure were significantly higher than they had been before. Additionally, there was an increase in the occurrence of new cases of hypertension.

In the COVID-19 study, a number of different biomarkers and comorbidities were shown to be accurate independent predictors of severe illness and bad outcomes.[10-12] Concerning hypertension, the connection between it and COVID-19 has been a topic of discussion since the beginning of the epidemic. In order to identify the association that exists between hypertension and COVID-19, as well as the function that hypertension plays in determining the result for these individuals, Tadic et al. conducted a review in which they searched through separate papers. The researchers Tadic and colleagues came to the conclusion that arterial hypertension was one of the COVID-19 patient population's most prevalent comorbidities.[13] It was hypothesised that hypertension may be involved in the pathophysiology of COVID-19.[13] because of the function that angiotensin converting enzyme (ACE) 2 plays in the SARS-CoV-2 infection. According to the findings of a new research conducted by Lippi and colleagues, hypertension is connected with a risk that is 2.5 times higher for increasing disease severity as well as death in COVID-19 patients. They also demonstrated that this impact was mostly seen in individuals who were beyond the age of sixty years old. [4] On the other hand, the use of ACE inhibitors or angiotensin (ANG) receptor blockers results in an increase in the amount of ACE 2, which functions as a receptor for SARS-CoV-2. Patients who use these medications have the chance of counteracting SARS-CoV-2 and have a poor prognosis for COVID-19, which have both been cited as sources of concern. Several research focused on this particular aspect. [14,15] The data does not support greater risks for SARS-CoV-2 infection or a bad prognosis for COVID-19 patients who are treated with renin angiotensin aldosterone system (RAAS) inhibitors, according to a review of research that looked at the matter. [16] This problem was validated by the American Heart Association as well as the European Society for Cardiology. [17,18]

The RAAS is a very important component of the cardiovascular system.[19]It is well knowledge that an overactive RAAS and an increase in ANG 2 levels are linked to unfavourable outcomes (through the ANG 1 receptors) in a variety of cardiovascular disorders. These conditions include heart failure, hypertension, myocardial infarction, and diabetic cardiovascular problems. [20] On the other hand, ACE 2 is an enzyme that has a negative regulator function in the activation of RAAS. It does this mostly by converting ANG 1 and ANG 2 into their respective forms of ANG 1–9 and ANG 1–7. The protective arm, which is ACE 2/ANG 1–7/Mas receptor, and the pathogenic arm, which is ACE/ANG 2/ANG 2 receptor type 1 receptor, are in a state of dynamic equilibrium.[21] The SARS-CoV-2 virus, which is responsible for the infectiousness of COVID-19, binds to ACE 2, which is also the cellular receptor for this virus. ACE 2 is expressed to a significant degree not just in the lung, but also in the cardiovascular system. A lower level of ACE 2 and a higher level of ANG 2 may both contribute to an increase in blood pressure. This is because ACE 2 has a detrimental function in the regulation of RAAS. An ongoing cohort research found that the levels of ANG 2 in COVID-19 patients were significantly higher when compared with healthy persons, and that the rise in ANG 2 was linearly connected with the amount of virus in the patients' bodies. [22] As a result, a rise in ANG 2 levels and blood pressure may be the result of a direct connection between the downregulation of ACE 2 and the imbalance of the systemic RAAS. Accordingly, the findings of the current research demonstrated that over the short-term follow-up period, both systolic and diastolic blood pressure were significantly elevated in COVID-19 patients. At the conclusion of the follow-up period, it was found that 18 of the patients had had newly onset hypertension.

There has been little progress made in determining how COVID-19 will influence BP. However, there have only been a few recorded incidences of hypertension after immunisation with mRNA-based COVID-19 prevention. Three days after receiving anti–COVID-19 immunisation, Athyroset al[23] described a hypertensive crisis with cerebral bleeding in the patient. Meylanet al.[24] presented a case series in which they discussed their one-month experience working at their vaccination facility. After the vaccine, they found 9 individuals who were already in stage 3 of hypertension. The authors of both reports and acknowledged that a clear understanding of the underlying process was not possible.[23,24] One possible parallel is coagulopathy, which may manifest as either during an infection with COVID-19 or after immunisation. Following the administration of the first dose of an mRNA vaccine, haematological and thromboembolic events were reported. After SARS-CoV-2 infection, the chances of such incidents were greater and persisted for longer periods of time than they were after immunisation. [25] The elevation in blood pressure that occurred after COVID-19 is indirectly supported by the hypertension that developed as a result of immunisation. It is necessary to do more studies in order to verify whether or not hypertension occurs after immunisation with mRNA and infection with SARS-CoV-2.

White coat hypertension is most often caused by mental health issues including stress and worry (WCH). Because of a number of factors, it seems doubtful that WCH had any impact on the findings of this particular research. To begin, there is a good chance that a greater number of people in the group under research presented at admission with symptoms of tension or worry related to the possibility of having COVID-19. At the control visit, on the other hand, the patients were aware that they had successfully

recovered from the COVID-19 illness, and as a result, they were likely in a better psychological state. Despite improvements in psychological state, post-COVID-19 measurements of both systolic and diastolic blood pressure were significantly higher than pre-COVID-19 readings. Second, the same patient's blood pressure was measured twice and both readings were compared to determine any changes. This helps compensate for the fact that I have a generally worried nature. To put it another way, if worry was present, it would be possible to detect it in both the first and the second measurement. Third, the measurement of blood pressure was carried out in a calm environment before the collection of nasopharyngeal and blood samples was carried out. Because of this, there was no procedure that was unpleasant or painful performed prior to the measurement of blood pressure. The current study does have some restrictions. To begin, there wasn't much time allotted for follow-up. It is recommended that additional research be planned in order to investigate whether or not the causal effect of COVID-19 on hypertension is no longer apparent after long-term follow-up. Second, the findings of the current research need to be backed up by the detection of biomarkers like ANG 2 and ACE 2 levels, among other potential candidates. Third, this research was conducted at a single location and only a limited number of patients were included in the analysis. On the other hand, our research cohort of unselected COVID-19 patients is representative of the situation in the real world.

CONCLUSION

In conclusion, the findings of the current investigation demonstrated that COVID-19 generates new cases of hypertension and leads to a rise in both systolic and diastolic blood pressure. The findings of this research have important implications for clinical practice. First and foremost, doctors need to be aware of the possible risk for new onset hypertension during the post-COVID-19 period and be prepared to take preventative measures.This preventive measures will decrease the morbidity and mortality in postcovid patients.

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