

# Outcome of Cardiopulmonary Resuscitation in the Intensive Care Units of a University Hospital

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## ABSTRACT

The purpose of this study is to evaluate the demographic characteristics of patients who suffered cardiac arrest in our ICUs and to identify those factors influencing outcome after resuscitation following cardiac arrest.

We reviewed the records of all patients who underwent CPR in the two ICUs at the Georg-August University Hospital Goettingen, Germany from 1 January, 1999 to 31 December, 2003.

During the study period 169 patients underwent CPR and 80 of the 169 patients survived to hospital discharge, giving a survival to hospital discharge rate of 47.3%. The initial monitored rhythm recorded at the time of arrest was asystole in 99 (58.6%) patients, ventricular tachycardia/fibrillation in 59 (34.9%) and pulseless electrical activity in 7 (4.1%) patients. The respective survival rates were 46 (54.8%), 31 (36.9%) and 5 (6.0%) to hospital discharge. Of the 80 patients that survived to hospital discharge 75 (93.8%) achieved good cerebral recovery (CPC 1 or 2) and were alert and fully oriented on discharge; 4 patients (5.0%) were severely disabled (CPC 3), while 1 (1.2%) remained unconscious and was reported dead five days after discharged to another local hospital. Illness severity as assessed by SAPS II score on admission was  $38.8 \pm 16.0$ . None of our patients with  $> 40$  SAPS II score 24 hours after CPR survived to be discharged from the ICU.

Our study showed that nearly half the patients that had cardiac arrest in our hospital ICUs had a favourable outcome despite initial rhythms that are traditionally associated with a poor outcome. This confirms that good results are achievable in these groups of patients. (*Afr J Reprod Health* 2006; 10[1]:104-115)

## RÉSUMÉ

**Résultat de la réanimation cardio-respirateur dans les unités de soins intensifs d'un Centre Hospitalier Universitaire**  
L'objectif de cette étude est d'évaluer les caractéristiques des patients qui ont subi un arrêt cardiaque dans nos USI et d'identifier ces facteurs—là qui influencent sur les résultats après la réanimation suite à un arrêt cardiaque.

Nous avons passé en revue les dossiers de tous les patients qui ont subi la RCP dans les deux USI du Centre Hospitalier Universitaire Georg-August à Geottingen, Allemagne, du 1<sup>er</sup> janvier 1999 au 31 décembre, 2003.

Au cours de la période de l'étude, 169 patients ont subi la RCP et 80 d'entre eux ont survécu jusqu'au moment de quitter l'hôpital, ce qui donne un taux de départ de l'hôpital de 47,3%. Le rythme surveillé initial enregistré au moment de l'arrêt était la pause cardiaque chez 99(58,6%) patients, la tachycardie/la fibrillation ventriculaire chez 59(34,9%) et une activité électrique non pulsatile chez 7(4,1%) patients. Les taux de survie respective étaient 46(54,8%), 31(36,9%) et 5(6,0%) jusqu'au départ de l'hôpital. Sur les 80 patients qui ont survécu jusqu'au départ de l'hôpital, 75(93,8%) ont accompli un bon rétablissement cérébral (CPC 1 ou 2) et étaient éveillés et complètement orientés au moment du départ de l'hôpital; 4 patients (5,0%) étaient gravement invalidés (CPC 3) alors que 1(1,2%) est resté sans conscience et est mort cinq jours après avoir été admis dans un autre hôpital local. La gravité de la maladie d'après l'évaluation par la cotation de SAPS II en admission était  $38,8 \pm 16,0$ . Aucun de nos patients avec  $> 40$  SAPS II de cotation 24 heures après n'a survécu pour quitter l'USI.

