Improved Resuscitation Efficacy with a Program Emphasizing In-Hospital Early Defibrillation

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Abstract

In-hospital resuscitation continues to have a low success rate as measured by survival to discharge. Few procedural changes in CPR responses have been studied or have shown efficacy in improving survival. One factor known to influence survival in out-of-hospital arrests is early defibrillation. We undertook a study to see if survival to discharge could be influenced by an emphasis on early defibrillation in-hospital. **Methods and Results:** A program was designed to enhance early defibrillation in the chain of survival and was implemented in September of 2000 at a 291 bed Veterans Administration teaching hospital. This program included intensive education of all nursing and medical staff, identification of a dedicated code team, and replacement and standardization of traditional monophasic defibrillators by a combination of biphasic defibrillators and automated external defibrillators (AEDs) in selected location. Repetitive education included workshops, lectures to medical staff, and recertification in BLS and ACLS. Resuscitation records were recorded according to modified Utstein criteria and reported to the National Registry for Cardiopulmonary Resuscitation. Outcomes were compared to historical controls from 1995 until implementation of the program. The average annual rate of survival to discharge prior to implementation of the program was 5.3 ± 0.6% of all patients with resuscitation events. This improved to 12% in the first year after program implementation. Most notably, cardiac arrest victims with ventricular fibrillation or pulseless ventricular tachycardia had a 46% survival rate. **Conclusions:** Implementation of a program emphasizing in-hospital early defibrillation with repetitive education, involving biphasic waveform devices and selective use of AEDs, was safe and improved outcome in patients with cardiopulmonary arrest. Given the reduced device costs, this approach is likely to have a favorable cost-benefit ratio.

Introduction

Cardiopulmonary resuscitation has been practiced for more than 40 years. Although it has become standard in hospital settings and is performed on large number of patients, in-hospital resuscitation continues to have a low success rate as measured by survival to discharge. Few procedural changes in CPR responses have been studied or have shown efficacy in improving survival. One factor known to influence survival in out-of-hospital arrests is early defibrillation and bystander CPR. We undertook a study to see if survival to discharge could be influenced by an emphasis on early defibrillation in-hospital. This program incorporated intensive education of all nursing and medical staff, identification of a dedicated code team, and replacement and standardization of manual monophasic defibrillators by a combination of manual biphasic defibrillators and AEDs in selected locations.

Hypothesis: Our hypothesis was that our multifactorial program combining intensive education, identification of a dedicated code team, and utilization of simpler and more efficacious technology, is more effective in improving survival in patients with in-hospital CPR events compared to standard practice.

Methods

Study Design

This study is a retrospective review of the 569 CPR events between January 1, 1995 and June 30, 2002 at the 291-bed Atlanta Veterans Administration Medical Center. This study was done without external funding, and the authors maintained complete control of all aspects of the investigation throughout its course.

Patients

The study sample comprised 569 patients who had an in-hospital cardiopulmonary arrest with resuscitation attempted between January 1, 1995 and June 30, 2002. Cardiopulmonary arrests that occurred in the emergency center were included only if the patient arrived at the center in a pre-arrest state. The medical records of all patients receiving CPR were extensively reviewed to determine the presence of following demographic data and clinical characteristics including age, race, initial cardiac rhythm, arrest location, shift when arrest occurred, and resuscitation duration. Each record was assessed to determine whether the patient survived to discharge. To enhance reporting uniformity, a single team member conducted all chart reviews, with 10 percent of the charts being randomly reviewed again. All results were reported to National Registry for Cardiopulmonary Resuscitation (NRCPR).

Intervention

The program to enhance early defibrillation consisted of intensive education of all nursing and medical staff, identification of a dedicated code team, and replacement and standardization of all 68 hospital-based manual monophasic defibrillators by a combination of 34 manual biphasic defibrillators and 27 AEDs in lower-use locations such as clinics and the ward units. Repetitive education started in fall 2000 and included 70 workshops and hands-on-training sessions for all nursing and medical staff designated to locations where AEDs were to be installed in 2001. Additionally, 12 monthly lectures to medical house staff regarding role of early defibrillation in CPR and hands-on-training with AEDs were given between fall 2000 and summer 2001, and AED training was incorporated into the annual nursing skills assessments.

Outcomes

Data between January 1, 2001 and June 30, 2002 regarding survival to discharge were obtained from the NRCPR. These data were compared to survival data from all arrest victims in our hospital receiving conventional therapy between January 1, 1995 and December 31, 2000 for which comparable data was available (428 patients).

