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Cardiopulmonary resuscitation in patients diagnosed with or suspected of COVID-19: A narrative review of the literature

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Abstract— *Objective: to map the production of knowledge and make considerations about the main updates and recommendations for the management of patients in cardiac arrest, diagnosed or suspected of having COVID-19. Method: narrative literature review. The source of information consisted of relevant publications in the literature carried out in June 2021, based on the narrative synthesis of evidence on the updates contained in the main guidelines and official recommendations published by bodies linked to the Brazilian and international health area: World Organization of Health, International Alliance of Resuscitation Committees, American Heart Association Guidelines (AHA 2020), European Council on Resuscitation, American College of Surgeons Committee on Trauma, National Association of Emergency Medical Technicians, Brazilian Association of Emergency Medicine, the Brazilian Society of Cardiology, Brazilian Association of Intensive Medicine, Brazilian Society of Anesthesiology and official associations and societies representing specialties affiliated with the Brazilian Medical Association, which recommend following practices specifically designed to care for patients diagnosed or suspected of having COVID-19. Results: there is a consensus that it is essential to completely dress the team with Personal Protective Equipment for respiratory isolation of aerosols during the service of cardiopulmonary arrest in this context, even if this delays the cardiopulmonary resuscitation maneuvers. Conclusion: health professionals from the multidisciplinary team involved in CPA care in the context of caring for patients suspected of or with a confirmed diagnosis of COVID-19 are exposed to numerous risks, and a range of challenges, and must follow the established protocol with scientific rigor. in health services, to maximize the effectiveness of CPR maneuvers, without losing sight of the objective of these actions, which is to increase survival, without giving up on preserving the health and integrity of the team and minimizing the risk of contagion by the virus and its spread.*

I. INTRODUCTION

Processes involving decision making to support cardiopulmonary resuscitation (CPR) guidelines need to be individualized in Emergency Departments and Intensive Care Units (ICU), and CPR should always be performed, unless consensus indicates otherwise[1].

The care of patients who are victims of cardiopulmonary arrest (CPA) in the context of a COVID-19 pandemic has peculiarities that should be highlighted. The following recommendations presented here in narrative form are in line with the recommendations of the Brazilian Association of Emergency Medicine (ABRAMEDE), Brazilian Society of Cardiology (SBC), Brazilian Association of Intensive Medicine (AMIB) and Brazilian Society of Anesthesiology (SBA) , associations and official representative societies of specialties affiliated with the Associação Medica Brasileira (AMB), which corroborate in guiding the various assistant teams, in a context of little solid evidence on the subject, maximizing the protection of teams and patients during a CPA[2] .

Coronaviruses represent a family of Ribonucleic Acid (RNA)-type viruses, responsible for infections of the respiratory and intestinal tract in humans. A large part of these viruses have low pathogenicity and high transmissibility, leading to signs and symptoms similar to those of flu, which can be more severe in risk groups, such as children, the elderly and people with chronic diseases, named comorbidities. At the end of 2019, Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-Cov-2) was discovered, as this new virus was named by the World Health Organization (WHO), having its origin in the city of Wuhan, China[3,4,5]. Coronavirus Disease 2019 or COVID-19 is a disease with a high rate of transmissibility, which resulted in an epidemic of Severe Acute Respiratory Syndrome (SARS) caused by SARS-Cov-2. Among the most evident and known clinical manifestations so far, it is worth highlighting: high fever, cough, odynophagia and dyspnea. However, patients with pre-existing comorbidities have strong evidence of having the most severe form of the disease[4].

Coronaviruses are viruses with an RNA structure that cause respiratory infections in a variety of animals, including birds and mammals. Among them, seven coronaviruses are known to cause disease in humans. It is described that in the last 20 years, two of them were responsible for the most violent and impactful SARS epidemics. The SARS epidemic, which emerged in Hong Kong (China) in 2003, with a fatality rate of approximately 10%, and the Middle East Respiratory Syndrome (MERS), which originated in Saudi Arabia in 2012, with a fatality rate of about 30%. Both are part of the list of priority diseases for research and development in the context of emergency[6].

COVID-19 is a new disease, still little known, and its pathophysiology is not fully understood. What is amply evident is that infected patients may clinically exhibit symptoms very similar to those of SARS-CoV and MERS-CoV infection, with a high probability of developing Acute Respiratory Distress Syndrome (ARDS), which can lead to hospitalization in services urgent and emergency care and in intensive care units (ICU), and can progress to respiratory failure, and therefore, if not managed effectively and early, can progress to cardiorespiratory arrests (CPAs)[4].

Considering this scenario, in which scientific evidence is broad, varied and not very solid, and is poorly documented or accessible, the Brazilian Association of Emergency Medicine (ABRAMEDE), the Brazilian Society of Cardiology (SBC), the Brazilian Association of Intensive Care Medicine (AMIB) and the Brazilian Society of Anesthesiology (SBA), associations and official representative societies of specialties affiliated with the Brazilian Medical Association (AMB), presented their recommendations, based on evidence available in the literature and reviewed by peers, aiming to optimize the actions to be followed by assistant teams in practices specifically designed to care for patients diagnosed or suspected of COVID-19. In all other cases, it is recommended to maintain the 2015 ILCOR (International Alliance of Resuscitation Committees) guidelines, AHA 2020 (American Heart Association) Guidelines and the Brazilian Society of Cardiology 2019 Cardiopulmonary Resuscitation and Emergency Care Guidelines Update[2] .