Notre étude a montré que presque la moitié de patients qui ont subi l'arrêt cardiaque dans les USI dans nos hôpitaux ont eu des résultats favorables malgré les rythmes initiaux qui sont traditionnellement liés aux résultats médiocres. Ceci confirme que les bons résultats sont réalisables chez ces groupes de patients. (*Rev Afr Santé Reprod* 2006; 10[1]:104-115)

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KEY WORDS: *Advanced Life Support (ALS); Cardiopulmonary resuscitation (CPR); Cardiac arrest; Intensive care; Utstein template.*

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## Introduction

Cardiac arrest is the third leading cause of coma, second only to trauma and drug overdose [1]. Over the past two decades several publications have reported the outcome of cardiopulmonary resuscitation (CPR) for in-hospital cardiac arrest<sup>2-11</sup>. The International Liaison Committee on Resuscitation (ILCOR) produced guidelines in an attempt to ensure the comparability of data regarding in-hospital resuscitation events. In 1997 ILCOR published the Utstein style guidelines for reviewing, reporting, and conducting research on in-hospital resuscitation based on internationally developed consensus views<sup>12</sup>. In addressing some of the limitations of the 1997 guidelines, an ILCOR task force reviewed and revised the Utstein definition and reporting templates for in-hospital resuscitation in 2004<sup>14</sup>. The technique of CPR, based on the International Consensus on Science, has now become a standard in health professional training in many parts of the world<sup>13</sup>. Although guidelines on the conduct and research of CPR have been published, only a sparse amount of data concerning the outcome after cardiac arrest in intensive care units (ICU) is available from Germany.

ICUs in health institutions serve to concentrate expertise in medical and nursing care, life sustaining technologies, and treatment of complex multi-organ system derangement. Cardiac arrest is not uncommon in patients admitted into an ICU. In an optimally functioning ICU, all arrests should be monitored with immediate response to the arrest by the ICU staff. Electronic monitoring of cardiac rhythm and haemodynamic measurements facilitate this early recognition of cardiac arrest.

Despite the recognised value of the standardised techniques and interventions of advanced life support (ALS) in the ICU, patients may be disadvantaged by chronic coexisting diseases, severe current medical illnesses and multi-organ failure that may lead to a worse outcome after CPR compared to general ward patients.

Only a sparse amount of data is available concerning the initial CPR success rates and long-term survival in adult ICUs and the small numbers of studies performed so far are inconclusive. Initial CPR success rates range from 16.8 to 44% and long-term survival to discharge from hospital ranges from 3.1 to 16.5%<sup>20-23</sup>. However, in the absence of chronic disease, the shorter duration of CPR, the initial rhythm of ventricular tachycardia (VT) or fibrillation (VF) in contrast to asystole and pulseless electrical activity (PEA), and early defibrillation may improve outcome after CPR. Severity of illness has been reported to have a significant predictive value on death after CPR in ICU patients<sup>4,20,21,24</sup>. It has been demonstrated that successful resuscitation depends on the initiation of early basic life support, early defibrillation as well as prompt institution of advanced cardiac life support. Although the initial successful resuscitation rate in ICU patients may be high, long-term and hospital discharge rates have been reported to be unsatisfactory<sup>3,17</sup>.

The purpose of this study is to evaluate the demographic characteristics of patients who suffered cardiac arrest in our ICUs as well as to identify those factors influencing outcome after resuscitation following cardiac arrest.

## Material And Methods

### *Clinical setting*

The Georg-August University Hospital Goettingen, Germany is a tertiary hospital with approximately 1,400 beds serving a local population of 120,000 and a regional population in the southern part of Lower Saxony of 560,000.

The department of anaesthesiology, emergency and intensive care medicine of this hospital has two intensive care units with a total number of 42 beds. These ICUs do not only provide perioperative care but also primary ICU care for all neurosurgical, trauma, cardiothoracic, orthopaedic, obstetric and gynaecological patients. In addition, patients from other departments (e.g.

internal medicine, neurology, psychiatry) are occasionally admitted to these ICUs.

