

## Original Articles

# Survival after cardiopulmonary resuscitation in an urban Indian hospital

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### ABSTRACT

**Background.** Survival after cardiopulmonary resuscitation depends upon the quality of pre-hospital support, availability of resuscitation equipment and the competence of the resuscitator. There are few data on the prognosis of patients undergoing such resuscitation in India.

**Methods.** In a retrospective analysis of 215 resuscitations done in a 125-bed community hospital between January 1995 and November 1997, return of spontaneous circulation and survival to discharge were evaluated. Multivariate methods were used to identify the predictors of successful outcome.

**Results.** Of all the patients, 14.4% were alive at discharge. Survival after a cardiorespiratory arrest in the hospital was 18.4%, which was significantly better than survival after pre-hospital events (5.9%;  $p=0.027$ ). Multivariate predictors of survival at discharge were resuscitation duration of less than 20 minutes [odds ratio (95% confidence limit): 32.6 (6.5–164.3)], presentation with ventricular tachycardia or fibrillation [odds ratio: 18.5 (4.4–77.9)], in-hospital cardiorespiratory arrest [odds ratio: 5.2 (1.2–21.6)] and female sex [odds ratio: 3.2 (1.1–9.6)]. Bystander resuscitation, though rarely provided, increased survival at discharge ( $p=0.026$ ).

**Conclusions.** With 5.5 resuscitation attempts needed for one live discharge after in-hospital cardiorespiratory arrest and 17 attempts to save a life after pre-hospital events, our outcomes are comparable to those reported from developed nations. A return of pulse after shorter durations of cardiopulmonary resuscitation, ventricular fibrillation or tachycardia as the abnormal presenting rhythm, in-hospital location of cardiorespiratory (CR) arrest and female sex were independent predictors of live discharge. Age and aetiology of CR arrest did not influence the outcome.

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### INTRODUCTION

The protocols for basic and advanced cardiac life-support are well developed in western countries<sup>1,2</sup> where cardiopulmonary resuscitation (CPR) is routinely administered to victims of cardiac

arrest. Outcomes after in-hospital and pre-hospital CPR have been studied well in these countries.<sup>3</sup> However, in India, very little data are available about survival after CPR.<sup>4</sup> As outcomes after CPR and the predictors of successful outcome are likely to be very different in the Indian context, extrapolation of the western experience to Indian practice is not entirely appropriate. The virtual absence of pre-hospital emergency medical services and bystander CPR suggest that outcomes in out-of-hospital arrests will be poor. Likewise, a limitation of resources, non-availability of resuscitative equipment and inadequate knowledge and skills among physicians<sup>5</sup> will preclude good outcomes after in-hospital CR arrests as well.

Therefore, there is a need to collect data on outcomes in the Indian milieu to evaluate the determinants of outcome after CPR. This will allow us to maximize the efficiency with which scanty resources could be utilized to obtain the best results. If we are to judge from the experience of countries with similar limitations in the 'chain of survival',<sup>6</sup> outcomes may not be bad enough for us to consider the abandonment of CPR entirely. The currently available data from Indian hospitals<sup>4</sup> are inadequate for this purpose. We evaluated the outcomes after CPR performed in our community hospital and examined the variables that are strong predictors of these outcomes.

### PATIENTS AND METHODS

#### Setting

The study was performed in an urban, 125-bed community hospital with a full-facility 12-bed critical care unit. Most of our patients are from the middle and upper socioeconomic classes. A 'Code Blue' alarm is triggered for all CR arrests in the hospital or in the emergency room. A resuscitation team led by the in-house critical care consultant responds to the 'Code Blue' at all times of the day. The American Heart Association's Advanced Cardiac Life Support (ACLS) protocol<sup>1</sup> is adhered to. The leaders of the resuscitation teams are ACLS certified and most members are certified in basic life support and have had on-the-job exposure to advanced life support systems.

