Can Hospital Standard Manual Defibrillators Be Replaced By Automatic External Defibrillators: Results On A Simulated Model

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Citation

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Abstract

Introduction: Although AED (automated external defibrillator) are being placed in many public places, standard manual defibrillator (SMD) still predominates in the hospital setting.

Study Objective: Determine differences in time to first shock by residents comparing AED's to SMD's.

Methods: Emergency Medicine residents were tested using both AED and SMD separately in simulated cardiac arrests. Measurements included time from discovery of the simulated cardiac arrest to first shock delivered.

Results: Median times to first shock for 20 residents were: SMD) 86.0 seconds; AED) 80.25 seconds (difference, 0.5 second; 95%CI: -18.0 to 27.0; Wilcoxon P=0.985). SMD-AED differences for first-year residents (-28.5), second-year (25.7) and third-year (10.0) were not significantly different (Kruskal-Wallis P=0.85).

Conclusion: The time to first shock for Emergency Medicine residents in all stages of training, was not impacted by their using AED or SMD. This study supports the decision to extend the placement of AED's to the hospital setting.

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INTRODUCTION

The key to survival in cardiac arrest is early defibrillation.[1,2,3,4,5,6] When time to first shock is five minutes, survival is 50% and falls of by 10% for each minute lost.[7] The American Heart Association (AHA), in an advisory statement on this subject, writes that electrical defibrillation provides the single most important therapy for the treatment of sudden cardiac arrest. The AHA also recommends AED training for all healthcare providers and strategic placement of AED's throughout healthcare facilities.[8] In fall 2001, the AHA amended Advanced Cardiovascular Life Support guidelines to include certification in the use of AEDs. Although AED's are being placed in many public places according to AHA recommendations,[9,10,11,12,13] hospitals still rely on standard manual defibrillators (SMD's) for their resuscitations.[6,14,15,16]

The majority of studies involving AED's have examined their utility in non-hospital settings. In reported studies, paramedics, EMT's, police and security personnel have all shown that they can successfully use AED's.[5,7,17,18,19,20] Few studies have looked at AED use in the hospital. In 1996, Destro, et al, proved that non-Critical care staff could successfully use AED's. As part of the study, AED's were placed in two non-Critical care units of his hospital and utilized during cardiac resuscitations that occurred on those two units. His data looked at outcome however, and not time to first shock.[14]

Our study objective was to determine if using AED's by ACLS certified residents could change the time to first shock when compared to their use of SMD's.

METHODS

STUDY DESIGN:

This was a randomized controlled trial using emergency medicine residents with one to three post-graduate years

(PGY) of training.

STUDY SETTING AND POPULATION:

All residents were from a single emergency medicine residency program based at a 434-bed community teaching hospital. All residents were ACLS certified and as such had received training in AED use.

STUDY PROTOCOL:

Upon approval and waiver of written consent from the IRB committee of the medical center, each resident volunteered to run two simulated code using AED for one and SMD for the other, thus serving as his or her own control. The trial order was randomized to both type of defibrillator used and level of training. A standard manual defibrillator (LifePac model #9P, PhysioControl, Redmond, WA) and an automatic external defibrillator (Heartstream model #FR2, Agilent Tech. , Seattle, WA) were used. An independent assistant served as the “nurse” at the bedside. The assistant acted as a facilitator to the resident, much like an examiner in an oral boards test. His/her instructions were always short and were identical for each resident. For example, when the resident commented about checking or securing the patients airway, he/she would immediately explain to the resident that the anesthesiologist had just entered the room and would take care of the airway. All trials were videotaped and reviewed to ensure that identical study protocols were followed for each trial.

MEASUREMENTS:

Two independent timers began taking measurements from the time the resident entered the room to discover the simulated ventricular fibrillation to the time the first shock was delivered to the mannequin.

DATA ANALYSIS:

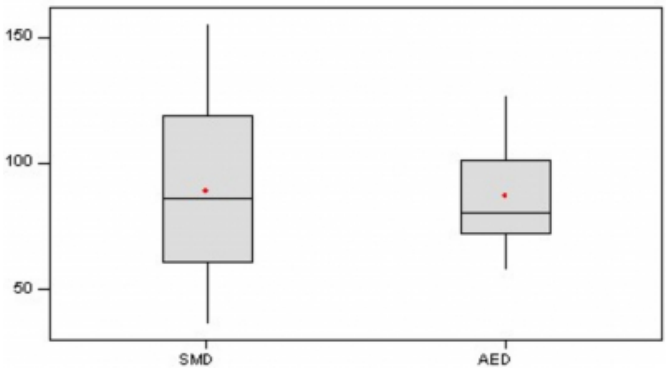
The non-parametric Wilcoxon Signed Rank Test was used to determine the statistical significance of differences between SMD and AED times. The non-parametric Kruskal-Wallis Test was used to determine significance of PGY level on the SMD-AED time differences. A sample size of 20 residents was calculated to give a power of 0.80 to detect at least a 15 second difference in time to first shock. Significance was set at P = 0.05 and all P values are two-tailed. Statistical calculations were performed on Minitab version 12.1 (Minitab, Inc., State College, PA).