There is an established cardiac arrest team (CAT) in the hospital made up of anaesthesiologists and intensive care nurses. This team is available 24 hours a day and can be activated for a severe emergency within the hospital. The nurses and doctors are advanced life support (ALS) trained. The CAT is usually not activated when a cardiac arrest occurs within the ICU. Cardiac arrests in these ICUs are jointly managed by on-duty anaesthesiologists, surgical (cardiothoracic/neurosurgical) residents, and the nursing staff. The indication for CPR is cardiac arrest confirmed by the ICU staff on duty. This team provides ALS to patients according to a protocol based on the ERC guidelines. The hospital policy is to always initiate CPR in the case of cardiac arrest unless a 'do not attempt resuscitation' (DNAR) order is present in the patients' records. The hospital does not have an official DNAR policy.

### *Study population*

Every resuscitation attempt in the ICUs is documented by the attending anaesthesiologist or surgeon. This is checked for quality by a senior colleague and then registered in our computerised patient data management system (Goettingen Information System in Intensive care, GISI). The GISI database was used to search for all admissions to these ICUs from January 1, 1999 to December 31, 2003 and records of patients who had CPR during their stay in the ICUs were retrieved and studied.

The study population included postoperative cardiothoracic and neurosurgical patients who were admitted to the ICU and patients admitted for respiratory support and other indications who then suffered cardiac arrest during their ICU stay. We reviewed all accessible charts and resuscitation records of patients who had confirmed cardiac arrest as documented by the attending doctor. A cardiac arrest is defined in the Utstein style as 'the cessation of cardiac mechanical activity

confirmed by the absence of signs of circulation'<sup>14</sup>. All records and data were retrieved and the following variables were analysed: patient demographic data, date and time of arrest, presenting rhythm, duration of arrest, time of definitive return of spontaneous circulation (ROSC), initial survival, SAPS II score, length of ICU and hospital stay. The patients' coexisting disease and current medical/surgical illness during hospitalisation were reviewed from the chart and resuscitation records. The Utstein recommendation was used to record patient demographic data, resuscitation event and outcome variables of the population studied. The ALS interventions in place at the time of the resuscitation including tracheal intubation, mechanical ventilation and invasive monitoring were also evaluated.

The following events were excluded from the study:

- (1) CPR outside the ICU facilities, even if resuscitation was ongoing on arrival at the ICU
- (2) When a patient suffered from several cardiac arrests in ICU during the time of the study, only the first episode was included in the analysis in order to prevent a false increase of the rate of successful resuscitation while diminishing the rate of survival to discharge.
- (3) All visitors, employees and staff within the ICUs who had cardiac arrest.

The survivor's functional status according to the cerebral performance category (CPC) score [12] was evaluated retrospectively from the medical records at discharge from hospital. Outcome was taken to be the best cerebral performance at discharge.

CPC score of 1 or 2 was considered a good neurological outcome and CPC score of 3, 4 or 5 was a poor outcome.

### *Statistics*

Calculations were performed using STATISTICA software package (Statistica 5.1, StatSoft

Inc, Tulsa, USA) on a personal computer (Pentium III 800 MHz, Microsoft Windows XP). Normal distribution was tested by the Kolmogorov-Smirnov-Test. Results are presented as mean value  $\pm$  standard deviation for variables that are normally distributed. We applied Student-t-tests for continuous variables. Categorical data were compared using Chi-square test to analyse differences between survivor and non survivors. For all statistical tests  $p < 0.05$  was considered to be significant.

The study protocol was approved by the medical ethics committee of the Georg-August University Hospital, Göttingen, Germany.

## Results

A total of 16,898 patients were admitted into the ICUs during the period under review. 15,208 (90%) of these admissions were postoperative patients. 927 patients died during their stay in these facilities giving a mortality rate of 5.5%.

There were 183 cardiac arrest calls in the study period, however, resuscitation was not attempted in 14 cases (Figure 1). Nine patients had a DNAR Order before the arrest because of the longstanding medical/surgical treatment and multiple coexisting diseases. Resuscitation was considered futile in four patients because of advanced lung carcinomas

