



PERFORMING SAFER PROCEDURES IN CARDIAC CATHETERIZATION LABORATORIES DURING THE COVID-19 PANDEMIC

Cardiology

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ABSTRACT

The current Corona Virus Disease 2019 (COVID-19) pandemic has disrupted medical care for cardiac patients. Several healthcare settings including cardiac catheterization laboratories are faced with a challenge of introducing reforms to meet the emergent safety requirements. Clinicians and other healthcare workers are working in these laboratories are performing procedures in patients with a confirmed or suspected status for COVID-19. We present expert opinion for the safe conduct of cardiac catheterization procedures in India. To ensure quality in patient care and adequate levels of prevention for spread of infection, reforms are needed in the infrastructure, administrative, and behavioral protocols in cardiac laboratories. The recommendations will continue to evolve as the medical community gains a better understanding of the spread and prevention of the COVID-19 infection.

KEYWORDS

COVID-19, cardiology, catheterization, safety, prevention

The Corona Virus Disease 2019 (COVID-19) pandemic is a global healthcare challenge. There are currently more than 70 million cases of COVID-19 in India and the numbers continue to rise each day.[1] The ongoing pandemic necessitates compliance with public health guidance for social distancing and optimal utilization of resources to curtail the spread of infection. Healthcare settings have a higher risk index for COVID-19 due to the presence of confirmed and suspected cases and interactions between patients and healthcare staff in enclosed spaces. High rates of COVID-19 infections in healthcare personnel are reported across countries.

The World Health Organization has issued guidelines for the prevention and control of infection in healthcare settings.[2] Experts in intervention cardiology have published recommendations, opinions, and consensus for preparedness of CCLs for safe conduct of cardiovascular procedures.[3-5] The Ministry of Health and Family Welfare (MoHFW), Government of India, has issued guidelines for healthcare workers in hospital settings (MoH-covid and noncovid) though there are no recommendations around safety in CCLs in India.[6]

We have developed recommendations for cardiac catheterization laboratories (CCLs) that are easy to implement steps and are presented in a clear and concise manner. Our goal is to build a guidance to enable safer procedures in CCLs in India. These laboratories, which are closed units with a set of staff members working closely for many hours, are a potential ground for spread of COVID infections. We recommend changes in CCL infrastructure and modifications in administrative processes and behavioral protocols for augmented safety in CCLs (Figure 1).

Infrastructure protocols

CCLs need a strategic design and smart layout for optimum safety. Safety measures should be instituted to prepare for a protected entry for the patient and the healthcare teams into the CCL and a safe conduct of the planned procedure. As part of floor plan for a CCL, it is recommended to maintain a negative air pressure, install a high-efficiency particulate air (HEPA) exhaust unit, ensure a unidirectional flow of air, and delineate separate entry and exit doors in the CCL. Given the limited resources in many settings in India, it may be challenging to build the most ideal infrastructure for CCLs.

To prepare the CCL for the planned procedure, all equipment should be set in place and kept covered until use, all non-essential and mobile equipment should be removed, switches and control panels should be

covered with plastic and changed between two procedures, all clean and contamination areas should be delineated and marked, clear drapes should be used to cover fixed and essential contact surfaces, any non-disposable materials, i.e. linen and others, should be avoided, and staff who are not directly involved in the procedures should stay 2 meters away from patients in the CCL.

Administrative protocols

Administrative controls can go a long way in eliminating the occupation risk of exposure to COVID-19 infection in a healthcare setting (CDC).[7] The COVID-19 pandemic calls for preserving and repurposing resources in CCLs to continue uninterrupted care for patients with cardiac conditions.[5] CCLs should review the administrative structure and introduce measures to allow a safe conduct of catheterization procedures. These measures include cleaning and disinfection of medical equipment and surfaces, advice to the patient prior to the procedure, adequate protective gear for staff members, planning for an early discharge and non-contact prescribing. A clustering model with provisions of working remotely on a rotational basis can help to break the chain of transmission and lower the risk of all CCL members being unable to work at the same time.[4] CCL staff should be trained to adopt safety measures in the incident of an aerosol generation and measures should be implemented for effective contact tracing in the hospital. Disinfection or sterilization should be done for all equipment, supplies, and consumables. Table 1 summarizes the key administrative controls to check the spread of COVID-19 in CCLs.

Case selection for emergent and urgent procedures and concentration of resources has an important role in the safe conduct of procedures in CCLs. Consensus decisions from a multidisciplinary team including experts in infectious diseases can guide for triaging case priority and timing. Factors such as regional disease prevalence, duration of the pandemic, and comorbidities of the patient are worthy of consideration for case selection and resource allocation.

