Editorial

Rethinking Cardiopulmonary Resuscitation Guidelines for Cardiac Arrest in Patients with COVID-19

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COVID-19 has modified our approach to resuscitation and underscored the importance of staff protection. The aim of this editorial is to review the published literature on cardiopulmonary resuscitation (CPR) in patients with COVID-19 and to outline the changes that have been made to our institutional protocol for cardiopulmonary resuscitation following cardiac arrest in suspected or confirmed cases of COVID-19.

The severe acute respiratory syndrome coronavirus 2 (SARS CoV2) was first identified in Wuhan city, Hubei province, China in December 2019, which has brought normal life to a halt throughout the world[1]. COVID-19 symptoms range from mild respiratory symptoms to severe pneumonia and multi-organ failure[2,3]. The high transmissibility of this virus coupled with asymptomatic infections initially prevented effective containment of the disease in Wuhan, leading to the spread of infection to other parts of China and subsequently to the rest of the world. The current global statistics of the pandemic show that over 11 million people have been infected and there have been 500,000 deaths worldwide as of 5 July 2020[4].

Measures adopted to control the spread of the virus were extensive testing, rapid isolation of cases, meticulous contact tracing, use of mobile phone applications for tracking cases, multilingual public awareness campaigns, and effective social distancing. This enabled a flattening of the curve of the epidemic without imposing a full lockdown. The overriding concern at that initial stage was the effect of unlimited and uncontrollable demand for ventilated ICU beds. Therefore, in preparation for an unpredictable increase in the number of cases, two field hospitals with nearly 9,000 beds and over 250 new ICU beds were rapidly established in the Kingdom.

As of 5 July 2020, Bahrain has reported a total number of less than 30,000 confirmed cases of which around 25,000 have recovered and 96 have died[4]. The mortality rate of the virus in Bahrain is approximately 0.3% compared to the mortality rate of over 0.5-5% globally[2,4,5].

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King Hamad University Hospital is a tertiary care center belonging to the public sector. It is currently not designated as a center for the care of COVID-19 patients. All patients for planned surgeries and non-surgical patients who need in-patient care are screened for the SARS CoV2 infection by taking a nasopharyngeal swab for Reverse Transcriptase Polymerase Chain Reaction (RT-PCR). If found positive for SARS CoV2 virus, the patients are transferred to the designated COVID-19 treatment centers in Bahrain. Patients who need emergency surgery or other interventions, a nasopharyngeal swab is sent on admission and the procedure is undertaken with full precautions against contact, droplet and aerosol transmission. A rapid test (Xpress SARS-CoV-2) is available for patients with a high index of suspicion; the result is ready within 1 hour.

The Emergency Medicine Department (EMD) does see positive cases. Those who fall under Manchester Triage System Category 4 and 5 are seen and kept in the screening tent located just outside the EMD[6]. These patients are managed in the isolation area in the tent until they are transferred to a COVID 19 treatment and isolation facility.

Manchester triage system Category 1, 2, and 3 patients are seen in the 8 bedded isolation area in the EMD, which includes four ICU beds. Suspected or positive cases are brought directly from the screening tent or by the ambulance to this area, managed by the EMD, and transferred to a COVID-19 treatment facility after stabilization.

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Even with these protocols in place, the possibility of a suspected or confirmed case of COVID-19 having a cardiac arrest in the hospital has to be anticipated and planned for. In the context of a cardiac arrest, it is a policy to regard all untested patients as potentially positive for the disease.

Why do we have to rethink our cardiopulmonary resuscitation protocols?

According to initial data from Wuhan, approximately 32% of patients who were hospitalized required admission to ICU[7]. In these critically ill patients, the most common cause of cardiac arrest was respiratory failure (87.5%) followed by cardiac causes (7%). The majority of patients in cardiac arrest had non-shockable rhythm. The initial cardiac arrest rhythm was pulseless electrical activity (4.4%) or asystole (89.7%), whereas shockable rhythms ventricular fibrillation or pulseless ventricular tachycardia were found in only 5.9% of patients[8]. The chances of survival after achieving ROSC are considerably less when the initial rhythm is non-shockable[13]. Following resuscitation after cardiac arrest in COVID 19 patients, 13.2% of patients achieved a return of spontaneous circulation and only 2.9% survived beyond 30 days, and just 0.7% of patients had a favorable neurological outcome.