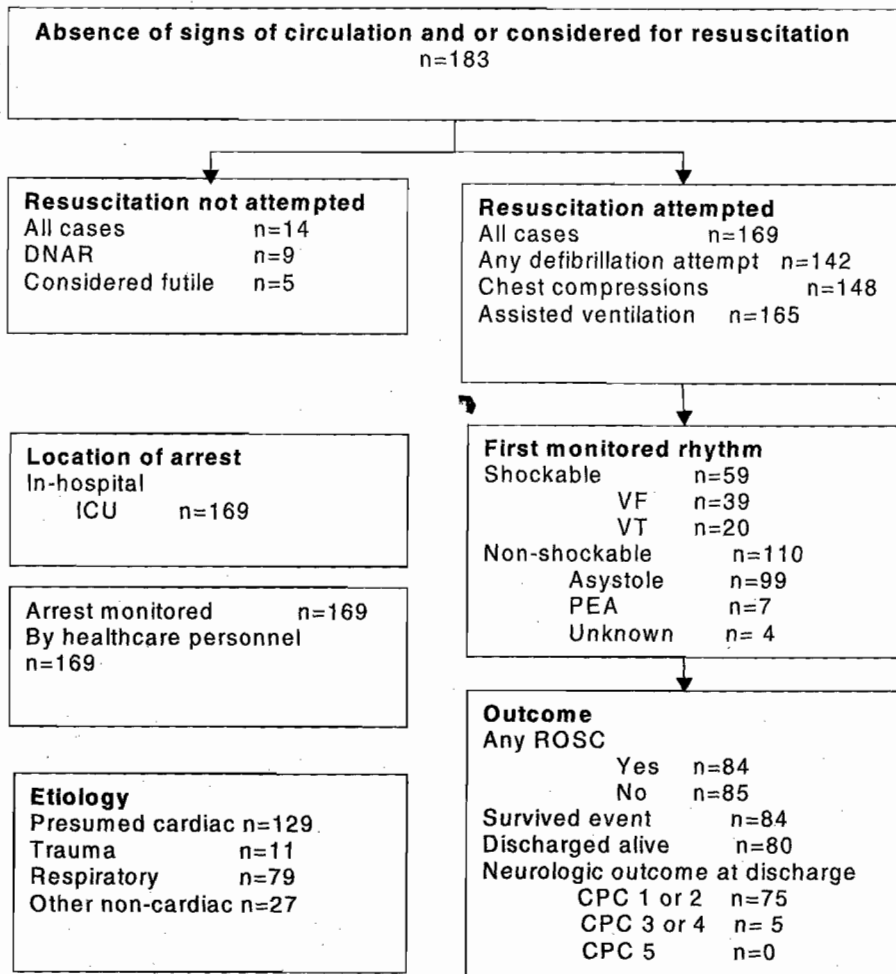


Figure 1: Utstein template for reporting of in-hospital resuscitation.

and multiple organ involvement and who were expected to die and thus had treatment limited.

Data on 169 postoperative patients who suffered cardiac arrest were therefore available for analysis.

#### *Pre-arrest variables*

During the study period, 169 (120 males, 49 females) of 16,898 patients (1.0%) had cardiac arrests and CPR was instituted during their stay in the ICUs. *Figure 1* shows the results of in-hospital resuscitation reported according to "Utstein Style" format<sup>14</sup>. 84 of the 169 patients with confirmed in-hospital arrest survived to ICU discharge, 80 to hospital discharge giving a survival to hospital discharge rate of 47.3%.

The demographic characteristics of the patients, co-existing diseases, and reasons for ICU admission are described in *Table 1*. The mean age of all the patients is  $68.0 \pm 12.0$ . The number of admitting diagnoses or primary contributing diagnoses (or both) of the patients at time of admission exceeds the number of patients because most of the patients had more than one diagnosis. Cardiac diseases (75.1%) and sepsis (51.5%) were the leading reasons for ICU admissions with cardiac disease and diabetes mellitus presenting in over half of the patients as coexisting diseases prior to ICU admission. The presence of more than two specific diagnoses was significantly associated with poor outcome. Illness severity as assessed with the SAPS II score

