Prevention of in-hospital cardiac arrest and decisions about cardiopulmonary resuscitation

Introduction

This new section of the Resuscitation Council (UK) guidelines stresses the importance of preventing cardiac arrest in all age groups, and of identifying patients for whom cardiopulmonary resuscitation is inappropriate.

Prevention of in-hospital cardiac arrest

Rates of survival and complete physiological recovery following in-hospital cardiac arrest are poor in all age groups. For example, fewer than 20% of adult patients having an in-hospital cardiac arrest will survive to go home.[1] Cardiac arrest is rare in both pregnant women and children, but outcomes after in-hospital arrest are also poor. Preventative strategies for each of these groups will be considered separately here.

Adults

Most adult survivors of in-hospital cardiac arrest have a witnessed and monitored ventricular fibrillation (VF) arrest and are defibrillated immediately. The underlying cause of arrest in this group is usually primary myocardial ischaemia and an irritable myocardium. In comparison, cardiac arrest in patients in unmonitored ward areas is usually a predictable event not caused by primary cardiac disease. In this group, arrest often follows a period of slow and progressive physiological deterioration involving unrecognised or inadequately treated hypoxaemia and hypotension. The underlying cardiac arrest rhythm is usually asystole or PEA, and the chance of survival to hospital discharge is extremely poor.

Regular monitoring and early, effective treatment of seriously ill patients appear to improve clinical outcomes and prevent some cardiac arrests. Closer attention to patients who suffer a 'false' cardiac arrest may also improve outcome, as up to one third of these patients die during their in-hospital stay.

Deficiencies in acute care

Analysis of the critical events preceding many adult cardiac arrests demonstrates many significant antecedents, usually related to abnormalities of the airway, breathing, and circulation.[2] Often, medical and nursing staff do not possess acute-care knowledge and skills[3] and may lack confidence when dealing with acute-care problems. Specific areas of concern involve the incorrect use of oxygen therapy and a failure to monitor patients or to involve experienced senior staff in the immediate care of sick patients. Additional factors include a failure to use a systematic approach to the assessment of critically ill patients, poor communication, lack of teamwork, and insufficient use of treatment limitation plans.

Hospital processes may also have significant effects on patient outcome. For example, patients who are discharged from intensive care units (ICU) to general wards at night have an increased risk of in-hospital death compared to those discharged during the day and those discharged to high-dependency units. Higher nurse-patient staffing ratios are also associated with reduction in cardiac arrest rates, as well as rates of pneumonia, shock, and death.

Recognition of 'at-risk', or critically ill, adult patients

When patients deteriorate, they display common signs that represent failing respiratory, cardiovascular, and neurological systems. This is the basis for monitoring patients' vital signs. Abnormal physiology is common on general wards,[4] yet the important physiological observations of sick patients are measured and recorded less frequently than is desirable. Monitoring the respiratory rate is essential, as it may predict cardiorespiratory arrest.

In recent years, early warning scores (EWS), or 'calling-criteria' have been adopted by many hospitals to assist in the early detection of critical illness.[5] EWS systems allocate points to routine vital sign measurements on the basis of their deviation from an arbitrarily agreed 'normal' range. The weighted score of one or more vital sign observations, or more often the total EWS, is used to alert ward staff or critical care outreach teams to the deteriorating condition of the patient. Systems that incorporate 'calling-criteria' activate a response when one or more routinely measured physiological variables reach an extremely abnormal value. It might be supposed that a system that can track changes in physiology and warn of impending physiological collapse, rather than one that is triggered only when an extreme value of physiology has been reached, may detect acutely ill patients at an earlier stage.

The sensitivity, specificity, and accuracy of EWS or calling-criteria systems to identify sick patients have yet to be validated. Several studies have identified abnormalities of heart rate, blood pressure, respiratory rate, and conscious level as possible markers of impending critical events. However, as not all important vital signs are, or can be, recorded continuously in general ward areas, the ability of these systems to predict cardiac arrest remains unconfirmed. Gaps in vital sign data recording are common; the use of physiological systems can increase the frequency of vital sign monitoring. The medical and nursing response to a patient's abnormal physiology needs to be both appropriate and speedy, yet this is not always the case.

The clinical response

Traditionally, the response to cardiac arrest has been reactive, with a cardiac arrest team attending the patient after the cardiac arrest. The use of such teams appears to improve survival in circumstances where no coordinated cardiac arrest response previously existed. However, their impact in other settings is questionable. For example, in one study only patients who had return of spontaneous circulation before the cardiac arrest team arrived were alive at hospital discharge.[6] In some hospitals the role of the cardiac arrest team has been subsumed into that of the medical emergency team (MET). This team responds not only to cardiac arrests, but to patients with acute physiological deterioration. The MET usually comprises medical and nursing staff from

intensive care and general medicine and responds to specific calling criteria. MET interventions often involve simple tasks such as starting oxygen therapy and intravenous fluids.

The results of research into the benefits of introducing a MET are variable. Studies with historical control groups show a reduction in cardiac arrests, deaths and unanticipated intensive care unit admissions, improved detection of medical errors, treatment-limitation decisions, and reduced postoperative ward deaths. A cluster-randomised controlled trial of the MET system demonstrated that the introduction of a MET increased the calling incidence for the team, but did not reduce the incidence of cardiac arrest, unexpected death, or unplanned ICU admission.[7]

In the UK, a system of pre-emptive ward care, based predominantly on individual or teams of nurses known as critical care outreach, has developed.[8] Although the data on the effects of outreach care are also inconclusive, it has been suggested that outreach teams may reduce ward deaths, postoperative adverse events, ICU admissions and readmissions, and increase survival.