Sputum and secretions from the upper and lower respiratory tract contain a high viral load of SARS CoV2[10-12]. The virus is predominantly spread by droplet and contact routes[13].

Respiratory secretions ejected as droplets (> 5-micron diameter) from the patient's airway during coughing, sneezing, speaking, or breathing does not spread beyond 1 meter[14]. Hence, a distance of at least 2 meters is considered to be a 'safe' distance to prevent droplet transmission.

Contact transmission occurs once the virus is deposited on a surface where it may remain viable for hours or even days[15]. Anyone who comes in contact with this surface is at risk of getting infected by self-transmitting the virus to their mouth, nose or eyes. Even if appropriate PPE (Personal Protective Equipment) is worn by HCPs (Healthcare Providers), proper strict protection is emphasized to avoid the risk of infection during removal.

Airborne transmission occurs due to particles less than 5 micrometers in diameter which can remain suspended in the air for longer periods. As airborne transmission is not seen routinely with SARS CoV 2, the use of airborne precautions has not been advocated in the community[16]. Procedures associated with airway management could create aerosols and could be transmission risk beyond two meters[17].

The WHO has declared that cardiopulmonary resuscitation may generate aerosol particles: bag-mask ventilation, endotracheal intubation and chest compressions[18]. The viral particles could remain in the air with a half-life of approximately 1 hour and be inhaled by those nearby[15]. Endotracheal intubation is particularly considered a high-risk procedure due to the high viral load that the HCP is exposed to. However, a systematic review found limited evidence regarding transmission of COVID 19 from patient to rescuer by aerosol generation during cardiopulmonary resuscitation[19].

A retrospective study from Wuhan found that 1,716 health workers were infected, 3.84% of total cases. Overall, 14.8% of confirmed cases among health workers were classified as severe or critical and 5 deaths were reported[20]. Wang et al reported that among 138 hospitalized patients with COVID-19, the presumed hospital-related transmission was suspected in 41% of patients[2]. Increased levels of anxiety, insomnia, and depression have been reported in HCPs because of the constant fear of getting infected and transmitting the infection to colleagues and family members. The emotional effects of dealing with dying patients, making ethical decisions, etc. add to the psychological burden on the HCPs[21].

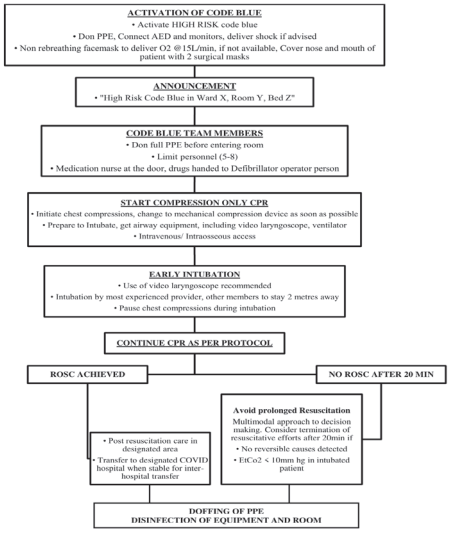
Risk versus benefit: Should resuscitation be performed?

Many countries have had to face a shortage of ICU beds and ventilators, resulting in a denial of required care to critically ill patients. Cardiac arrest in COVID-19 has a mortality rate of more than 85%, and many countries have decided not to resuscitate such patients, while some have limited the resuscitation to younger patients free of comorbid conditions[22]. In Bahrain, we have taken into consideration this high mortality rate and the high risk of nosocomial outbreaks, along with guidance from the American Heart Association while formulating our guidelines for cardiopulmonary resuscitation of cardiac arrest victims diagnosed with COVID-19.

