**COVID-19 and Cardiac Surgery: An Overview From a Lower Middle-Income Country**

# Introduction

 The novel severe acute respiratory syndrome coronavirus 2 (SARS-CoV2) responsible for the coronavirus disease 2019 (COVID-19) is causing a global public health crisis. The World Health Organization (WHO) declared it a pandemic on March 21, 2020. As of this writing, it has affected a total of 20,144,884 cases worldwide with over 736,072 deaths globally (1). It was in late December 2019 that the first case of COVID-19 emerged in the city of Wuhan, China and since then it has spread around the globe like wildfire. The highly transmissible nature, unprecedented global spread, aggressive clinical presentation, and absence of reliable treatment has resulted in the loss of tens of thousands of lives, imparting an unparalleled strain on healthcare systems around the world (2). However, experience from China, New Zealand, and Taiwan has demonstrated that measures like highly effective contact tracing, case isolation, and lockdown to break the chain can control the outbreak of COVID-19 within an average of three months [https://dx.doi.org/10.1007%2Fs12262-020-02173-3].

This outbreak has impacted healthcare systems worldwide, demanding the adaptation of extraordinary measures by healthcare systems across the globe. Health care professionals (HCPs) are a high-risk population working at the front lines caring for patients with COVID-19. A worldwide shortage of protective equipment, paucity of information, and no empirical findings regarding infection control on COVID-19 has caused quite a burden on the health care systems.

Telemedicine clinics have replaced regular outpatients in an affort to reduce patient visits to hospitals and thereby controlling the transmission of the virus. All the patients seeking medical help have been affected due to the pandemic, but patients requiring surgical treatment are facing delays, postponement, or cancellation of operations.

Cardiac surgery, which is highly dependent on technology and very labor intensive, is the largest user of intensive care units in most hospitals. Preservation of resources and manpower, particularly in the pandemic, where shortage of PPEs and cyclic illness of HCPs due to exposure, has halted the provision of routine cardiac surgery services worldwide. The Centers for Disease Control and Prevention (CDC) has recently published guidelines for patients undergoing surgeries during the COVID-19 pandemic with some modifications provided by the American College of Surgeons (ACS) (2). With all the set guidelines (3), still only emergency surgeries are being performed in order to protect surgeons and specialized professionals and lower the risk of transmission (4). To add to the insult, the emerging data show a high mortality in patients who contract COVID-19 within 30 days of surgery

Published literature suggests that increasing age, cardiac disease, diabetes, obesity, hypertension, smoking, and preexisting pulmonary diseases are risk factors for COVID-19 related morbidity and mortality. Patients with previous cardiovascular metabolic diseases may face a greater risk of developing the severe condition, and the comorbidities can also greatly affect the prognosis of COVID-19. On the other hand, COVID-19 can, in turn, aggravate the damage to the heart (5), hence cardiac surgical patients are found to be more susceptible to developing severe complications related to COVID‐19.

This study is an overview of the impact of COVID-19 on the provision of cardiac surgery in a Lower Middle Income Country, Pakistan, the fifth most populous country in the world with 24% of Pakistan's population living below the national poverty line (3) before the COVID-19 outbreak.

**Pakistan:**

Pakistan, like the rest of the world, is also fighting the COVID-19 war. As of now, 10th August 2020, Pakistan has 284660 confirmed cases, with over 6097 deaths being claimed by the disease (7). The virus first showed its appearance on 26th February 2020, when a student returning back from Tehran was found positive and was treated at Aga khan University Hospital - one of the largest private tertiary care hospitals in Karachi.

The government of Pakistan imposed lockdowns on April 1st 2020 in an effort to stop the spread of the virus (8). Amidst this lockdown, consulting clinics, surgical units, and rehab centers of the country suspended their normal activities. Only life-threatening emergency operations were performed following strict SOPs.

Pakistan is a Lower Middle Income Country with limited resources and fewer health care facilities. COVID-19 has had a major impact on the health care system.

