

# The COVID-19 Pandemic and Impact on the Cardiovascular Disease Patient: Special Emphasis on Rheumatic Valvular Heart Disease Care

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## ABSTRACT

The COVID-19 crisis has surged worldwide putting immense stress on the health care services, leading to institutions deferring elective procedures and struggling to triage the emergency care of the cardiac patient. This has affected the management of the rheumatic valvular heart disease patient especially in Asia and other developing countries, potentially placing these patients at enormous risk for complications like congestive cardiac failure, stroke and death. In this current review, we explore the COVID-19 pandemic and its impact on the cardiovascular disease patient with special emphasis on rheumatic valvular heart disease care. We try to provide a framework that address the procedural considerations of interventions like percutaneous transluminal mitral commissurotomy (PTMC) and mitral and aortic valve surgeries. We also highlight the implications for the outpatient valve clinic and address the safety issues of the patient and health care workers during this on-going COVID-19 pandemic.

**Keywords:** COVID-19, Cardiovascular, ARF, RHD, PTMC

## INTRODUCTION

The COVID-19 infection caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) first identified in Wuhan, China in December 2019, was declared a global pandemic of concern by World Health organization (WHO) on March 11<sup>th</sup> 2020 (WHO 2020). To stem the spread of the virus nations have imposed lockdowns and social distancing, affecting the daily life, leading to hardships and economic slowdown.

The COVID-19 infection presentation can range from mild symptoms like that of a common cold to severe acute respiratory distress syndrome (ARDS) leading to difficulty in breathing, fatigue, fever, and dry cough. Studies emerging from China reveal that majority of the patients i.e. around 80% have mild form of COVID-19 viral infection and the remaining 20% have severe to critical disease requiring intensive care unit (ICU) admission and invasive ventilation, and the fatality rate was 4.3% (Wang et al., 2020).

The cardiovascular involvement and manifestations in COVID-19 infection ranges from viral myocarditis, and myocardial ischemic injury as a result of hypoxemia and hemodynamic instability caused by severe pneumonia. Acute cardiac injury is present in 7% of the virus infection with an elevation of troponins and arrhythmias were seen in 16.7% and shock in 8.7% of the patients respectively (Wang et al., 2020). Since the risk factors for COVID-19 infection are similar to that for myocardial ischemia, namely age more than 60 years with comorbidities like hypertension and diabetes mellitus, there is a potential for Type 1 myocardial ischemia due to atherosclerotic plaque rupture caused by the stress of pneumonia and resultant inflammation

and shock. The thromboembolic risk is increased in this viral infection due to the resultant inflammation and immobilisation in severe cases (Libby 2020). A retrospective analysis done in China showed that the incidence of cardiovascular disease in patients who were admitted to ICU with COVID-19 infection was higher compared to those who were not admitted to the ICU i.e. 23% vs. 11% (Huang et al., 2020).

Rheumatic heart disease (RHD) is characterized by immune mediated destruction of cardiac valves in the setting of episodes of acute rheumatic fever (ARF) after exposure to strains of group A streptococcus bacteria. Most episodes of ARF occur in children between age 5 and 14 years, but they may well occur in adulthood, and an Indian study done revealed that RHD was prevalent even in the elderly population aged more than 60 years (Lawrence et al., 2013, Manjunath et al. 2014). RF and RHD are global problems but are most prevalent in developing countries. In these countries, RF accounts for up to 60% of all cardiovascular disease in children and young adults in their most productive years, and it has the potential to undermine national productivity and puts additional burden on the economy (Githang'a 1999, Joint WHO/ISFC meeting on RF/RHD control with emphasis on primary prevention, Geneva 1994). A large proportion of the individuals with CHF required cardiac valve surgery within 5–10 years (Murray et al., 1996). The reported prevalence of RHD in the world varies between 0.2 to 77.8 per 1000 population and the estimated annual mortality from RHD was 332000 in the year 2000 (Report of a WHO Expert Consultation Geneva 2001).

