Frequency of COVID-19 in patients with myocardial infarction treated with primary percutaneous coronary intervention

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Research Article

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Abstract

Introduction: COVID-19 is a disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) There are some evidences that myocardial injury may play a role in increasing mortality in patients with COVID-19. In this study, we investigated the prevalence of COVID-19 in patients with myocardial infarction treated with primary percutaneous coronary intervention (PCI) and demographic and clinical indicators of patients with this complication for a six months period.

Methods: This cross-sectional study was retrospective and descriptive and all patients with acute myocardial infarction under primary PCI including 85 patients were included in the study. Measured parameters included COVID-19, age, sex, ethnicity, diabetes, and hypertension. Data were analyzed by SPSS.v25 software**.**

Results: 14 patients with MI under primary PCI (16.5%) had COVID-19. COVID-19 was diagnosed by RT-PCR for 2 patients and by lung CT scan of the remaining 12. Background Diabetes and Hypertension were present in 21.4% (n = 3) and 7.1% (n = 1) of COVID-19 patients, respectively. Recurrence of MI occurred in 14.3% (2 cases) of patients with COVID-19. The death occurred in only one case of COVID-19 patients, a 70-year-old Persian woman with diabetes and hypertension. There was no significant difference between age and sex, ethnicity, underlying diabetes, and underlying hypertension between COVID-19 and non-COVID-19 groups.

Conclusion: The prevalence of COVID-19 is significant in MI patients undergoing primary PCI. Further studies are recommended to investigate the role and mechanism of demographic and contextual variables on the severity and consequences of primary PCI in MI patients with COVID-19.

Introduction

On March 11, 2020, the World Health Organization (WHO) declared a new disease identified in Wuhan, China named coronavirus disease. A worldwide pandemic rapidly spreading and caused by a novel enveloped RNA beta coronavirus named severe acute respiratory syndrome coronavirus-2 (SARS-CoV2) which to date has infected more than 281 million people worldwide and nearly 5 million deaths (1, 2). The 2019 coronavirus (COVID-19) is correlated with an essential risk of mortality in addition to severe clinical symptoms and can also cause cardiovascular disorders such as myocardial infraction (MI), arrhythmia, acute coronary syndrome, and thromboembolism (3). Although COVID-19 mortality rates (estimated at 2 to 3%) are lower than SARS (approximately 10%) and *middle east respiratory syndrome* (approximately 40%), the COVID-19-associated epidemic has been much more severe (4).

Preliminary clinical data suggest that COVID-19 vulnerability and sequelae are strongly associated with cardiovascular disease (CVD). A high prevalence of previous CVD has been observed in patients with COVID-19 and the presence of these underlying diseases is associated with increased patient mortality. Children with COVID-19 have also been reported to develop severe inflammatory shock with features similar to Kawasaki disease, including heart failure and coronary artery disease (5, 6).

Some patients without common symptoms, such as fever or cough, present with cardiac symptoms as the first clinical manifestation of COVID-19. MI during COVID-19 is independently associated with high mortality(7).

COVID-19 has saliently affected healthcare and infected millions of people by widespread global prevalence and some diseases including MI, have also been affected by medical care. Garcia et al has recently shown that due to COVID-19, there was a 38% reduction in ST elevation myocardial infarction (STEMI) cardiac catheterization laboratory activations and therefore, reperfusion therapy may not be sufficient for MI patients during COVID-19 pandemic (8). In general, comprehensive data on the effect of the prevalence of COVID-19 on MI patient characteristics, clinical manifestations, and in-hospital outcomes are uncommon (9).

Under the influence of COVID-19 pandemic, the management of STEMI patients has varied in different countries worldwide, but at present, percutaneous coronary intervention (PCI) is the best management strategy for patients presenting with MI with increased ST-segment (STEMI) (10).

In this study, we investigated the prevalence of COVID-19 in patients with MI treated with primary PCI and demographic and clinical indicators of patients with this complication for a six months period.

