Over recent months legitimate concerns have been raised by healthcare staff, in all care settings, regarding the risk of the transmission of coronavirus while performing cardiopulmonary resuscitation (CPR). Along with a number of national bodies, the Resuscitation Council (UK) has responded swiftly to these concerns by providing new advice and guidelines – such as RCUK (2020a; b; c; d) – when resuscitating patients with Covid-19 or suspected Covid-19; these are aimed at minimising the risk to rescuers while maximising the best outcomes for patients.

This article outlines the latest advice and guidance relating to resuscitation and the patient with Covid-19. Throughout this article, Covid-19 refers to both confirmed and suspected cases.

Safety

Historically, guidelines for resuscitation have always stressed that “your personal safety and that of resuscitation team members is the first priority during any resuscitation attempt” (RCUK, 2015a). The current pandemic poses serious health risks to nurses and other healthcare workers when resuscitating patients with Covid-19 and nurses must remember their Code and “take account of your own personal safety as well as the safety of people in your care” (Nursing and Midwifery Council, 2018). It is paramount that nurses ensure their own safety first, and follow the appropriate advice and guidance for personal protective equipment (PPE) and local protocols (RCUK, 2020a; b; c; d).

Decisions about emergency care and resuscitation

Evidence from Wuhan, China, suggests that patients with Covid-19 who require intubation and ventilation have poor survival rates (Shao et al, 2020); it is probable that these rates will be substantially lower following a cardiac arrest (Fritz and Perkins, 2020). As there will undoubtedly be pain and suffering for these patients if they are resuscitated, together with the risk to staff, there is a moral imperative to identify those who are deteriorating and either intervene to prevent cardiac arrest or have honest discussions with the patient and those close to them concerning potential outcomes.

Keywords
Resuscitation/Covid-19/Coronavirus/Infection prevention/PPE

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In this article...
- Caring for patients with Covid-19 who are at risk of cardiac arrest
- Use of infection prevention precautions during a resuscitation attempt
- Discussing resuscitation and end-of-life care with patients who have Covid-19

How to ensure safe and effective resuscitation for patients with Covid-19

Key points

The coronavirus pandemic poses serious health risks to health workers when resuscitating patients with Covid-19

Health professionals must discuss Do Not Attempt Cardiopulmonary Resuscitation (DNACPR) decisions with the patient, or those close to the patient if the patient lacks mental capacity

Care for people with Covid-19 should aim to identify those who are deteriorating, treat them effectively and prevent cardiac arrest

There is confusion around guidance on personal protective equipment for the resuscitation of patients with Covid-19

The Resuscitation Council (UK) advises that chest compressions are an aerosol-generating procedure requiring level 3 PPE

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Abstract
Caring for patients who are critically ill with Covid-19 presents a number of complex challenges including decisions regarding resuscitation and concerns about use of personal protective equipment while undertaking chest compressions. This article explores these issues, summarises recent guidance and provides an overview of what nurses should do when patients with confirmed or suspected Covid-19 require resuscitation.

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prognosis in the event of a cardiac arrest (Fritz and Perkins, 2020).

Decisions on resuscitation status have undoubtedly been influenced by Covid-19 and are crucial in these unprecedented times. Wherever possible, it is important to avoid the need for CPR when it is not in the best interests of the patient. The RCUK (2020e) has not advocated any form of blanket approach to these decisions. The Royal College of Nursing (2020) stresses that it is a requirement for health professionals to discuss Do Not Attempt Cardio-pulmonary Resuscitation (DNACPR) decisions with the patient or, if the patient lacks mental capacity and high-quality communication is required, with those close to the patient.

The NMC and the General Medical Council (2020) recently issued a joint statement, emphasising the need to provide individualised care, particularly relating to DNACPR directives. They noted that “person-centred individualised care is at the heart of clinical practice. The pandemic does not permit any health or care professional to deviate from that approach by making decisions on a group basis”. As such, it is important DNACPR decisions are well documented and communicated.

