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Clinical considerations for out-of-hospital cardiac arrest management during COVID-19



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Abstract

Managing out-of-hospital cardiac arrest requires paramedics to perform multiple aerosol generating medical procedures in an uncontrolled setting. This increases the risk of cross infection during the COVID-19 pandemic. Modifications to conventional protocols are required to balance paramedic safety with optimal patient care and potential stresses on the capacity of critical care resources. Despite this, little specific advice has been published to guide paramedic practice. In this commentary, we highlight challenges and controversies regarding critical decision making around initiation of resuscitation, airway management, mechanical chest compression, and termination of resuscitation. We also discuss suggested triggers for implementation and revocation of recommended protocol changes and present an accompanying paramedic-specific algorithm.

Keywords: Out-of-hospital cardiac arrest (OHCA), Paramedic, COVID-19, Aerosol generating medical procedures (AGMPs), Termination of resuscitation (TOR)

Introduction

The COVID-19 pandemic has been associated with an increase in the occurrence of out-of-hospital cardiac arrest (OHCA).^{1,2} The presentation of OHCA has also changed during this time with more than 90% of patients presenting in a non-shockable rhythm (asystole or pulseless electrical activity [PEA])^{1–3} compared to approximately 80% during non-pandemic times^{1,2}. Asystole is known to be associated with a notably low likelihood of survival in both COVID-19 and non-COVID-19 patients.^{3,4}

Cardiac resuscitation by paramedics occurs in unpredictable environments and involves a number of high-risk procedures that place them at increased risk of viral exposure.^{5,6} An under-appreciated aspect of paramedic practice is the risk of personal protective equipment (PPE)

displacement during access and extrication of a patient from confined spaces which can include transferring patients from narrow spaces (e.g. between a bed and a wall), lifts or manual handling, bariatric challenges, use of undersized elevators, carries up or down staircases, putting and removing that patient in and out of the ambulance and exposure to inclement outdoor environments. A single PPE letdown can be sufficient for disease transmission. Existing resources from the American Heart Association,⁷ European Resuscitation Council,^{8,9} and International Liaison Committee on Resuscitation¹⁰ have provided general guidance for OHCA management, however, there is a lack of clarity and specificity for paramedics regarding when and how to safely operationalize these recommendations.

Specific recommendations in the management of OHCA would aid paramedics in identifying key interventions for patients who have a

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high likelihood of survival, while also limiting interventions for those patients whose survival is very unlikely. These recommendations may also help to mitigate overburdening hospitals' limited critical care resources. In this commentary, we propose a balanced approach to all adult OHCA during the COVID-19 pandemic with a focus on paramedic safety and patient survival.

These recommendations relate to OHCA of presumed cardiac etiology. They do not apply to OHCA with obvious non-cardiac etiologies (e.g. trauma, drowning, drug overdose, lightning strike, electrocution), to pediatric OHCA (children under 18 years, neonate, newborn), or in cases of known or visible pregnancy. Lastly, they may not apply to systems with robust extracorporeal CPR algorithms for OHCA.

The initial approach: PPE and is the rhythm shockable or non-shockable?

It is challenging to distinguish between patients who do or do not have COVID-19 in an undifferentiated OHCA. The probability of encountering a

patient with COVID-19 who has sustained an OHCA will obviously vary with the prevalence of cases in the community. As well, there is only very weak evidence that the most effective life-saving procedure (i.e. defibrillation) is an aerosol generating medical procedure (AGMP).^{5,7,8} This has resulted in a wide variation in published PPE recommendations such as all prehospital care providers should don airborne and droplet PPE before entering the scene,⁷ or alternatively, defibrillation can be undertaken while wearing droplet precaution PPE while airborne PPE should be worn while performing chest compressions and airway/ventilation interventions.⁸ Ultimately, paramedics should don PPE according to local or regional recommendations prior to patient contact for all OHCA cases irrespective of COVID-19 status (Fig. 1).^{5,6}

To limit the potential exposure to aerosolized particles, paramedics should resist the urge to listen or feel for breathing. Providing compression-only CPR and initial passive oxygenation through a "high oxygen concentration with low flow" mask system coupled with a high-efficiency particulate air (HEPA) filter or a nonrebreather face mask (covered with a surgical mask) is an acceptable alternative to