Methods

Study subjects

This retrospective cross-sectional study with a descriptive approach was performed on 85 patients with MI who underwent primary PCI at our cardiology center starting from March 20, 2020 through September 20, 2020. According to other studies, for the evaluation of the COVID-19 epidemic effect on accessibility to primary PCI for MI patients with ST-segment elevation, available and sequential sampling methods were used. MI and primary PCI were the criteria for inclusion, and patient death before primary PCI was the exclusion criteria for this study.

Statistical assessment

A checklist of demographic records of all patients with MI under primary PCI was used to collect data. Study variables included COVID-19, sex, age, ethnicity, diabetes, blood pressure at admission, immediate consequences after stenting (including: death, re-MI) and laboratory findings including troponin I were extracted and classified from the file of patients.

Statistical analysis

After collecting the study participants' information, the data were entered into SPSS software version 25. Mean and standard deviation were used to describe quantitative variables, and for qualitative variables, frequency distribution test was used to report the number and percentage of cases. Chi-square test was

used to analyze qualitative variables. Quantitative variables in qualitative groups were compared using independent t-test. The level of significance in all tests was considered 0.05.

Results

A total of 95 patients with MI were referred to the cardiovascular center, 85 of whom underwent primary PCI and were included in this study and 14 patients (16.5%) had COVID-19. COVID-19 was diagnosed by RT-PCR for 2 patients and by CT scan of the remaining 12 patients.

Demographic characteristics of the study population

The mean age of the subjects was 56.16 ± 11.75 years (range 25-87 years). The comparison of the age of the subjects in the two groups with and without COVID-19 is shown in Figure 1.

As shown in the diagram, the mean age of non-COVID-19 patients in patients with primary PCI is 56.68 ± 11.45 and in patients with COVID-19 is 53.57 ± 13.32. which was not statistically significant (p = 0.901).

The study population was consisted of 60 male patients (74.1%) and 21 female patients (25.9%). The comparison of patients included in the study in two groups with and without COVID-19 based on gender is shown in Figure 2. In both groups, male patients are more numerous than female patient and the frequency of gender in the two groups with and without COVID-19 is not statistically different from each other (p = 0.371).

In total, the study population included different ethnicities consisted of 48 Persian (56.5%), 27 Turkmen (31.8%), 2 Sistani (2.4%), and 8 Turks (9.4%). Due to the small population of Sistani and Turks, the two groups were merged to perform the Chi-square test and compared as other ethnicities. The comparison of included patients into two groups with and without COVID-19 based on the ethnicity is shown in Figure 3. The number of people with Persian and Turkmen ethnicity in the group of people with COVID-19 was equal to each other, while in the non-infected group the number of Persian ethnicity was twice that of Turkmen; However, this difference was not statistically significant (p = 0.529).

8 patients (9.4%) of the total study population had secondary hypertension. The comparison of patients included in the study in two groups with and without COVID-19 based on underlying hypertension is shown in Figure 4. As can be shown, there was no significant difference between the two groups in terms of hypertension (p = 0.743).

Out of the entire study population, 9 patients (10.6%) had underlying diabetes. The comparison of enrolled patients in the two groups with and without COVID-19 based on their underlying diabetes is shown in Figure 5. There was no significant difference in the frequency of diabetes between the two groups of MI patients with and without COVID-19 (p = 0.186).

Outcomes of MI in patients with COVID-19 and under primary PCI

Out of a total of 14 MI patients undergoing primary PCI with COVID-19, 100% tested positive for troponin I. Demographic and clinical characteristics of MI patients undergoing primary PCI with COVID-19 are listed in Table 1.

As shown in the table.1 in 14.3% of cases, MI patients undergoing primary PCI with COVID-19 re-developed MI. Also, in 20% of cases, primary PCI was performed in the right coronary artery (RCA) branch. Only one death occurred in MI subjects under primary PCI; A 70-year-old Persian woman with hypertension and underlying diabetes suffering from acute anterior MI and primary PCI performed on her left arterial descending (LAD) coronary branch.