Cardiopulmonary resuscitation (CPR) is a procedure considered as the most urgent action among health actions, and it can occur in patients diagnosed with COVID-19 who progress to cardiorespiratory arrest. Therefore, it demands special attention from the team, particularly regarding the increased risk of aerosol formation during external chest compression and ventilation maneuvers, offering a significant risk of contamination for the assistant team[1,7].

It is described that the appearance of COVID-19 has a global impact, and with it evidence that there are limitations to the full understanding of transmission patterns, risk factors, virus characteristics, pathogenicity, clinical and laboratory repercussions, and its severity, both in the population in general, as well as for health professionals. Health professionals are more vulnerable to transmission, as they provide direct assistance to these patients. Studies show that a significant number of these workers were affected in previous outbreaks of Severe Acute Respiratory Syndrome (SARS) and Middle East Respiratory Syndrome (MERS), contributing to the spread

of the disease inside and outside the health service environment[4].

Approximately 12% to 19% of COVID-19 positive patients require hospital admission. Ten to 15% of infected patients are at risk of developing respiratory failure requiring admission to the ICU. Data from the National Health Commission of China showed that in February 2020, in Wuhan, about 15% of patients developed severe pneumonia and 6% required non-invasive or invasive ventilatory support. The AHA and collaborators corroborate that 3% to 6% of these victims progress with a serious condition. Thus, it is essential for health assistants, especially the nursing staff, due to their greater proximity in the care process, to establish surveillance and prevention measures to continuously monitor the early signs of clinical deterioration and preventable deaths from cardiorespiratory arrest[8].

In the context of severity of this recent infection, cardiorespiratory arrest becomes common[5,9,10,11] due to: hypoxemic respiratory failure secondary to acute respiratory distress syndrome (ARDS), myocardial injury, ventricular arrhythmias, shock, as well as the widening of the QT interval, which in the latter, is one of the possible adverse events caused by the proposed experimental treatment with the combination of the drugs hydroxychloroquine and azithromycin[12]. In view of this new scenario that presents itself, the updating and elaboration of specific protocols and guidelines are necessary for the qualitative confrontation of the disease. Furthermore, with the exponential growth of contamination, it is considered that cases of cardiorespiratory arrest also increase[1,2,8,12,13].

Transmission occurs through respiratory droplets generated by sputum, coughing, sneezing, speaking and breathing of the infected individual, as well as by Aerosol Generating Health Procedures (PSGA), understanding that not only physicians work in this context, but also other professionals on the team. assistants, we prefer to use the term health procedures as a synonym for medical procedures, which should be highlighted: airway aspiration, orotracheal intubation, bronchoscopy and CPR in all its stages[4].

Furthermore, the guidelines are not completely clear as to the effective protective measures of these professionals during CPR in patients with COVID-19. In this context, the study is justified by the need to obtain evidence that can support the knowledge to be applied in the care of patients in CPA diagnosed or suspected of COVID-19, and who need CPR maneuvers. In this way, providing greater technical and scientific robustness to the practices of professionals working in these cases, who are at risk of assistance, contributing to greater professional competence in this situation. Added to this is the importance of studies on COVID-19 in the context of public health, as it is a current issue of a pandemic character that has a scarcity of research carried out in this perspective.

From this perspective, the study aims to map the production of knowledge and make considerations about the main updates and recommendations for the management of patients in cardiopulmonary arrest, diagnosed or suspected of having COVID-19.

II. METHOD

Narrative literature review. The source of information consisted of relevant publications in the literature carried out in June 2021, from the narrative synthesis of evidence on the main updates for cardiopulmonary resuscitation (CPR) in patients suspected of or with confirmed diagnoses of COVID-19, contained in in the main guidelines and official recommendations issued by bodies linked to the Brazilian and international health area, namely: World Health Organization (WHO), International Alliance of Resuscitation Committees (ILCOR), AHA 2020 Guidelines (American Heart Association), European Council of Resuscitation (ERC), American College of Surgeons Committee on Trauma, National Association of Emergency Medical Technicians, Brazilian Association of Emergency Medicine (ABRAMEDE), Brazilian Society of Cardiology (SBC), Brazilian Association of Intensive Care Medicine (AMIB) and the Brazilian Society of Anesthesiology (SBA), associations and official representative societies of and specialties affiliated with Associação Medica Brasileira (AMB), which recommend following practices specifically designed to care for patients diagnosed or suspected of COVID-192.

It is agreed that CPR maneuvers should follow the recommendations and guidelines of specialized agencies and guidelines, and some clear changes related to CPA care in hospital and extra-hospital settings in patients with suspected or confirmed COVID-19 were developed, gathered and published during the pandemic.

The results found especially refer to the existence of extra risks to health professionals, due to possible exposure to bodily fluids, administration of external chest compressions, in addition to several procedures involving the generation of aerosols, such as positive pressure ventilation, airway aspiration and installation of advanced airways[1,5,14].

