4 Pre-hospital cardiac arrest

Introduction

A pre-hospital chapter has been included for the first time in the Resuscitation Council (UK) Guidelines. The aim is to bring together those resuscitation topics of specific relevance to the pre-hospital emergency medical services. These topics comprise:

- telephone-advised cardiopulmonary resuscitation (CPR);
- CPR versus defibrillation first;
- pre-hospital airway management;
- rules for stopping resuscitation.

Telephone-advised CPR

Telephone-advised CPR has been included in the 2010 RC(UK) Guidelines because:

- there is widespread use of telephone triage systems that include advice for a rescuer attending a cardiac arrest victim;
- the wide availability of mobile phones makes it likely that there will be a phone available at the site where the victim has collapsed;
- there is robust research examining best practice of both the diagnosis of cardiac arrest by telephone and also the content and delivery of subsequent instructions provided to rescuers;[18, 19, 28]
- in adults, telephone-advised compression-only CPR produces better survival rates than telephone-advised conventional CPR (chest compressions and mouth-to-mouth ventilation);[19a]
- the time to first chest compression can be reduced significantly if a lay bystander can deliver compressions while waiting for professionals to arrive.

Telephone triage guidelines

Telephone triage is used throughout the UK to grade the urgency of emergency calls to the emergency medical services (EMS) and is becoming an integral part of the chain of survival for victims of cardiac arrest. As part of the call, if appropriate, call handlers will offer BLS instructions to the caller.[29-31] After out-of-hospital cardiac arrest, help from the EMS will be accessed by telephone and because of the widespread use of mobile phones it is common for a phone to be available at the point where resuscitation is

taking place. The opportunity to provide instructions by phone on how to give BLS enables the time to the first cardiac compression to be reduced dramatically, compared with waiting for the arrival of the EMS. The shorter the time until cardiac compressions are commenced, the higher the survival rate. However, significant delays in giving advice over the phone and/or poor quality CPR will limit the benefits.[31]

Standardised advice to bystanders should increase the chance that the cardiac arrest will be diagnosed and treated correctly. Further research on this topic will help to improve outcome.

Telephone triage systems

In the UK, call handlers who answer 999 calls generally have no background medical training apart from that provided when they were trained to use the system. They read the triage questions from a screen and the deviation allowed from the precise wording in either the question or the advice supplied, varies from supplier to supplier.

Wording

The wording of both the questions asked and the instructions offered must be understood not only by the caller, but also by the call handler who is relaying the questions and advice from a screen. Instructions must be brief, clear and memorable. Medical jargon must be avoided. The call handler is permitted some flexibility in wording to clarify the meaning to the caller but too much flexibility may give rise to ambiguity and lengthen the call.

Diagnosis

The diagnosis of cardiac arrest may be difficult over the telephone. Palpation of the carotid pulse by laypeople is unreliable for the diagnosis of cardiac arrest.[32] Absence of breathing can be a better indicator of cardiorespiratory arrest, but many cardiac arrest victims gasp initially (agonal breathing) and this is often misinterpreted by the lay rescuer as breathing.[10] Consequently, the call handler should ask if the victim is “breathing normally” instead of simply “breathing”. A few cardiac arrest victims will display some seizure activity. Seizure activity as a feature of cardiac arrest can cause confusion and delay the correct diagnosis. Asking whether the patient is a known epileptic may help to reduce the risk of patients with epilepsy receiving bystander CPR inadvertently.[33]

These challenges may be compounded by a caller (rescuer) who is very distressed, may not have any support, and who may fear providing medical intervention for reasons unknown to the dispatcher.

Education of call handlers

Call handlers must be trained in the management of cardiac arrest and choking in all age groups, so that they can appreciate the instructions that they are giving. Giving the call handlers background information about the decay in survival by delaying BLS will make them aware of the urgency of the instructions. They also need to be trained to handle very distressed callers.

Telephone-advised compression-only CPR

When EMS response times are short (less than 5 min), there is some evidence that compression-only CPR produces at least equivalent outcomes to conventional CPR (chest compressions and mouth-to-mouth ventilation).[14] In adults, telephone-advised compression-only cardiopulmonary resuscitation (CPR) produces better survival rates than conventional CPR.[19, 19a, 28, 30] Rescuers may be more willing to give resuscitation if they do not have to provide ventilation.[34] In children 70% of out-of-hospital cardiac arrests are asphyxial in origin and survival rates are better if they are provided with both chest compressions and ventilations.[21] However, after cardiac arrest from a primary cardiac cause, even in children there is no difference in survival after compression-only or conventional CPR – either technique produces better survival rates than no CPR.[21] Telephone-advised CPR guidelines should provide instruction in compression-only CPR for both adults and children because it is quicker and easier to describe.[35] A rescuer receiving telephone advice is unlikely to provide effective ventilation and this would simply delay effective chest compressions.

CPR versus defibrillation first

Several studies have examined whether a period of CPR before defibrillation is beneficial, particularly in patients with an unwitnessed arrest or prolonged collapse without resuscitation. A review of evidence for the 2005 guidelines resulted in the recommendation that it was reasonable for EMS personnel to give a period of about 2 min of CPR (i.e. about five cycles at 30:2) before defibrillation in patients with prolonged collapse (> 5 min).[36] This recommendation was based on clinical studies in which response times exceeded 4-5 min and in which a period of 1.5 to 3 min of CPR by paramedics or EMS physicians before shock delivery improved return of spontaneous circulation (ROSC), survival to hospital discharge[37, 38] and one-year survival[38] for adults with out-of-hospital VF/VT compared with immediate defibrillation.