Discussion

The aim of this study was to determine the frequency of COVID-19 in patients with MI under primary PCI and related demographic and clinical indicators. In the first six months of 2020, 95 patients with MI were referred to our cardiovascular center, and 85 of them underwent primary PCI and were included in this study. 14 patients (16.5%) had COVID-19. COVID-19 was diagnosed by RT-PCR in 2 patients and by lung CT scan in the 12 remaining patients. In the present study, the frequency of male gender in both COVID-19 and non-COVID-19 groups was higher than female. The prevalence of Persian and Turkmen ethnicity was equal in the group of patients with COVID-19. One-fifth of cases of COVID-19 were predisposed to diabetes, and only one case of hypertension was observed in people with COVID-19. Also, recurrent MI occurred in two patients with COVID-19. About 80% of cases were MI in the upper part and primary PCI was performed in about 80% of cases in the LAD coronary branch.

Studies have shown that COVID-19 may directly affect the cardiovascular system. There are evidences that myocardial injury may play a role in increasing mortality in infected patients. The effect of COVID-19 in patients with MI with increased ST-segment levels can be either directly with a high incidence of progressive acute heart failure or indirectly by increasing the delay between the first medical contact and initial PCI due to contamination that has recently been followed up by hospitals. However, it is believed that the worst prognosis for a patient with COVID-19 may be associated with ST-segment elevation of myocardial infraction (STEMI).

Sherif Seif and colleagues followed up and treated a 58-year-old female patient with COVID-19 who had STEMI. Reperfusion was performed through primary PCI, but ballooning and thrombectomy failed to restore coronary blood flow due to the enormous thrombotic load, and led to the death of the patient. In this study, extensive thrombosis occurred in the middle part of the RCA branch. In this study, primary PCI was proposed as the first choice for vascular regeneration in patients with COVID-19 and STEMI. In our study, only one case of death occurred in MI subjects under primary PCI. A 70-year-old Persian woman with hypertension and diabetes mellitus who had acute anterior MI and primary PCI was performed on her LAD coronary branch. Sherif Seif et al. have been suggested that, primary PCI is the first choice in STEMI patients compared to fibrinolytic therapy, which they believe will not be able to confront with such a large thrombosis, and a strong new generation of P2Y12 inhibitors such as Prasugrel should be

preferred. It is also possible to prescribe a glycoprotein IIb / IIIa receptor inhibitor in each patient with STEMI in order to achieve optimal conditions during the initial PCI (11). In our study, drug treatment after initial PCI was not considered for patients. It is also unclear whether the death occurred solely due to MI thrombotic load or COVID-19-related cardiovascular complications were involved.

A retrospective cohort study conducted by Chun Shing Kwok et al. In 2020 at the United Kingdom aimed to identify any changes in the PCI in patients with MI by increasing the ST-segment by analyzing the number of procedures, clinical features and disease outcome during the COVID-19 epidemic; Only patients with primary PCI were analyzed for STEMI. Analyzes were limited to 44 hospitals that reported concurrent activity in PCI. A total of 34,127 patients with STEMI (33938 primary PCI, 108 facilitated PCI, and 81 rescued PCI) were included in the study. The results showed that the number of procedures in April 2020 (n = 497) decreased by 43% compared to the average monthly procedures between 2017 and 2019 (n = 865). For all patients, the mean time from onset of symptoms to hospital after general quarantine increased (150 min vs. 135 min, p = 0.004) and a longer time from onset of symptoms to ballooning was indicated at quarantine time after lockdown. (P> 0/001). The mortality rate in the hospital was 4.8% before quarantine and 3.5% after quarantine (p = 0.12) (12).