The texts found were read, organized and synthesized into two thematic categories, namely: Clinical dimension of care in cardiopulmonary resuscitation in patients

diagnosed with or suspected of COVID-19 and Management and organizational dimension of the multidisciplinary team in the management of diagnosed or suspected patients of COVID-19 in cardiorespiratory arrest requiring CPR and the summary presented below.

III. RESULTS AND DISCUSSION

Clinical dimension of care in cardiopulmonary resuscitation in patients diagnosed with COVID-19 or suspected cases

The European Resuscitation Council (ERC) published its guideline on resuscitation of patients diagnosed with COVID-19 on April 24, 2020, which is also available as an authorized translation in multiple languages on the AHA website.

These guidelines address the peculiar characteristics of healthcare for patients suspected of or diagnosed with COVID-19, but also highlight fundamental self-protection measures for the safety of the patient and the multidisciplinary team. The recommendations are based on a risk assessment carried out by the International Alliance of Resuscitation Committees (ILCOR) based on evidence from the peer-reviewed literature on how high the potential risk of transmitting SARS-CoV-2 to health team, particularly with regard to transmission through aerosols produced during resuscitation measures[14].

In this context, it is important that all patients suspected or diagnosed with COVID-19, who are at increased risk of acute clinical deterioration or CPA, should be monitored and properly signaled to the Rapid Response Teams (RRT) or teams that potentially can perform early care, avoiding deterioration, cardiorespiratory arrest, sequelae and preventable deaths, following the chain of survival. The use of severity scores and tracking systems and triggering of care codes aimed at these patients allow early detection of evidence of severity and can be a potential tool to optimize the care of eventual CPAs.

The assessment of potential difficulty for laryngoscopy/tracheal intubation must be mandatory when the patient is admitted to the hospital and/or ICUs and must be duly registered in the patient's medical record. Scores such as MACOCHA (Figure 1) or mnemonics such as LEMON ("Look, Evaluate, Mallampati, Obesity/Obstruction and Neck") can help to determine difficult airway, previous support activation and request for difficult airway equipment. For the level of understanding, the MACOCHA score ranges from 0 (easy) to 12 (very difficult). MACOCHA score > 3 indicates difficult airway[2].

MACOCHA Score Calculation Worksheet	Points
- Factors related to patient	
Mallampati Score III or IV	5
Obstructive Sleep **A**pnoea Syndrome	2
Reduced Mobility of **C**ervical Spine	1
Limited Mouth **O**pening <3cm	1
- Factors related to pathology	
Coma	1
Severe **H**ypoxaemia (<80%)	1
- Factor related to operator	
Non **A**naesthesiologist	1
Total	12

Sources: De Jong et al. 2014a; 2013b
M. Mallampati score III or IV
A. Apnoea Syndrome (obstructive)
C. Cervical spine limitation
O. Opening mouth <3cm
C. Coma
H. Hypoxia
A. Anaesthesiologist Non trained

Coded from 0 to 12
0 = easy
12 = very difficult

Fig.1: MACOCHA score.

Source: Hurtado et al. 2017[15].

It is recommended that the rules for decision-making involving resuscitation should remain individualized, however, even if CPA outcomes in these patients are not fully known, mortality remains high, worsening when associated with risk factors such as age and comorbidities, particularly when involving cardiovascular diseases. In the meantime, ensuring effective communication between members of the multidisciplinary team regarding the orders of "no cardiopulmonary resuscitation" (NRCP) established in accordance with family members and in the rounds should be a priority, as well as the adequate documentation of this definition. Likewise, it is essential to follow institutional policies related to palliative and terminal care[2,8].

Recognition of CRP will occur through the absence of: awareness (non-responsiveness), carotid pulse (absence of carotid or femoral pulse) and normal breathing (apnea or gasping/agonic breathing, present in up to 40 to 60% of CPA cases)[8] .

During all CPA care, the reversible causes (5h and 5t) must be identified and treated, before considering the interruptions of the maneuvers. In the most recent and current publications on COVID-19 there is a special consideration for hypoxia, acidosis and coronary thrombosis. In mechanically ventilated patients, the adoption of protective ventilation strategies is recommended, however cases of pneumothorax were observed and should be strongly considered in any ventilated patient with sudden respiratory worsening[8,16].

The decision-making processes to initiate or not CPR must continue to be individualized in pre-hospital care services, emergency departments and ICU. One must always take into account the benefits to the patient, the safety and exposure of the team and the potential futility of the maneuvers[2,17,18]. CPR must always be carried out, unless previously defined directives indicate otherwise. Decisions/policies for "no cardiopulmonary resuscitation" (NRCP) must be properly documented and communicated to the team17, and, similarly to palliative and terminal care, must follow local and institutional policy[1,2,17].

CPR should be initiated by chest compressions and the pace assessed quickly to determine the appropriate algorithm to be followed. However, in the presence of shocking rhythms (ventricular fibrillation and pulseless ventricular tachycardia) and a readily available defibrillator, defibrillation should occur as early as possible, even before the start of compressions, since the reestablishment of spontaneous circulation may contraindicate new resuscitation measures. It is noteworthy that, in cardiac arrests caused by COVID-19, 80% present electrical activity without pulse or asystole, which reduces the positive response to maneuvers, with survival and hospital discharge from about 15 to 20%[8,17].

