Review article

Redefining in-hospital resuscitation: the concept of the medical emergency team

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‘For it happens in this, as the physicians say it happens in hectic fever, that in the beginning of the malady it is easy to cure but difficult to detect, but in the course of time, not having been either detected or treated in the beginning, it becomes easy to detect but difficult to cure’.


Cardiopulmonary resuscitation (CPR) has evolved over centuries with the greatest progress being made in the last 4 decades [1]. In 1958 and 1960 key advances were described by Safar [2] and Kouwenhoven [3] which have now become the basis for modern day basic life support (BLS) CPR. Extending BLS, advanced life support (ALS) guidelines have been developed to deal with the complex scenarios that result in and accompany cardiac arrest situations [4–6]. Cardiopulmonary resuscitation (CPR) is accepted practice for sudden in-hospital and out of hospital death.

Cardiopulmonary resuscitation has become something of an industry. There are international organisations and conferences on resuscitation, numerous textbooks are written on the subject and journals, such as Resuscitation, are dedicated to improving resuscitation outcomes. Resuscitation features increasingly in the lay media. Television medical dramas commonly feature CPR. Interestingly, the results of television CPR are usually shown as successful and unrealistic in the US while in the UK the TV outcome is more likely to be bad and realistic [7,8]. The general public perception of outcome following CPR is overoptimistic while unfortunately CPR is usually a perimortem event.

A recent review stated that CPR will be futile in some victims of cardiac arrest [9]. In fact, the majority of patients requiring in-hospital CPR die before hospital discharge. Survival to discharge rates after in-hospital CPR vary from 1 to 2% [10] to around 14% [11,12]. Other studies indicate survival figures between these figures [13–19]. It is interesting to note that there has not been a demonstrated improvement in general mortality rates after in-hospital CPR over the last 30 years. This is in spite of the enormous resources devoted to CPR in terms of education, research and the clinician’s time as well as refinements and developments related to CPR.

Cardiopulmonary resuscitation has become something of a medical icon. Most are enthusiastic about its use in spite of the poor outcomes, few have urged restraint [20–22]. Increasingly there
are attempts to define patients that are likely to benefit from CPR but there are no clear guidelines on when CPR can be limited to likely survivors. It has been estimated that, in the USA, it costs approximately US $400 000 per life saved, to operate in-hospital CPR programs [23].

2. System failure

While a great deal of attention has focused on the performance of CPR surprisingly little has been directed on the issues behind in-hospital cardiorespiratory arrest. Most arrests do not occur unexpectedly or suddenly. In an illuminating study, Schien and colleagues demonstrated that 84% of patients had identifiable deterioration long before they had their arrest [24]. These included changes in breathing pattern, pulse rate and level of consciousness. In this study only 8% of patients who had CPR, survived to hospital discharge. Other studies have also demonstrated that in-hospital patients who arrest have easily detected and potentially preventable antecedent factors [25,26]. Other studies have documented very high preventable death rates in acute hospitals [27–29]. The general wards of acute hospitals have been identified as particularly dangerous areas, where cardiac arrest and CPR is associated with very poor outcomes [10,30]. The system for managing the seriously ill particularly in our general wards, may not be appropriate. In contrast, patients rarely die suddenly in ICU’s [31,32]. The majority die as a result of withdrawing and withholding treatment, rather than unexpectedly and suddenly arresting. Special areas such as emergency departments (EDs), intensive care units (ICUs) and high dependency units (HDUs) probably also provide an environment where early signs of deterioration are detected and staff trained in advanced resuscitation are available at all times.

As well as suffering cardiac arrest or death, patients may also deteriorate to the stage where they require admission to intensive care [30,33]. Many of these patients have the same easily identifiable antecedent factors as patients who suffer in-hospital cardiac arrest.

In short, there appears to be a systematic failure to recognise and respond rapidly to the seriously ill at all times with staff trained in advanced resuscitation. Peter Safar, one of the pioneers of resuscitation, said as long ago as 1974, ‘the most sophisticated intensive care often becomes unnecessarily expensive terminal care when the pre-ICU system fails’ [34].

The reasons for the system failing in general wards are probably related to a combination of factors. Nurses have traditionally recorded deteriorating signs and noted the patients who are ‘going off’, but have not been empowered, nor trained to act on these signs. They often usually rely on junior doctors who themselves have had little undergraduate training in advanced resuscitation [35,36]. Apart from some specialties such as Anaesthesia, Intensive Care Medicine and Emergency Medicine, there is little formal postgraduate training in advanced resuscitation. Although resuscitation courses such as Advanced Life Support (Resuscitation Council UK) [37] now supported by the European Resuscitation Council and Advanced Cardiac Life Support (American Heart Association) [38] are becoming increasingly common, even when resuscitation skills have been acquired, there may be no mechanism to see they are maintained.

