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Cardiorespiratory arrest in a coronavirus pandemic: comprehensive literature review

Parada cardiorrespiratória na pandemia por coronavírus: revisão compreensiva da literatura

Paro cardiorrespiratorio en una pandemia de coronavirus: revisión exhaustiva de la literatura

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ABSTRACT

Objective: to present updates for cardiopulmonary resuscitation in suspected and confirmed patients with COVID-19. **Method:** comprehensive literature review with narrative synthesis of the evidence of guidelines and recommendations from World Health Organization, Associação de Medicina Intensiva Brasileira, American Heart Association, Resuscitation Council UK, American College of Surgions Committee on Trauma and National Association of Emergency Medical Technicians. **Results:** the main updates bring information about the specifics of cardiopulmonary resuscitation maneuvers; preparation of the environment and human and material resources, recognition of cardiorespiratory arrest and initial actions; ventilation and invasive airway access strategies; mechanical ventilator adjustments and cardiopulmonary resuscitation maneuvers in patients in the prone position. **Final considerations:** health professionals involved in the care of cardiorespiratory arrest of suspected and/or confirmed patients with COVID-19 can face numerous challenges, so they must strictly follow the protocol established to maximize the effectiveness of resuscitation maneuvers and minimize the risk of contagion by the virus and its spread.

Descriptors: Pandemics; Coronavirus Infections; Cardiopulmonary Resuscitation; Heart Massage.

RESUMO

Objetivo: apresentar atualizações para a ressuscitação cardiopulmonar em pacientes suspeitos e confirmados com COVID-19. **Método:** revisão compreensiva da literatura, com síntese narrativa das evidências de diretrizes e recomendações da Organização Mundial de Saúde, Associação de Medicina Intensiva Brasileira, American Heart Association, Resuscitation Council UK, American College of Surgions Committee on Trauma e National Association of Emergency Medical Technicians. **Resultados:** as principais atualizações trazem informações sobre especificidades das manobras de ressuscitação cardiopulmonar; preparação do ambiente, recursos humanos e materiais, reconhecimento da parada cardiorrespiratória e ações iniciais; estratégias de ventilação e acesso invasivo da via aérea; ajustes do ventilador mecânico e manobras de ressuscitação cardiopulmonar em pacientes pronados. **Considerações finais:** profissionais de saúde envolvidos no atendimento à parada cardiorrespiratória de pacientes suspeitos e/ou confirmados com COVID-19 podem encontrar inúmeros desafios, portanto devem seguir com rigor o protocolo estabelecido para maximizar a efetividade das manobras de ressuscitação e minimizar o risco de contágio pelo vírus e sua disseminação.

Descritores: Pandemias; Infecções por Coronavírus; Reanimação Cardiopulmonar; Massagem Cardíaca.

RESUMEN

Objetivo: apresentar actualizaciones para la reanimación cardiopulmonar en pacientes sospechos os y confirmados con COVID-19. **Método:** revisión exhaustiva de la literatura con síntesis narrativa de la evidencia de guías y recomendaciones de la Organización Mundial de la Salud, Associação de Medicina Intensiva Brasileira, American Heart Association, Resuscitation Council UK, American College of Surgions Committee on Trauma and National Association of Emergency Medical Technicians. **Resultados:** las principales actualizaciones aportan información sobre los detalles de las maniobras de reanimación cardiopulmonar; preparación del medio ambiente y recursos humanos y materiales, reconocimiento de paro cardiorrespiratorio y acciones iniciales; estrategias de ventilación y acceso invasivo a las vías aéreas; ajustes del ventilador mecánico y maniobras de reanimación cardiopulmonar en pacientes en decúbito prono. **Consideraciones finales:** los profesionales de la salud involucrados en la atención del paro cardiorrespiratorio de pacientes sospechosos y/o confirmados con COVID-19 pueden enfrentar numerosos desafíos, por lo que deben seguir estrictamente el protocolo establecido para maximizar la efectividad de las maniobras de reanimación y minimizar el riesgo de contagio por el virus y supropagación.