As mentioned, CPR should be initiated by continuous chest compressions in adults. If the patient does not have an invasive/advanced airway installed (orotracheal tube, supraglottic device), the oxygen mask should be kept with low flow or a towel over the patient's mouth and nose, until the invasive airway is obtained; Chest compression movements can trigger the elimination of aerosols and should be initiated carefully. In children, preferentially perform CPR with compressions and ventilations with a Mask Valve Bag (BVM) coupled to the HEPA filter until the definitive airway is obtained (Figure 2 and Figure 3); since pediatric arrest is most often secondary to respiratory/hypoxic causes and compression-only CPR is known to be less effective in this population[1,7,18].

Fig.2: Bag-valve-mask device with HEPA filter.

Source: Guimarães et al. 2020[7].

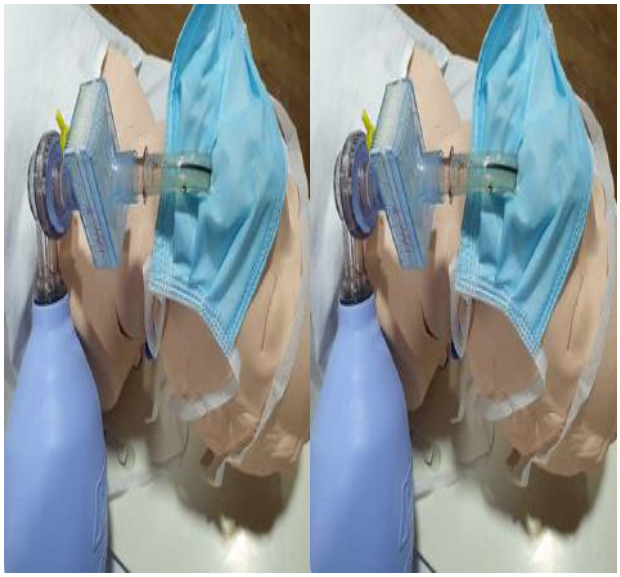

Fig.3: Intubated patient, with bag-valve-mask and HEPA filter and Patient with supraglottic device with HEPA filter, in addition to occlusion of the oral cavity with a mask.

Source: Guimarães et al. 2020[7].

The guidelines continue to recommend performing high-quality chest compressions, ensuring: Compression frequency from 100 to 120 compressions/minute; in adults, a depth of at least 5 cm (avoiding compressions deeper than 6 cm); in infants, depth of 1/3 of the anteroposterior diameter of the chest; and in children, 1/3 of the anteroposterior diameter of the chest or at least 5 cm; allow the complete return of the chest after each compression, avoiding leaning on the victim's chest; minimize interruptions in compressions, limiting pauses to a maximum of 10 seconds to perform two breaths or

checking pulse when applying the algorithm. Consider achieving the highest possible chest compression fraction, aiming for a minimum of 60% to 80%; take turns with another rescuer every 2 minutes to avoid tiredness and poor quality compressions; if the patient is in horizontal dorsal decubitus, perform compressions in the center of the chest, in the lower half of the sternum; understanding the particularities about the use of personal protective equipment for aerosolization by professionals, the high physical demand of the maneuvers, their potential for exhaustion and the need to minimize the team present in the resuscitation, the use of mechanical CPR devices is suggested for adults, if available[2,18].

For suspected or confirmed patients with COVID-19 who are prone (pronated) without an advanced airway, return to supine for CPR is recommended. 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 device and circuit avulsion (disconnection), which would generate aerosolization to the environment. Instead, the defibrillator adhesive pads (Figures 4 and 5) should be positioned anteroposteriorly and the CPR should be placed with the hands in a normal position, however, over the region of the T7/10 vertebrae (Figures 6 and 7)8.

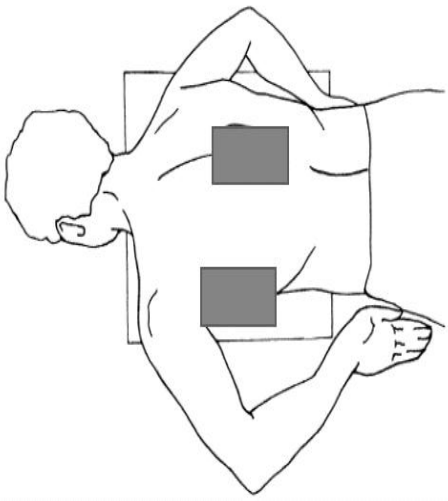

Fig.4: Suggested position of defibrillation paddles in prone patients.

Source: Guimarães et al. 2020[7].

Fig.5: Suggested paddle position for defibrillation in prone patients.

Source: Timerman et al. 2020[2].