In another case study, Delio Tedeschi et al. Examined a 60-year-old man with no risk factors for CVD and no history of hospitalization for heart disease by diagnosing interstitial pneumonia due to COVID-19 disease. After 7 days, blood tests showed a significant increase in inflammatory and procoagulant markers, along with an increase in cardiac troponin I with high sensitivity. The electrocardiogram was consistent with the diagnosis of acute lower wall MI and the patient underwent primary PCI intervention. Angiography showed a widespread acute right thrombosis of the RCA branch with no evidence of coronary artery stenosis or atherosclerotic plaques. Despite optimal drug treatments and different PCI techniques, the final Thrombolysis in MI flow was 0.1 and the patient stopped cardiac arrest after 3 hours. According to this information, diffuse thrombosis was resistant to drug and mechanical therapy. this supports the hypothesis that the proinflammatory and prothrombotic status associated with COVID-19 infection was a major cause of coronary thrombosis. They concluded that acute coronary stroke with ST-segment elevation in MI is a COVID-19-related complication and due to the high level of proinflammatory mediators, diffuse coronary thrombosis can occur even in patients without a history of concomitant heart diseases. This clinical case showed that coronary thrombosis in COVID-19 patients may not respond to optimal drug therapy (Glycoprotein IIb-IIIa injection) and mechanical therapy such as PCI (13). In the present study, 78.6% of MI patients underwent primary PCI with COVID-19 did not experience any adverse outcomes, and only one death and two recurrent MI cases were observed in this group of patients. Only one case of death among 85 patients with primary PCI who also had COVID-19 indicated a possible role for the effect of SARS-CoV-2 infection on previous strokes and their associated outcomes can be considered at the time of the COVID-19 epidemic. In the present study, the primary PCI in the deceased patient was performed on the coronary LAD branch, which contradicts the studies of both Sherif Seif et al. And Delio Tedeschi et al (11, 13).

A 2020 study by Dingcheng Xiang et al. Examined the management and outcomes of STEMI patients during COVID-19 outbreaks in China. Thus, during COVID-19 epidemics, medical professionals must strike a balance between providing timely treatment to STEMI patients and implementing infection control methods to prevent the spread of COVID-19 among other vulnerable cardiovascular patients. Based on data from 28,189 STEMI patients admitted between December 27, 2019 and February 20, 2020 at a number of cardiovascular centers in China, the effect of COVID-19 prevalence and the modified STEMI protocol on the number of STEMI patients was analyzed. They found that the prevalence of COVID-19 reduced the number of STEMI cases reported to cardiovascular centers in China.

According to the modified STEMI protocol of the China Cardiovascular Center, the percentage of patients undergoing primary PCI decreased while the percentage of patients undergoing thrombolysis increased. With an average delay of about 20 minutes for reperfusion treatment, hospital mortality and heart rate increased during the outbreak, but the bleeding rate remained constant in the hospital. This means that despite the inevitable delays in the treatment schedule due to Mandatory methods of infection control and changes in reperfusion strategies During the outbreak, the proportion of patients receiving effective reperfusion is constant. Finally, it was found that there were deficiencies in STEMI patients' access to health care, delays in treatment schedules, changes in reperfusion strategies, and increased hospital mortality and heart failure during the COVID-19 epidemic in China (14).

Butala et al. Quantitatively studied the effect of different STEMI treatment strategies on patient outcomes and their risk to the COVID-19 pandemic. In this study, the effect of initial PCI versus drug-invasive strategy for STEMI management on 30-day patient death and risk of donor infection was assessed based on cardiogenic shock suspected to coronary heart disease, and known or hypothesized COVID-19 infection. It was found that for patients with a low risk of COVID-19, primary PCI has an advantage over drug strategies and reduces mortality and the possibility of infection transmission to the intervening person for patients suspected of having COVID-19 with cardiogenic shock, PCI has significant mortality advantages over the drug-invasive strategy for patients (7.9% absolute reduction in 30-day mortality), but is more likely to develop infection for the person undergoing the intervention (2.3% absolute increase in the risk of presenter infection). For patients suspected of having COVID-19 with non-anterior STEMI without cardiogenic shock, primary PCI showed a 0.4% absolute reduction in mortality compared to drug-invasive strategies and a 0.2% increased risk of transmission of infection to the intervention patient. Risk exchange between patient and individual under primary PCI intervention was revealed in more severe COVID-19 infections (15).