The current protocol for CPR for management of cardiac arrest being followed in our hospital is in line with Advanced Cardiac Life Support guidelines by the American Heart Association (AHA)[23]. The AHA has published interim guidance on CPR in suspected or confirmed COVID-19 patients[24]. A search was performed on Pubmed and SciELO using the keywords "cardiopulmonary resuscitation, COVID-19, cardiac arrest". All English articles on these topics were reviewed. The hospital Code Blue Committee also went through various national and international guidelines and hospital protocols to generate a protocol for in-hospital cardiac arrests for our hospital.

The modified protocol for cardiopulmonary resuscitation in patients with COVID-19 who suffer cardiac arrest is as follows:

Figure 1: Algorithm Highlighting Changes in CPR in Suspected or Confirmed Cases of COVID-19



1. The announcement: In-hospital cardiac arrests occurring outside the Emergency Medicine Department (EMD) and the ICU are routinely announced through the public address system of the hospital in the format "Adult Code Blue activated at ward X, Room number Y, Bed number Z". For patients with COVID-19, the format for the announcement of cardiac arrest has been changed to "HIGH-RISK Adult Code Blue activated at ward X, room number Y, Bed number Z".

The term 'high risk' was chosen instead of 'COVID-19 patient' to alert the rescuers to the COVID status of the patient and the necessity of putting on PPE, and at the same time prevent undue panic amongst other patients and visitors in the hospital.

2. The cardiac arrest response team: Care is taken to minimize the number of personnel exposed to the patient to a minimum of 5 to a maximum of 8 persons. For cardiac arrests occurring in the EMD or the ICU, the response team consists of 2 doctors and 3 nurses. Roles and responsibilities are to be identified internally by the team leader. The medication nurse should stay outside the patient room, with the door open, with a 'Crash Cart' containing the emergency drugs and equipment for resuscitation, which are handed to the team members as needed. Drug administration is taken over by the team member handling defibrillation.

Adult cardiac arrests occurring outside the EMD and ICU, the roles are predetermined as follows:

- Team Leader-Internal Medicine Physician
- Airway-Anesthesiologist
- Defibrillation-ICU or ED nurse
- Medication-ICU or ED Nurse
- Recorder-Internal Medicine Trainee Physician

3. PPE: The team members are to enter the patient's room only after putting on full PPE. This includes a fluid-resistant gown with long sleeves, gloves, well-fitting N95 respirator certified by United States National Institute for Occupational Health and Safety (NIOSH), face shields, shoe covers and goggles.

4. Defibrillation: Defibrillator and monitors are connected by the nurse who initiates the cardiac arrest code. If a shockable rhythm is identified, a shock is delivered. Defibrillation is not considered an aerosol-generating procedure.

5. Airway management: A non-rebreathing face mask is placed on the patient's face, with oxygen flow 15L/min until definitive airway is obtained by intubation. If an oxygen face mask is not present 2 surgical masks should be placed to cover the patient's mouth and nose, until the oxygen mask becomes available. Bag and mask ventilation should not be done to prevent aerosol generation. Care is taken to turn off the oxygen flow during the delivery of the shock. The Oxygen mask is not to be removed from the face of the patient during delivery of the shock.

6. Chest compression: Until definitive airway is secured by endotracheal intubation, compression-only CPR is initiated. Chest compressions are taken over as soon as possible by mechanical compression device, LUCAS 2 (Lund University Cardiac Assist System) chest compression system. The device is available in the EMD and ICU, and in case of cardiac arrests outside these units, it will be brought by the EMD nurse. It can be used for adults and adolescents fitting the height and weight criteria for use of this device. This helps to reduce the number of personnel required to run the code. Nurses from the EMD and ICU have been trained in the use of the device. According to a Cochrane review, when used by trained individuals, mechanical chest compression device is a reasonable alternative to manual chest compressions when high-quality manual chest compressions involve a risk to the provider[25]. These devices can be based on pistons, load-distributing bands or pneumatic vests. We use a battery-powered portable piston device called LUCAS 2. This delivers chest compressions at a frequency of 100-104 compressions per minute. It can be used for all adult patients and adolescents who fit the patient specifications, i.e. adult patients who fit into the device, with a sternum height of 170-303mm, and a maximum chest width of 449mm. Chest compressions should be paused during intubation.

