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CURRENT TOPIC / АКТУЕЛНА ТЕМА

Prehospital care of cardiac arrest in COVID-19 patients

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SUMMARY
During the COVID-19 pandemic, there was an urgent need to revise the existing cardiopulmonary resuscitation (CPR) guidelines published in 2015. The coronavirus pandemic increased the rate of cardiac arrests, and the need for CPR. International resuscitation associations proposed updated resuscitation guidelines during the COVID-19 pandemic. Although there is a clear consensus in most recommendations, there are also disparities. Their implementation in everyday clinical practice would alleviate the fear of health workers at the prehospital level and reduce the indecision to apply CPR in such patients as well.
Keywords: cardiopulmonary resuscitation; COVID-19; recommendations; prehospital care

INTRODUCTION

The year 2020 will be remembered as the year when the WHO declared the pandemic of the COVID-19 disease [1]. Thus, guidelines for cardiopulmonary resuscitation (CPR) published in the same year were adapted to this disease [2].

Cardiac arrest (CA) is the leading cause of death in the world, with around 700,000 people dying annually in Europe alone. It is most common at the out-of-hospital level with an incidence of 67–170 per 100,000 inhabitants [3]. The ongoing COVID-19 pandemic has dramatically altered the landscape of pre-hospital response to out-of-hospital CA (OHCA). Research exploring the incidence of OHCA events during the pandemic has been mixed. Parisian study indicated an increasing number of OHCA associated with an escalating COVID-19 case burden [4]. Italy's research demonstrated no appreciable change in OHCA incidence during the early pandemic period [5]. However, a meta-analysis published in December 2020 reported a 120% increase in incidence since the start of the pandemic, as well as higher mortality rates [6].

OHCA is potentially curable if early CPR is initiated [2]. The main and most significant difference between non-COVID and COVID-19 patients is in the second link of the chain, where early application of basic life support (BLS) in COVID-19 patients requires the application of a protective mask for rescuer and casualty, and that CPR is performed only by chest compressions [2].

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BASIC LIFE SUPPORT ADAPTED FOR COVID-19 PATIENTS

BLS can be performed by: lay persons, trained nonprofessionals, health care workers (HCWs) outside the workplace and without professional equipment, until the arrival of the emergency medical team (EMT) [7] or HCWs (both in- and out-of-hospital).

Emphasis is placed on: early identification of suspected or positive COVID-19 patients, the importance of safety (self, bystander, the patient) and application of personal protective equipment (PPE) in case of a decision to perform CPR [2].

In COVID-19 patients, CA is identified if a person is unresponsive and not breathing normally [2, 8]. In the current COVID-19 circumstances, to check breathing by the look-listen-feel method [9] is declared invalid and is replaced by a modified method look-feel for no longer than 10 seconds [7]. Do not open the airway (lifting the chin and tilting back the forehead) and do not check breathing by leaning over the persons' mouth/nose because of possible aerosol transmission [8].

If there are no signs of life and no breathing, or if there is any doubt about it, immediately perform CPR, call the emergency number 194 [8], and inform the dispatcher about the suspected or confirmed infection with the COVID-19 virus, so that a EMT can be sent with complete PPE.

Lay rescuers start and conduct compression-only CPR until the arrival of the EMT. There is evidence that compression-only CPR was better than no attempt at CPR [7]. Lay rescuers should consider placing a facemask or cloth/towel over the person's mouth and nose before performing chest compressions and public-access defibrillation. This may reduce the risk of spreading the virus during chest compressions.

Medical PPE, according to the European Resuscitation Council, is divided into two groups: minimum droplet-precaution PPE (gloves, short-sleeved apron, surgical mask, eye and face protection: fluid resistant surgical

mask with integrated visor or full-face shield/visor or polycarbonate safety glasses or equivalent) and minimum airborne-precaution PPE (double gloves, scaphander or long-sleeved apron, filtering facepiece FFP3/N99 mask/respirator (FFP2/N95 if FFP3 not available), eye and face protection: full-face shield/visor or polycarbonate safety glasses or equivalent) [2].