**Table 1: Demographic characteristics of the study population**

<b>Age [years]</b>	68.0 $\pm$ 12.0 (Mean $\pm$ SD)		
<b>Sex: Male / Female</b>	120 (71%) / 49 (29%)		
<b>Coexisting diseases</b>			
<i>Cardiac disease</i>	129		
<i>Diabetes</i>	101		
<i>Renal Failure</i>	81		
<i>Pulmonary</i>	79		
<i>Cancer</i>	6		
<b>Reason of ICU admission/ current medical illness</b>			
	<b>Postop(CS)</b>	<b>Postop(NS)</b>	
<i>Myocardial infarction/ ischaemia</i>	126	1	127
<i>Sepsis</i>	84	3	87
<i>Respiratory failure</i>	54	6	60
<i>Multiple trauma/ haemorrhage</i>	1*	43	44
<i>Head injury (GCS&lt;8)</i>	28	0	28
<i>Cerebral haemorrhage</i>	20	0	20
<b>SAPS II Scores (on admission)</b>	38.8 $\pm$ 16.0		

**SAPS II:** Simplified acute physiology score II, **Postop(CS):** Postoperative cardiac surgery, **Postop(NS):** Postoperative Neurosurgical, \*:Postoperative Thoracic surgery.

on admission showed a mean score for all patients to be  $38.8 \pm 16.0$ . From 87 (51.5%) patients with the clinical diagnosis of sepsis on ICU admission, only 11 (12.6%) were successfully resuscitated and lived to hospital discharge. Of the remaining 82 patients without sepsis on admission, 79 (96.3%) were successfully resuscitated and lived to be discharged from the ICU while 3 patients died in the wards from complications of septic shock. CPR was performed on 6 patients with cancer, including 3 with known meta-

static disease. None survived initial resuscitation efforts. This was significantly different from the outcome of the 163 patients without cancer, 80 of whom lived to hospital discharge ( $p < .001$ ).

#### *Intra-arrest variables*

The demographics of patients with cardiac arrest, the characteristics and the application of CPR are shown in Table 2.

**Table 2: Outcome of cardiopulmonary resuscitation**

	<u>Survival to ICU discharge</u> <u>discharge</u>	<u>Non-survival</u> (n=85)	<u>p-value</u>
<b>Age</b>	68.0 $\pm$ 11	68.0 $\pm$ 12	n.s.
<b>Sex</b>			
Female	22 (26.2%)	27 (31.8%)	
Male	62 (73.8%)	58 (68.2%)	n.s.
<b>Monitored Rhythm</b>			
Asystole	46 (54.8%)	53 (62.4%)	
VF	19 (22.6%)	20 (23.6%)	
VT	12 (14.3%)	8 (9.4%)	
PEA	5 (6.0%)	2 (2.4%)	
Unknown	2 (2.4%)	2 (2.4%)	
<b>Arrest certification</b>			
Nurses	49 (58.3%)	47 (55.3%)	
Doctors	35 (41.7%)	38 (44.7%)	n.s.
Time to start CPR	< 20s	< 20s	
<b>ROSC (minutes)</b>	10.6 $\pm$ 10.5	27.8 $\pm$ 15.7	0.001
<b>ICU LOS (Days)</b>	14.5 $\pm$ 20.5	7.8 $\pm$ 13.0	0.01
<b>Hospital LOS (Days)</b>	42.6 $\pm$ 41.9	17.0 $\pm$ 16.7	0.0001
<b>SAPS II Scores</b>			
On admission	42.4 $\pm$ 13.1	53.4 $\pm$ 16.7	< 0.0001
24 hours before arrest	40.1 $\pm$ 12.0	44.5 $\pm$ 14.9	0.005
24 hours after arrest	40.9 $\pm$ 12.9	50.8 $\pm$ 17.2	< 0.0001

**SAPS II**- simplified acute physiology score 11, **ROSC** return of spontaneous circulation, **LOS**-length of stay, **n.s.** - not significant, **VF** -Ventricular Fibrillation, **VT**- Ventricular Tachycardia, **PEA**-Pulseless Electrical Activity.

