Automated external versus blind manual defibrillation by untrained lay rescuers

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Received 24 June 1996; revised 16 July 1996; accepted 16 July 1996

Abstract

Introduction: sudden cardiac death is an important cause of mortality in the United States today. A major determinant of survival from sudden cardiac death is rapid defibrillation. Communities with high rates of bystander cardiopulmonary resuscitation (CPR) and early defibrillation enjoy the highest survival rates from out-of-hospital cardiac arrest. First responders and emergency medical technicians (EMTs) have been trained to use automated external defibrillators (AEDs). The period of instruction for successful use of the AED remains to be determined. It was the purpose of this study to compare AED versus blind manual defibrillation (BMD) by untrained lay rescuers using a simple instruction sheet and following a 20-min training period. Methods: 50 employed volunteers were confronted with a simulated cardiac arrest and asked to attempt defibrillation using either AED or BMD by following a written instruction sheet. Success was defined as delivery of three countershocks during the simulated resuscitation. Time to first and third shocks were recorded. Results: 24 of 25 volunteers (96%) were successful in operating the AED compared to none in the BMD group. Time to delivery of first shock averaged 119.5 ± 45.0 s and time to third shock averaged 158.7 ± 46.3 s. A 95% confidence interval for time to first shock for untrained lay rescuers was 100.5–138.4 s. Conclusions: untrained lay rescuers demonstrated a very high success rate using the AED during simulated cardiac arrest. Success with BMD by untrained rescuers is poor. This study suggests that prehospital personnel can be successfully trained in the use of AED in a substantially shorter period of time than in current practice. Strategic placement of AEDs like fire hoses and pool-side life preservers could result in improved survival from sudden cardiac death. Copyright © 1997 Elsevier Science Ireland Ltd.

Keywords: Defibrillation; Automated external defibrillation; Cardiac arrest

1. Introduction

Sudden cardiac death is a major cause of mortality in the United States of America. It has been estimated that up to 1000 sudden cardiac deaths occur each day [1]. The majority of these patients are suffering from coronary artery disease. However, most are not experiencing large myocardial infarcts at the time of their cardiac arrest.

A major predictor of outcome from out-of-hospital cardiac arrest is the time to application of defibrillation [2,3]. Emergency medical services (EMS) have developed with advanced practitioners, at least in part, to improve survival from out-of-hospital cardiac arrest [4,5]. Unfortunately, response times for advanced life support teams are quite long in many communities and some major cities report essentially zero survivors from out-of-hospital cardiac arrest [6].
Automated external defibrillators (AEDs) use internal decision algorithms to analyze cardiac rhythm and deliver defibrillation [7]. These devices permit rescue workers to provide defibrillation following several hours of instruction [8–10]. How long a training period is necessary for a successful use and the frequency of recurrent training required to maintain proficiency have not been determined. We hypothesized that current AEDs have become so user friendly as to be operable by lay persons without prior training.

2. Materials and methods

Fifty volunteers were recruited from non-clinical areas of the Methodist Hospital and Baylor College of Medicine, Houston, Texas. Individuals with patient care training or experience were excluded. The majority of these volunteers were clerical or maintenance personnel. Subjects were asked to participate in a study of healthcare equipment and were not informed further about the nature of the study prior to participation.

The participants were randomly assigned to the AED group (Laerdal Heartstart 1000, a fully automated device, Armonk, NY) or a blind manual defibrillation (BMD) group (Lifepak 5 defibrillator, Redmond, WA). The subjects were presented with a mannequin simulated ventricular fibrillation cardiac arrest with cardiopulmonary resuscitation (CPR) in progress and were asked to defibrillate the victim using a simple written instruction sheet. Success was defined as delivery of three countershocks at appropriate energy levels to the precordium during the simulated resuscitation. Time to delivery of the first and third defibrillation were recorded.