Recommended treatment

Having conversations to understand and record patients’ wishes about resuscitation has never been more important than during the current coronavirus pandemic. The Recommended Summary Plan for Emergency Care and Treatment (ReSPECT) process provides health professionals and patients with an individualised framework to help them discuss, and support decision making about, future care and treatment, such as admission to an intensive care unit or being ventilated (RCN, 2020).

When the ReSPECT approach is used, it is important to make sure that conversations with the specific individuals concerned remain at the heart of the process (RCUK, 2020f).

Prevention of cardiac arrest

The plan of care for people with Covid-19 should aim to identify those who are deteriorating and treat them effectively with the objective of preventing cardiac arrest and the subsequent need to undertake resuscitation. Responding to the coronavirus pandemic, the Royal College of Physicians (2020) suggests that:

- The patient’s respiratory function should be carefully monitored as it can quickly deteriorate, leading to a rapid increase in oxygen requirements. This may not be associated with a significant rise in the NEWS2 score so any increase in oxygen requirements should trigger a timely escalation call to a competent professional;
- While awaiting senior clinical review of the patient, NEWS2 observations should be recorded at least hourly.

Personal protective equipment

There is currently uncertainty and confusion around personal protective equipment (PPE) guidance for resuscitation in patients with Covid-19 (Ford, 2020). RCUK (2020g), in line with other national and international bodies, advises that chest compressions are an aerosol-generating procedure (AGP) requiring level 3 PPE; however, Public Health England (2020) advises that chest compressions are not an AGP and, so, only level 2 PPE is required. This confusion has made guidelines difficult to write and, consequently, a lack of clarity around PPE has been observed during resuscitation situations involving patients with Covid-19.

The confusion also poses a dilemma at organisation level: what guidance should organisations adopt and cascade to staff to protect themselves, their colleagues and their families?

A recent systematic review found that there was limited evidence that chest compressions or defibrillation cause aerosol generation or transmission of Covid-19 to rescuers but the authors concluded there was an urgent need for further studies (Couper et al, 2020). More importantly, there is no evidence that chest compressions are not an AGP.

We have a combined total of over 70 years’ clinical experience and have attended many cardiac arrests during which patients have coughed and spluttered while chest compressions were being performed, so it is baffling that PHE has disagreed with RCUK about chest compressions being an AGP. However, there does appear to be some compromise, with PHE allowing healthcare providers to make their own local decisions regarding PPE and resuscitation. In addition, the RCUK (2020c) now advises that, if level 3 PPE is not available, the patient’s nose and mouth should be covered with a cloth and only chest compressions should be performed, with no ventilations.

In the clinical situation, cardiac arrest team members need to don level 3 PPE for resuscitation because airway interventions and manual ventilation are considered AGPs (PHE, 2020; RCUK, 2020a). In practice, while cardiac arrest team members quickly get prepared, defibrillation will be given priority before chest compressions (see ‘Chest compressions and AGP airway manoeuvres’, pg3); as such, by the time chest compressions need to start, a member of the team who is already wearing level 3 PPE will usually be available.

Communication

Good communication is paramount between members of the cardiac arrest team in any emergency situation. Most of this communication will be verbal, between team members themselves and with the patient; however, with all members of the team wearing a visor and mask, being able to hear each other over the background noise is challenging and facial expressions can be difficult to interpret.

Knowing who is who is also important. Who has what skillset? What role does each member have? When every member of staff is wearing the same blue scrubs and face-covering PPE, it can be almost impossible to recognise individuals quickly. For team leaders, delegating tasks to the team can also be difficult and presents an increased risk of miscommunication that leads to mistakes. There is often little room for this in an emergency and, to overcome these barriers, flexibility, adaptability and creativity in the team is called for. One solution that has been put into practice is team members quickly writing their position or role on their visor.

