

Survival after Cardiopulmonary Resuscitation in the General Wards

-The Results of a Dedicated "Code" Team

K H Lee,**FAMS, MBBChir (Cambridge), MRCP (UK)*

Abstract

We describe our experience with a dedicated cardiopulmonary resuscitation team over 13 months for adults out-of-intensive care unit cardiopulmonary arrests. There were 137 recorded arrests with the majority (69%) happening "out-of-office-hours". The ages of patients ranged from 27 to 95 years, with 42% of patients ≥ 70 years old. Spontaneous circulation was established in 38% with transfers to the intensive care unit. However, only 27% of these patients eventually survived to hospital discharge. Thus, there was an overall 10% hospital survival for all adult arrests in the general wards. Those that had return of spontaneous circulation were significantly younger than the non-survivors. Patients less than 70 years old had a higher hospital survival rate than those ≥ 70 years old (16.5% vs 8.6%, $\chi^2 \sim 0.0001$).

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Introduction

Cardiopulmonary resuscitation (CPR) is widely practised for cardiopulmonary arrests with variable success.¹ The initial intention was to defibrillate patients with ventricular fibrillation after acute myocardial infarction, to save those with "hearts too good to die".² This led to the development of coronary care units and subsequently, such CPR techniques were widely applied both in- and out-of-hospital for cardiopulmonary arrests. The technique is taught worldwide with the Basic Cardiac Life-Support (BCLS) and Advanced Cardiac Life-Support (ACLS) courses.³ However, CPR was not intended for universal application, especially when such interventions would be deemed medically futile, or if the patient themselves requested otherwise. This has led to the development of "DNR" (do-not-resuscitate) orders in order to preserve the dignity of the dying patient. Secondly, CPR programmes are expensive and the outcomes are dependent on the type of arrest and time to intervention, besides the competence of intervention.⁴

Singapore provides both BCLS and ACLS courses. However, in Singapore (exception is Mount Elizabeth Hospital) unlike other hospitals in the United States of America, United Kingdom or Australia, there is no single dedicated team tasked to respond to cardiopulmonary arrests in the hospitals. Instead, each individual team will be called to attend to their own patients. It is currently unclear whether there is any outcome differ-

ence with a dedicated "code" team compared to individualised resuscitation. The National University Hospital started a "code" team in May 1996 to attend to all adult cardiopulmonary arrests in the hospital outside the intensive care units (ICUs) and A&E. This has the advantage of stream-lining the emergency response (one call instead of several pages) and brings the needed expertise rapidly to the bedside of the collapsed patient. Our impression is that this is an improvement over the previous arrangement. We report our experience with such a system since its initiation a year ago.

Patients and Methods

All adult patients that had a cardiopulmonary arrest in the general wards that were not DNR cases were attended to by the code team. This team is available 24 hours a day every day. It comprises the medical, surgical and anaesthetic residents (plus an intensivist during working hours), a sister from the ICU, and a porter. The team is activated by dialling "4000". The call is answered by the operators within 2 rings, and the team is activated through dedicated pagers. The different locations are coded by a 4-digit number. Each arrest is recorded on a standard form, which is returned to the co-ordinator. Data were collected prospectively from 1 May 1996 to 31 May 1997.

Data are presented as mean $\pm$ standard deviation (SD). Continuous data were compared using t-test, and non-

* Senior Lecturer and Consultant

Department of Medicine

National University Hospital

Address for Reprints: Dr Lee Kang Hoe, Department of Medicine, National University Hospital, 5 Lower Kent Ridge Road, Singapore 119074.

e-mail: mdcleekh@nus.edu.sg

parametric data with χ^2 . A P value of less than 0.05 was taken as significant.

Results

There were 137 recorded arrests (average of 10.5 arrests per month). The mean age of the patients was 64 (± 17 SD) years, with a range of 27 to 95 years (Fig. 1). Forty-two per cent of cases were ≥ 70 years old. More patients had a cardiac cause of arrest (66%). Thirty-eight per cent had return of spontaneous circulation (ROSC) with transfers to intensive care. Out of these (ROSC), only 27% left the hospital alive. Overall, 10% of those with cardiopulmonary arrests left the hospital alive. The average stay in ICU before death was 6.6 (f13.6 SD) days. Patients with ROSC were significantly younger than those that died at the primary arrest (60.3 ± 17.5 years vs 66.4 ± 16.2 years, $P = 0.025$). There was a higher proportion of hospital survivors for those < 70 years old compared to those ≥ 70 years old (16.5% vs 8.6%, $\chi^2 < 0.0001$). Thirty-one per cent of the arrests happened between 0830 and 1700 hours (office-hours). A higher proportion of those that had their arrest during office-hours had ROSC compared to those that occurred outside office hours (41% vs 26%).