There was no difference in the mean age between the male and the female patients. However, of the 120 male patients who had cardiac arrest, 62 (51.7%) were resuscitated successfully and discharged from ICU while only 22 of 49 (44.9%) of the female patients survived to ICU discharge. 85 (50%) patients died in the ICU with additional 4 (male 3 vs. female 1) patients dying in the ward after successful CPR and discharge from ICU. Eighty patients (47.3%) were subsequently discharged alive from the hospital with a mean hospital length of stay of  $42.6 \pm 41.9$  days.

There was no significant difference in the age distribution between survivors and non-survivors (Figure 2). However, 49% of the surviving patients were 70-79 years old with survival amongst patients  $\geq 80$  years old declining sharply to 5%. Most of the patients already had intravenous access (99.6%) and intravenous medications (96%) up to the time of arrest. All the patients had electrocardiographic monitoring before arrest and over 90% of the patients had tracheal intubation and were mechanically ventilated before arrest. Cardiac arrest was witnessed in all patients by nurses and/or doctors on duty. CPR was promptly started within twenty

seconds of confirmation of arrest. 129 patients were defibrillated, 70 had DC shock once and 36 of these patients survived to be discharged from the hospital (Table 3).

The initial monitored rhythm recorded at the time of arrest was asystole in 99 (58.6%) patients. No misdiagnosis of asystole was documented. Ventricular tachycardia/fibrillation was recorded in 59 (34.9%) and pulseless electrical activity in 7 (4.1%) patients. Rhythms that were not documented occurred in 4 (2.4%) patients (Fig. 1). 46 (54.8% of survivors), 31 (36.9%) and 5 (6.0%) patients with initially recorded asystole, VT/VF and PEA rhythms, respectively, survived to discharge. The mean time to ROSC was shorter (10.6 vs 27.8,  $p = 0.001$ ) and SAPS II scores were less ( $42.4 \pm 13.1$  vs  $53.4 \pm 16.7$ ,  $p < 0.0001$ ) in those patients surviving to discharge from the ICU and subsequent discharge from hospital.

The patients that survived CPR stayed longer in the ICU ( $p < 0.01$ ) and hospital ( $p < 0.001$ ) when compared with non-survivors. Table 3 shows that the number of surviving patients with duration of CPR  $< 15$  minutes was significantly higher when compared with non-survivors ( $p = 0.0002$ ).