Mitral valve is the most commonly affected valve in RHD (60%) followed by combined mitral and aortic involvement (29%), tricuspid (10.7%) and pulmonary valve (0.04%) (Manjunath et al. 2014).

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Percutaneous transluminal mitral commissurotomy (PTMC) is done for mitral stenosis with favourable anatomy and the risk of restenosis is 40% after seven years (Farhat et al., 1998). Surgical procedures performed are closed mitral commissurotomy, valve repair, and valve replacement surgeries with both mechanical and bioprosthesis in mitral, aortic, tricuspid and pulmonary positions respectively. The patient having atrial fibrillation, and with mechanical valves need anticoagulation and this is an independent determinant of long-term survival (Butchart et al., 2002).

Percutaneous mitral valve repair with Mitraclip system for rheumatic mitral regurgitation is a feasible option in appropriately selected patients with suitable mitral valve anatomy and no co-existing mitral stenosis or severe valve calcification (Wong et al., 2019). Transcatheter mitral valve repair and replacement are yet to be proven effective treatment modalities for primary rheumatic mitral regurgitation. On-going trials will reveal the future directions and usefulness of these technologies in RHD patients (Overtchouk et al., 2020). Rheumatic aortic stenosis is typically characterised by valve thickening and commissural fusion, rather than the calcific degeneration encountered in the degenerative aortic valve disease.

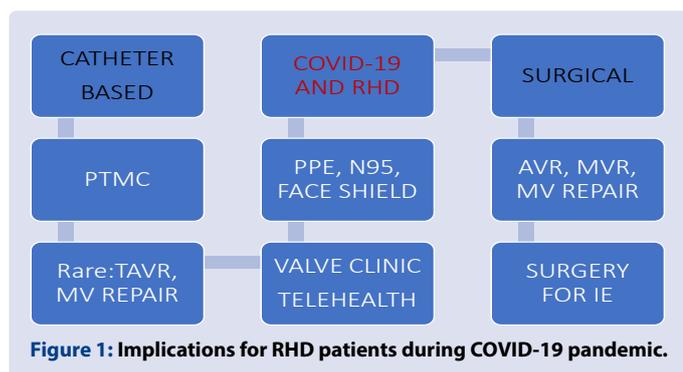
A single-center TAVR study done in the United Kingdom for rheumatic aortic valve disease showed similar procedural and clinical outcomes compared to conventional TAVR patients, and the results reveal that for high risks patients with severe rheumatic aortic valve disease TAVR could be a viable alternative (Brennan et al., 2019). Transcatheter tricuspid interventions currently are in the infancy and further studies are needed to recommend the use of these procedures in rheumatic tricuspid valve disease.

During an outbreak like COVID-19, delivery of cardiovascular services becomes a challenge especially for those suffering from valvular heart disease and elective cardiac procedures are invariably postponed. Due to the vast number of coronavirus patients presenting to the hospital and beds in hospital preferentially earmarked for them, other clinical services are bound to suffer. Patients with underlying cardiovascular conditions have high risk of adverse outcomes and strategies have to be put in place to prioritise those who require critical cardiac interventions and at the same time reduce the chances of virus infection to them and the health care professionals.

## COVID-19 AND THE IMPLICATIONS FOR THE RHD PATIENT

### Cardiac Interventional Procedure Considerations

All elective structural heart interventions should be postponed until the pandemic recedes. In the hospital triage systems favour COVID-19 patients and intensive care unit (ICU) beds would be needed to treat these patients. Scheduling a non-urgent interventional procedure at this stage will put more strain on the hospital resources and also potentially expose the patient and the caregivers to the viral infection in the



hospital environment. Few cases of structural heart interventions need anaesthetist back-up for intubation and also require trans-oesophageal echocardiography (TEE), thus exposing the healthcare professionals to high risk situations, requiring personal protection equipment (PPE) to prevent the virus contagion. The symptomatic rheumatic valvular heart disease requiring interventional procedure would be a high risk for complications like cardiac failure and postponing interventions in them could be fatal.