Descriptores: Pandemias; Infecciones por Coronavirus; Reanimación Cardiopulmonar; Masaje Cardíaco.

INTRODUCTION

Since January 30th, 2020, the spread of the *Coronavirus Disease* (COVID-19), an illness caused by the new coronavirus (Sars-cov-2), has been a public health emergency of international importance, having been designated as a pandemic in March 2020 by the World Health Organization (WHO)[1,2]. According to an updated report, 5,175,925 cases of COVID-19 and 338,089 deaths were confirmed worldwide until May 23rd. By the same date, Brazil verified 347,398 cases and 22,013 deaths[2].

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Approximately 12% to 19% of the COVID-19 positive patients require hospitalization[3]. Ten to 15% of the infected patients are at risk of developing respiratory failure requiring admission to intensive care units[1,4]. Data from the Chinese National Health Commission showed that, in February 2020, in Wuhan, approximately 15% of the patients developed severe pneumonia and 6% required non-invasive or invasive ventilatory support[5].

The American Heart Association and collaborators corroborate that 3% to 6% of these victims progress with a serious condition[3]. Thus, it becomes essential for health assistants, especially the nursing team due to their greater proximity in the care process, to establish surveillance and prevention measures to continuously monitor the early signs of clinical deterioration[2,6,7].

In the context of the severity of this recent infection, in-hospital cardiac arrest (IHCA) becomes common due to hypoxemic respiratory failure secondary to acute respiratory distress syndrome (ARDS), myocardial injury, ventricular arrhythmias, and shock, as well as the widening of the QT interval, which is one of the possible events caused by the proposed experimental treatment with the hydroxychloroquine and azithromycin drugs[3].

In view of the new scenario established, updating and elaborating specific protocols become necessary in this confrontation. Furthermore, with the exponential growth of contamination, it is estimated that the cases of IHCA will also increase. In this sense, this article aims to gather the main updates for cardiopulmonary resuscitation (CPR) in suspected and confirmed COVID-19 patients.

METHOD

This is a comprehensive literature review carried out in April 2020, based on the narrative synthesis of the evidence on the main updates for cardiopulmonary resuscitation (CPR) in suspected and confirmed COVID-19 patients contained in the main official guidelines and recommendations disclosed by agencies linked to the Brazilian and international health area: World Health Organization, Brazilian Intensive Medicine Association, American Heart Association, Resuscitation Council UK, American College of Surgeons Committee on Trauma, and National Association of Emergency Medical Technicians.

RESULTS

CPR manoeuvres must follow the recommendations and guidelines of the specialized agencies and some changes related to the care of IHCA settings in suspected or confirmed COVID-19 patients have been collected and published. The results found refer especially to the existence of extra risks for the health professionals due to the possible exposure to body fluids and to the administration of chest compressions, in addition to various procedures that involve the generation of aerosols, such as positive pressure ventilation and advanced airway installation[8].

The nursing professionals make up a strategic group to ensure the effectiveness and safety of care IHCA. In most cases, this team is the first to identify and initiate care in hospital settings, also comprising the professionals responsible for the provision of essential materials that will support patient care. Therefore, it is extremely important that the entire nursing team is aligned with the flow of care for IHCA of suspected or confirmed COVID-19 patients.

Reduction of the exposure of professionals and use of PPE during CPR in suspected or confirmed COVID-19 patients

Concern about the safety of the scene, i.e., of the health care provider, immediately before starting to assist the victim, has always been a recommendation of the main emergency guidelines[6,9,10]. The general principles for CPR in suspected and confirmed COVID-19 patients involve several measures to reduce the exposure of the professionals, including the establishment of exclusive IHCA care teams. Rapid Response Teams (RRTs) should be considered in the face of acute deterioration[11].

As it is a procedure with potential aerosol generation, given the first signs of IHCA risks[3], attention must be paid to the fast and safe transportation to a respiratory isolation unit with negative pressure and HEPA (High Efficiency Particulate Arrestance)[1,3,12,13]. In its absence, a private room with a closed door is recommended[13].