7. Intubation: Intubation is to be done by the most experienced provider, preferably with a video laryngoscope. A video laryngoscope has been made available in the wards, ICUs, and EMD.

Chest compressions are to be paused during intubation to minimize aerosol generation, and resumed only after confirmation of position and inflation of the cuff of the endotracheal tube, followed by the connection to the Heat and Moisture Exchanger (HME) filter or High-Efficiency Particulate Air (HEPA) filter and then to the ventilator circuit.

Code Blue team members who are not directly involved with intubation are to maintain a distance of 6 feet or 2 meters from the head end of the bed during intubation.

If the pause in chest compressions is excessive and endotracheal intubation does not seem likely to be achievable soon, a supraglottic airway device with an HME filter or HEPA filter is considered. In cases where effective ventilation is not achieved with a supraglottic airway device, bag-mask ventilation can be used as a last resort, with an HME filter or HEPA filter connected to the mask.

8. Terminating resuscitative efforts: Avoid prolonged resuscitation if the Return of Spontaneous Circulation (ROSC) has not been achieved and if there is no easily reversible etiology identified for the cardiac arrest. It is not unreasonable to limit the period of resuscitation to 20 minutes in such cases.

End of the resuscitative efforts should be considered in the intubated patient with capnography monitoring who fails to achieve an End-tidal carbon dioxide concentration (ETCO2) of greater than 10mm hg after 20 minutes of CPR

9. Post-cardiac arrest care: After the return of spontaneous circulation, the patient if not already in the ICU, should be transferred to an isolation unit with intensive care facilities, and routine post-resuscitation care continued as per guidelines. The patient remains in the ICU until stable enough to be transferred to a hospital designated for the treatment of COVID-19 patients.

10. Doffing of protective gear: Removal of the protective gear in the stipulated order without contaminating oneself is of utmost importance. Doffing is done outside the patient room and is observed by a supervisor.

11. Disinfection of equipment and room: The laryngoscope blade used for intubation is placed in a sealable biohazard bag and sprayed with double enzymatic spray cleaner before sealing, then placed in a second biohazard bag and sealed, and immediately sent to the Central Sterilization unit in the hospital. The laryngoscope blade is sealed in a separate bag for high-level disinfection or sterilization as recommended by the manufacturer.

All potentially contaminated surfaces within the resuscitation are physically cleaned by hospital detergent and disinfected.

Education

The key to implementing these changes is to educate the healthcare providers so that they can modify their reactions as outlined above. Many methods were used to achieve this including emailing a copy of the protocol to all code blue team members, conducting online training programs where the changes were discussed, making detailed online video demonstrations regarding donning and doffing of PPE, and by conducting mock drills. In addition, special training sessions where the nurses are trained on proper wearing and performing fit test for the N95 masks.

A constant lookout for more research and more information regarding cardiopulmonary resuscitation following cardiac arrest in COVID-19 patients is maintained so that better strategies can be formulated based on the growing database of evidence.

CONCLUSION

Reducing the risk of a nosocomial outbreak by transmission of the virus to other patients and healthcare workers is of utmost importance while giving optimum care to victims of COVID-19 with cardiac arrest. We have adopted measures such as specialized announcements to alert the cardiac arrest response teams to the COVID status of the patients, donning of PPE by the team before entering the patient room, limiting the number of team members, avoiding bag-mask ventilation, early intubation, use of mechanical compression devices, and avoiding prolonged resuscitation in selected patients. As more and more clinical experience is gained and research articles published, these measures can be tailored to obtain the best possible evidence-based practice for better outcomes.

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