RESULTS

A total of twenty-two emergency medicine residents were tested during this study, with each resident running simulated cardiac arrest using both the SMD and the AED. The training levels of the residents were as follows: eight PGY1, eight PGY2, and six PGY3. Two of the PGY1's trials were discarded due to mechanical dysfunction. The median time to first shock for 20 residents using SMD was 86.0 seconds (IQR: 60.2 to 118.8). The median time for these same residents using AED was 80.25 seconds (IQR: 71.8 to 101.4). The median difference between SMD use and AED use was 0.5 seconds (95% CI: -18.0 to 27.0). This difference was not significant (Wilcoxon P = 0.985) and shown visually in figure 1.0.

Figure 1

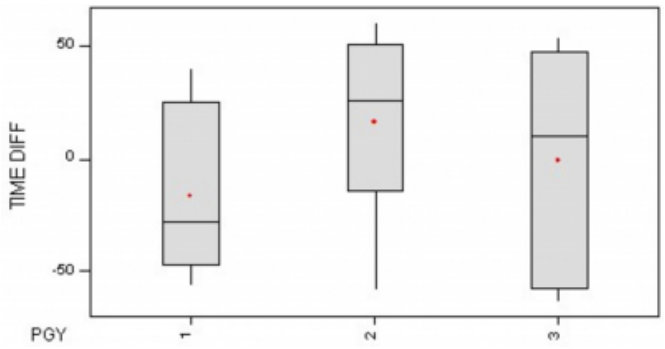
Figure 1: Boxplots of SMD times and AED times (menas are indicated by solid circles)



When stratified by level of training (figure 2.0), PGY1 had SMD-AED median difference of -28.5 seconds (IQR: -47.2 to 25.5) while PGY2 had median difference of 25.7 seconds (IQR: -14.1 to 50.6) and PGY3 had median difference of 10.0 seconds (IQR: -58.4 to 47.4). As a secondary observation we found that there was no significant effect of PGY year in terms of differences in time to first shock using an AED vs. SMD (Kruskal-Wallis P = 0.468).

Figure 2

Figure 2: Boxplots of TIME DIFF by PGY (means are indicated by solid circles)



DISCUSSION

AED's role in out of hospital cardiac arrest has grown significantly in the last ten years. In addition to becoming standard medical equipment on many airlines, they have recently gained acceptance for use by EMT's, police personnel and other first responders including the lay public. Furthermore, studies have shown that nurses could be trained to use these devices within the hospital and retain the necessary knowledge to continue using them safely [16,21,22]. All of this has been for one purpose: to decrease the amount of time to first shock – a critical point that has proved to decrease morbidity and mortality. This study was designed to determine if there were differences in time to first shock by house officers using an AED as compared to an SMD.

With increasing emphasis being placed on the successful use of AED's outside the hospital, many medical centers have placed AED's in the non-patient care areas of their facilities. Some studies have previously looked at whether the use of AED's could be extended to the patient care areas as well. We were able to determine that there was no difference in time to first shock when residents used AED's or SMD's. There was also no difference based on the residents' level of training. Our study shows that residents can adapt to using either an SMD or an AED to run a code and although AED's were designed with the lay person in mind, this study supports the use of AED's in the hospital setting.

STUDY LIMITATIONS AND FUTURE QUESTIONS

One limitation of this study involves the use of only Emergency Medicine residents. Since these residents are trained to specialize in resuscitations, their ability to equally use AED or SMD may not represent differences that could exist in residents from other specialties. Another limitation concerns the wide variability in the time to first shock between individual residents even though the exact same scenario was presented to each resident by the same facilitator. It may be that groups of residents with smaller within group variability would actually show significant difference between AED and SMD times. With these limitations in mind, future studies will include residents from a variety of specialties and larger sample size.

CONCLUSIONS

Our data shows that Emergency Medicine residents are quite capable of delivering a shock in a timely manner with whatever type of defibrillator is supplied to them. We also found that the level of training was not a factor when comparing time to first shock with either instrument. This study supports the decision of hospitals to extend the placement of AED's within the hospital.

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