**Impact of COVID-19 on Cardiac Surgery;**

In this global health and economy crisis, developing countries with meager resources, dismal health care infrastructure, and unfavorable social indicators have a potential of placing a large population under threat of death and poverty. The lack of personal protection equipment (PPE), shortage of ventilators, low reserves at blood banks, deployment of cardiac surgery related HCP to COVID-19 related areas, use of cardiac intensive care units for COVID-19 patients, and diversion of funds from cardiac surgery to COVID-19 areas are some of the reasons which may jeoperdize cardiac surgery in Pakistan.

Cardiac surgery has undergone dramatic changes along with suspension of training and research, exams being postponed, and an increased number of cardiac patients.

**Clinical practices:**

1. **Limiting Exposure:**

The COVID-19 pandemic has put mounting pressure on health services with an exponential increase in the number of cases. Thus, the decision of whether or not to perform cardiac surgery is a critical one with there being risk of exposing these patients to a possible COVID-19 infection during admission and getting health care workers exposed to potential COVID-19 patients.

All patients requiring surgery must be treated as positive until proven otherwise, thus limiting exposure. Provision of PPE and implementing strict rules and clear protocols to abide is the first goal to prevent spread. All patients presenting to clinic should be advised to wear masks and observe social distanceing. They should be triaged for COVID-19 before they enter the clinic. All patients booked for a case are advised to get tested for COVID-19 before surgery.

Another important factor for consideration is the transport of COVID-19 patients. The transit should be kept as short as possible, with a direct route separate and away from other patients to decrease exposure. All transferring staff should be equipped with PPE.

All elective cases should be cancelled and only emergencies are to be performed. All associated staff should be trained to correctly don, doff, and dispose off PPE. Getting COVID-19 prior to emergency may not be possible so in that case such patients are to be performed in a COVID-19-dedicated operating room (OR) (9). These are negative pressure ORs with a higher air exchange cycle rate to reduce the viral load within the OR (10, 11).

When in the OR, it is essential to decrease the OR population to a minimum to limit exposure. Also minimize the equipment in the OR to only necessary ones required for the procedure. All PPE should be restocked in the COVID-19 OR .Handling of tissues, instruments, and linen should be adequately managed (12).

Careful planning is important to contain exposure. This requires having discussions with the anesthesiologist, technician, perfusionist, and the surgical assistant prior to proceeding with the case. Anesthetists should use disposable airway equipment, and they should have respirators on during laryngoscopy and intubation (13). Avoid awake intubations. If possible, a dedicated ventilator should be used for general anesthesia.

Similarly, perfussionists should have a dedicated bypass machine for COVID-19 patients. Full PPE precautions should be observed. Adequate care should be taken to prevent contact with bodily fluids. ECMO can be considered in carefully selected COVID-19 patients (14, 15).

**Teaching and Training:**

COVID-19 has had a profound impact as far as teaching and training of residents and fellows is concerned. Keeping in view the risk of exposure and spread of disease, travel has been restricted, medical meetings banned, and conferences cancelled. Specialized Rotas have been designed to limit exposure of health care workers (10). All this has halted teaching and training opportunities for trainees. However, the webinar and zoom meetings have brought the medical community together with international collaborations with hospitals, planning of emergency situations, use of social media, and synchronous and asynchronous teaching and telemedicine. All this has bridged the gap between knowledge and training for these young learners.

**Research**

Empirical researches are required to better understand the virus and the outbreak. There is immense ground to cover when it comes to researching COVID-19 and cardiac surgery. We have seen a decreasing number of patients presenting with myocardial infarction as reported internationally. There is also a trend towards myocardial infarction patients reporting late with complications to hospital. There are cardiac implications of COVID-19, and the effect of COVID-19 on the immune and coagulation system is a burning topic. These and similar topics can be worked up on to have a better understanding of the disease.

**Future challenges/CONCLUSION**

The COVID‐19 pandemic has affected health care systems globally with uncertainty of decisions by the hierarchy of positions. Massive and large scale researches are being conducted to understand the disease epidemiology, develop preventive treatments, and establish management protocols.