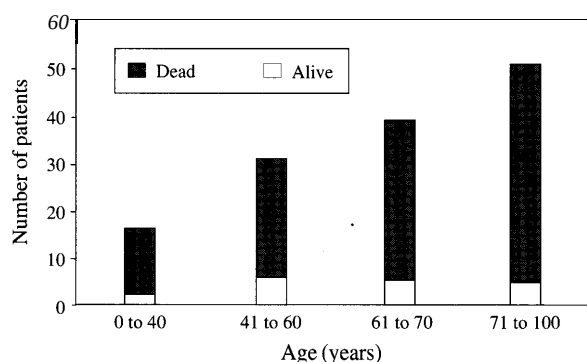


Fig. 1. Hospital outcome of patients that had cardiopulmonary arrest.

Discussion

Overall, 10% of our patients with cardiopulmonary arrests survived until hospital discharge. Bedell et al⁵ described a survival of 14% for in-hospital arrests over an 18-month period, while the success of ICU arrests has been reported to vary from 5% to 39%.⁶⁻⁸ Hypotension, sepsis, and an elevated APACHE II score were each independently reported with a poorer outcome.⁶ Direct comparisons are difficult between different studies as the case-mix for different series is variable.

The important issue of whether a dedicated team will lead to better outcome has not been studied in this report. Our rationale of implementing such a team that is currently in widespread practice overseas was shaped by the following concerns when individual teams were called to provide cardiopulmonary resuscitation: time

to arrival of team (nurses looking for pager numbers to call; which team to call), houseman attending to codes without senior staff, inability to manage airway adequately, lack of experience, lack of knowledge with ACLS protocol. The implementation of the "code" team has led to better response time (no data), clearer definitions of role in the team (team-leader, airway control), more experienced nursing help, and standardisation of equipment in the resuscitation trolley. Furthermore, the decision to terminate therapy or transfer to ICU can be executed in a more timely fashion. Normally, resuscitation is continued for a minimum of 15 minutes before termination of efforts. Primary teams are still consulted and provide the necessary information for likely prognosis and family's wishes. The main disadvantage of such a system is inappropriate activation and therefore, increased consumption of personnel time. With further education and awareness, this problem should be reduced.

Our study also demonstrated that younger patients (< 70 years old) had a significantly better outcome (nearly twice the survivor figures for those ≥ 70 years old) and ROSC was more common in those resuscitated during office hours. Other studies have also confirmed that age itself appears to be an important factor predicting outcome. A study from the USA involving out-of-hospital arrests demonstrated that those over the age of 70 years old had a higher hospital mortality rate than younger patients (71% vs 53%).⁹ Some have ascribed this to the difference in the presenting cardiac rhythm: the younger patients have a higher proportion of ventricular tachycardia / fibrillation.¹⁰ The underlying cause of cardiac arrest also affects outcome. Cardiac arrest from arrhythmias without preceding hypotension and reversible metabolic disorders have the best outcomes, while other serious medical conditions that lead to cardiac arrest, such as profound septic shock, are associated with a poor outcome.⁵ Our study unfortunately did not fully examine the medical factors for poor outcome (diagnosis, pre-morbid condition, presenting rhythm), but this will be addressed in future studies.

Of note is that two-thirds of those with ROSC subsequently die after an average of one week in the ICU. A study from Rhode Island reported that their patients from out-of-hospital arrests who required further CPR on arrival only had 9% ROSC and these patients then stayed an average of 2.3 days in the ICU, with no survivors.¹¹ This represents a substantial consumption of hospital resources, and underlines the expensive nature of CPR programmes if one calculates the cost per life saved. Data analysed from several countries have estimated that it cost approximately US\$407,000 per life saved for out-of-hospital arrest,⁴ while others (using US data) have estimated US\$60,327 per survivor for in-hospital arrests.¹²

If ROSC is achieved, the neurological status and the development of multiorgan failure will affect subsequent outcome. We do not have data from our study to comment on this. Edgren et al¹³ have reported a simple bedside test, assessing the unresponsiveness to pain on the third day, that predicted those patients that remained permanently comatose, or severely disabled 12 months post-arrest. In the multicentred Brain Resuscitation Clinical Trial I, there were no reported survivors at 1 year in a persistent vegetative state,¹⁴ and less than 3% of 6-month survivors were comatose in the Brain Resuscitation Clinical Trial II.¹⁵ It would thus appear that coma after ROSC that persists heralds a poor prognosis, and may justify conservative measures. Biochemical variables have also been investigated to aid prognostication.¹⁶⁻¹⁸ Most recently, a group from Heidelberg has used serum neuron-specific enolase levels of less than 33 ng/mL after CPR to predict persistent coma with a high specificity (100%).¹⁶

This report documents the first systematic study in Singapore of CPRs for cardiopulmonary arrests. This is a preliminary description of outcome following in-hospital arrests. Further work is required to document the appropriateness of the CPR, the effectiveness of such a CPR team (response time for ventricular fibrillation mortality has been calculated to increase by 3% per minute until CPR was commenced and 4% per minute until the first defibrillation was delivered,¹⁹ correct diagnosis, intubation skills), the reasons for poor outcome (multivariate analysis), and the cost of such an intervention.

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