Statistical Analysis

Categorical variables were analyzed by chi-squared statistic. All statistical evaluations were made using Stata Statistical Software (College Station, Texas).

Results

Table 1: Demographic characteristic of arrest victims before and after program initiation

Variable	Time period 1995-2000	Time period Jan 2001- June 2002	p-value
Number of subjects	428	141	
Age (years)	66.6 12.2	65.4 12.5	0.30
Age			
<65	41.2%	49.6%	0.08
>65	58.8%	50.4%	
Gender			
Male	100.0%	96.5%	<0.001
Female	0.0%	3.5%	
Race			0.26
White	59.0%	64.5%	
Black	41.0%	35.5%	
Initial Rhythm			0.65
VF/VT	18.8%	17.0%	
Other	81.2%	83.0%	
Defibrillated During CPR Event			0.09
Yes	48.0%	57.1%	
No	52.0%	42.9%	
Duration of code (min)	22.7 12.0	23.3 15.0	0.67
Shift when arrest occurred			0.26
Night	40.0%	43.4%	
Day	34.7%	38.2%	
Evening	25.3%	18.4%	
Location of arrest			0.09
ICU	37.8%	35.3%	
General Ward	47.7%	53.4%	
Other	10.5%	4.5%	
ER/OR	4.0%	6.8%	

Table 2: Outcome of arrest before and after program initiation

Time period	1995-2000	2001-2002
Number of subjects	428	141
Outcome		
Discharged alive	21 (4.9%)	18 (12.8%)*
Died in hospital	407 (95.1%)	123 (87.2%)

* p = 0.001

Improvement in survival to discharge after initiation of an early defibrillation program

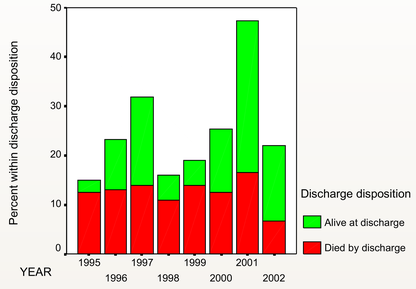

Figure 1. The percentage of arrest victims either alive or dead at discharge as a function of year. The percentage of patients surviving to discharge was greater after a program encouraging early defibrillation was instituted in 2001.

Improvement in survival to discharge after program initiation among patients presenting with ventricular tachycardia or fibrillation

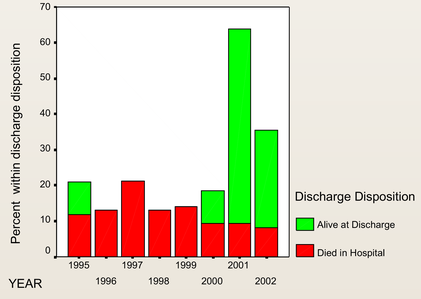

Figure 2. The percentage of arrest victims presenting with ventricular tachycardia or fibrillation either alive or dead at discharge as a function of year. The percentage of patients presenting with reentrant rhythms surviving to discharge was greater after a program encouraging early defibrillation was instituted in 2001.

Percent survival to discharge by defibrillation device used

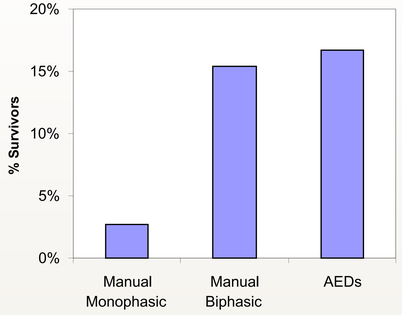

Figure 3. The percentage of survivors among patients receiving defibrillation with various types of devices. For this analysis all patients were grouped. In the hospital setting, AEDs appeared equally effective to more traditional defibrillators. The improvement with biphasic waveform devices may be confounded by other aspects of the early defibrillation program.

Conclusion

Emphasizing in-hospital early defibrillation by use of a program consisting of repetitive education, identification of a dedicated code team, utilization of biphasic waveform defibrillators and selective use of AEDs was safe and improved outcomes in patients with cardiopulmonary arrest.

Improved survival was achieved predominately because of increased success in addressing reentrant tachycardia.

The results could not be explained by baseline differences in age, race, presenting rhythm, frequency of defibrillator use, location of arrest, time of arrest, or resuscitation duration.

It would appear that AED use in the hospital settings is safe and may yield the same promising results as this technology has in the nonmedical setting.