Without PPE, the use of BLS is not recommended for anyone [7], except in the case when the rescuer himself is infected or has contracted COVID-19.

HCWs perform CPR with chest compressions and ventilation with a bag-valve-mask (BVM) and oxygen at a 30:2 ratio [2]. In order to achieve effective chest compressions, apply pressure quickly, strongly, and without interruption: on the lower half of the sternum ('in the center of the chest'), depth of 5–6 cm, at a rate of 100–120/minute with as few interruptions as possible and allow the chest to recoil completely after each compression [8].

If a BVM not available, perform compression-only CPR. If a BVM available, use special high-efficiency particulate air (HEPA) filters or bacteria/virus filters during ventilation that reduces aerosol generation during CPR.

Instead of the usual method of ventilation with a BVM in non-COVID patients, the method of **one rescuer and two hands** (so-called C-E grip): one hand covers the mask-face seal, and the other presses the Ambu bag), in COVID-19 patients ventilation is performed by the method of **two hands and two rescuers** (so-called V-E grip): one rescuer covers the mask-face seal with both hands i.e., the thumbs and thenar eminence are placed over each side of the mask while the second through fifth digits pull the jaw upward, another rescuer presses the Ambu bag twice after 30 compressions) [10].

Early use of automated external defibrillator significantly increases the chances of survival and does not increase the risk of COVID-19 infection [2].

ADVANCED LIFE SUPPORT ADAPTED FOR COVID-19 PATIENTS

Guarantee a safe environment. Before starting CPR, all EMT members must make use of the recommended PPE, following the established fitting and removal standards. In COVID-19 era, CPR, due to some components being high aerosol-generating procedures [11], has become high-risk procedure for the HCWs. Instead of "*Primum non nocere*" (first do no harm), we are forced to change to "*Primum non nocere ad te*" (first do no harm to yourself) [12].

The following devices have been designed around the world to reduce COVID-19 virus contamination: Polycarbonate barrier box in which ventilation is performed by a technique involving two persons: one person holds a mask and the other ventilates on an Ambu bag, and protective aerosol box on intubation [13].

Once adequately protected, the presence of CA is to be confirmed, assessing the patient response to stimuli and the presence of spontaneous ventilation and pulse [14]. The quality chest compression should be started as soon as possible. Until the available defibrillator or until advanced airway management occurred [ideally with the use of endotracheal intubation (ETI)], compression-only CPR are performing [8]. Providing compression-only CPR and initial passive oxygenation through a "high oxygen concentration with low flow" mask system coupled with a HEPA filter or a nonrebreather face mask (covered with a surgical mask) is an acceptable alternative to active BVM ventilation during the initial phase of CPR [15]. Once a BVM device arrives, proceed with a compression: ventilation ratio of 30:2. The person doing compressions can pause to squeeze the bag [2].

Defibrillate as soon as indicated; without delay for application of PPE. In the witnessed shockable CA, and situations where a defibrillator can be applied immediately for defibrillation and the resuscitator has not been able to put on the corresponding PPE to start CPR, it is reasonable to follow the recommendation of applying three consecutive discharges without previous chest compression or compression between discharges [14]. There is no scientific evidence that direct current shock delivery leads to aerosol generation, so it can be delivered safely. Whenever possible, use self-adhesive electrodes instead of handheld defibrillator electrodes. If a defibrillator is not available, one team member will begin only the external massage until the defibrillator is delivered and prepared.

If not yet, place an oxygen mask and give oxygen. Leave the mask on the patient until a BVM device arrives [2], and then, proceed CPR with a compression: ventilation ratio of 30:2. Manual ventilation with a BVM with high-flow 100% oxygen (target: SaO_2 of 94–98%), should be performed only by experienced staff using a 2-person technique (V-E grip), because an ill-fitting mask/poor seal will generate an aerosol [2].