#### Study design

All CPRs performed in the hospital between January 1995 and November 1997 were retrospectively identified from the hospital database. The completeness of this search was verified by reviewing the admission registers in the emergency room and intensive care units and by examining the charts of all patients who died during this period. A total of 237 CR arrests were identified. These were defined as the absence of a pulse in an unconscious individual with no respiration or with agonal breaths only.<sup>7</sup> All arrests

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due to trauma (9) and re-arrests (13) were excluded from the analysis. Data were abstracted from the remaining 215 charts by one of the authors (RR) who was not blinded to the outcomes of the patients.

Age, sex, presenting electrical rhythm and place of CR arrest were identified in all the charts. The probable aetiology of CR arrest was judged by the reviewer by analysing the circumstances leading to the event and the patient's past medical history. Post-mortem confirmations were not available. The interval of time between the CR arrest and initiation of CPR could be obtained in only 178 events and the duration of CPR in 205. The chart review allowed the identification of individuals in whom a delay in ACLS support should have warranted bystander CPR and also the clinical status of the patient at discharge.

We defined return of spontaneous circulation (ROSC) as a return of pulse and its maintenance for at least 30 minutes. The other outcome measure used was survival after successful resuscitation, to the time of discharge from the hospital.

#### Statistical analysis

The abstracted data were analysed using EpiInfo software (version 6.03; CDC and WHO). The summary statistics are presented as mean (SD) unless otherwise specified. The predictor variables, namely age, sex, presenting rhythm, place of CR arrest, aetiology, duration of CPR, CR arrest-CPR interval and the performance of bystander CPR were dichotomized for univariate analysis. Significance testing was done by the Chi square test (with Yates correction where appropriate) and the Fisher's exact test and *p* values of <0.05 were considered statistically significant. The risk ratios for ROSC and survival to discharge were estimated for each of these variables and a 95% confidence interval (CI) was calculated. Multivariate analysis was done by logistic regression using Stata (Release 5) statistical software (Stata Corporation, College Station, TX, USA). These data are summarized as the odds ratio with a 95% CI.

## RESULTS

### Baseline characteristics

The mean age of the 215 patients who underwent CPR was 58 (17) years. The population was predominantly composed of elderly individuals with 52% above 60 years of age and 27% above 70 years; 66% of the patients were male. The majority of cardiac arrests (68%) occurred in the hospital with only 68 (32%) occurring in the pre-hospital phase. Of the 147 in-hospital arrests, 64 occurred in the intensive care units (ICUs) and 83 in other areas of the hospital including the emergency room. These 147 in-house CR arrests constituted 38% of all hospital deaths (*n*=385) during the study period, with 62% of individuals not being subjected to resuscitative attempts.

The CR arrest was due to cardiac causes (ischaemia, infarction, congestive heart failure) in 121 patients (56%) and due to primary respiratory disease in 25 (11%). Other aetiologies included hyperkalaemia, sepsis, hypovolaemia and non-traumatic haemorrhagic shock. Ventricular fibrillation (VF) or ventricular tachycardia (VT) was the presenting rhythm in 31 (14%) patients. Eighty-two patients (38%) were asystolic at presentation and 102 (48%) had pulseless electrical activity (PEA). There were 99 patients who were eligible for bystander CPR either because the CR arrest occurred out of hospital or on the medical floors and ACLS was delayed. Among them, bystander CPR was provided in 11 cases (11%), with only 3 out of 68 (4.4%) out-of-hospital CR arrests receiving basic life support.