### Percutaneous transluminal mitral commissurotomy (PTMC)

PTMC with Inoue balloon is the preferred intervention for patients with New York Heart Association (NYHA) class III-IV symptoms with moderate to severe mitral stenosis (Mitral valve area <1.5 cm<sup>2</sup> and or valve area index <0.6 cm<sup>2</sup>/m<sup>2</sup>) and suitable anatomy based on Wilkins scoring system (Wilkins et al. 1988).

PTMC has excellent hemodynamic and long-term results with low rate of complications. After the procedure, patients experience significant improvement in symptoms and this procedure is a viable alternative for those who are high risk for mitral valve surgery (Feldman et al. 1991) Patients with mild symptoms of NYHA class I-II and moderate to severe mitral stenosis (MS) should be optimised on medications and closely followed up by telehealth clinic for any deterioration in symptoms that warrant emergency PTMC.

It is not uncommon especially in the Indian subcontinent to come across overt or silent MS during the second or third trimester of pregnancy. The combination of physiological changes of pregnancy and the pathological impact of MS over pregnancy and labour can lead to cardiac decompensation and pulmonary oedema, and if untreated carry significant maternal and foetal mortality (Kannan et al., 2010).

In symptomatic MS with pregnancy, the second trimester is the preferred period for PTMC which provides reduction in symptoms and has good success rate (Sutton et al., 2005). Mitral valve replacement (MVR) surgery in pregnancy is reserved for severe calcified MS with mural thrombus but this carries high maternal mortality of 1.5–5% and the reported foetal loss is 16–33% (Sharma et al., 1994). A pregnant patient with symptomatic MS requiring PTMC should not be denied the intervention during this pandemic and appropriate institutional triage system should be created to manage these patients. Also, adequate hospital infection prevention protocols should be followed to negate the risk of contagion to the patient and the healthcare professionals.

### Other structural intervention considerations

In RHD patient procedures like TAVR, transcatheter mitral valve repair and replacement are not the common therapeutic options and instead surgical valve repair and replacements are the first choice. Nonetheless in rare selective symptomatic patients when these emergency procedures are considered, appropriate guidelines should be followed, minimising the risk to the patient and the heart care team (Shah et al., 2020).

### Cardiac Surgery Considerations

The symptomatic RHD patient not amenable for cardiac catheter intervention should be considered for cardiac surgery on a case to case basis, after the heart team discussion. To sustain hospital services all elective surgeries should be deferred and the patients followed up closely via telehealth for any escalation of symptoms. Each service providing centre should develop a case triage protocol for emergency cardiac surgeries and minimise the risk of COVID-19 infection to the patient and healthcare staff. Before considering an emergency surgery, the availability of hospital resources like ICU beds, ventilators, cardiopulmonary bypass (CBP) machine, extracorporeal membrane

oxygenator (ECMO) and operation room supplies like valves, blood products and sutures should be taken into account (Mavioglu et al., 2020).

The indications for surgical treatment are as follows (Bonow 1998):

- In the presence of MS, patients with moderate or severe MS (mitral valve area  $1.5 \text{ cm}^2$ ) and NYHA class II/IV symptoms.
- In the presence of MR, patients with NYHA functional class symptoms II/III/IV with:
  - normal left ventricular (LV) function (ejection fraction  $>60\%$  and end-systolic dimension  $< 45 \text{ mm}$ );
  - mild dysfunction (ejection fraction  $50\text{--}60\%$  and end-systolic dimension  $45\text{--}50 \text{ mm}$ );
  - moderate dysfunction (ejection fraction  $30\text{--}50\%$  and end-systolic dimension  $50\text{--}55 \text{ mm}$ );
  - severe LV dysfunction and chordal preservation, or normal LV function and pulmonary hypertension.
- In the presence of AS, symptomatic patients with severe AS or in the presence of LV dysfunction, ventricular tachycardia,  $>15 \text{ mm LV}$  hypertrophy, valve area  $< 0.6 \text{ cm}^2$ .
- In the presence of AR, with NYHA functional class symptoms II/ III/ IV with:
  - NYHA functional class III/IV and preserved LV function (ejection fraction  $>50\%$ );
  - preserved LV function (ejection fraction  $>50\%$ ), but LV dilation or declining ejection fraction at rest or at functional studies;
    - mild dysfunction (ejection fraction  $50\text{--}60\%$  and end-systolic dimension  $45\text{--}50 \text{ mm}$ );
    - moderate dysfunction (ejection fraction  $30\text{--}50\%$  and end-systolic dimension  $50\text{--}55 \text{ mm}$ ).