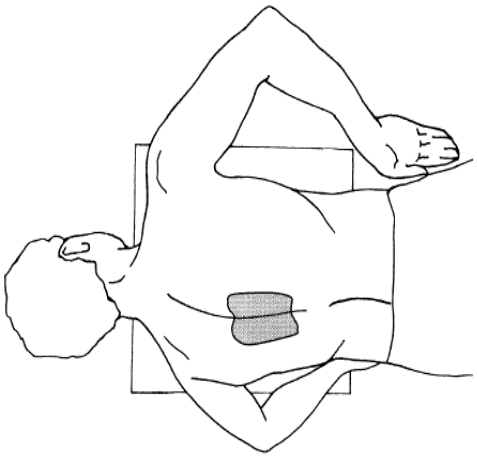

Fig.6: Place of the hands to perform compressions in patients in the prone position.

Source: Timerman et al. 2020[2].

Fig.7: Place of the hands to perform compressions in patients in the prone position.

Source: Timerman et al. 2020[2].

If defibrillation equipment is not available, a reasonable alternative is compression-only CPR, keeping the patient with a mask or towel over the mouth. Even with the guidance of some services so that the care of pre-hospital care for CPA, in the absence of a health professional, is performed only with CPR with the hands only ("hands only"), the care described above about sealing the patient's oral cavity for protection from aerosolization remains recommended[1,7,17].

Studies continue to recommend that monitoring to determine the rhythm/modality of CRP (shocking or non-shocking rhythm) should be carried out as soon as possible, in order not to delay defibrillation when indicated and to establish the appropriate algorithm. Defibrillation at shockable rhythms should not be postponed for airway access or any other procedures. If the patient has an oxygenation face mask before the occurrence of CPA, there is a recommendation to keep it until intubation, but without a high oxygen flow (6-10 liters/minute at most), increasing the risk of generating aerosol. If the patient does not have an airway device, the professional should place a cloth/towel over the victim's mouth and nose and perform continuous external chest compressions[1,2,7,17].

There is unanimity among specialists that defibrillation of shockable rhythms should not be postponed for airway access or other procedures. After this evaluation and defibrillation of shockable rhythms, intubation should be carried out at the first possible opportunity for a better ventilation/oxygenation pattern, since hypoxia is one of the main causes of CPA in these patients[1,7,8].

As the orotracheal intubation of critically ill patients diagnosed with Covid-19 related to severe ARDS was associated with episodes of contamination by health professionals, it is recommended that the procedure should be prioritized, in an attempt to promote airway isolation and reduce aerolization and be performed by the most qualified person on the team, aiming to optimize success, preferably in the first attempts. External chest compressions should be discontinued at the time of intubation and the use of a videolaryngoscope should be considered, if available, in an attempt to reduce the exposure of the intubator professional and assistants to aerosol particles generated by the procedure. It is recommended to use waveform capnography as the method of choice to confirm the correct positioning of the endotracheal tube[7,8].

Manual ventilation with BVM or endotracheal bag-tube should be avoided, due to the high risk of aerosolization and contamination of the assistant team. In situations of extreme need for ventilation with BVM, the technique for sealing the mask should involve two professionals (Figure 8), using an oropharyngeal cannula[8].

Fig.8: Manual ventilation with BVM and mask sealing technique involving two professionals.

Source: Machado et al. 2020[8].

If there is any delay in obtaining an advanced airway (intubation), ventilation with a supraglottic airway or with BVM with a HEPA filter should be considered. It is noteworthy that there is no consistent evidence showing that the use of supraglottic devices generate fewer aerosols than the BVM, there are, however, case reports showing good results and ease of insertion, making it possible to achieve sufficient sealing pressure and that their use can save hands of work, reducing the exposure of the assistant team. It is worth noting that new-generation supraglottic devices provide a conduit for tracheal intubation and that, in this context, mouth-to-mouth and mouth-to-mask ventilation are contraindicated[8].

When cardiopulmonary arrest occurs in patients already on mechanical ventilation, it is recommended to keep the patient connected to the ventilator, in a closed ventilation circuit, and adjust the parameters as follows: Volume mode, assist-controlled, adjusted to 6 mL/kg the predicted weight of the patient; 100% inspired oxygen fraction; respiratory rate around 10 to 12 breaths/minute and inspiratory time of 1 second; flow trigger: turn off sensitivity; if impossible, change the pressure sensitivity mode and adjust it to the least sensitive way possible (varies according to fan model from 15 to 20 cm H2O); positive end-expiratory pressure (PEEP) of zero; adjust alarms for maximum and minimum tidal volume alarms allowed by the equipment; maximum pressure alarms of 60 cm H2O and minimum of 1 or 0 cm H2O; minute volume alarms must allow the maximum and minimum of each device; the respiratory rate alarm set to the maximum allowed and the apnea time of 60 seconds; the same parameters must be adjusted in children[2,8].

It is mandatory to continuously assess whether the ventilator is managing to maintain these aforementioned parameters, without self-tripping associated with external chest compression, generating hyperventilation and air trapping with excessive pressures (systematically above 60 cm H20). In children, it may be necessary to disconnect from the ventilator, in this case, a valve bag connected to a HEPA filter must be used; some ventilators available on the market have the "CPR/CPA" function, which automatically adjusts the alarm limits and triggers the parameters aligned above[2,8].

