

REVIEW ARTICLE

COVID-19 Pandemic and the Impact on the Cardiovascular Disease Patient Care

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Abstract: The COVID-19 pandemic has emerged as a serious global threat causing a large number of fatalities and putting enormous strain on the health care resources across the world. This has resulted in preferentially triaging the coronavirus infected patients and placing others, especially cardiovascular patients at increased risk for adverse complications. The effective management of cardiac patients in the hospital environment during this COVID-19 pandemic has emerged as a real challenge. We try to address this issue and also highlight the interplay between COVID-19 and cardiovascular diseases. We hereby review the available literature and emerging guidelines about cardiovascular implications related to COVID-19 which will have a bearing on the patient care, health care professionals and cardiac centres.

Keywords: COVID-19, cardiovascular, myocarditis, acute coronary syndrome, primary PCI, anxiety.

1. INTRODUCTION

The COVID-19 infection caused by Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) was first identified in Wuhan, China in December 2019. This viral pandemic, since then, has rapidly disseminated across the globe and according to the World Health Organization (WHO), it has infected more than 2 million individuals in 213 countries and has resulted in about 357 688 fatalities as on May 19, 2020 [1, 2]. To contain the spread of this highly contagious infection, many nations have imposed lockdowns, restricted travel, and advocated social distancing, leading to disruption of daily lives, causing anxiety and hardships in the society.

The individuals infected with COVID-19 have a varied clinical presentation. A retrospective single-centre study conducted in China revealed that, of the confirmed cases: 81% were mild, defined by no or mild pneumonia, 14% were severe with significant lung infiltrates or signs of respiratory compromise and 5% were critical with respiratory failure requiring mechanical ventilation (47% of the total cases), shock or multi-organ system failure. Those requiring Intensive Care Unit (ICU) care were predominantly older (median age 66 years) with a higher prevalence of co-morbidities like diabetes mellitus, hypertension, cardiovascular and cerebrovascular diseases than in those not needing ICU care. The acute cardiac injury was observed in about 7% and the overall mortality was 4.3% [3].

The myocardial involvement in coronavirus infection is direct in the form of viral myocarditis and indirect injury to myocardium can occur due to increased oxygen demands caused by fever and tachycardia, and reduced oxygen delivery caused by hypotension and hypoxemia. During the acute infection, cytokines released can augment thrombotic risk leading to acute coronary syndromes [4]. Anecdotal reports suggest that presentation of COVID-19 infection mimicking ST-Elevation Myocardial Infarction (STEMI) with an increase in the levels of cardiac biomarkers especially the troponins, electrocardiographic and echocardiographic abnormalities is frequently encountered, and is associated with more severe disease form and worse prognosis [5]. This overlapping of COVID-19 presentation with STEMI which is being termed as “STEMI mimics” has compounded the diagnostic challenges of the coronavirus infection.

In cardiac centres around the world, surprisingly there is a significant reduction in presentations of STEMI during the coronavirus pandemic. A retrospective analysis, at the nation's cardiac service, centres conducted by the Spanish society of cardiology revealed a significant reduction of 40% in the admissions for STEMI and a reduction in the number of diagnostic procedures by 57%, coronary intervention procedures by 48% and structural heart interventions by 81% [6]. A similar reduction in STEMI admission numbers by 70% is observed in Italy's Lombardy region [7]. A real-time data analysis conducted by the Minneapolis heart institute foundation from nine large USA STEMI centres shows a 38% reduction in the cardiac catheterization laboratory STEMI procedures [8].

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The vast number of COVID-19 infected patients being prioritised in-hospital triage and ICU has a direct impact on cardiovascular disease patient care and may hinder in providing optimal treatment for them. Cardiac care clinicians and healthcare workers amid this pandemic can become vulnerable to coronavirus infection and inadvertently become vectors of virus transmission. Clinicians and healthcare systems must be aware of the dynamic changes occurring during this crisis and judiciously use the resources for patient care. The objective of this review is to address these vital issues arising during this pandemic and to optimize cardiovascular patient care outcomes.

2. IMPACT ON CARDIOVASCULAR DISEASE PATIENT CARE

2.1. Outpatient Clinic Considerations

To mitigate the spread of COVID-19 infection lockdowns and physical distancing imposed across nations has interrupted the daily life in the community. This has a direct bearing on the patient’s visit to the doctor’s office and has drastically transformed the physician practices from physical to virtual consultation. Many hospitals are turning to telehealth to address this transition and are ramping up their capabilities to include video consultations, telephone calls and electronic messaging. This is advantageous to both the patients and healthcare workers as there would be no potential risk of exposure to COVID-19 infection by avoiding in-person consultation [9]. In this crisis, by adopting virtual practices the strain on emergency departments is reduced and the healthcare workers can be optimally utilised in the management of COVID-19 patients.