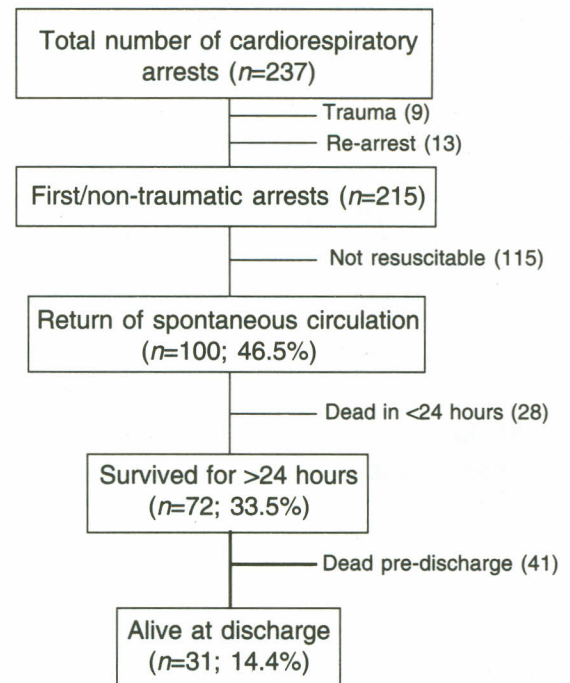


Fig 1. Summary of outcomes in all patients on whom resuscitation was attempted. All trauma arrests were excluded. In patients with multiple cardiorespiratory arrests, only the first was evaluated.

Of the 179 patients in whom data on the CR arrest to CPR interval were available, 108 (60%) had an estimated delay of 0–4 minutes, 31 (17%) of 5–10 minutes, and 40 (23%) of more than 10 minutes. The duration of CPR was  $\leq 20$  minutes in 89 patients (43%), between 21 and 40 minutes in 69 (34%) and  $\geq 41$  minutes in 47 (23%) of the 205 patients in whose charts these data were unambiguously recorded.

### Outcomes

Successful resuscitation (ROSC) occurred in 100 patients (46.5%, CI: 39.8%–53.2%) and 72 (33.5%, CI: 27.2%–29.8%) survived for at least 24 hours. However, only 31 patients (14.4%, CI: 10%–19.8%) were discharged alive from the hospital (Fig. 1). While ROSC was only marginally better in CR arrests occurring in the hospital (48.3% v. 42.6% in pre-hospital CR arrests; *p*=0.4), 27 of the 147 (18.4%, CI: 12.5%–25.6%) in-hospital CR arrests resulted in the patient surviving to discharge, in contrast to 4 of 68 (5.9%, CI: 1.6%–14.4%) in pre-hospital arrests (*p*=0.027; Fig. 2). Similarly, a comparison of outcomes after resuscitation in the ICU with CPR done in other areas of the hospital showed that ROSC was poorer in the ICU (29.7% v. 62.7% in non-ICU patients; *p*=0.0001), but survival rates at the time of discharge (12.3% v. 22%, respectively) did not achieve statistical significance (*p*=0.1).

### Predictors of outcome: Univariate analysis

Univariate analysis of the data examined the effect of the predictor variables on ROSC and survival to discharge. ROSC was most likely to occur if the CPR duration was <20 minutes or if VF or VT was the presenting rhythm. Other significant predictors of ROSC included female sex and a non-cardiac aetiology of CR arrest. Except for the aetiology of CR arrest, all the other predictors associated with ROSC were also associated with the survival to

TABLE II. Independent predictors of outcome (multivariate analysis; n=205)

Predictor	Outcome	
	ROSC Risk ratio (95% CI)	Alive at discharge Risk ratio (95% CI)
CPR duration ≤20 minutes	75.4 (26.8–212.2)*	32.6 (6.46–164.3)*
Presenting rhythm VF/VT (v. PEA/asystole)	7.79 (1.93–31.39)*	18.52 (4.41–77.85)*
Female sex	4.49 (1.6–12.57)*	3.17 (1.05–9.6)*
In-hospital CR arrest	1.09 (0.41–2.87)	5.17 (1.24–21.6)*
Non-cardiac aetiology	2.45 (0.89–6.71)	0.69 (0.20–2.38)
Age ≤ 70 years	2.03 (0.71–5.78)	2.48 (0.64–9.41)

ROSC return of spontaneous circulation VF ventricular fibrillation  
VT ventricular tachycardia PEA pulseless electrical activity \* p <0.05

VF/VT as the presenting rhythm (p=0.004) and female sex (p=0.004). Independent predictors of survival at the time of discharge from the hospital were CPR duration of <20 minutes (p<0.0001), VF/VT as presenting rhythm (p<0.0001), in-hospital arrest (p=0.024) and female sex (p=0.041). Though bystander CPR was important in the univariate analysis, introduction of this variable into the multivariate model did not result in a significant change.