In mechanical ventilation, it is recommended to install HEPA filters in the ventilatory circuit after the orotracheal tube, and another in the expiratory circuit path (Figure 7); the use of strong straight forceps is important to clamp (Figure 10) the tube when there is a need to change circuits/fans (mask valve bag for the mechanical ventilator circuit, for example), in order to minimize aerosolization; when applying defibrillation, for the safety of the team and the patient, the use of adhesive pads should always be preferred, which do not require the need to disconnect the ventilator to release the shock[2].

In the case of manual defibrillation paddles, the shock must be released after placing the ventilator in stand-by mode and disconnecting the orotracheal tube from the ventilator always after the HEPA filter, keeping it connected to the tube[1,2,7,8].

If return of spontaneous circulation is achieved prior to intubation, it is recommended that providers assess the need and potential benefit of intubation with respect to individual care goals. If mechanical ventilation is required, secure the endotracheal tube before disconnecting from the patient. Make sure a closed in-line suction system is connected. At the end of resuscitation attempts, everyone should carefully remove personal protective equipment and hand sanitize. It is recommended that staff watch themselves while removing personal protective equipment to monitor for possible violations of infection control procedures. Equipment must be cleaned, disinfected or disposed of in accordance with hospital protocols; carrying out procedures, communication, personal protective equipment and prevention of transmission COVID-19 are priority actions and focus of care. Any violations of personal protective equipment must be documented, reported and followed up in accordance with local protocols. Keeping a record of the team participating in the resuscitation to facilitate proper monitoring of infection control is necessary and recommended[17].

Considering recent therapies being tested with chloroquine or hydroxychloroquine and their potential risk to extend the QT interval in up to 17% of cases, it is essential to consider the risk of severe polymorphic ventricular arrhythmias, with special attention needed for torsades de pointes, and consequent occurrence of cardiorespiratory arrest in shocking rhythms, namely: Ventricular Fibrillation and Pulseless Ventricular Tachycardia. Patients at greatest risk for polymorphic tachycardias in this context are the elderly, females, Covid-19-related myocarditis, heart failure, liver or renal dysfunction, electrolyte disturbances (particularly potassium and magnesium reduction), bradycardia. Thus, it is essential to identify patients who already have arrhythmias, prolonged corrected QT interval (greater than 500ms) with daily ECG monitoring during the use of such drugs1,2,7,12.

Fig.9: Positioning the HEPA filter in the expiratory circuit.

Source: Machado et al. 2020[8].

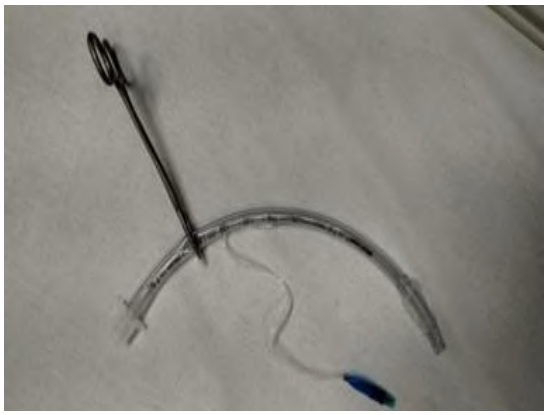

Fig.10: Endotracheal tube clamped with straight forceps.

Source: Guimarães et al. 2020[7].

Regarding guidelines in the pre-hospital setting, it is suggested that CPR should not be initiated in suspected or confirmed COVID-19 patients with obvious signs of death; professionals should use standard precaution +

aerosol for the care of suspected or confirmed victims COVID-19; guide the population that, when calling the Emergency Care Service - SAMU 192 (Brazil), they should inform if the victim is suspected of having COVID-19, this will facilitate the prior attire of the care team. It is suggested that the emergency medical service telephone operators and regulators carry out an active search for these patients, inquiring about flu-like symptoms, fever and dyspnea; perform continuous compressions. Mouth-to-mouth ventilation and the use of a pocket mask should not be performed for suspected or confirmed patients COVID-19; considering that most out-of-hospital cardiopulmonary arrests occur at home, in pediatric out-of-hospital CPA, the lay rescuer will most likely be a family member or caregiver of the child, who is already in close contact and exposed to secretions. In this case, the lay rescuer should perform compressions and consider mouth-to-mouth ventilation, if able and willing to do so, since most pediatric arrests occur for respiratory/asphyxial causes[2].

Compression-only CPR is a reasonable alternative if the rescuer is unable to ventilate or has had no prior close contact with the child; rescuers should place a cloth/towel over the victim's mouth and nose or position a mask with continuous low oxygen flow to prevent aerosol suspension during CPR; do not delay defibrillation: the early use of an Automated External Defibrillator (AED) is still recommended as it significantly increases the person's chances of survival and does not increase the risk of infection; positive pressure ventilation with Bag-Valve-Mask (BVM) should be avoided as much as possible and, if necessary, should be performed by two professionals, one of whom is solely responsible for coupling the mask to the patient's face, as appropriately as possible , preventing air leakage. BVM should only be used with a HEPA filter interposed to the mask[2,17].

One of the technologies that facilitate CPR are mechanical chest compression devices (DMCT). Although superiority for the patient has not yet been proven in comparison with manual external chest compressions, DMCTs are indicated by the AHA, in situations where high-quality manual compressions can be a challenge or dangerous for the professional, for example: limited availability of rescuers, prolonged resuscitation, resuscitation during a hypothermic cardiopulmonary arrest, cardiopulmonary resuscitation in a moving ambulance, and resuscitation in restricted locations[19].