Establishment of an advanced airway in COVID-19 patients due to the high degree of aerosol contagion is one of the riskiest procedures in the treatment of these patients [16]. Provide airway by using ETI or supraglottic device or with mandatory placement of HEPA filters on the Ambu bag [17], as well as on the ventilator hoses. It is recommended that the ETI be performed by an experienced physician so that the procedure can be done in one act, which reduces the exposure to the virus, as well as to use an endotracheal tube with a balloon cuff [18]. If ETI is delayed, consider ventilation with a self-inflating balloon and/or the insertion of a supraglottic device, both with HEPA filters. The position of the placed endotracheal tube should not be checked auscultatory (transmission of infection), but only by capnography [9, 18] or observation of chest movements during ventilation with an Ambu bag. After ETI, perform chest compressions with 10 ventilations per minute. If feasible, one person performs ETI, another assists, and a third administers medication and sets up electrocardiogram monitoring [18]. Shao et al. [19] suggested frequent changes (every minute) of persons performing chest compressions, since performing chest compressions while wearing PPE causes rapid fatigue.

Provide a venous route for drug administration, giving preference to the intraosseous approach.

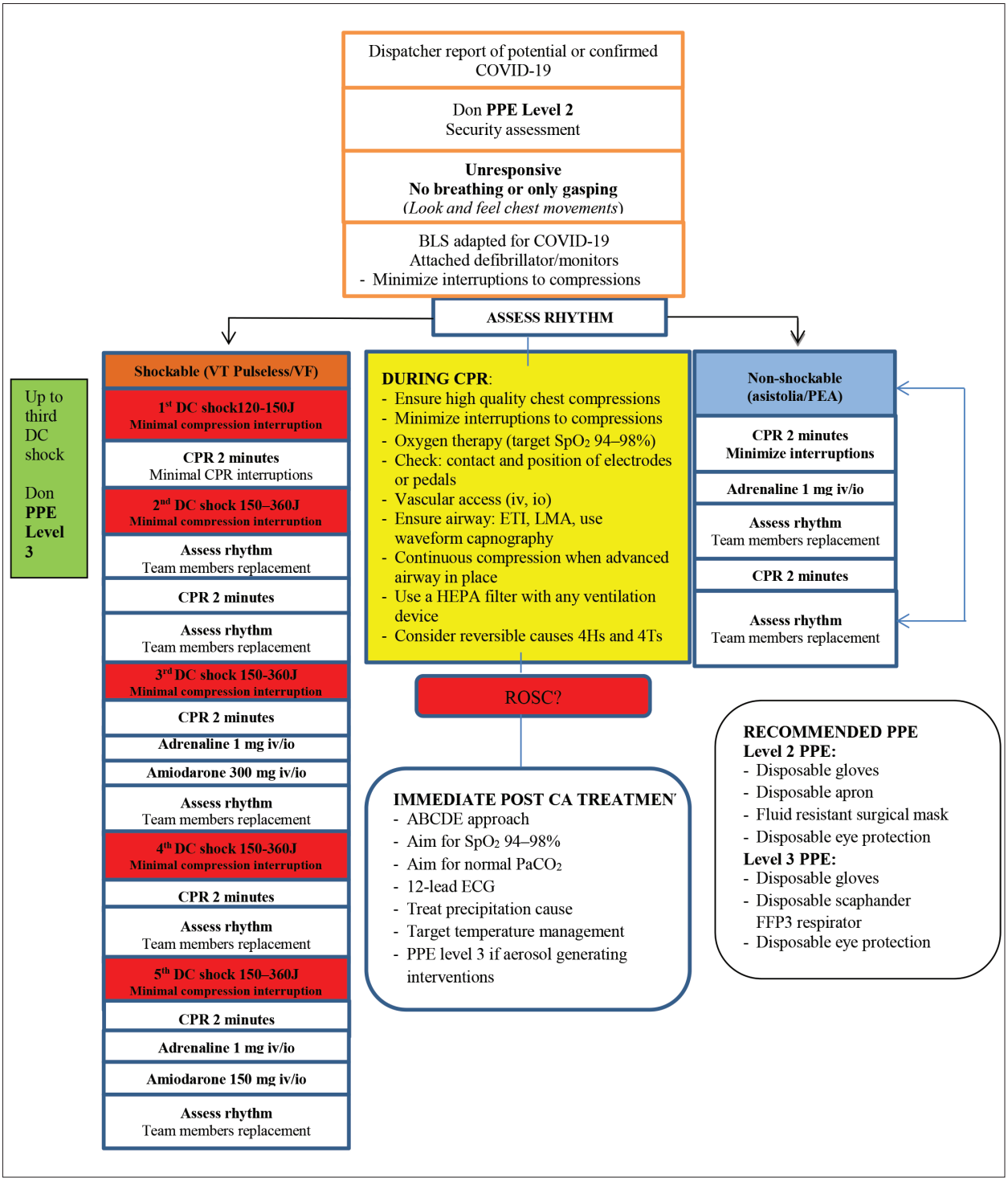

Figure 1. Advanced Life Support Algorithm for COVID 19 adult patients. Adapted for Resusci-tation Council UK guidance, available from: https://firstaidforlife.org.uk/giving-cpr-during-the-pandemic-resuscitation-council-uk-guidance/ [20]; PPE – personal protective equipment; BLS – basic life support; VT – ventricular tachycardia; VF – ventricular fibrillation; DC – direct current; CPR – cardiopulmonary resuscitation; ETI – endotracheal intubation; LMA – laryngeal mask air-way; HEPA – high-efficiency particulate air; ROSC – return of spontaneous circulation; CA – cardiac arrest; ECG – electrocardiogram; IV – intravenous; IO – intraosseous; PEA – pulseless electrical activity

All other algorithmic procedures during the management of CA (shockable or nonshockable), reversible causes of arrest, post-resuscitation care and the use of sophisticated medical equipment remain unchanged compared to the recommendations from 2021.