DISCUSSION

In our study, 46% of resuscitated patients had ROSC, while 33% were alive for at least 24 hours, only 14% survived to be alive at the time of discharge from the hospital. These figures compare very favourably with western studies<sup>3,4,8-14</sup> where the published estimates for ROSC are 13%–59% (average 38.5%) and for survival to discharge vary between 1.3% and 27% (average 14.6%).<sup>3,8</sup> The BRESUS study, a prospective multicentre evaluation of CPR in 3765 patients at 12 British hospitals reports ROSC in 39% with 17% alive at discharge.<sup>9</sup> Identical outcomes have been reported from many countries in Europe and North America.<sup>14</sup>

CPR outcomes are better in patients who have CR arrests in-hospital when compared with those who have them pre-hospital. The data from BRESUS<sup>9</sup> demonstrate this, with in-hospital CPR being associated with survival to discharge of 20.4% in contrast to only 7.8% in out-of-hospital CR arrests. The survival rates of 18.4% and 5.9%, respectively, in our patients are, once again, comparable.

Outcomes after CPR have not changed much in the last three decades, especially for CR arrests occurring in the hospital.<sup>13</sup> However, in the pre-hospital phase, survival can be much improved if bystander CPR can be used more frequently. A study of pre-hospital CR arrests in Bonn<sup>15</sup> suggests that the poor outcomes associated with the absence of bystander CPR (7.3% alive at discharge) can be raised to the levels seen with in-hospital resuscitation (23% alive at discharge) if basic CPR is delivered by trained laymen. The best outcomes are achieved when the quality of the CPR is good.<sup>3,16,17</sup>

In our study, univariate analysis showed that bystander CPR improves outcome, but it was provided in only 11% of the situations in which it was indicated, and in only 4.4% of out-of-hospital CR arrests. This is very poor in comparison to the 18%–

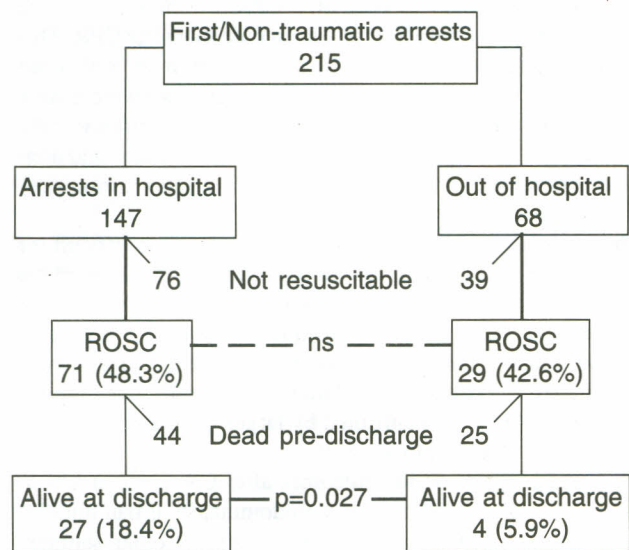


FIG 2. A comparison of outcomes in cardiorespiratory arrests that occurred in the hospital with those which occurred pre-hospital. Survival at discharge was significantly better after hospital-based events. ROSC return of spontaneous circulation

TABLE I. Predictors of favourable outcome after cardiopulmonary resuscitation (univariate analysis)

Predictor	n	Outcome	
		ROSC Risk ratio (95% CI)	Alive at discharge Risk ratio (95% CI)
CPR duration ≤20 minutes	205	7.26 (4.42–11.94)*	18.9 (4.6–77.1)*
Presenting rhythm VF/VT (v. PEA/asystole)	215	1.58 (1.18–2.12)*	5.56 (3.08–10.07)*
Female sex	215	1.56 (1.16–2.01)*	1.83 (0.96–3.48)*
In-hospital CR arrest	215	1.13 (0.82–1.56)	3.12 (1.14–8.57)*
Bystander CPR provided†	99	1.86 (1.40–2.47)*	4.0 (1.44–11.13)*
Age ≤70 years	215	1.42 (0.98–2.07)	1.97 (0.79–4.88)
Non-cardiac aetiology	215	1.51 (1.13–2.01)*	0.80 (0.42–1.59)
CR arrest–CPR interval ≤10 minutes	179	1.04 (0.71–1.58)	1.94 (0.72–5.22)