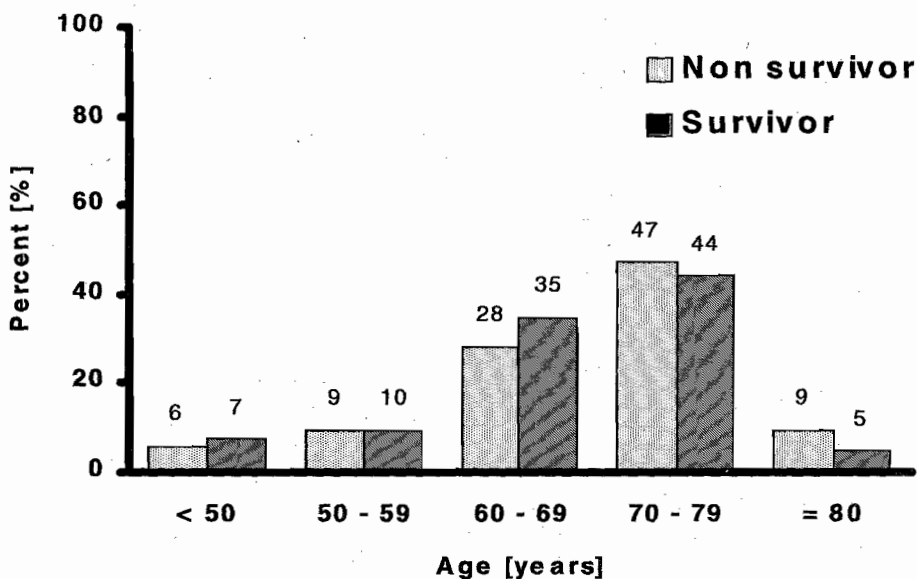


Table 3: Intra-arrest variables

	Survival to ICU discharge N = 85	Non-survival n = 84	p-value
<b>Mechanical ventilation</b>			
Ventilated	81 (96.4%)	84 (98.8%)	0.04
Not ventilated	3 (3.6%)	1 (1.2%)	
<b>Intubation</b>			
Before	80 (95.2%)	75 (88.2%)	
During	3 (3.6%)	4 (4.7%)	
Not intubated	1 (1.2%)	6 (7.1%)	
<b>Duration of CPR</b>			
≤ 15min	75 (89.3%)	32 (37.6%)	0.0002
> 15min	9 (10.7%)	53 (62.4%)	
<b>Number of defibrillation</b>			
Once	36	34	
> Once	10	49	

Table 4: Neurological and functional status of survivors

	On discharge n (%)
<b>Cerebral performance category (CPC) score</b>	
Good cerebral performance (1)	44 (55.0%)
Moderate cerebral disability (2)	31 (38.8%)
Severe cerebral disability (3)	4 (5.0%)
Coma or vegetative state (4)	1 (1.2%)
Brain death (5)	0
<b>Discharged to</b>	
Home	45 (56.3%)
Rehabilitation center	22 (27.5%)
Other hospital	13 (16.2%)

Cerebral performance status and destination of all patients (80) who survived to hospital discharge following in-hospital CPR. CPC score on hospital discharge: score 1 = Good, Score 4 = Poor.

### Post-arrest variables

Of the 169 patients in whom resuscitation was attempted, 84 were successfully resuscitated and survived to be discharged.

All 84 patients who were successfully resuscitated survived to be discharged from the ICU with a mean ICU length of stay of  $14.5 \pm 20.5$  days. Four patients died within 1 week on the ward, with the remaining 80 (47.3%) patients



surviving to be discharged from the hospital with mean length of hospital stay of  $42.6 \pm 41.9$  days.

The CPC score and hospital discharge destination of the surviving patients are reported in table 4. Of the 80 patients who survived to hospital discharge 75 (93.8%) achieved good cerebral recovery (CPC 1 or 2) and were alert and fully oriented on discharge. Four patients (5.0%) were severely disabled (CPC 3), while 1 (1.2%) remained unconscious and was reported dead five days after discharge to another local hospital. The majority of these patients (45 = 56.3%) were discharged home, 22 (27.5%) to rehabilitation hospitals and 13 (16.2%) to other local hospitals.

## Discussion

This study reports the results of a retrospective evaluation of outcome after CPR in our ICUs over a five-year period. The location of the arrest within the hospital is important. Patients resuscitated in the ICU have a hospital discharge rate of 48% as compared to 16% of those in the wards<sup>5, 21-28</sup>. Clearly, the success rate of survival to discharge in an ICU depends not only on the early recognition and initiation of interventions but also on the type of patient admitted into the ICU and the severity of the illness<sup>5, 24</sup>. In this study, the initial successful CPR and ICU discharge rate was 49.7% in 169 patients and survival to hospital discharge was 47.3%.

This rate seems high when compared with other reports on in-hospital CPR<sup>4, 5, 22, 23</sup>. This may be attributed to the fact that 100% of our patients are postoperative patients most of whom were mechanically ventilated, had intravenous catheters, invasive blood pressure monitoring and a continuous electrocardiography. Several factors within the ICU such as close monitoring and immediate intervention by ICU personnel who are more experienced, trained and familiar with cardiac arrest situations and application of CPR were also major contributing factors. Thus, in the ICU, the time to start CPR, ALS, and drug interven-

tion is much shorter than that observed in the ward or in out-of-hospital CPR. In our study, the time to start intervention was less than 20 s in all patients. In contrast in other hospitalised patients, interventions occurred within 1 min in 80%<sup>6</sup> and within 2 min in 50% of the patients<sup>22</sup>.