In a study, Giuseppe De Luca et al. Examined the effect of COVID-19 pandemic and diabetes on mechanical reperfusion in STEMI patients. A total of 6,609 patients underwent primary PCI at 77 centers in 18 countries. Diabetes was observed in a total of 1356 patients (20.5%) with a similar ratio between 2019 and 2020. The COVID-19 epidemic had a significant effect on the treatment of patients with STEMI with a similar reduction in primary PCI procedures in patients with and without diabetes. Also, hypertension had a significant effect on reducing PCI only in patients without diabetes (16).

Conclusion

The findings of the present study showed that during the outbreak of COVID-19, most of the patients who referred to our cardiovascular center due to chest pain and MI and underwent primary PCI were male and of Persian ethnicity. The prevalence of COVID-19 is significant in MI patients undergoing primary PCI. The association of underlying diseases, including diabetes and hypertension, can worsen the patient's condition and have adverse consequences, including mortality.

Declarations

Ethical approval and consent to participate: The study and all experimental protocols were approved by the Professional Ethics Committee of the Golestan University of Medical Sciences with the ethical code of ir.goums.rec1396.262. The informed consent was also obtained from all patients for the implementation of this project.

All methods were carried out in accordance with relevant guidelines and regulations.

Consent for publication: Not applicable.

Availability of data and materials: The data that support the findings of this study are available from corresponding author but restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available. Data are however available in the form of an Excel file from the authors upon reasonable request and with permission of Alireza fatemi.

Competing interests: The authors declare no competing interest.

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Authors contribution:

M.Z: Cardiology assessment and necessary data collection.

F.D: Patients visiting and necessary data collection.

A.F: Manuscript writing and data entry.

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Table 1

Table 1. Demographic and clinical characteristics of MI patients undergoing primary PCI with COVID-19

Demographic and clinical characteristics	Number (%)	
Gender	Male	(3/64) 9
	Female	(7/35) 5
Nationality	Persian	(9/42) 6
	Turkmen	(9/42) 6
	Others	(3/14) 2
Diabetes		(4/21) 3
High blood pressure		(1/7) 1
Re-MI		(3/14) 2
MI site	Anterior	(6/78) 11
	Posterior	(4/21) 3
PCI site	LAD	(6/78) 11
	RCA	(4/21) 3

Figures

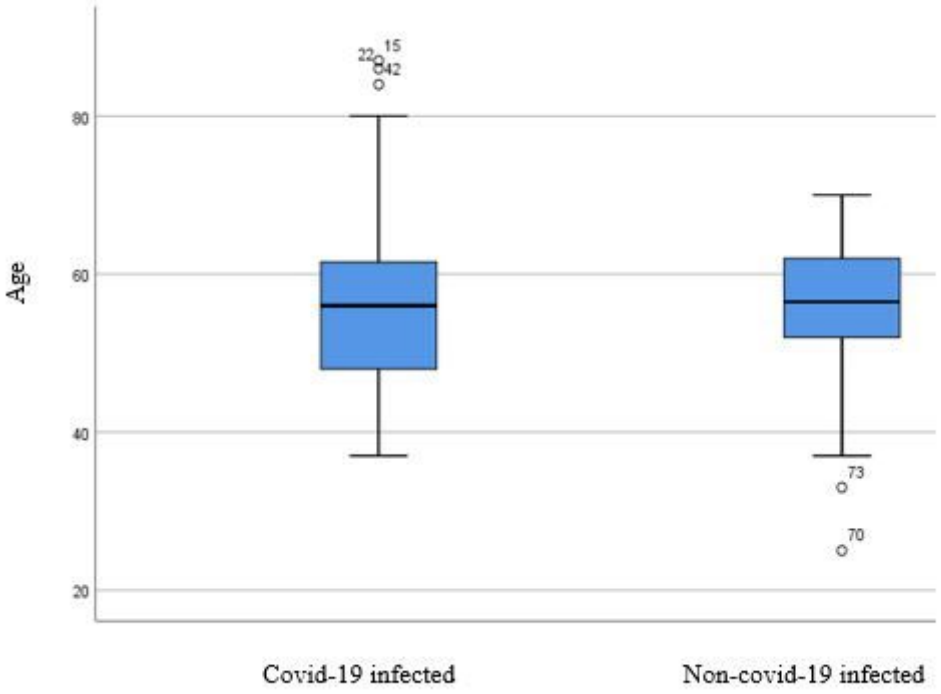

Figure 1

Comparison of age of patients with and without COVID-19 in patients undergoing primary PCI