The role of education in cardiac arrest prevention

The recognition that many cardiac arrests may be preventable has led to the development of postgraduate courses specifically designed to prevent physiological deterioration, critical illness, and cardiac arrest (e.g. Acute Life Threatening Events – Recognition and Treatment: ALERT).[9] Early evidence suggests that they can improve knowledge and change attitudes about acute care. Courses, such as Immediate Life Support and Advanced Life Support, now also include sections related to this important topic. Other courses focus on managing sick patients in the first 24 hours of critical illness when more direct critical care expertise is not immediately available. It is recognised that training in acute and critical care should commence early, and many countries have established curricula for inclusion in undergraduate medical education programmes.

Pregnant patients

The latest report of the triennial Confidential Enquiry into Maternal and Child Health (CEMACH) suggests that more than half of pregnancy-related deaths were associated with substandard care.[10] In general, these were caused by errors in diagnosis or patient treatment, or failure to refer to senior colleagues. Staff failed to recognise and act on the common signs of critical illness. There was also a lack of communication and clinical teamwork. The CEMACH report makes several recommendations to prevent deaths associated with pregnancy, including the need for hospitals to implement, audit, and regularly update multidisciplinary guidelines for the management of women at risk of, or who develop, complications in pregnancy. It also recommends that clinical protocols and local referral pathways, including patient transfer, should be developed for pregnant women with pre-existing medical conditions, a history of psychiatric illness, and serious complications of pregnancy (sepsis, pre-eclampsia and eclampsia, obstetric haemorrhage). The routine emergency ‘fire drills’ for maternal emergencies, including cardiopulmonary resuscitation, is emphasised.

Children

In children, cardiopulmonary arrest is more often due to profound hypoxaemia and hypotension than primary cardiac disease. Ventricular fibrillation is less common than asystole or pulseless electrical activity. As with adults, there may be opportunities to introduce strategies that will prevent arrest.

There is already evidence of marked, often untreated, abnormalities of common vital signs in the 24 hours prior to the admission of children to an ICU, similar to those reported in adults.[11] Recognition of the seriously ill child relies on determination of the normal and abnormal age-related values for vital signs, and reassessing them in the context of the progression of the child's condition. As in adults, serial measurement of heart rate, respiratory rate, temperature, blood pressure, and conscious level, particularly following any clinical intervention, must be performed and acted upon. Intervention at an early stage in an unwell child reduces significantly the risk of developing irreversible shock. Systemic blood pressure decreases at a late stage in shock in the child compared with the adult, and should not be used as the sole determinant of whether or not treatment is required.

Paediatric emergency teams, responding to early warning scores, have been established in some hospitals[12] and appear to reduce the incidence of cardiac arrest.

Resuscitation decisions

Cardiopulmonary resuscitation was originally conceived to save the lives of patients dying unexpectedly – 'hearts too young to die'. In-hospital death now invariably involves attempted cardiopulmonary resuscitation, even when the underlying condition and general health of the patient makes success unlikely – 'hearts too bad to live'. However, even when there is clear evidence that cardiac arrest or death are likely, ward staff rarely make decisions about the patient's resuscitation status. Improved knowledge, training, and do-not-attempt-resuscitation (DNAR) decision-making should improve patient care and prevent futile CPR attempts. Patients for whom cardiopulmonary resuscitation will not prolong life, and may merely prolong the dying process, should be identified early.

A DNAR decision should be considered when the patient:

- does not wish to have CPR, or
- will not survive cardiac arrest even if CPR is attempted.

Recommended strategies for the prevention of avoidable in-hospital cardiac arrests

1) Place critically ill patients, or those at risk of clinical deterioration, in areas where the level of care is matched to the level of patient sickness.

2) Regularly monitor such patients using simple vital sign observations (e.g. pulse, blood pressure, respiratory rate). Match the frequency and type of observations to the severity of illness of the patient.

3) Use an EWS system to identify patients who are critically ill, at risk of clinical deterioration or cardiopulmonary arrest, or both.

4) Use a patient vital signs chart that encourages and permits the regular measurement and recording of early warning scores.

5) Ensure that the hospital has a clear policy that requires a clinical response to deterioration in the patient's clinical condition. Provide advice on the further clinical management of the patient and the specific responsibilities of medical and nursing staff.

6) Introduce into each hospital a clearly identified response to critical illness. This will vary between sites, but may include an outreach service or clinical team (e.g. MET) capable of responding to acute clinical crises. This team should be alerted, using an early warning system, and the service must be available 24 hours a day.

7) Ensure that all clinical staff are trained in the recognition, monitoring, and management of the critically ill patient.

8) Agree a hospital DNAR policy, based on national guidelines, and ensure that it is understood by all clinical staff. Identify patients who do not wish to receive CPR and those for whom cardiopulmonary arrest is an anticipated terminal event for whom CPR would be inappropriate.

9) Audit all cardiac arrests, 'false arrests', unexpected deaths, and unanticipated intensive care unit admissions, using a common dataset. Audit the antecedents and clinical responses to these events.

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