Another reason is related to the hierarchal medical system where problems in acute hospitals are passed up through levels of seniority. Even when the acute resuscitation problem is referred to a senior clinician, they may not be available because of numerous commitments and they often lack comprehensive knowledge and practical skills in advanced resuscitation. With increasing specialisation, there are few generalists who have all the relevant skills and knowledge associated with the rapidly expanding area of acute medicine and critical care. Specialists in emergency medicine, intensive care medicine, anaesthesia and cardiology often possess these skills but they tend to practice within their own four walls; either because of lack of initiative or resistance amongst other physicians to give up patient ownership. Senior doctors sometimes consider that they ‘own’ patients, and with ownership there are many considerations, including financial, that can influence patient care. Senior doctors may be reluctant to give up ownership to a system-based approach for the seriously ill. While consultations with other professionals occur for more elective and time independent problems, the response to the seriously ill is often too little and/or too late.
Cardiac arrest teams are often the only systemised response to the seriously ill which cross specialty and hospital functional boundaries. Unfortunately the patient is frequently dead by the time the cardiac arrest team is called. Consequently, cardiac arrest teams, even if they had staff with formal training in all aspects of acute medicine, are called too late.

The breakdown of systematic identification of the seriously ill in our hospitals, combined with the failure to respond rapidly with trained personnel, not only results in cardiac arrests and deaths but also serious complications and increased lengths of stay. Potentially reversible factors precede admission to the ICU [30,33,39,40], promoting pleas to practice intensive care medicine outside the four walls of the ICU [41,42]. Many of the studies on matching oxygen delivery to oxygen consumption in the seriously ill demonstrated that a majority of patients were admitted to intensive care with hypovolaemia, hypotension, hypoxia and irreversible shock [43–47]. All of these reports involved patients who required an increase in the oxygen delivery to cells after admission to the ICU, usually by increasing cardiac output, often to supranormal levels. While some of these studies demonstrated an improvement in outcome, others showed no benefit [44,48]. Early restoration of normal oxygen delivery rather than late attempts to achieve supranormal levels would seem to have been more appropriate.

Similar failures have been encountered when specific anti-cytokine or anti-endotoxins have been employed in the seriously ill [49–52]. The search for expensive, specific pharmacological interventions (‘magic bullets’) in the seriously ill may not be the ideal direction for our future research. Once the complex cytokine cascade has been triggered, it appears to be too late to prevent tissue damage. This is not surprising as even minor degrees of ischaemia and hypoxia cause measurable cell damage [53–58]. The damage is often either irreversible or has to run its course with patients suffering multi-organ failure and having to be managed in ICUs. It may be more productive to channel our research into ways of detecting and correcting ischaemia at an earlier stage.

Rapid detection and early resuscitation of ischaemic and hypoxic states should be the priority in resuscitation research. There is a need to move from our current limited concept of CPR to a broader definition of resuscitation and what its aims are. Defining CPR as the only form of resuscitation is inappropriate. Resuscitation requires a 24-h service to every hospital patient who is at risk from even minor degrees of cellular damage as a result of ischaemia and hypoxia.

3. The trauma system model

Modern trauma systems are an excellent model for resuscitation [59–62]. In an ideal trauma system, the patient is rapidly attended at the scene and resuscitation commenced immediately. The patient is then transported to a centre, where a 24-h trauma team is available. The trauma team is called to patients based on criteria. Rapid and systematic resuscitation then occurs, according to protocols and guidelines, by staff with appropriate training. Definitive management rapidly occurs. The adequacy of resuscitation is constantly reviewed. The system is tracked by outcome indicators and adjusted as necessary.

There is little in the way of similar systems for in-hospital patients who are not suffering from trauma. And yet the principles for such a system are the same: criteria based identification of at-risk patients; activation of the emergency response followed by rapid and systematic resuscitation. The response team should be trained in all aspects of advanced resuscitation and the effectiveness of the system is measured and appropriately adjusted when necessary. The Medical Emergency Team is an example of this system [63–65].

4. The medical emergency team

The Medical Emergency Team (MET) was achieved by changing the name and adjusting the function of the cardiac arrest team to a MET. The MET was initiated at Liverpool Hospital in 1990 and has now been introduced in six hospitals in South Western Sydney Area Health Service and numerous hospitals within Australia and abroad. Usually a physician and nurse, both from the ICU, form the basis of the team, 24 h a day. However in some small rural hospitals where there is no guarantee of 24 hour medical staff cover who are fully trained in all aspects of advanced resuscitation nurses may form the MET, as is found in
some rural areas of New South Wales. The criteria for calling the MET are widely and easily measured normal observations such as vital signs that may also form the basis for identification of critical illness (Table 1). The MET responds in the same fashion as a cardiac arrest team following telephone/pager activation. However, if the system is working effectively the number of cardiac arrest calls that the team attends should be small as patients are identified before cardiac arrest occurs.