Currently, there are two widely used devices approved by the Food and Drug Administration - federal agency of the US Department of Health and Human Services: the AutoPulse (Zoll Medical Corporation, Chelmsford, MA, USA) a charge-distributing band device that rhythmically compresses and constrains the chest wall and the LUCAS (Physio-Control /Jolife AB, Lund, Sweden) a piston device with a shell that is placed in the center of the chest and pushes the sternum down a distance of 5.2 cm and pull it back to neutral position. As they do not demonstrate better outcomes in the treatment of patients with CPA, manual chest compressions are still the recommended standard treatment. However, the use of these devices can be an alternative for less contact between the team and the patient, making it possible to reduce the number of professionals in the scene and bring the professional face to face with the victim[19].

In children, perform CPR preferably with compressions and ventilations with BVM coupled to the HEPA filter. Airway management, in the pre-hospital setting, should follow the recommendations mentioned above, in order to ensure that the bag-valve-masks and other ventilation equipment are equipped with HEPA filters, and an advanced airway (orotracheal intubation or device supraglottic) is installed early[1,2,7,8].

Open the transport vehicle's rear doors and activate the HVAC (Heating, Ventilation, and Air Conditioning) system during aerosol generation procedures (perform this procedure away from pedestrian traffic). Do not allow companions to be taken in the ambulance in the same compartment as the patient. Patients suspected or diagnosed with Covid-19 cannot have a companion at risk of contamination, according to the recommendations of the Ministry of Health (MS). It is suggested that caregivers go to the reference health unit by their own means for more information. If the vehicle does not have an insulated driver's compartment, open the external air vents in the driver's area and turn on the rear exhaust fans to the highest setting[2].

Management and organizational dimension of the multidisciplinary team in the management of patients diagnosed with or suspected of COVID-19 in CPA, who need CPR

The main updates and recommendations converge strongly to information about the specifics of CPR maneuvers in this scenario; focusing on the preparation of the environment, human and material resources, recognition of cardiac arrest and initial actions; ventilation strategies and invasive airway access; mechanical ventilator adjustments and CPR maneuvers in pronated patients. In addition to recommendations on ethical aspects involving protocols for starting CPR maneuvers and do-not-resuscitate orders in patients without clinical indication[2].

Emergency health actions are critical in terms of time and, in the initial approach phase, often carried out in confined spaces, the manipulation of the airways and

measures that favor the formation of aerosols are often carried out. Although inpatients are usually tested for an infection such as Covid-19 in the hospital, the status of the infection is often unknown in the initial approach, whether out-of-hospital or in-hospital. A SARS-CoV-2 infection and Covid-19 disease can only be determined in these cases on the basis of clinical or symptomatic judgment. Therefore, the use of adequate personal protective equipment that protects against the transmission of airborne infection in all patients with signs and symptoms suggestive of Covid-19 is mandatory[14].

SARS-CoV-2 is transmitted primarily through droplets. This type of transmission occurs when infectious droplets come into contact with the conjunctiva or mucosal surfaces of the upper respiratory tract, either directly transmitted by coughing or sneezing or by contacting a surface where the droplets have deposited. The use of personal protective equipment for isolation from respiratory contact (waterproof apron, N95 mask, face shield, caps, goggles and gloves) reduces the risk of transmission as it provides a physical barrier between the droplets and the entry port, and it is recommended in the consensus on to prevent the transmission of SARS-CoV-2[17,18].

Aerosol transmission is by smaller air-dissipated particles with a diameter of less than 5 µm, which arise from evaporative droplets in the water layer and which have a long range, can float in the air for a long period of time and probably represent an essential transmission mechanism for SARS-CoV-2[14].

Airborne transmission of SARS-CoV-2 can occur if aerosols are generated during specific procedures such as intubation and non-invasive ventilation. These aerosol-generating procedures are likely to result in an infectious aerosol beyond what would normally be released by coughing, sneezing, or breathing. These aerosols can remain suspended in the air for a period of time and can be inhaled, leading to healthcare provider infection. In this context, there is a consensus that the use of personal protective equipment is recommended for health professionals who perform aerosol generation procedures in patients with confirmed or suspected Covid-19[17].

In this context, the defined and recommended precaution (STANDARD + AEROSOL precaution) is indicated for all resuscitation team members, in order to ensure adequate individual protection during CPR. The ready availability of Personal Protective Equipment, such as clothing kits in the emergency car, will promote less delay in the beginning of chest compressions and continuity of care. It is a consensus that the following should be included in the personal protective equipment kit: cap, N95 mask, goggles, face shield, waterproof apron, long-length disposable gloves and pro-feet. Furthermore, although there may be delays in the beginning of chest compressions, the safety of the team is a priority and the use of adequate personal protective equipment is essential for those who care for an individual in cardiac arrest with confirmed or suspected Covid-19[2,16].