The smallest possible number of professionals should work in the environment, normally four people with designated functions[1], since viral particles can remain suspended in the air for about an hour and be inhaled by people nearby[3]. For this purpose, the use of mechanical devices that replace manual chest compressions should also be considered[3,8].

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Although there may be a delay in the start of chest compressions, ensuring the safety of the team is an essential action. Therefore, Personal Protective Equipment (PPE) must be available in the resuscitation cart ready for use by all the professionals involved in the care provided[11]. It is essential to minimize unnecessary exposure since, by becoming vulnerable, they reduce the already overburden workforce, but mainly by apprehension at the possibility of becoming seriously[3].

PPE recommendations can vary based on the epidemiological data, on the current availability of inputs, and on institutional routines. Despite chest compressions and defibrillation being considered less risky resuscitation interventions[1], the use of a bag-valve-mask (BVM) and endotracheal intubation have an increased potential for aerosolization[1,3,4]; therefore, the attire of these professionals according to the ANVISA must include the following[13]: hand hygiene with water and liquid soap or 70% alcohol preparation; goggles or face shield; N95/PFF2 mask or equivalent (procedure that generates aerosols); waterproof apron (procedure that generates aerosols); procedure gloves and hat (procedure that generates aerosols).

Overalls with an integrated hood can be used, evaluating their ease of removal, in order to avoid contamination during this stage. There is no definitive evidence that the Powered Air-Purifying Respirator (PAPR) reduces the likelihood of viral transmission in the scenario of procedures with aerosol generation, despite offering greater protection compared to N95 respirators. A hooded PAPR covering the entire head and neck can provide additional protection against contamination compared to the typical equipment used in conjunction with an N95 mask, with the following as the main obstacles to implementation: training to safely remove equipment without contamination, the need for protocols on device hygiene for next use, and local availability[1].

It is known that the earlier chest compressions and defibrillation are initiated, the greater the chances of successful CPR. This early care may not be possible for confirmed or suspected COVID-19 patients, because the time taken for dressing can be quite long.

In addition, maintaining the use of PPE during CPR maneuvers can be challenging. The movements generated by the rescuer when compressing the chest can lead to the unpositioning of the health professional's safety devices. Keeping any device attached to the face at the time of maneuver becomes a major challenge for these professionals.

The impact of the equipment on the quality of CPR was questioned in a study where 136 cases of patients who suffered IHCA and underwent the resuscitation maneuver were investigated. Of these, only four patients survived 30 days after the date of the cardiopulmonary arrest, which represented only 2.9% of the sample. The uncertain quality of the resuscitation maneuvers, which can vary, for example, depending on the type of PPE that the professional is using as it limits their movement for an adequate cardiac compression, was considered one of the key factors for the resuscitation of patients with severe pneumonia due to COVID-19 in Wuhan[14].

It is noteworthy that, unlike the current routines, instead of taking the resuscitation cart to bed, specific kits should be considered due to the challenge related to decontamination, thus minimizing the waste of materials and medications after the procedure[1]. Another strategy is to keep a professional out of the room, with the door closed, exclusively in charge of delivering any additional equipment/medication that may be required[11,15]. However, care should be taken, since the recurrent transit of people to the room can increase the risk of viral transmission[1].

IHCA recognition and initial actions

The decision-making rules that involve resuscitation should remain individualized[7]; however, even though the outcomes of IHCA in these patients are unknown, mortality is high and it worsens when associated with risk factors such as old age and comorbidities, particularly cardiovascular diseases[3]. Ensuring effective communication among the team members regarding “do-not-resuscitate” (DNR) orders established with family members and in the rounds should be a priority, as well as the proper documentation of this definition[7]. Likewise, it is essential to follow the institutional policies related to palliative and terminal care[12].

The recognition of IHCA will occur through the absence of consciousness, carotid pulse, and normal breathing[6,7]. Activating the RRT, if available at the institution, is a highly effective measure.