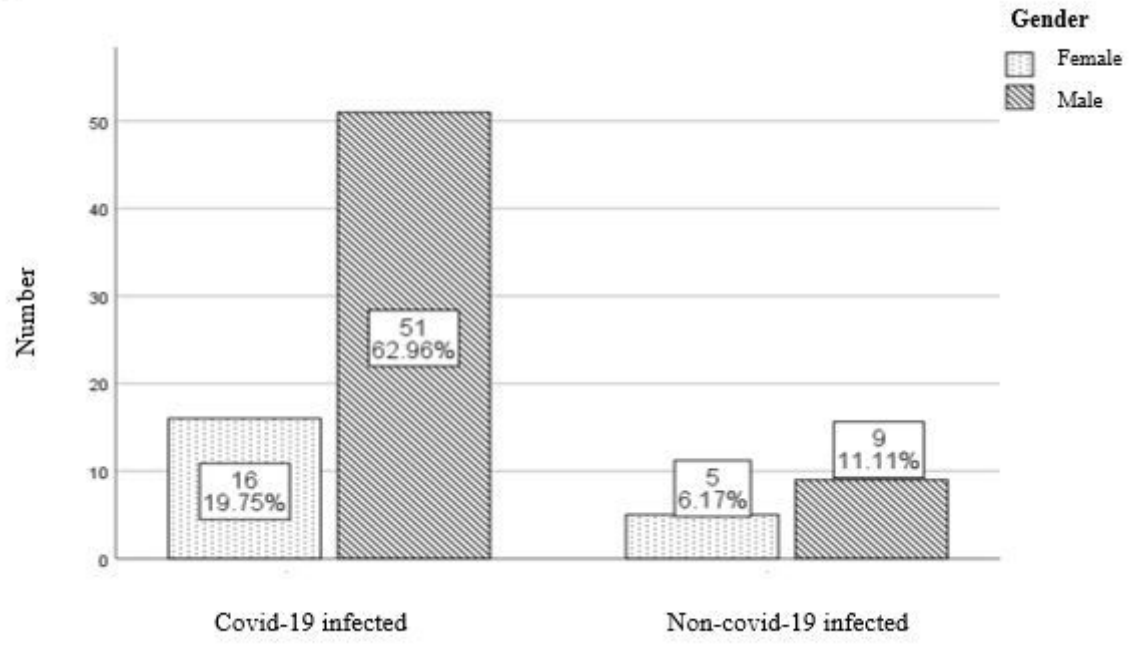

Figure 2

Comparison of the frequency of sex of people with and without COVID-19 in patients undergoing primary PCI