The emergency surgeries for RHD that can be considered during the pandemic are (Matt et al. 2020):

1. Mitral valve replacement:
  - (a) Symptomatic severe mitral stenosis with valve anatomy not favourable for PTMC.
  - (b) Symptomatic severe mitral regurgitation.
2. Aortic valve replacement in symptomatic severe aortic stenosis or severe aortic regurgitation.
3. Infective endocarditis involving the left sided valve causing a severe valve defect and/or large mobile vegetation.

### Implications for the Healthcare Personnel

Healthcare workers are at a heightened risk for getting infected during this pandemic especially when operating on a suspected or COVID-19 positive patient (Adams et al., 2020). The staff should be equipped with PPE including a N95 respirator mask, goggles, face shield and adhere to meticulous hand washing and personal hygiene measures (Adams et al., 2020). They should be well versed with the PPE donning and doffing protocols, and avoid contaminating or touching the surfaces in the hospital environment which could harbour the coronavirus (Adams et al., 2020). The institution and the stakeholders could devise and constitute multiple units of different cardiac professionals and post them on rotation for emergency services, so that in case of an exposure

to the virus, quarantine issues can be applied to the individual unit rather than the entire group (Matt et al. 2020).

### Outpatient Valve Clinic Considerations

During this pandemic outpatient clinic visit for the RHD patient would be adversely affected due to lockdown and sparse transportation availability. In this context virtual consultation, telehealth and video counselling are becoming the favoured mode of interaction between the physician and the patient. Many institutions are rapidly ramping up the telehealth facilities to address this sudden transition in the outpatient clinic services. The virtual clinics are important for the uninterrupted follow-up of the recently operated patients and this will help them avoid making multiple trips to the hospital and minimize the risk of virus transmission among the patients, and health care personnel (Adams et al., 2020). Many of the RHD patients having atrial fibrillation and or those who have undergone valve replacement surgeries will be on anticoagulants like warfarin and will require test of international normalised ration (INR). This testing may be hampered or unavailable as most of the health services are working with less capacity. Till the time INR tests become available, asymptomatic patients should continue to take the anticoagulants especially if the preceding INR values were stable and in the therapeutic range. Some clinics are providing home testing of INR to avoid patient needing to visit the hospital (COVID-19/Coronavirus Illness and Heart Valve Disease 2020). As secondary prophylaxis to prevent recurrent attacks of RF, RHD patients are required to take intramuscular injection of benzathine benzyl penicillin every three or four weeks (Lue et al. 1986). Due to limited stock supplies and curtailed hospital services during this pandemic, the patient might face difficulties to take this injection. Oral penicillin may be used as an alternative in secondary prophylaxis if penicillin injection is not available.

### CONCLUSION

The present COVID-19 pandemic has led to disruption of hospital systems and severely affected the RHD patient management. The heart care team needs to harness its skills and continue to provide telehealth services and optimal emergency care to the patients. With the hospital triage under increasing strain from burgeoning number of critically ill COVID-19 patients, institution-based protocols are to be devised to provide a safe environment for the health care professionals and the patients seeking the cardiac services.

### CONFLICT OF INTEREST

The authors declare no conflict of interest.

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