With surgeries being cancelled, a huge back log of awaited surgical patients, HCPs exposed, and senior surgeons, doctors, and paramedic staff losing their battle to the disease has burdened the system profoundly. The future seems blurred with huge financial crises, reduced training and teaching of surgical skills, and cancellation of learning forums, and the true cost of COVID-19 is yet to be estimated.

**References:**

1. Novel Coronavirus (2019-nCoV) situation reports - World Health Organization (WHO)
2. Patel V, Jimenez E, Cornwell L, Tran T, Paniagua D, Denktas AE, Chou A, Hankins SJ, Bozkurt B, Rosengart TK, Jneid H. Cardiac Surgery during the COVID‐19 Pandemic: Perioperative Considerations and Triage Recommendations. Journal of the American Heart Association. 2020 May 16;9:e017042.
3. . Cheeyandira A. The effects of COVID-19 pandemic on the provision of urgent surgery: a perspective from the USA. Journal of Surgical Case Reports. 2020 Apr;2020(4):rjaa109.
4. COVID-19: Guidance for Triage of Non-Emergent Surgical Procedures. American College of Surgeons. https://www.facs.org/covid-19/clinical-guidance/triage Updated March 17, 2020. Accessed April 15, 2020.
5. Li B, Yang J, Zhao F, et al. Prevalence and impact of cardiovascular metabolic diseases on COVID‐19 in China. Clin Res Cardiol. 2020;109:531‐538. [PMC free article] [PubMed] [Google Scholar]
6. Mohamed Abdel Shafi A, Hewage S, Harky A. The impact of COVID‐19 on the provision of cardiac surgical services. Journal of Cardiac Surgery. 2020 May 17.
7. Government of Pakistan See the real time Pakistan and Worldwide COVID-19 situation. http://covid.gov.pk/ [Internet]. [accessed date: 16 June 2020]
8. Asian Development Bank. (n.d.). Poverty in Pakistan. Retrieved 16 June 2020, from <https://www.adb.org/countries/pakistan/poverty>
9. Coccolini, F., Perrone, G., Chiarugi, M., Di Marzo, F., Ansaloni, L., Scandroglio, I., Marini, P., Zago, M., De Paolis, P., Forfori, F., Agresta, F., Puzziello, A., D'Ugo, D., Bignami, E., Bellini, V., Vitali, P., Petrini, F., Pifferi, B., Corradi, F., Tarasconi, A., … Catena, F. (2020). Surgery in COVID-19 patients: operational directives. World journal of emergency surgery : WJES, 15(1), 25. <https://doi.org/10.1186/s13017-020-00307-2>
10. Centers for Disease Control and Prevention. Coronavirus Disease 2019 (COVID-19) situation summary. Available from URL: https://www.cdc.gov/coronavirus/2019-ncov/summary.html
11. . Ti LK, Ang LS, Foong TW. Ng BSW What we do when a COVID-19 patient needs an operation: operating room preparation and guidance. Can J Anaesth. 2020;6 [Epub ahead of print].
12. Wong J, Goh QY, Tan Z, Lie SA, Tay YC, Ng SY, Soh CR. Preparing for a COVID-19 pandemic: a review of operating room outbreak response measures in a large tertiary hospital in Singapore. Can J Anaesth. 2020; [Epub ahead of print].
13. Peng PWH, Ho PL, Hota SS. Outbreak of a new coronavirus: what anaesthetists should know. Br J Anaesth. 2020; [Epub ahead of print]
14. Ramanathan K, Antognini D, Combes A, et al. Planning and provision of ECMO services for severe ARDS during the COVID-19 pandemic and other outbreaks of emerging infectious diseases. The Lancet Respiratory Medicine.
15. Adams JG, Walls RM. Supporting the Health Care Workforce During the COVID-19 Global Epidemic. JAMA. 2020 Mar 12