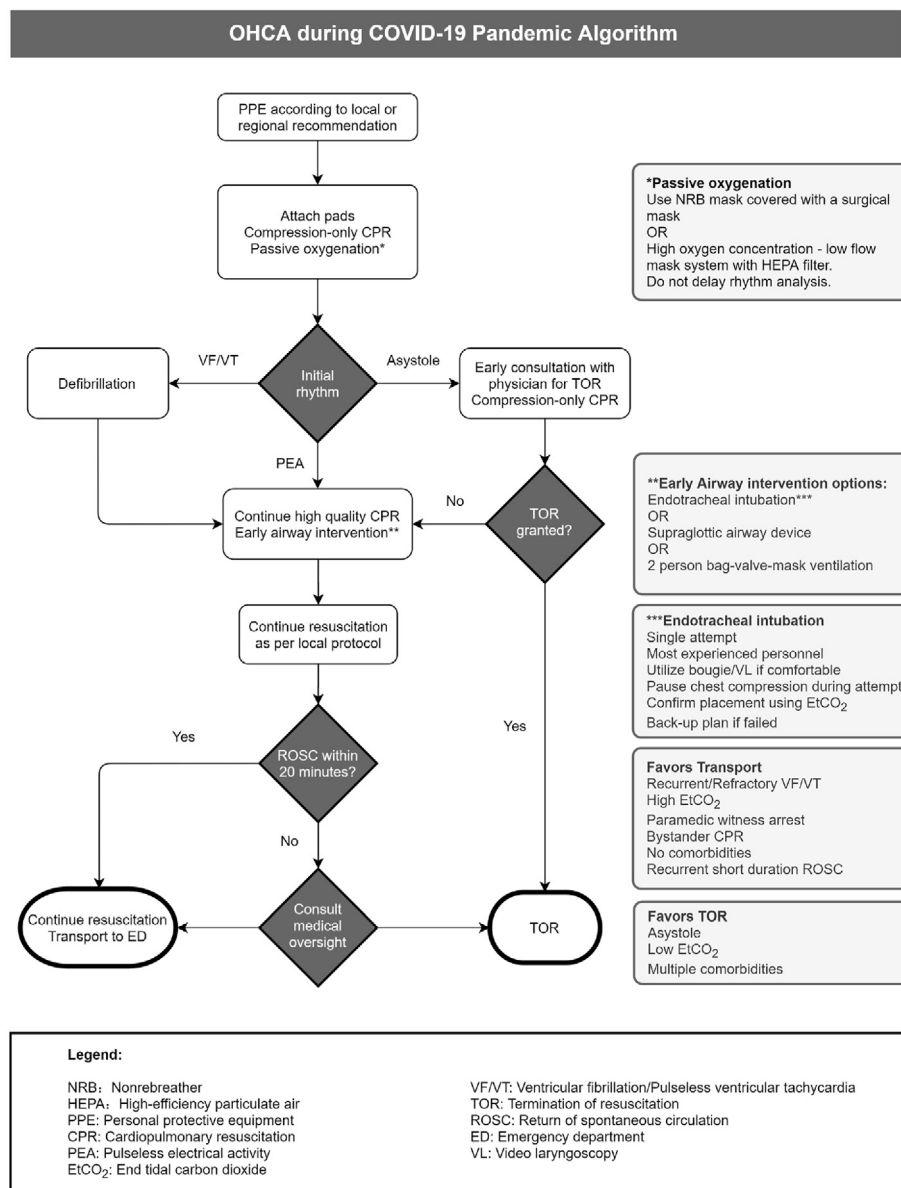


Fig. 1 – Out-of-hospital cardiac arrest algorithm for the COVID-19 pandemic.

active bag-valve-mask (BVM) ventilation during the initial phase of resuscitation.¹¹

Rapid determination of the initial rhythm is the most critical decision point to guide subsequent resuscitation including a determination of possible early termination of resuscitation (TOR). Attaching defibrillation pads is not considered to be an AGMP and would not pose an additional risk to paramedics.^{5,6} Patients whose OHCA is caused by COVID-19 is likely secondary to hypoxic respiratory failure which usually presents with an initial non-shockable rhythm,^{1–3} typically asystole. An initial shockable rhythm is least likely to be associated with COVID-19.