Preparation

In light of the risks outlined above, healthcare providers should have revised their resuscitation guidelines to reflect the risks associated with Covid-19. Cardiac arrest trolleys should be adequately stocked with recommended level 3 PPE for AGPs as dictated by local policy (RCUK, 2020a)[*] and the cardiac arrest team, along with all staff who could be required to attempt resuscitation on patients with Covid-19, should be:

- Trained using the revised RCUK (2020a) guidelines;
- Familiar with the safe use of PPE equipment.

The best way to achieve this is likely to be to run Covid-19 cardiac arrest simulation drills in relevant clinical areas. This will apply to every clinical and non-clinical setting.
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Fig 1. Advanced life support for patients with Covid-19 in acute hospital settings

Phase 1

Conversations and decisions on emergency treatment completed and documented

DNACPR?

Yes

No

Phase 2

End-of-life care

Unresponsive and not breathing normally

Call resuscitation team
State Covid-19

Assess rhythm

Phase 3

AGP PPE

Don PPE
CPR for 2 min
Minimise interruptions

Non-shockable
(PEA/asystole)

Don PPE
CPR for 2 min
Minimise interruptions

Shockable
(VF/pulseless VT)

Up to 3 shocks

Immediate post-cardiac arrest treatment

- Use ABCDE approach
- Aim for SpO2 of 94-98%
- Aim for normal PaCO2
- 12-lead ECG
- Treat precipitating cause
- Targeted temperature management
- AGP PPE if AGP interventions

Return of spontaneous circulation

- Use ABCDE approach
- Aim for SpO2 of 94-98%
- Aim for normal PaCO2
- 12-lead ECG
- Treat precipitating cause
- Targeted temperature management
- AGP PPE if AGP interventions

During CPR

- Ensure high-quality chest compressions
- Minimise interruptions to compression
- Give oxygen
- Consider reversible causes 4Hs and 4Ts (Box 1)
- Use waveform capnography
- Continuous compressions when advanced airway in place
- Use a viral filter with any ventilation device, including BVM device, SGA or ETube
- Vascular access (IV or IO)
- Give adrenaline every 3-5 minutes
- Give amiodarone after 3 shocks

Recommended PPE

Level 2
- Disposable gloves
- Disposable apron
- Fluid-resistant surgical mask
- Eye protection

Level 3 AGP PPE
- Disposable gloves
- Disposable apron
- Filtering face piece (FFP3) respirator
- Eye protection

Consider

- Ultrasound imaging
- Mechanical chest compressions to facilitate transfer/treatment
- Coronary angiography and percutaneous coronary intervention
- Extracorporeal CPR

PaCO2 = partial pressure of carbon dioxide; PEA = pulseless electrical activity; PPE = personal protective equipment; SGA = supraglottic airway; SpO2 = oxygen saturation; VF = ventricular fibrillation; VT = ventricular tachycardia.

Source: Resuscitation Council (UK) (2020a)
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Adult resuscitation in acute hospital settings

The adult advanced life support algorithm for patients with Covid-19 in acute hospital settings, recently formulated and published by RCUK (2020a), outlines the procedure for resuscitation in hospital. It consists of three distinct phases that are aimed at minimising the infection risk to rescuers, while achieving the best possible outcomes for patients (Fig 1).

● Phase 1 stresses it is far better to minimise the requirements for CPR. All patients should be reviewed to ascertain whether a DNACPR directive should be agreed and put in place. A track-and-trigger system, such as NEWS2 (RCP, 2020), should be used to identify and escalate patients who are deteriorating. Treatment planning using the ReSPECT process is also recommended (RCUK, 2020a).

● Phase 2 emphasises the need to determine promptly whether defibrillation is needed – this requires level 2 PPE to protect against droplets;

● Phase 3 involves chest compressions and airway interventions that are AGPs, requiring all team members to have level 3 PPE.