2.2. Inpatient Care and Catheterization Laboratory Considerations

The telehealth services under the present circumstances are a convenient solution for patients with chronic and stable cardiac ailments seeking physician consultation. Patients presenting with acute coronary syndrome will require emergency medical attention and appropriate strategies should be adopted by hospitals to provide optimal care for them. Given the on-going pandemic and overlapping of presentations of both COVID-19 and STEMI, the cardiac health care providers are at a heightened risk of contracting the virus infection. Hence institutions must develop protocols of infection prevention, control and adhere to treatment guidelines in the care of these patients [10].

The American College of Cardiology’s (ACC) interventional council and the Society of Cardiovascular Angiography And Intervention (SCAI) have issued a joint statement of catheterization laboratory considerations during the coronavirus (COVID-19) pandemic [11] and the summary is enumerated below and in Table 1 [12].

2.2.1. ST-elevation Myocardial Infarction (STEMI) Patient

During this pandemic, China adopted protocols of its Sichuan provincial people’s hospital that followed the principles of maximum protection for health care professionals. When dealing with patients of STEMI having fever and respiratory symptoms, and presenting within 12 hours of symptoms, this protocol advocates rapid nucleic acid testing and fibrinolytic therapy [13]. For those with a delayed presentation of STEMI beyond 12 hours, the risk of infection versus PCI should be weighed. If such patients are stable, serial echocardiograms should be performed and they should be treated conservatively and followed up closely for deterioration of symptoms [13]. However, worldwide for those suffering from STEMI, Primary Percutaneous Coronary Intervention (PPCI) is the gold standard treatment and hence offering thrombolytic therapy should be carefully considered especially in unstable patients. Also, COVID-19 rapid testing kit may not be readily available in most centres, and thrombolytic therapy can be riskier in COVID-19 infection with STEMI, as patients with a severe infection have deranged coagulation parameters and prone for bleeding [14]. However, given the pandemic and the strain on health care systems, a stable active COVID-19 patient presenting with STEMI thrombolysis can be considered, carefully gauging the patient benefit and staff risk of exposure to the virus. In patients with active COVID-19 and unstable STEMI requiring Primary PCI, appropriate Personal Protective Equipment (PPE) including an N95 mask should be worn by all the members of the cardiac team involved in the care of these patients [11]. Additionally, all the personnel should be trained and well versed with proper techniques for doffing and donning of the PPE. Ideally, cardiac intervention procedure on a COVID-19 positive patient should be performed in a negative pressure catheterization laboratory [11, 15]. In most hospitals, operating rooms and catheterization laboratories use positive ventilation systems, and in normal circumstances, these

Table 1. COVID-19 pandemic and the cardiovascular disease patient care considerations.

Outpatient Clinic Care	Inpatient /ICU Care	Cardiac Catheterisation Laboratory Considerations	Cardiac Surgery Considerations
<ul style="list-style-type: none"> • Telehealth • Virtual consultation 	<p>STABLE PATIENTS</p> <ul style="list-style-type: none"> • Telehealth <p>ICU CARE</p> <ul style="list-style-type: none"> • Use PPE during procedures where appropriate in COVID-19 patient (as per guidelines) 	<ul style="list-style-type: none"> • Avoid elective procedures • Negative pressure labs for emergency procedures • PPE for staff during emergency interventional procedures in COVID-19 patients (as per guidelines) • Thrombolysis for STEMI if PCI not feasible 	<ul style="list-style-type: none"> • Cancel elective surgeries • Negative pressure operating rooms for emergency surgeries • PPE for staff in operating rooms during emergency surgeries in COVID-19 patient (as per guidelines)

steps help to protect the equipment and patients from surrounding airborne contaminants like viruses, bacteria and fungi [16]. In these positively pressured rooms, the air inflow is designed specifically in such a way that airborne contaminants disperse downwards away from the patient to the other end of the room [17]. However, in the current pandemic for enhanced safety of the patients, these rooms will require conversion to an air neutral or negative-pressure area so that infectious transmission originating within the room while operating on a COVID-19 patient does not occur [16]. A positive-pressure operating room can be converted into a negative-pressure zone by establishing an anteroom within this area and additionally by sealing off other access points and reversing the airflow design in the room [16, 18, 19]. In the non-availability of a negative-pressure catheterization laboratory or operating room, terminal cleaning protocols should be adopted after the end of each procedure [20].