The initial mechanism of arrest has been reported in several series as a major determinant of survival. Patients with an initial rhythm of VF/VT are more likely to survive than patients with asystole and PEA<sup>3, 5, 22, 24</sup>. Although asystole and PEA are often considered as rhythms with unfavourable prognosis, our study showed that 46 (46.5%) of the 99 patients with initial rhythm of asystole and 5 (71.4%) of the 7 patients with PEA survived to be discharged with good neurological outcomes. Similar observations have also been reported by other investigators<sup>15, 16, 26, 28, 29</sup>. These reports as well as the 11% survival rate from asystole observed by Skogvoll, *et al.*<sup>25</sup> and 17% reported by Rankin<sup>19</sup> challenge other reports that CPR is always futile in patients with initial rhythm of asystole and PEA. Mackay, *et al.*<sup>26</sup> reported 35% survival to discharge in non-VF/VT arrests which was more than five times higher than that reported by Gwinnutt, *et al.*<sup>16</sup>. Our results may represent an improvement in monitoring, prompt intervention measures and trained personnel in the ICUs. Asystole however may be reversible when there is a rapidly correctable cause of hypoxia, bleeding and cardiac tamponade which are readily treatable in the cardiac surgical ICU as was the observation in our review.

The duration of CPR has consistently been shown to be an important intra-arrest predictor of mortality<sup>5, 18, 21</sup>. In our study, only 9 of the 62 patients survived to be discharged when CPR lasted more than 15 minutes.

Age and its relationship to survival has been an issue of extensive controversy despite substantial data. Some studies have found dismal survival rates in groups of older patients and age to be an independent risk factor for poor outcome<sup>6, 16, 17</sup> or an arrest with unfavourable

characteristic for survival<sup>30</sup>. Others have reported no relationship between age and survival<sup>4,5</sup>.

Our study found a gradual decline in survival with advancing age but no age at which survival disappeared. We found that most arrests (91%) and survivors (84%) occurred in patients who were  $\geq 60$  years old. A similar observation has been reported by Mackay, *et. al.*<sup>26</sup> who found that one-third of the elderly patients survived to hospital discharge after cardiac arrest, confirming that good outcomes are achievable in this group of patients. The outcome of resuscitation appears not to be influenced by age alone. Location of arrest, type of arrest, coexisting disease and severity of illness in combination influence the survival rates after cardiac arrest in the elderly<sup>3,5</sup>.

Illness severity has previously been reported to be a prognostic factor in CPR<sup>4,5,20,21,24</sup>. In our study, we used the SAPS II score to evaluate illness severity in our patients. SAPS II score is a widely used score which has been validated across several ICUs and has been shown to predict overall mortality in the ICU<sup>31,32</sup>. In our study, illness severity as assessed by SAPS II score on admission was  $38.8 \pm 16.0$  which may be a significant factor influencing survival after CPR. Again, none of our patients with a SAPS II score  $> 40$  obtained 24 hours after CPR survived to be discharged from the ICU. This is in line with results from Bialecki, *et. al.*<sup>20</sup> who reported a poor outcome in patients with APACHE II score  $> 20$  on admission.

#### Study limitation

Our study suffers from the shortcomings of retrospective studies like inadequate documentation by the attending doctor at time of CPR and incomplete or missing patient records. Our data did not permit the calculation of the exact 24 hour survival rate, but instead we calculated the percentage of patients surviving to ICU discharge. These limitations notwithstanding, this study was able to identify factors that significantly affect the outcome after CPR.

We, therefore, recommend a multi-institutional registry (database) of in-hospital resuscitation in Germany. This registry will ensure availability of data on CPR process and outcome, which will allow participating institutions to appraise their resuscitation performance critically in comparison to other institutions.

This registry would in addition provide important observational data that can be used by organisations such as ERC to improve the base of evidence for future resuscitation guidelines and research.

#### Conclusion

Our study showed that nearly half the patients that had cardiac arrest in our hospital ICUs had a favourable outcome despite initial rhythms that are traditionally associated with a poor outcome. This confirms that good results are achievable in these groups of patients. The overall survival (47.3%) from CPR is close to that which is reported internationally. Patients' characteristic, location of arrest and early initiation of resuscitation protocol had significant effects on the outcome of CPR observed in our study.

Conflict of Interest Statement None.

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