Immediately following this initial simulated patient encounter, participants viewed a 20-min instructional videotape on the use of their assigned device. These videos depicted step-by-step operation of each device. Information common to both devices was identical. Following viewing of the tape the participants were asked to demonstrate the application and use of their assigned device on the mannequin. Approximately 10 months following initial training, subjects were again confronted with an unannounced simulated cardiac arrest and asked to demonstrate defibrillation with their assigned device. Participants were sent to a non-clinical office by their supervisor on an apparent work-related task. Upon entering the office, they were ushered into a meeting room where a simulated cardiac arrest with bystander CPR was in progress and were asked to utilize their assigned device to resuscitate the victim. Success and time to first and third defibrillation were again recorded.

3. Results

The volunteers were recruited from many areas of the hospital system. All were English-speaking and, as noted previously, none had any clinical experience or responsibility. Approximately 50% of the volunteers had previously received CPR training, although most were not current. Most had completed high school and a few held college degrees. None were patient care personnel. All volunteers completed the first phase of the trial, being confronted with an unannounced cardiac arrest and attempting to use their assigned device.

Twenty-four of the 25 volunteers assigned to the AED group (96%) were successful in operating the defibrillator without training, compared with none from the BMD group. Time to delivery of the first shock averaged 119.5 ± 45.0 s and time to the third shock averaged 158.7 ± 46.3 s. A 95% confidence interval for the time to first shock for untrained lay rescuers was 100.5–138.4 s.

All participants were able to successfully operate their assigned defibrillator at the conclusion of the brief training period. Participants were not given additional instruction in resuscitation or the use of their assigned device. In follow-up testing at approximately 10 months, 18 of 19 AED subjects (95%) were successful at operating the defibrillator. No one in the BMD group was able to successfully utilize their assigned device at follow-up testing. Time to first shock averaged 79.1 ± 34.9 s and time to third shock averaged 115.4 ± 34.4 s. Time to delivery of first and third shock were significantly improved at follow-up compared with untrained times (P < 0.003, paired t-test).

4. Discussion

Ventricular fibrillation is the most common presenting rhythm in out-of-hospital cardiac arrest [11,12]. The development of paramedic-level pre-hospital care brought defibrillation to the community [4]. Unfortunately, the cost of staffing and equipping a paramedic-level ambulance is substantial, limiting the availability of this type of care. Long times from dispatch to scene arrival have resulted in dismal survival statistics in many cities [6].

AEDs were developed to allow less skilled rescuers to provide defibrillation services [13,14]. Previous studies have shown that with several hours of training, EMTs and student nurses can be trained to utilize the AED [15,16]. Advances in microprocessor technology and other technical areas have led to greatly improved devices. The AED analyzes the electrocardiographic rhythm and determines whether a shock is appropriate [17]. The AED used in this study ‘talks’ to the rescuer and may be programmed to follow a specific resuscitation protocol.
In this study, we have demonstrated that untrained lay rescuers can successfully operate the AED in simulated cardiac arrest. We have also demonstrated that previous training improves the speed with which defibrillation is applied. The success of untrained lay rescuers in actual cardiac arrest has yet to be determined. The stress associated with an actual arrest may impair performance of some individuals.

No lay rescuer was successful in operating the manual defibrillator prior to training or at follow-up. It is curious that BMD subjects were unsuccessful at completing the first task of BMD (placement of the electrodes) even though this task was identical to the AED. We speculate that the complex appearance of the manual defibrillator impeded the performance of BMD subjects. The poor performance of the BMD group also supports the contention that the study population had not acquired defibrillation skills through casual contact as employees of a health care organization.

In conclusion, lay rescuers demonstrated a high success rate using the AED during simulated cardiac arrest. Training with the device improves performance as measured by time to first or third shock. Performance using BMD by lay rescuers, even following a brief training period, was dismal. This study suggests that prehospital personnel may be trained with relatively brief periods of instruction, substantially shorter than in current practice. The failure of the BMD group to complete even the first task strongly suggests that the interface between emergency equipment and the operator should be as simple as possible. Inclusion of brief instruction on AED usage in CPR training programs to lay rescuers could potentially result in a large number of defibrillation-capable rescuers without adding substantially to basic CPR instruction. Strategic placement of AEDs around areas of high risk, coupled with trained lay rescuers, could result in increased survival from sudden cardiac death.

Acknowledgements

The authors wish to thank the Laerdal Corporation for provision of the automatic external defibrillator and associated equipment.

References