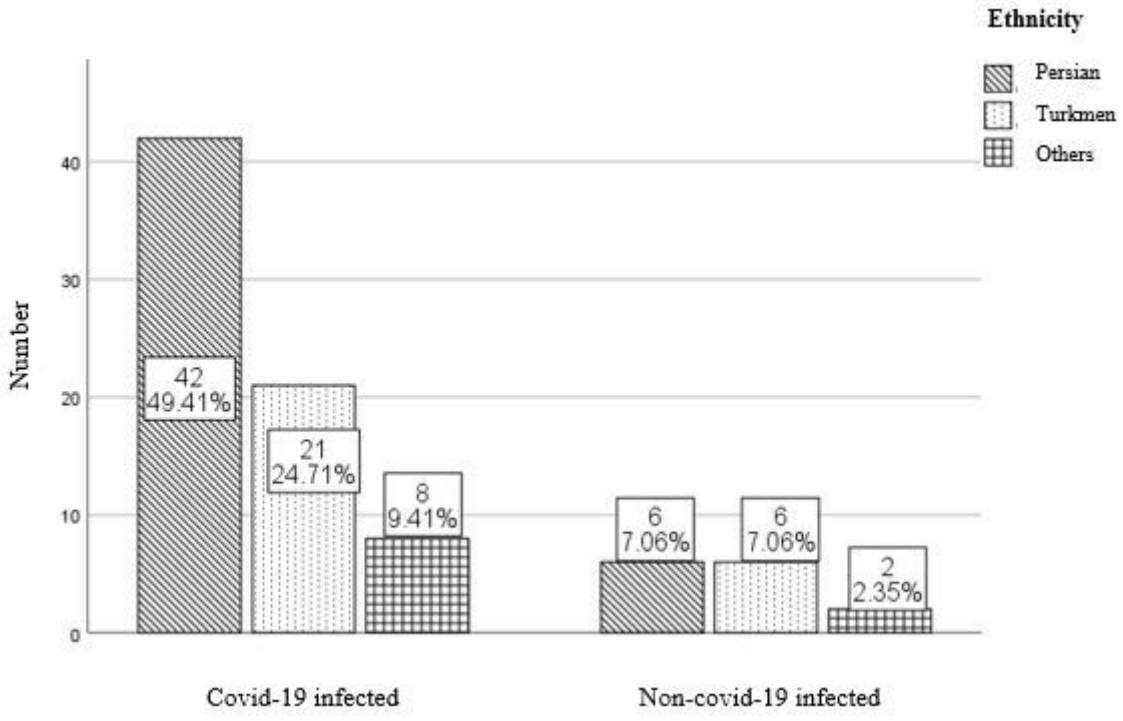

Figure 3

Comparison of ethnicity of patients with and without COVID-19 in patients undergoing primary PCI

