ABSTRACT

Background: The novel severe acute respiratory syndrome-coronavirus-2 (SARS-CoV-2) outbreak has affected ST-elevation myocardial infarction (STEMI) care worldwide. Reports from China, Europa, and North America showed a significant decline in STEMI volume with a simultaneous increase in time from symptoms to hospital presentation.

Aim: The aim of the study was to study the effect of the SARS-CoV-2 outbreak on primary percutaneous coronary intervention (PPCI) volume performed for STEMI, symptom onset to hospital presentation time (symptom-to-door [S2D]), and door-to-balloon time (D2B) at the main nationwide PPCI center in Qatar.

Methods: A retrospective evaluation of prospectively collected quality improvement cardiac catheterization data in Qatar was performed. PPCI volume and S2D and D2B time during the outbreak from March 9, 2020, to May 14, 2020, were compared with that of the same period from the prior year and the period immediately preceding the outbreak.

Results: Since the SARS-CoV-2 outbreak in Qatar, 137 PPCI procedures were performed. There was a 40% reduction in the volume of PPCI when compared with the period immediately preceding the outbreak and 16% reduction in volume when compared with that of the same period in 2019. The median S2D time was 115 min (interquartile range [IQR: 124]), which was not statistically different from that of the preceding period or the same period in 2019. D2B time during the outbreak increased by an average of 7 min when compared with that of the same period preceding the outbreak (median: 47 min [IQR: 28] during the outbreak vs. median: 40 min [IQR: 21] during the preceding period, \( P = 0.016 \)).

Conclusion: In a statewide PPCI program in Qatar, we observed a mild reduction in PPCI cases during the SARS-CoV-2 outbreak (16% when compared with the same period in 2019), with a modest increase in D2B time. PPCI can be performed effectively during the SARS-CoV-2 outbreak at very high-volume centers with the adoption of strict infection control measures. With proper training and monitoring, both target D2B and hospital staff safety can be achieved.

Keywords: Door to Balloon time, PPCI, SARS-CoV-2
INTRODUCTION

The novel severe acute respiratory syndrome-coronavirus-2 (SARS-CoV-2) has resulted in major changes in the provision of cardiovascular care delivery worldwide.[1] This was driven mainly by the highly contagious nature of the disease, the high rate of asymptomatic infected patients, the shortage of personal protection equipment, and the exponential increase in hospital admissions. ST-elevation myocardial infarction (STEMI) care was among the most affected. Studies from China, Europe, and North America reported a significant decline in the total number of STEMI with a longer symptom-to-door time (S2D).[2,3]

The concern about the high rate of infection among health-care workers along with the potential delays in door-to-balloon (D2B) time with the full implementation of infection control measures led many institutions to adopt fibrinolytic or pharmaco-invasive therapy as the primary reperfusion strategy during the SARS-CoV-2 pandemic.[4,5]

Because of the limited data available from the Middle East region, we sought to review the impact of the SARS-CoV-2 pandemic on STEMI volume, time from symptoms to hospital presentation, and D2B time at a statewide primary percutaneous coronary intervention (PPCI) center in Qatar.

METHODS

Study design

This was a retrospective analysis of prospectively collected quality improvement data. These data include patients’ demographics, past medical history, and interventional details. Data regarding the total number of PPCI performed for STEMI, symptom onset to hospital presentation, and D2B time for all PPCI were analyzed for the period of the outbreak (March 9, 2020 to May 14, 2020) and compared with that of the same duration (in days) immediately prior to the outbreak and compared with that of the same period in 2019.

The outbreak onset was defined by the date the State of Qatar announced the partial lockdown on March 9, 2020. The study was reviewed and approved by the Quality Improvement Department at the Heart Hospital and by the Institutional Review Board at Hamad Medical Corporation.

Study setting

Qatar Heart Hospital provides a statewide PPCI program in Qatar (population >2.8 million). The Heart Hospital, a high-volume cardiac tertiary hospital, performs >1000 PPCI annually and receives >95% of all the national STEMI cases by direct referral from ambulance services. From the beginning of the SARS-CoV-2 outbreak in Qatar in the early March 2020, a decision was made to continue PPCI as the main reperfusion strategy with the adoption of strict infection control measures [Table 1]. Fibrinolytic therapy was reserved for confirmed SARS-CoV-2 infection with low cardiac risk.

Statistical analysis

This article analyzed the volume of PPCI, S2D, and D2B in 2019 and 2020. Categorical variables were presented in counts and percentage. All continuous variables were presented as median and interquartile range (IQR) as they were nonnormally distributed. Data departure from normality was tested using Shapiro–Wilks test and Skewness test. Skewness values >0.5 and >1 were considered moderately and highly skewed, respectively. The number of PPCI in 2019 and 2020 in addition to the incidence of SARS-CoV-2-19 was plotted in a run chart using Excel Spreadsheet (Microsoft Excel 2016).