Figure 1 presents the Universal Advanced Life Support Algorithm adapted for COVID 19 patients [20].

TRANSPORT OF A SUCCESSFULLY RESUSCITATED PERSON

For easier memorization, the transport of a successfully resuscitated person is subject to the acronym **STOP COVID** [21]:

S (secure) – secure airway,

T (team building) – team griefing,

O (organize) –competence, team,

P (prepare) – prepare all the equipment,

C (checklist) – checklist for equipment and sequence of procedures,

O (optimize) – optimization of hemodynamic status and oxygenation,

V (vigilated) – careful dressing/undressing of protective equipment,

I (invasive) – invasive airways evaluation,

D (debriefing) – oral and written report at the time of patient handover.

After transport, completely and thoroughly disinfect (with chlorine-based solution) the ambulance and used medical apparatus and equipment, before the vehicle is re-included in the normal work process.

CONCLUSION

This paper presents a sublimation of relevant recommendations during the COVID-19 disease pandemic. Their implementation in everyday clinical practice would alleviate the fear of health workers at the prehospital level and reduce the indecision to apply CPR in such patients as well.

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The authors are familiar with the ethical standards of the journal. The work was done in accordance with these standards, as well as with the standards of the institutional committee on ethics.

Conflict of interest: None declared.

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Прехоспитално збрињавање срчаног застоја код оболелих од ковида 19

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САЖЕТАК

Током пандемије ковида 19 указала се хитна потреба за ревидирањем постојећих смерница за кардиопулмоналну реанимацију (КПР), објављених 2015. године. Пандемија ковида 19 је повећала инциденцу срчаног застоја и потребу за КПР. Међународна удружења за КПР предложила су модификоване препоруке за КПР током пандемије ковида 19. Иако постоји јасан консензус у већини препорука, постоје и диспаритети. Њихова примена у свакодневној клиничкој пракси ублажила би страх здравствених радника на прехоспиталном нивоу и смањила неодлучност да примене КПР и код оваквих болесника.

Кључне речи: кардиопулмонална реанимација; ковид 19; препоруке; прехоспитално збрињавање