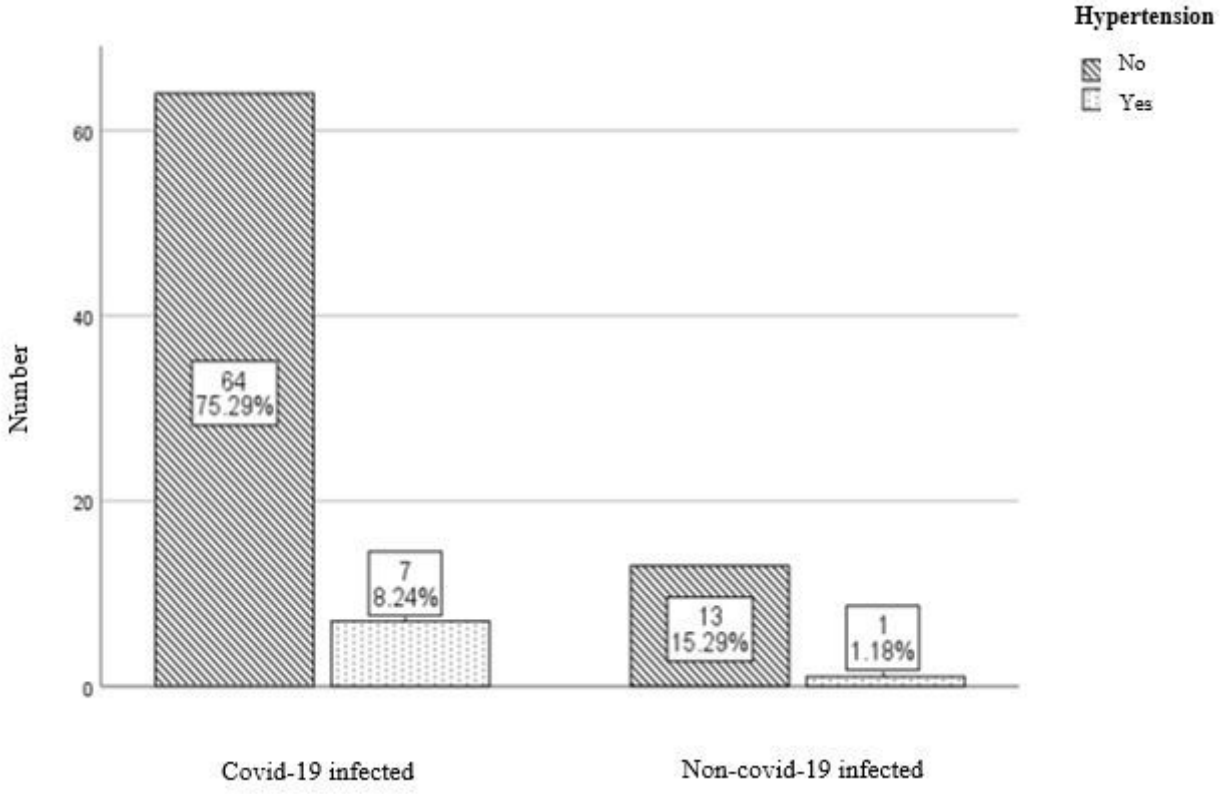

Figure 4

Comparison of the frequency of hypertension in patients with and without COVID-19 in patients with primary PCI

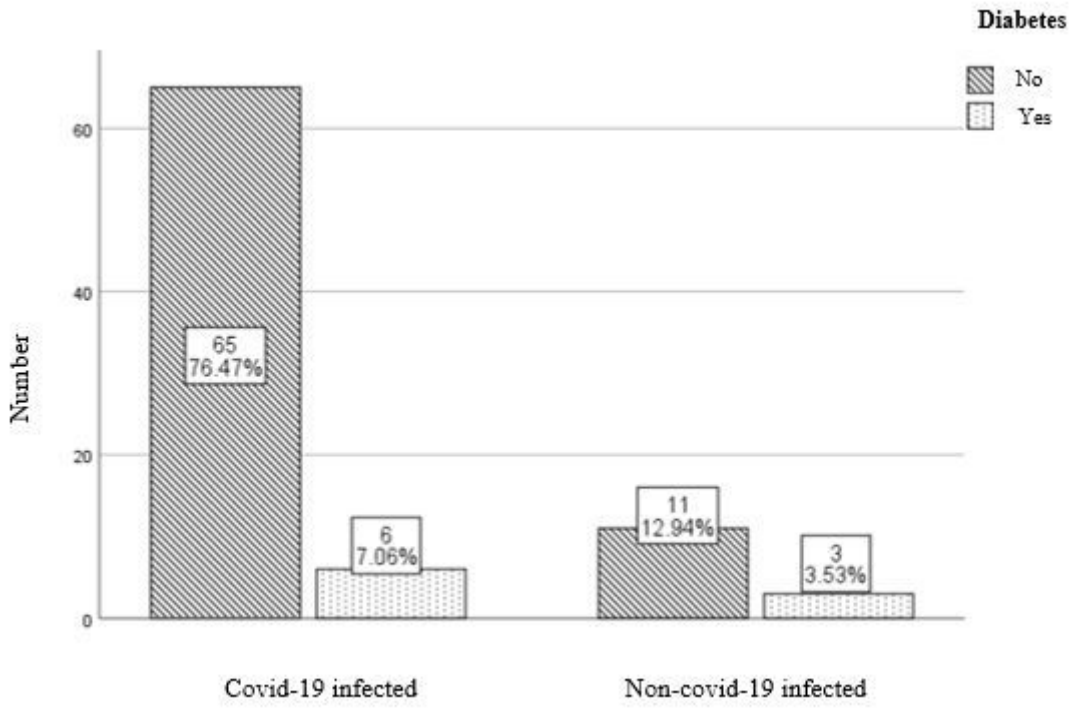

Figure 5

Comparison of the frequency of diabetes in two groups with and without COVID-19 in patients with primary PCI