In particular, CPR should not be initiated on a suspected or confirmed Covid-19 patient until the team is fully clothed. It is recommended to restrict the number of professionals at the point of care (if it is a common single room). Hand hygiene plays an important role in reducing Covid-19 transmission. It is recommended that professionals sanitize their hands properly with soap and water, in case of dirt, or alcohol gel. It is important that all guidelines from the Ministry of Health and local governments are properly respected[1].

In the managerial and organizational dimension of the multidisciplinary team, it is important to anticipate the request for a bed in the ICU and respiratory isolation in case of return of spontaneous circulation. The recommendations converge to the disposal or cleaning of all equipment used during CPR following the manufacturer's recommendations and the institution's local guidelines. In addition, any work surfaces used to position airway/resuscitation equipment will also need to be cleaned in accordance with local guidelines, specifically, equipment used for interventions involving the airway (for example, laryngoscope, face masks, others) . It is recommended to check that such equipment has not been left on the patient's bed, it is suggested to leave them on a tray; ensure that the suction tube is not also on the patient bed, dispose of the contaminated end inside a disposable glove. Remove personal protective equipment safely to avoid self-contamination[1,16,17].

If resuscitation is unsuccessful, family members may be allowed to see the body in accordance with local hospital policies and infection control measures. However, restrictions in place due to Covid-19 can significantly disrupt the usual grief processes; for example, not being able to touch or kiss the deceased. If necessary, the support of Social Services and Psychology must be provided to family members in a safe place or via telehealth where Covid-19 prevents the visit. Appropriate personal protective equipment must be worn by staff when preparing the body for the morgue[17].

It is recommended that at the end of each procedure, a debriefing is performed, which is believed to stimulate improvements and growth of the assistant team. Furthermore, it is strongly recommended that simulations for training the correct placement and removal of personal protective equipment and CPA care should be carried out

as early as possible, and whenever possible by all teams involved in the care of patients suspected of or diagnosed with Covid- 19[1].

Decisions regarding termination of resuscitation must be made in accordance with currently accepted ethical standards. A cardiac arrest in a patient with Covid-19 infection and respiratory failure should prompt rapid assessment and treatment for potentially reversible causes. If no cause is identified, physicians should consider the futility of resuscitation in advance[8,16,17,18].

The changes described above require significant adaptation for many doctors, nurses, physiotherapists, nurse technicians and paramedics. All healthcare professionals must have regular personal protective equipment and advanced life support training, be able to access in situ simulation sessions, and receive extensive information after actual resuscitations. This will ensure safe, timely and effective management of the cardiac arrest patient with Covid-19[17].

Finally, it is noteworthy that nursing professionals are a strategic group to ensure the effectiveness and safety of care in cardiac arrest. This team, in most cases, is the first to identify and initiate care in hospital environments, and they are responsible for providing the essential materials that will support the care. Thus, it is extremely important that the entire nursing team is aligned and informed about the algorithms and care protocols for cardiac arrest in patients with suspected or diagnosed Covid-19[8].

IV. CONCLUSION

In the course of the current pandemic, it is recommended to consider each collapsed patient as a potential spreader of infection by Covid-19.

The risk of infection for health professionals on the assistant team who work to fight the disease is real and many have already died.

It is a consensus that CPR maneuvers are actions that generate aerosols, with the potential to infect healthcare professionals. Efforts to maintain the integrity of personal protective equipment are essential during CPR. In patients with multiple comorbidities and no return of spontaneous circulation, a sensible policy of not starting or not continuing CPR should be adopted.

Proper simulation training and exercises for putting on and taking off personal protective equipment in CPR are strongly recommended. All health services must constantly formulate and re-evaluate their guidelines, with the objective of maximizing results, without losing sight of the health professionals' protection strategies during CPR.

When facing a pandemic for a disease with high infectivity, in which many aspects are not fully understood, extremely serious clinical situations, such as CPA, become an additional challenge for the multidisciplinary team.

It was found that the information available in the literature on the subject is based on expert opinions, observational studies, case reports and experiences or single-center studies, in many cases with small samples, therefore not offering high levels of evidence.

A satisfactory knowledge of infection prevention and control, surveillance and protective measures, strict adherence to the placement and removal of personal protective equipment, and preparation for the care of infected patients are of fundamental importance. It was evident the importance that health professionals involved in the care of patients suspected or diagnosed with Covid-19 must follow with scientific rigor all established protocols for the care of CPA, aiming to minimize the risk of contagion by the virus and dissemination of the disease.

Understanding the current epidemiological factors of Covid-19 gives professionals better preparation to protect themselves during procedures that generate aerosols. Based on this understanding, it is recommended to strengthen cooperation between the care team, researchers and managers, for the development of research and continuous records of their practices, so that they can help in a better understanding of the nature of this disease, in particular in the context of cardiorespiratory arrest.

Finally, although the risks of infection presented by Covid-19 influence several aspects of the management of cardiac arrest, the basic principles of CPR remain the same. Prioritizing rapid defibrillation and addressing reversible causes of cardiac arrest continue to be recommended as critical interventions. Modifications include a greater emphasis on the safety of healthcare professionals and the use of appropriate personal protective equipment. Based on these findings, it is recommended that further studies be carried out, with the aim of carrying out updates, which may be the object of other future research and, consequently, updates to the guidelines.

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