At least one member of the MET needs to be trained in comprehensive advanced resuscitation, not just CPR. Current resuscitation courses such as ALS [37] and ACLS [38] tend to concentrate on CPR. Therefore, an Advanced Resuscitation Course (ARC) has been developed to provide a comprehensive training in all aspects of resuscitation. The course provides training for 10–15 doctors or nurses at a time and consists of six months of self-directed learning covering the theory of advanced resuscitation. Concurrently the skills required for advanced resuscitation are taught by anaesthetists at the candidate's base hospital. These include airway skills, ventilation, peripheral and central venous cannulation and intercostal catheter insertion. The course is followed by a 3 day evaluation, consisting mainly of simulated medical emergencies. There is also a continuing education program to maintain knowledge and skills. As a result, each of the 6 hospitals in Sydney South Western Area Health Service now have a 24 h early detection system for seriously ill patients, with a rapid response by staff formally trained in most aspects of advanced resuscitation.

A fundamental component of any health system is the collection of data. Data on all MET calls are recorded by the attending team. To assess the system, key performance indicators, all hospital deaths, cardiorespiratory arrests and unanticipated admissions to the ICU are also collected. Potential preventability is defined by whether or not MET criteria were present prior to the MET call and whether or not they were appropriately responded to during the 24 h prior to the event. Patient’s with ‘do not attempt resuscitation’ (DNAR) orders are excluded. The data is relatively easy to collect because only the last entries in the patient’s notes need to be examined in any detail for potential preventability and further analysis. The data is fed back to the clinicians who are able to influence and improve the system. Weekly meetings are held to review all the MET calls and ways to improve the system discussed. Thus the quality improvement loop is closed.

Moving away from CPR and concentrating on the wider meaning of resuscitation will involve coming to terms with some uncomfortable facts. Doctors are not necessarily trained in all aspects of advanced resuscitation. For many years we have staffed our hospitals with notionally competent medical staff on the mistaken assumption that they could care for the seriously ill. Acute hospitals are increasingly managing only the seriously ill, as part of the world wide trend to decrease length of stay and limit hospital admissions to those who cannot be managed in a more appropriate and cost-efficient fashion (e.g. day case facilities) [66,67].

More appropriate ways of providing round the clock advanced resuscitation to all in-hospital patients’ need to be developed. For example a plan might be conceived to use the intensive care or emergency department staff to practice critical care on a hospital-wide basis, rather than confining their skills within the four walls of their own department [42]. Another option is the use of ‘hospitalists’ or in-hospital based specialists, specifically trained in acute medicine [68].

A new era of resuscitation is with us. It is far wider in its scope and more appropriate to the needs of the seriously ill than simply CPR. It involves training and experience in acute medicine, based in specialties such as emergency medicine, anaesthesia, cardiology and intensive care.

Table 1
Criteria for calling the medical emergency team

<table>
<thead>
<tr>
<th>Acute changes in</th>
<th>Physiology</th>
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<tbody>
<tr>
<td>Airway Threatened</td>
<td>All respiratory arrests</td>
</tr>
<tr>
<td>Breathing</td>
<td>Respiratory Rate &lt; 5</td>
</tr>
<tr>
<td></td>
<td>Respiratory Rate &gt; 36</td>
</tr>
<tr>
<td>Circulation</td>
<td>All cardiac arrests</td>
</tr>
<tr>
<td></td>
<td>Pulse rate &lt; 40</td>
</tr>
<tr>
<td></td>
<td>Pulse rate &gt; 140</td>
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<tr>
<td></td>
<td>Systolic blood pressure &lt; 90 mmHg</td>
</tr>
<tr>
<td>Neurology</td>
<td>Sudden fall in level of consciousness (Fall in GCS of &gt; 2 points)</td>
</tr>
<tr>
<td></td>
<td>Repeated or prolonged seizures</td>
</tr>
<tr>
<td>Other</td>
<td>Any patient who you are seriously worried about who does not fit the above criteria</td>
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</tbody>
</table>
medicine. It involves a wide range of practical skills and knowledge as well as the whole spectrum of early recognition and rapid resuscitation of all at-risk patients. It seems appropriate that discussion about redefining in-hospital resuscitation begins in the journal, ‘Resuscitation’.

References