2.2.2. Non ST-elevation Myocardial Infarction (NSTEMI) Patient

In an NSTEMI patient with suspected COVID-19, diagnostic testing for COVID-19 should be performed before taking up for the cardiac catheterization procedure. If unstable NSTEMI patients undergo coronary revascularization, they should be discharged early to prevent exposing them to the viral infection and followed-up by telehealth [12, 13]. In a COVID-19 patient, presenting with features suggestive of type 2 myocardial infarction or myocarditis, these patients could be treated conservatively and if possible invasive management should be deferred.

Elective cardiac catheterization procedures should be deferred to avoid patient exposure to potential COVID-19 infection and preserve precious resources like hospital beds, which can be utilised to manage the coronavirus infected patients especially in locations with high case volumes.

2.3. Cardiac Surgery Considerations

The COVID-19 pandemic has put enormous strain on the global health care services. Optimal utilisation of the hospital resources is the need of the hour and in this context, elective cardiac surgeries should be postponed. Emergency cardiac surgeries not amenable by medical management or interventional procedures should be undertaken after adhering to infection prevention and control protocols of the hospital. Examples of emergency surgeries include severe left main coronary artery stenosis or symptomatic severe triple vessel disease, left-sided infective endocarditis with severe valve defects or large mobile vegetation, acute type A aortic dissection and symptomatic valvular heart disease [21]. Cardiac surgeries should be preferably carried out in a negative pressure operating room and all personnel should wear PPE if operating on a COVID-19 patient.

2.4. COVID-19 Drug Therapy and Cardiovascular Considerations

Currently, there are no definitive treatment regimens for the COVID-19 infection and experimental therapies are constantly evolving.

Antivirals like ribavirin, lopinavir and ritonavir have shown *in-vitro* effectiveness against SARS-CoV-2 and have been included in clinical trials for COVID-19 [22, 23]. Lopinavir and ritonavir may cause prolongation in QT and PR intervals and should be monitored especially in those on QT-prolonging drugs [23]. Ribavirin, lopinavir and ritonavir have potential interactions with anticoagulant warfarin and hence warfarin dosing should be closely monitored [24]. Lopinavir and ritonavir may be avoided with CYP3A mediated novel anti-coagulant drugs such as rivaroxaban and apixaban [25, 26].

Lopinavir and ritonavir through CYP3A4 inhibition can decrease serum concentrations of anti-platelet drugs like clopidogrel and prasugrel and increase the serum concentrations of ticagrelor leading to increased bleeding risk [27, 28] and hence should be monitored in concomitant therapy of these drugs.

Lopinavir and ritonavir can interact with statins and can increase their levels leading to myopathy. Concomitant therapy of statins like simvastatin and lovastatin with these antivirals should be avoided as there is a risk of rhabdomyolysis. Low doses of atorvastatin and rosuvastatin should be administered when they are used concomitantly with lopinavir and ritonavir [23].

Antimalarial drugs Chloroquine and hydroxychloroquine have shown *in-vitro* inhibitory activity against SARS-CoV-2 [29, 30]. These drugs on long term usage can cause myocardial toxicity leading to restrictive or dilated cardiomyopathy [31, 32]. These drugs are also associated with a risk of inducing torsade des pointes in patients with electrolyte abnormalities, those who are on QT-prolonging drugs or have underlying cardiac ailments especially channelopathies. Chloroquine and hydroxychloroquine can potentiate concentrations of beta-blockers and hence should be monitored closely when on concomitant therapy with both these drugs.

Steroid drugs such as methylprednisolone are being used in COVID-19 associated Acute Respiratory Distress Syndrome (ARDS) and were extensively used in Chinese hospitals involved in coronavirus patient care [33]. This drug can cause electrolyte derangement, fluid retention and hypertension and should be closely watched for side effects, especially in patients with a pre-existing cardiac condition.

CONCLUSION

The COVID-19 pandemic has caused enormous crisis impacting lives, health care systems and economy across continents. Until this pandemic mitigates and newer therapies and vaccines are discovered against the coronavirus, preventive measures like social distancing and personal hygiene should be vigorously practiced. Relatively stable cardiovascular patients can make use of telehealth and virtual physician consultations for follow-up care and health-related queries. Health care systems should defer elective procedures, make the judicious utilisation of scarce resources, including PPE and continue to provide optimal emergency cardiovascular services.

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CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

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