Confirming cardiac arrest

In patients with confirmed or suspected Covid-19, cardiac arrest should be confirmed by:

● Looking for the absence of signs of life and normal breathing;

● Palpation for a carotid pulse – if you are trained to do so.

Do not listen or feel for breathing by placing your ear and cheek close to the patient’s mouth. Minimum level 2 PPE is required to safely assess patients, but it is important to consult local policies and procedures.

When making an adult emergency (2222) call, as well as stating cardiac arrest and the location (following local protocols), also state “risk of Covid-19”.

Defibrillation

Defibrillation is not currently considered to be an AGP so if you are wearing level 2 PPE, attach a defibrillator and, if a shockable rhythm is present, defibrillate immediately. Ideally, chest compressions (see ‘Chest compressions and AGP airway manoeuvres’) are delivered between shock attempts but, while waiting for colleagues to don level 3 PPE, repeat defibrillation if required – up to three shock attempts should be made. If rescuers are already wearing level 3 PPE, chest compressions can be given between shocks as is usual practice.

If an automated external defibrillator (AED) is used and the rhythm is shockable, the device will deliver the first shock. You should then wait for staff with level 3 PPE to arrive before starting chest compressions.

Chest compressions and AGP airway manoeuvres

Chest compressions are considered an AGP (RCUK, 2020a,g) and, therefore, all team members present should be wearing level 3 PPE before chest compressions are started. Mouth-to-mouth or pocket mask ventilation should not be undertaken. It must be stressed that no airway procedures or ventilation should be undertaken without full level 3 PPE (RCUK, 2020a). In addition, a viral filter between the self-inflating bag and airway should be used (Fig 1).

While waiting for the bag/mask device to arrive, if the patient was receiving supplementary oxygen before collapse, leave the mask in situ or, if one is easily accessible, put it on the patient’s face. This creates a barrier that may limit aerosol/droplet spread while chest compressions are being performed (RCUK, 2020a).

Restricting staff numbers

It is important to limit numbers around the bed space, particularly if the room is small. Where possible, allocate a gate-keeper to control number of people entering the room.

Reversible causes

It is important to identify and treat any reversible causes of cardiac arrest; these can be identified using the 4H and 4T mnemonic (Box 1). When caring for people with Covid-19, respiratory-related reversible causes such as severe hypoxaemia and tension pneumothorax should be prioritised before considering stopping CPR.

Care of equipment used during resuscitation

It is important to dispose of, or clean, all resuscitation equipment in line with manufacturers’ recommendations and local guidelines. Care should be taken with used disposables. As an example, oropharyngeal suction catheters are often placed under the patient’s pillow and are, therefore, easy to forget; the contaminated end of the catheter should be put inside a disposable glove when disposed of.

Remove PPE carefully and safely following local policy, preferably with a ‘buddy’ to avoid self-contamination, and dispose of clinical waste bags as per local guidelines. Remember to follow relevant hand-hygiene protocols at all times.

Post-resuscitation debrief

A structured post-resuscitation debrief should be undertaken after a Covid-19 resuscitation attempt. It is important to look after staff members’ mental health and wellbeing, and it may be necessary to seek local specialist help and advice. It is also important to learn from the resuscitation attempt to identify what went well, as well as areas that require improvement and further education.

Prostrate position

The prone position (lying patients on their front) can be used to improve ventilation in those with Covid-19 (Ghelichkhani and

Box 1. Identifying reversible causes of cardiac arrest: the 4H and 4T approach

Reversible potential causes or aggravating factors must be considered during all cardiac arrests. These are divided into two groups known as the 4Hs and 4Ts.