CPR should be initiated by chest compressions and the rhythm evaluated quickly, to determine the appropriate algorithm[11]. However, in the presence of shockable rhythms (ventricular fibrillation and pulseless ventricular tachycardia) and with a defibrillator readily available, defibrillation should occur quickly, even before compressions begin, since the restoration of spontaneous circulation may prevent the need for new resuscitation measures[3,7].

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It is highlighted that, in In-hospital cardiac arrests due to COVID-19, 80% have pulseless electrical activity or asystole, which reduces the positive response to the maneuvers, with survival and hospital discharge rates of approximately 15 to 20%[14,16].

Ventilation strategies and invasive airway access

It is unanimous among the specialists that defibrillation of shockable rhythms should not be delayed for access to the airways or other procedures[3,7,12]. After this assessment and defibrillation of shockable rhythms, intubation should be performed at the first possible opportunity for a better ventilation/oxygenation pattern[3], since hypoxia is one of the main causes of IHCA in these patients[12].

As the intubation of critically ill patients with coronavirus related to severe ARDS has been associated with episodes of contamination by health care professionals, the procedure should be prioritized in an attempt to promote airway isolation and to reduce aerosolization[1] and be performed by the most qualified person on the team to optimize the success of the first attempt[1,3,4,7].

Chest compressions should be stopped at the time of intubation and the use of the video laryngoscope considered, if available, in an attempt to decrease the exposure of the intubator and of the assistants to aerosol particles[3,11,17]. Using waveform capnography is the method of choice to confirm the correct positioning of the endotracheal tube[3,4].

Manual ventilation with BVM or endotracheal tube-bag should be avoided, due to the high risk of aerosolization and contamination of the team. In situations of extreme need for ventilation with BVM, the technique for sealing the mask should involve two professionals, using an oropharyngeal airway[12].

FIGURE 1: Technique used for manual ventilation with BVM, using two health professionals. Source: The authors. Rio de Janeiro - RJ, Brazil, 2020.

In order to optimize oxygenation strategies, reducing the risk of contamination, a HEPA filter must be attached between the bag and the mask. Likewise, after intubation, a HEPA filter should be placed in the ventilation circuit, just after the tracheal tube, and another at the expiratory outlet of the mechanical ventilator[3,12].

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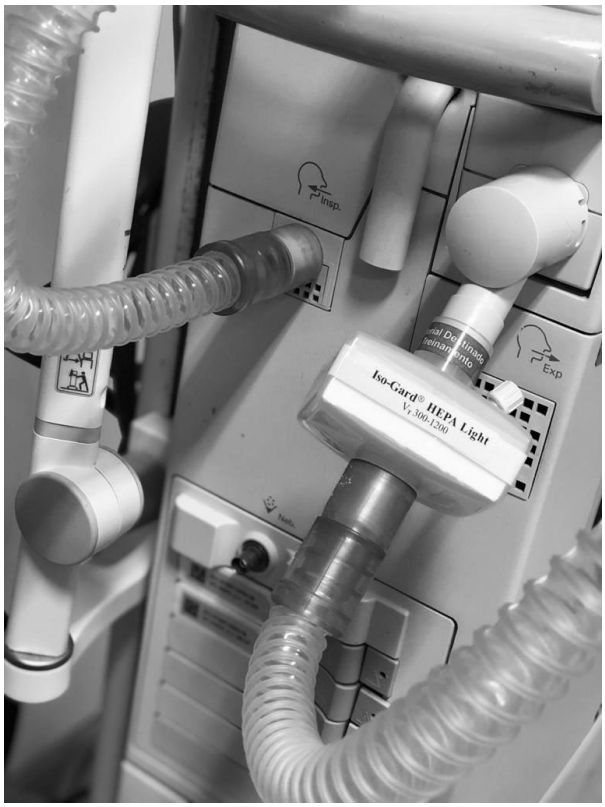

FIGURE 2: HEPA filter positioned at the expiratory outlet of the mechanical ventilator. Source: The authors. Rio de Janeiro - RJ, Brazil, 2020.