In contrast, in two randomised controlled trials, a period of 1.5 to 3 min of CPR by EMS personnel before defibrillation did not improve ROSC or survival to hospital discharge in patients with out-of-hospital VF/VT, regardless of EMS response interval.[39, 40] Four other studies have also failed to demonstrate significant improvements in overall ROSC or survival to hospital discharge with an initial period of CPR,[37, 38, 41, 42] although one did show a higher rate of favourable neurological outcome.[41]

The duration of collapse is frequently difficult to estimate accurately and there is evidence that performing chest compressions while fetching and charging a defibrillator improves the probability of survival.[43] For these reasons, in any cardiac arrest that they have not witnessed, EMS personnel should provide good-quality CPR while a defibrillator is fetched, applied and charged, but routine delivery of a specified period of CPR (e.g. 2 or 3 min) before rhythm analysis and shock delivery is no longer recommended.

Pre-hospital airway management

There is insufficient evidence to support or refute the use of any specific technique to maintain an airway and provide ventilation in adults with pre-hospital or in-hospital cardiac arrest. Tracheal intubation has been perceived as the optimal method of providing and maintaining a clear and secure airway during cardiac arrest but data are accumulating on the problems associated with pre-hospital intubation. It is now strongly recommended that tracheal intubation should be used only when trained personnel are available to carry out the procedure with a high level of skill and confidence. In the absence of experienced personnel the use of supraglottic airway devices (SADs) during CPR is probably more rational. However, there are only poor-quality data on the pre-hospital use of these devices during cardiac arrest. The use of SADs is discussed in more detail in the advanced life support (ALS) chapter.

Tracheal intubation

The perceived advantages of tracheal intubation over bag-mask ventilation include: enabling ventilation without interrupting chest compressions,[44] enabling effective ventilation (particularly when lung and/or chest compliance is poor), minimising gastric inflation and therefore the risk of regurgitation, protection against pulmonary aspiration of gastric contents, and the potential to free a rescuer's hands for other tasks.

Use of the bag-mask is more likely to cause gastric distension, which, theoretically, is more likely to cause regurgitation and aspiration. However, there are no reliable data to indicate that the incidence of aspiration is any higher in cardiac arrest patients ventilated using a bag-mask compared with those ventilated via a tracheal tube.

The disadvantages of tracheal intubation over bag-valve-mask ventilation include:

- The risk of an unrecognised misplaced tracheal tube – in patients with out-of-hospital cardiac arrest, the documented incidence ranges from 0.5% to 17% (emergency physicians 0.5%;[45] paramedics 2.4%,[46] 6%,[47, 48] 9%,[49] 17%,[50]).
- A prolonged period without chest compressions while intubation is attempted: in a study of pre-hospital intubation by paramedics during 100 cardiac arrests, the total duration of the interruptions in CPR associated with tracheal intubation attempts was 110 s and in 25% the interruptions were for more than 3 min.[51]

- A comparatively high failure rate: intubation success rates correlate with the experience of the intubator.[52]

Healthcare personnel who undertake pre-hospital intubation should do so only within a structured, monitored programme, which should include comprehensive competency-based training and regular opportunities to refresh skills. Rescuers must weigh the risks and benefits of intubation against the need to provide effective chest compressions. The intubation attempt may require some interruption of chest compressions but, once an advanced airway is in place, ventilation will not require interruption of chest compressions. Personnel skilled in advanced airway management should be able to undertake laryngoscopy without stopping chest compressions; a brief pause in chest compressions will be required only as the tube is passed through the vocal cords. Alternatively, to avoid any interruptions in chest compressions, the intubation attempt may be deferred until return of spontaneous circulation.[53, 54] No intubation attempt should interrupt chest compressions for more than 10 s; if intubation is not achievable within these constraints, recommence bag-mask ventilation. After intubation, confirm correct tube placement and secure the tube adequately.

Confirmation of the correct placement of the tracheal tube

Waveform capnography is the most sensitive and specific way to confirm and monitor continuously the position of a tracheal tube in victims of cardiac arrest and should supplement clinical assessment (auscultation and visualisation of the tube passing between the vocal cords).[55] Waveform capnography will not discriminate between tracheal and bronchial placement of the tube – careful auscultation is essential. Existing portable monitors make capnographic initial confirmation and continuous monitoring of tracheal tube position feasible in almost all settings where intubation is performed, including out of hospital.

Rules for stopping resuscitation

Following out-of-hospital cardiac arrest, failure of ALS-trained EMS personnel to achieve ROSC at the scene is associated with an extremely low probability of survival. The rare exception, where the transfer to hospital of a patient with ongoing CPR results in long-term good quality survival, is usually associated with special circumstances, such as pre-existing hypothermia or drug overdose. For this reason, attempts have been made to formulate and validate rules for stopping resuscitation that allow EMS personnel to stop the resuscitation attempt and pronounce life extinct without transporting the victim to hospital. One such rule recommends stopping CPR when there is no return of spontaneous circulation, no shocks are administered, and the arrest is not witnessed by EMS personnel.[56] However, this rule was validated with defibrillation-only emergency medical technicians in Canada and may not apply to an EMS system staffed by paramedics. In the UK, guidelines from the Joint Royal Colleges Ambulance Service Liaison Committee (2006), advise that ambulance clinicians may stop resuscitation if **all** of the following criteria are met:

- 15 min or more has passed since the onset of collapse.
- No bystander CPR was given before arrival of the ambulance.
- There is no suspicion of drowning, hypothermia, poisoning/overdose, or pregnancy.
- Asystole is present for more than 30 s on the ECG monitor screen.

Pre-hospital resuscitation attempts are also generally discontinued if the rhythm remains asystole despite 20 min of advanced life support (ALS) except in cases of drowning and hypothermia.