COVID-19 OHCA airway management: Prioritize early advanced airway

All airway interventions are high-risk AGMPs.^{5,6,8} Therefore, during the COVID-19 pandemic, paramedics should be cautious when performing airway management. The approach to airway management should begin by selecting the most appropriate technique with the lowest overall risk of aerosolization according to paramedics' skill and competence level. The airway device should be connected to a HEPA filter. Prioritizing early advanced airway intervention will mitigate the ongoing risk of aerosol exposure.^{7,8}

If feasible, paramedics should consider performing early endotracheal intubation (ETI). The paramedic team should decide who will intubate by selecting the most experienced and regularly trained paramedic with the highest level of competence to perform the procedure. Paramedics should optimize the chance of success on the first attempt by ensuring the patient is in a good anatomical position and consider using available adjuncts (e.g. bougie or video laryngoscope) according to experience and competence level.

ETI has the advantage of optimizing oxygenation and ventilation while preventing further aerosolization by creating a closed-circuit airway with a properly inflated cuff.⁷ Performing an out-of-hospital ETI is difficult even in the most controlled setting. PPE, with its associated limitations such as fogging, sweating, and displacement, adds to the difficulty. Therefore, we recommend that confirmation of endotracheal tube placement includes the use of end tidal carbon dioxide (EtCO₂) measurement in services where this equipment is available and paramedics have received prior training in its use. The act of performing ETI is associated with one of the highest known risks of exposure to aerosolization.⁶ Thus, in order to limit exposure, only one attempt at ETI while pausing chest compressions is recommended. Paramedics should pause cardiopulmonary resuscitation (CPR) during ETI for as short time as possible, ideally less than 20 s corresponding to evidence that a perishock pause of <20 s is associated with increased survival to hospital discharge.¹² Multiple ETI attempts are likely to increase the exposure risk to the paramedic and other responders.

In the event of a failed ETI, or paramedics are inexperienced or uncomfortable attempting ETI, one must consider achieving airway control with the next best available device, typically a supraglottic airway (SGA). It is not known whether a SGA is as reliable as ETI in preventing aerosolization.⁹

In any situation where ETI or SGA is unavailable or beyond the scope of paramedics, BVM ventilation is required. This should be performed using a two-person technique, with one paramedic maintaining a two-handed grip on the mask to ensure a tight seal while the other paramedic squeezes the bag. Pausing BVM ventilations is recommended during patient transfers. Chest

compressions should be paused while delivering ventilations using an SGA or BVM device.

Mechanical chest compressions during pandemic OHCA: Not the time to be learning!

Mechanical chest compression devices may be an alternative to manual chest compressions, particularly for patients who require prolonged resuscitation or chest compressions during ambulance transfer.¹³ This limits the number of personnel performing chest compressions, thus mitigating exposure to aerosolized particles. Mechanical chest compression devices have similar rates of survival to hospital discharge compared to high-quality manual chest compressions.¹⁴

Mechanical chest compression devices are not widely available and require hands-on training and on-going experience to use proficiently. This proficiency is important to limit hands-off time while applying the device to an OHCA patient so as to not significantly reduce the chest compression fraction. Therefore, these devices should only be used by paramedics who are well-trained and already use them on a regular basis.

Termination of Resuscitation: Does the pandemic alter our approach?

In Wuhan, China, Shao reported that 89.7% of monitored COVID-19 patients with in-hospital cardiac arrest (IHCA) presented with asystole.³ Despite 89% of patients receiving initiation of resuscitation within one minute, only one of 136 patients achieved a favourable neurological outcome after 30 days.

In the Lombardy region of Italy, Baldi reported a 58% increase in OHCA cases during the first 40 days of the COVID-19 outbreak compared to the same time period in 2019.¹ Ninety percent of the pandemic period cases presented in a non-shockable rhythm and only 7.8% of all patients were transported with a return of spontaneous circulation (ROSC) compared to 19.5% in 2019. Neither the percentage of patients presenting with asystole nor survival to discharge were reported.

On the other hand, Marijon observed an 88%–115% surge of OHCA cases during the peak weeks of the COVID-19 pandemic in Paris with only 9.2% presenting with initial shockable rhythm compared to 19.1% during a comparable non-pandemic period from 2012 to 2019.² Although France had a fully functional health care system during the surge, survival to hospital discharge was only 3.1%, compared to 5.4% during the same comparable non-pandemic period. The number of patients with favourable neurological outcome was not reported.