ROSC return of spontaneous circulation VF ventricular fibrillation  
VT ventricular tachycardia PEA pulseless electrical activity  
CPR cardiopulmonary resuscitation CR cardiorespiratory \* p<0.05  
†Only patients in whom advanced cardiac life support was delayed

discharge. In addition, in-hospital resuscitation became an additional predictor of survival. Those who received bystander CPR (n=11) had significantly better outcomes than eligible patients who did not (p=0.02 for ROSC and p=0.026 for survival to discharge). The results are summarized in Table I as the risk ratios for favourable outcomes.

Independent predictors of outcome: Multivariate analysis

Multivariate analysis using logistic regression (Table II) showed that only three variables persisted as independent predictors of ROSC. These were CPR duration of <20 minutes (p<0.0001),

55% rates reported from the West.<sup>3</sup> This, along with the fact that none of the patients with pre-hospital CR arrests were transported to the hospital by a professional team capable of performing basic CPR, is a major deficiency in our community and in most of India. Despite these problems with infrastructure, good outcomes after CPR are common enough to warrant its routine application to in-hospital and pre-hospital events.

The trend seen in our study towards poorer outcome after CPR in the ICU is not surprising. This has been demonstrated in other studies as well,<sup>18,19</sup> in which ICU-related CPR results in live discharge in as few as 3.3% to 5% of all patients in whom resuscitation was attempted. Logically, the severity of the underlying illness would be a major factor determining successful resuscitation. This has been shown to be the case in a study that demonstrated the correlation of the pre-CR arrest APACHE II score with survival.<sup>20</sup>

Studies on CPR outcomes are heterogeneous in their methods and definitions. This alone may account for much of the variation in survival rates reported in medical literature. Therefore, we defined our population using strict and conservative criteria<sup>7,11</sup> and excluded isolated respiratory arrests<sup>9</sup> and trauma arrests from analysis as these are associated with very different levels of prognosis. Also, as suggested by Ballew *et al.*,<sup>11</sup> we report the frequency with which resuscitation is attempted in patients who die in hospital. Ballew *et al.* feel that the increased use of 'do not resuscitate' (DNR) orders may 'improve' survival rates by allowing CPR to be administered only to selected low-risk groups. In our study, 38% of patients dying in hospital had CPR. This contrasts with a rate of 22% reported from a tertiary care university hospital and of 18% in patients with cancer,<sup>11</sup> but is similar to the 34% reported by Taffet *et al.*<sup>10</sup> It is possible that the high success rate (72% ROSC and 18% survival to discharge) reported in the Indian literature by Bajan *et al.*<sup>4</sup> from a tertiary care hospital may be influenced by the existence of these biases in patient selection.

In our study, the independent (multivariate) predictors of survival to discharge were the duration of CPR, VF or VT being the presenting rhythm, in-hospital arrest and female sex. The fact that CR arrests associated with VF or VT have favourable outcomes has been consistently demonstrated in earlier studies also.<sup>4,14,19,21</sup> These rhythms are easily treated by defibrillation, unlike asystole, which is considered an agonal rhythm and is seldom associated with a successful outcome. Likewise, the time taken to restore circulation after a CR arrest is a reasonable indicator of the severity of the underlying process that has led to the arrest. Consequently, the duration of CPR is a good predictor of outcome as demonstrated by us and numerous others.<sup>10,14,20</sup>

The only unusual feature of the multivariate analysis was the persistence of female sex as a strong predictor of survival. Most studies do not show any benefit being conferred on women who undergo CPR.<sup>9,12</sup> We are unable to speculate on the reason for its importance in our study and will need to evaluate it further. Selection of cases may have been a factor as we had an unexpectedly higher number of males in our study (male:female ratio 2:1).

A strong correlation between mortality and delay in defibrillation or CPR (the CR arrest-CPR interval) is well known.<sup>1</sup> However, we were unable to demonstrate this association in our study. We attribute this anomaly to the poor quality of the data. The reported time of CR arrest was often what was recalled by a friend or family member and was likely to be erroneous especially in unwitnessed CR arrests.