If intubation is delayed, ventilation with a supraglottic airway or BVM with a HEPA filter should be considered[3]. Although there is no consistent evidence demonstrating that the use of supraglottic devices generates fewer aerosols than BVM, there are reports on the ease of insertion, the possibility of reaching sufficient sealing pressure and that its use can save manpower, reducing the team exposure. Moreover, new-generation supraglottic devices provide a conduit for performing tracheal intubation[18]. Mouth-to-mouth and Mouth-to-Mask ventilation are prohibitted[12].

There are insufficient data to support extracorporeal cardiopulmonary resuscitation (E-CPR) for patients with COVID-19[3].

Mechanical ventilator settings: closed circuit during CPR

Unlike the CPR protocols used so far, in cases of IHCA in patients with COVID-19 under mechanical ventilation, the connection to the ventilator in a closed circuit must be maintained[3,11,12].

Some mechanical ventilators have the "CPR" function[12]; however, for those that do not have it, the main recommendations for allowing asynchronous ventilation are the following: adjusting the mode to guarantee a tidal volume of 6 mL/kg of ideal body weight[3]; frequency from 10/min[3] to 12/min[11]; fraction of inspired oxygen at 100%[11]; keeping the trigger off (to prevent the ventilator from automatically starting with chest compressions and possibly avoiding hyperventilation and air retention)[11] or as low as possible; assessing the need to maintain a positive end-expiratory pressure level to balance pulmonary volumes and venous return; and adjusting the alarms to avoid fatigue.

Maintaining the safety of the devices (endotracheal tube/tracheostomy) as well as of the circuit is essential in order to prevent unplanned extubation and accidental disconnection from the circuit which would increase exposure to aerosol[11].

As soon as the Return of spontaneous circulation (ROSC) is achieved, the ventilator settings should be changed according to the patient's clinical conditions, with the adoption of protective ventilation strategies[3,11].

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Causes of IHCA

Throughout the IHCA service, reversible causes must be identified and treated, before considering interruptions in the maneuvers. In the most current publications on COVID-19 there is a special consideration for hypoxia, acidemia, and coronary thrombosis[7,12].

In mechanically ventilated patients, protective ventilation strategies are recommended; however, cases of pneumothorax have been observed, and should be strongly considered in any ventilated patient with sudden respiratory worsening[1].

IHCA with the patient in a prone position

For suspected or confirmed COVID-19 patients who are in prone position without an advanced airway, it is recommended to return to the supine position for CPR. For those in the prone position with advanced airways, placement in the supine position should be avoided, unless the maneuver is performed without risk of avulsion of devices and disconnection of the circuit, which would generate aerosolization to the environment. Instead, the defibrillator pads should be positioned anteroposteriorly and the CPR performed with the hands in a normal position, however, on the T7/10 vertebral bodies[8,18].

FINAL CONSIDERATIONS

Faced with the pandemic of a highly contagious disease where many details are still not fully understood, situations of extreme severity such as In-hospital cardiac arrestbecome an enormous challenge for the entire multidisciplinary team.

It is observed that the information available in the literature on the subject is still based on consensus of specialists, case reports, and experiences or unicentric studies with reduced samples, thus not offering high levels of evidence. However, by learning from previous SARS experiences and understanding the current epidemiological factors of COVID-19, the professionals involved in cardiopulmonary resuscitation will be much better prepared to protect themselves during aerosol-generating procedures.

Good knowledge of infection prevention and control, surveillance of protective measures, strict adherence to the placement and removal of PPE and preparation for the care of infected patients are extremely important. The importance is clear that the health professionals involved in the care of suspected and/or confirmed patients affected by COVID-19 contamination must strictly follow all the protocols established for the care of IHCA in order to minimize the risk of contagion by the virus and dissemination.

It is suggested that the cooperation between the health care team and researchers be strengthened for the development of data records that can help in a better understanding of the nature of this disease, especially of cardiac arrest, in the national context.

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