In 2018, Buick reported in the Toronto region that only 0.63% of patients presenting in asystole survived to hospital discharge.⁴ Together these reports suggest an extremely low likelihood of survival from cardiac arrest presenting with asystole whether a result of IHCA³ or OHCA during the COVID-19 pandemic^{1,2} or OHCA under non-pandemic conditions.⁴

This evidence is important when considering the principle of “distributive justice” recently discussed by the European Resuscitation Council. It provides a system level ethical perspective to facilitate navigation through the unprecedented resource imbalances created by the COVID-19 pandemic.¹⁵ Distributive justice aims to provide “the greatest good for the greatest number of people” by balancing between an individual patient’s needs and the whole community, including prehospital care providers. Given the dismal success of resuscitation attempts for patients presenting with asystole, we support a paradigm shift towards earlier TOR for these patients during the COVID-19 pandemic. Such a change will result in a reduced risk of disease transmission to paramedics. Accordingly, once asystole has

been identified as the presenting rhythm, paramedics should continue compression-only CPR and communicate with the medical oversight physician to discuss the potential for early TOR.

On the other hand, PEA represents a heterogeneous group with multiple potential underlying etiologies and variable survival rates.¹⁶ Some patients may benefit from additional treatment strategies aimed at the specific underlying etiology. Early TOR in these patients is controversial, although transporting these patients to hospital with ongoing resuscitation without ROSC is futile in most situations. Paramedics should consult with their medical oversight physician on a case by case basis for discussions regarding continued resuscitation and transport. Additional information such as rhythm changes, EtCO₂, witnessed arrest, bystander CPR, comorbidities, intermittent short duration ROSC and incident history may be useful in making decisions regarding TOR versus transport. Where a sustained ROSC has not been achieved, we recommend resuscitation for at least 20 min prior to consultation with the medical oversight physician.

Patients presenting in VF/VT have the highest likelihood of survival.⁴ Early sustained ROSC following defibrillation mandates immediate transport. Otherwise, ongoing resuscitative efforts including defibrillation, vasopressors and anti-arrhythmic medications should continue for at least 20 min by which time 90% of patients who are likely to survive will have achieved ROSC.¹⁷ For patients without ROSC after 20 min, consultation with the medical oversight physician should be sought.

What is the trigger for activation/revocation of these recommendations?

One challenge is to determine an ethically suitable trigger to activate implementation/revocation of these recommended protocol changes. Because they are directly related to the management of OHCA during the COVID-19 pandemic, we propose that the trigger for activation be related to a public health (or equivalent) authority issuing an order that requires paramedics to use enhanced PPE beyond routine practice. Conversely, the trigger for revocation should be when the authority advises a return to routine practice. A predictable “on/off” trigger structured this way is scalable on a local, regional or national level and has the advantage of transitioning automatically in each direction.

An alternative approach is to implement when there is a sudden surge of COVID-19 cases that threatens paramedic safety or threatens to overwhelm critical care resources.^{15,18,19} Revocation would occur when these two threats have ended.

The first approach would apply more broadly geographically and provides optimum protection for paramedics and preservation of critical care resources since the triggers are likely to be implemented earlier and revoked later than the alternative approach. The alternative approach would likely be more fragmented geographically and temporally (since not all local or regional critical care resources will be uniformly affected) but provides an extended time period where full resuscitation efforts are provided to patients presenting with asystole.

Decision making in times of a pandemic is complex and needs to take dynamic changes into account. Ultimately implementation and revocation of triggers must be made at a system leadership level, driven by sound ethical principles coupled with scientific fact, clinical evidence and appreciation of operational challenges.

Conclusions

COVID-19 is here for the foreseeable future. With possible subsequent pandemic waves, this paper proposes modifications to

conventional protocols for paramedic management of OHCA in adults during the COVID-19 pandemic. This proposal considers a distributive justice approach and provides a balance between safety of paramedics and optimal patient care, working as an integrated system with the hospital sector to take into account potential stresses on the capacity of critical care resources.

Credit authorship contribution statement

Yuen Chin Leong: Conceptualization, Writing - original draft, Visualization. **Sheldon Cheskes:** Conceptualization, Project administration, Writing - review & editing. **Ian R. Drennan:** Investigation, Methodology, Writing - review & editing. **Jason E. Buick:** Investigation, Methodology, Writing - review & editing. **Ron G. Latchman-singh:** Visualization, Validation, Methodology. **P. Richard Verbeek:** Conceptualization, Writing - review & editing.

Declaration of competing interest

None of the authors has any conflict of interest to declare.

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