Though initially debated,<sup>12,19,21,22</sup> advanced age has been shown

to be a predictor of poor survival after CPR.<sup>9,10,13</sup> In our study, we were unable to show the effect of age on outcome after CPR. This may be an artifact of the dichotomous fashion in which we analysed the effect of age on survival. Similarly, we were unable to demonstrate any link between survival and the aetiology of the arrest, because we dichotomized the data set into cardiac and non-cardiac aetiologies. The heterogeneity of the latter group may have confounded the analysis.

The retrospective nature of this study has made it difficult for us to adhere to the 'Utstein style' that is currently considered the standard format for reporting outcomes after CPR.<sup>7</sup> Also, the outcomes reported here may not be representative of CPR in other Indian hospitals because of the variations that exist in the availability of auxiliary equipment and trained personnel. The findings of this paper need to be confirmed by larger, prospective studies that take these factors into account.

This study reports on the outcomes after CR arrest in a non-tertiary care hospital, catering to a predominantly urban middle-class population, which makes extrapolation to other settings, especially rural hospitals, difficult. It shows, however, that in this setting, in-hospital CPR can be an effective procedure resulting in 1 live discharge for every 5.5 attempts made. In the absence of good pre-hospital care, out-of-hospital CR arrests are associated with poorer results, with only 1 live discharge for every 17 attempts. Though this can be improved by bystander CPR, there is a clear need for greater education of both physicians and the lay public in basic CPR. The fact that VF and VT influence survival confirms the importance of defibrillation in adult CPR. The outcomes in our study are comparable to those reported from developed countries.

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## Factors influencing response to lymphonodovenous shunt in filarial lymphoedema

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### ABSTRACT

**Background.** Although several studies have been published on lymphonodovenous shunt, there are no objective data either on the outcome of lymphoedema or on various parameters likely to influence the results.

**Methods.** A trial of lymphonodovenous shunt was carried out in 75 patients with unilateral filarial lymphoedema. The primary aim of the trial was to identify a cohort of responders as against non-responders and to correlate the outcome with various factors such as age, gender, duration and preoperative grade of lymphoedema, number of preoperative attacks of adenolymphangitis, operative impression of the lymph node, effect of venous reflex and type of nodovenous anastomoses. Change in oedema volume was measured objectively by water displacement method using the normal limb as a control.

**Results.** There was no operative mortality. Predominant postoperative complications included wound haematoma (8.5%), wound infection (13.6%) and transient lymphorrhoea (13.6%). In the immediate postoperative period, a reduction of 25%-50% in the oedema volume was recorded in 46.7% of cases and of more than 50% in 17.3% cases. The difference in response with respect to the type of lymphonodovenous shunt was not

statistically significant, although the end-to-side type of shunt showed marginally better results. The response was significantly higher in patients with preoperative oedema volume more than 2 L. There was a significant reduction in postoperative attacks of adenolymphangitis, irrespective of the reduction in oedema volume. Of the 75 patients, 22 showed regression of oedema volume to preoperative or higher levels in the postoperative phase. A majority (21/22) could be identified as non-responders within 3 months of surgery.

**Conclusion.** The best results of lymphonodovenous shunt were seen in patients with large-volume lymphoedema. The results are better when combined with early excisional surgery. Other factors did not significantly affect the outcome. Non-responders could be identified within 3 months after surgery. Even in patients who did not respond well, a significant decrease in the frequency of adenolymphangitis attacks was observed. Higher initial oedema volume and history of higher frequency (25-50 per year) of adenolymphangitis attacks can be considered as indicators for good response to lymphonodovenous shunt.

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### INTRODUCTION

Lymphatic filariasis is endemic in many parts of India. Hydrocele and lymphoedema are the commonest manifestations of the disease. Of the several procedures available for the surgical management of lymphoedema, lymphonodovenous shunt (LNVS) is commonly employed.<sup>1</sup> While several studies have been published about the results of the procedure, there are no data on factors which influence the response to surgery. This study was conducted to quantify the response to LNVS and correlate it with factors such as age, gender, preoperative grade of lymphoedema,

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