Despite all measures to reduce exposure, there is a possibility of limited availability of staff member in CCLs. Staffing algorithms should be devised and a log should be maintained for the infected, exposed, and quarantined staff members as this could help to maximize the team availability. There have been many instances of shortages of protective equipment and masks in various healthcare settings. The optimal use of protective equipment requires good administrative protocols which can identify the elective cases that can be deferred and plan for number of personnel who scrub into procedures. When applicable, patients who are confirmed positive for COVID-19 and

need a catheterization, should have procedures scheduled towards the end of the day. This would build in ease for the terminal cleaning of the CCLs after such procedures.

Behavioral protocols

Behavioral interventions can prevent the spread of COVID-19 in CCLs. Personal protective equipment (PPE) are key to controlled exposure to COVID-19 in an occupational setting (CDC). [7] PPEs should be used based on the risk profile of healthcare workers in a CCL who should be trained on the use of PPEs. The MoHFW, India has issued specific guidance for the rational use of PPEs to protect against COVID-19 infections in healthcare workers.[8]

Behavioral measures should be instituted to ensure safety of healthcare workers. CCL staff should be trained to wear, remove, and safely dispose the PPEs. All CCL personnel should have adequate protective gear in correct size and preferably a long-sleeved water-resistant theatre gown with a fitted filtering face piece (FFP) 3/2 respirator. Additionally, the safety attire includes long visor/face shield, gloves, elastic theatre hat, safety glasses, and foot covers/footwear. Any jewelry should be avoided under the kit. Contaminated gowns and outer gloves should be retained in the CCL and should be disposed with protocol. All personnel should wear a FFP2/ N95 mask at all times inside the CCL. In any circumstance of no or limited availability of N95 masks, conventional disposable surgical face masks are a good substitute and a mandate.[9] All personnel should be trained for proper wearing, removal, and disposal of masks. Some procedures like cardiopulmonary resuscitation and intubation have a high risk for aerosol generation and call for correct selection and utilization of respiratory protective equipment in CCLs.[10] Above all, hand hygiene has particular importance in infection control. One should never fail at hand washing at five critical times: before and after touching a patient, before a clean or aseptic procedure, after touching the patient, the patient's surroundings, or risk of body fluid exposure. All staff members should maintain a distance of at least 1 meter in the laboratories and should refrain from touching patients, and any surface or equipment without washing hands after a sneeze or cough. Waste from the CCLs should be adequately handled and labelled for proposal disposal.

Healthcare providers should observe caution when performing cardiopulmonary resuscitation (CPR) and when handling medical waste. Where possible, one should use a mechanical chest compression device for CPR and utilize a portable vent with vital filter if transport is needed after CPR. Staff attending the deceased should exercise caution. All drains and catheters should be removed from the body and any instruments or devices used on the patient should be disinfected in accordance to protocol. Plugging oral and nasal orifices of the corpse can help to prevent leakage of body fluids. The body should be kept in a leakproof plastic body bag. It is important to disinfect and sanitize the CCL after a body is taken out.

CCL managers should work closely with the infection control groups of their institutions to ensure adequate availability of protective gear and the implementation of all described safety protocols. A continual and serial re-evaluation of the administrative protocols can serve to introduce timely changes for maximal impact. Evolving guidance from the MoHFW and state authorities will continue to direct the need for any updates in CCL protocols.

Key steps for safety

We suggest a quick checklist for CCLs to aid the safe conduct of cardiovascular procedures. The parameters in the checklist include the following:

- Is the CCL procedure non-deferrable or does it have lifesaving importance?
- Is all staff in CCLs trained on standard operating procedures (SOP) and safety measures for COVID-19?
- Is the staff in CCL adequately equipped to deal with emergency situations like accidental aerosol generation?
- Is the staff in CCL fit for and trained in correctly wearing the required protective equipment?
- Have the between procedures like changing covers over switches and control panel been completed?
- Are there any surplus staff members who may not be required to scrub into the planned procedure?
- Have all staff members secured personal belongings outside the CCL?

As the medical communities gain more experience in dealing with COVID-19, it is important to exchange information, experiences, and best practices. Failures in measures of protection are possible due to factors like a missed diagnosis of COVID-19, non-adherence to safety protocols, and inadvertent exposure to high viral loads.