Table 1: A summary of the changes to primary percutaneous coronary intervention care during the severe acute respiratory syndrome-coronavirus-2 outbreak

| Target                  | Intervention                                                                 |
|-------------------------|-------------------------------------------------------------------------------|
| Staff training          | All staff underwent rigorous training for the proper use of PPE, doffing and donning |
|                         | Multiple drills were conducted for different PPCI case scenarios               |
|                         | For the first 2-3 weeks, all the staff involved in the care received a debriefing after each case |
| PPE                     | All patients with unknown SARS-CoV-2 status were treated such as positive cases from infection control standpoint during PPCI |
|                         | Full PPE (N95 mask, face shield, head cover, shoe cover, impermeable apron, etc.) are used in all PPCI cases by all staff involved in the care including medical aides |
| SARS-CoV-2 testing      | SARS-CoV-2 PCR tests on nasopharyngeal swabs were performed for all patients after the procedure |
|                         | After the procedure, the patients were placed on airborne isolation until the results were out |
| Personnel allocation    | Limiting the number of nurses involved in the care in the emergency room (start intravenous access, obtain ECG, prepare the access site, etc.) |
|                         | No fellows or other trainees scrubbed in the PPCI procedure. All PPCI(s) were performed by the interventional cardiologists and scrubbed technician |
| Catheterization laboratory arrangement | One of the three coronary catheterization laboratories with easy access to the emergency room and cardiac intensive care unit was dedicated for PPCI |
|                         | Two HEPA filters were installed in the catheterization laboratory dedicated for PPCI |
|                         | Environmental surface cleaning was conducted following each procedure |

HEPA: High-efficiency particulate air, PPCI: Primary percutaneous coronary intervention, SARS-CoV-2: Severe acute respiratory syndrome-coronavirus-2, PPE: Personal protection equipment, ECG: Electrocardiogram, PCR: Polymerase chain reaction
Figure 1: Total weekly cases of primary percutaneous coronary intervention in 2019 and 2020. March 9, 2020, was the date when Qatar announced the nationwide partial lockdown.

Figure 2: Weekly mean symptom-to-door time in 2019 and 2020. March 9, 2020, was the date when Qatar announced the nationwide partial lockdown.

Figure 3: Bar graph illustrating the median values of symptom-to-door time during the outbreak days (after March 9, 2020) compared with the period preceding the outbreak (before March 9, 2020) and to the same period from the prior year (after March 9, 2019). Mann–Whitney U-test was used for analysis.
RESULTS

Since the beginning of the outbreak in Qatar, 137 patients underwent PPCI, of which 14 (10%) patients tested positive for SARS-CoV-2. There was a 40% reduction in the volume of PPCI in Qatar when compared with that of 228 PPCI cases performed during the period immediately preceding the outbreak and a 16% reduction in volume when compared with 163 PPCI cases performed during the same period in 2019 [Figure 1]. The S2D time during the SARS-CoV-2 outbreak was unchanged when compared with the period immediately preceding the outbreak (median: 115 min [IQR: 124] during the outbreak vs. median: 111 min [IQR: 124] during the preceding period, \( P = 0.093 \)) [Figures 2 and 3].

The D2B time during the SARS-CoV-2 outbreak increased by an average of 7 min when compared with the period immediately preceding the outbreak (median: 115 min [IQR: 124] during the outbreak vs. median: 108 min [IQR: 124] during the preceding period, \( P = 0.016 \)).

Figure 2: Bar graph illustrating the median values of door-to-balloon time during the outbreak days (after March 9, 2020) compared with the period preceding the outbreak (before March 9, 2020) and to the same period from the prior year (after March 9, 2019).

Mann-Whitney U-test was used for analysis because the continuous data were nonnormally distributed. Two-tailed \( P < 0.05 \) was considered statistically significant. SataCorp 4905 Lakeway Drive College Station, Texas 77845 USA was used for analysis.
47 min [IQR: 28] during the outbreak vs. median: 53 min [IQR: 28] during the same period in 2019, \( P = 0.026 \) [Figures 4 and 5].

None of the staff (23 nurses, 21 cardiovascular technicians, and 12 interventional cardiologists) involved in the PPCI was infected or tested positive for SARS-CoV-2 on the routine biweekly screening.

**DISCUSSION**

Many studies from Europe, China, and North America have reported a significant reduction in hospital admission with STEMI during the SARS-CoV-2 outbreak. We observed a modest decline in the total number of PPCI compared, but a similar pattern was observed in 2019, which suggests that the decline is mainly driven by seasonal variation.

Our data, in contrast to other studies, did not show a significant change in S2D time before and after the outbreak or when it is compared with the same period last year. This suggests that patients in the State of Qatar continued to seek medical attention without additional delay despite the SARS-CoV-2 outbreak. There is no definite explanation of this finding, but it may be related to the state policy which declared the Heart Hospital as a non-SARS-CoV-2-treating facility, which gave the public the assurance that they are less likely to get infected should they be admitted to the Heart Hospital.

Despite the extensive infection control measures, we observed only a mild increase in D2B time compared with the period before the outbreak. Of note, D2B remained – during the outbreak –lower than that of the same period in 2019. The clinical significance of this increase in D2B is undetermined, however we believe that it is clinically justified and strikes a reasonable balance when compared with the use of thrombolysis.

The infection control measures were enough to prevent the medical staff from acquiring the infection and were not excessive to cause clinically unacceptable delays in D2B time.

**Limitation of the study**

This retrospective study was subjected to two major limitations. First, few STEMI patients who were managed by fibrinolytics and late STEMI presenters who were not managed with any immediate reperfusion strategy were not captured in this study. The inclusion of these patients might influence the S2D time. Second, in this study, we did not explore the impact of the modest increase in D2B time during the outbreak on clinical outcomes.

**CONCLUSION**

In a statewide PPCI program in Qatar, we observed a mild reduction in PPCI cases during the SARS-CoV-2 outbreak (16% when compared with the same period in 2019), with a modest increase in D2B time. PPCI can be performed effectively during the SARS-CoV-2 outbreak at a very high-volume center with the adoption of strict infection control measures. With proper training and monitoring, both target D2B and hospital staff safety can be achieved.

**Financial support and sponsorship**

Nil.

**Conflicts of interest**

There are no conflicts of interest.

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