The 4Hs

● Hypoxia – inadequate supply of oxygen to the tissues

● Hypovolaemia – decreased volume of circulating blood

● Hyperkalaemia – elevated level of potassium in the blood

● Hypothermia – low body temperature

The 4Ts

● Coronary thrombosis – blood clot in a coronary artery

● Tension pneumothorax – accumulation of air under pressure in the pleural space

● Cardiac tamponade – collection of fluid in the pericardium surrounding the heart, resulting in compression of the heart

● Ingestion of therapeutic or toxic substances such as opiates, carbon monoxide

Source Resuscitation Council (UK) (2015b)
Esmaeili, 2020). This technique can pose obvious difficulties when chest compressions are needed. RCUK (2020b) states that chest compressions should be started posteriorly, using the conventional technique of compressing the spine in between the scapulae, without any initial change in position.

The placement of an arterial cannula and end-tidal carbon dioxide monitoring allows the effectiveness of posterior chest compressions to be measured. If deemed ineffective, counter pressure may be required on the sternum. If the effectiveness of the compressions has still not improved, the patient may need to be turned into the supine position (lying on their back) (Working Group of the Resuscitation Council (UK) et al, 2014). It should be noted, this guidance was intended to be specific to neurosurgery patients who may have head clamps applied during surgery.

Changing from prone to a supine position carries significant clinical risks, including endotracheal tube displacement, placement of arterial lines and monitoring equipment; staff are also at risk of manual handling injuries (Intensive Care Society, 2019). Often, cardiac arrests on intensive care units are anticipated due to the close monitoring of these patients – as such, there may be an opportunity to change the position of a patient to a supine position before the arrest, in preparation for chest compressions.

**Resuscitation in non-acute hospital settings**

RCUK (2020b) has issued guidance on the resuscitation of patients with Covid-19 in primary and community health care settings. The principles are the same as those described above for acute hospital settings but there is also a particular emphasis on the needs of children. Often, the timing of CPR is unexpected as the patient is not anticipated to arrest, as such, there may be an opportunity to change the position of the child to a supine position before the arrest, in preparation for chest compressions.

**Box 2. Further information**

The coronavirus pandemic is a fast-moving situation; guidelines are therefore being updated and revised as the evidence base and clinical experience develop. For the latest information regarding resuscitation and patients with Covid-19, visit the Resuscitation Council (UK)’s website at www.resus.org.uk. For the latest information on managing patients with Covid-19, visit www.icmanaesthesiaCovid-19.org. This website was recently set up by a number of national bodies including the Intensive Care Society.

An AED should be used as soon as possible, as this intervention will significantly increase the patient’s chances of survival. If Covid-19 is confirmed or suspected:

- Use PPE equipment, including an FFP3 facemask, disposable gloves and eye protection if this is available;
- Place a cloth or towel over the patient’s mouth and nose – this may help to limit aerosol/droplet spread before starting compressions-only CPR;
- After the procedure, wash your hands thoroughly with soap and water, or use an alcohol-based hand gel and seek advice from the NHS 111 coronavirus advice service or a medical adviser.

**Paediatric resuscitation**

**In hospital**

The RCUK’s (2020d) algorithm, Paediatric Advanced Life Support for Covid-19 Patients, is very similar to that for adults. However, ventilations and oxygenation (not chest compressions and defibrillation) are the priority in children. In addition, cardiac arrests in children are rarely sudden events; usually there is a period of deterioration first. It is important to ensure level 3 PPE is immediately available to use and in some situations it will be practical to don it in preparation for having to start CPR.

**In the community**

In the community, cardiac arrest in children is usually caused by a respiratory problem and the priority, initially, is oxygenation. It is likely the rescuer will know the child and, although there is a cross-infection risk associated with Covid-19, this is small compared with not performing rescue breaths – which will result in certain cardiac arrest and death. Again, it is important to call 999 as soon as possible.

**Conclusion**

Covid-19 presents healthcare staff with unprecedented challenges and difficulties. Nurses must ensure they remain up to date with national guidelines – resources highlighted in Box 2 will help with this – and that patients still receive individualised care and treatment. The professional requirement for nurses to ensure their own safety as well as the safety of their colleagues and patients relating to Covid-19 is also important.

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