Summary

Healthcare workers in CCLs are at a risk of exposure to COVID-19 infection during work. Our guidance for changes in infrastructure, administration, and behaviors in CCLs is inspired by the standard recommendations from key regulators, the Government, and apex healthcare institutions around prevention of spread in infection with standard, contact, and respiratory precautions. The goal is to ensure CCL staff is safest at all times and the patients receive a reasonable and scientific care. This guidance will allow the gradual reintroduction of procedures in CCLs with appropriate safeguards. We acknowledge that this guidance has been formulated at a time when the transmission, severity, and management of COVID-19 is not well understood. The guidance may continue to evolve in future with a deeper understanding of the infection. There is no one universal safety solution for cardiac laboratory procedures. It is key to adopt the best possible measures in accordance with the type of setting, i.e. a COVID hospital or a general care center, the size of the hospital, the available infrastructure in the setting, and the potential to invest for upgrading the facilities. For the least, use of a mask and adherence to hand hygiene is the first key step to safety. Finally, it is best to follow the law of the land and comply with the relevant guidelines issued by the center and the states where the setting is located.

Table 1: Administrative protocols for safety in cardiac catheterization laboratories

Protocol	Safety parameters
Advice to patient before procedure	Wear mask and other protective gear provided by hospital Keep distance of at least 2 meters from others in the waiting room Don't touch things unless absolutely necessary Ask for help if anything is needed Request for hand sanitization if anything is touched accidentally Follow hand and respiratory hygiene
Protective equipment	Circulating and operating staff to wear the right protective gear including FFP2/N95 mask, cap, splash goggles, and face shield The operating staff should wear a double layer of sterile gloves while the circulating staff should have nitrile gloves All staff to have a fluid-impermeable gown (min 70 gsm) and this should be sterile for the operating staff
Protocol for aerosol	Alert for aerosols, e.g. cough, sneeze, and vomiting Maintain a negative pressure in the cath lab. If this is not possible, switch off the positive pressure and air conditioning Cover medical equipment with plastic sheets Clean room 20 minutes after last aerosol generation If there is a high risk of aerosol, consider usage of powered air purifier respirator (PAPR)
Non-contact prescribing	Practice maximum patient reach-out by telecalls or videos to avoid or minimize physical visits Assess medical need and triage according to urgent or self-manageable condition If urgent, call for a face to face visit with all safety precautions Consider tele follow up for all eligible patients and track progress
Early discharge	Limit the hospital stay Identify patients who qualify for an earlier discharge, e.g. clinically stable patients and those with minimum baseline comorbidities Patients may be discharged earlier if they have adequate caregiver support Ensure patient and caregiver education as part of planning for an earlier discharge, obtain the correct contact information, and schedule a follow up appointment Some procedures like single or multivessel PCI, proximal LAD, bifurcation PCI or uncomplicated

	CTO support an earlier discharge Practices like introduction of effective dual-antiplatelet therapy and a patent hemostasis can help to facilitate an earlier discharge
Contact tracing within hospital	Identify staff members who, without PPE kits, were in direct contact or within 1 meter of distance for >15 minutes Review list of patients who shared a room or bathroom Review list of visitors who visited the patient or another patient in the same room
Cleaning and disinfection of medical equipment	Clean the stethoscope with an alcohol-based rub Wash BP cuffs and covers with detergent and hot water Clean injection and dressing trolley with detergent and water, disinfect with 70% alcohol Clean thermometer with detergent and water and wipe with alcohol rub after patient use Do not reuse any medical apparatus without disinfection
Disinfected surfaces	Regular disinfection of surfaces is desirable in a cath lab Proper hand hygiene should be ensured after disinfection Adequate room ventilation is key High touch surfaces should be disinfected every 3-4 hours* Low touch surfaces should be disinfected daily** 1% sodium hypochlorite solution or another disinfectant should be applied to surface using a damp cloth and not sprayed

*High touch surfaces: Stretchers, door knobs, call bells, telephones, bedrails, stair rails, light switches, monitoring equipment, wall areas around toilets

**Low touch surfaces: Floor, windows, walls, ceilings, cabinets

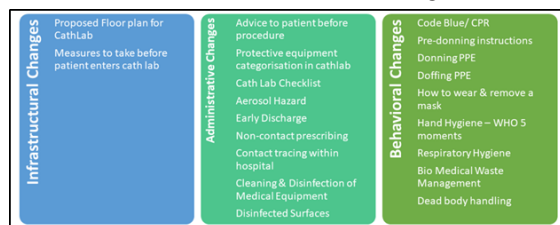


Figure 1: Safety behaviors in cardiac catheterization laboratories

CPR: Cardiopulmonary resuscitation; PPE: Personal protective equipment; WHO: World Health Organization.

WHO 5 moments for hand hygiene: Before touching a patient; After touching a patient; Before a procedure; After a procedure or body fluid exposure risk; After touching patient's surroundings.

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