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WEB PAPER

An innovative approach to teaching resuscitation skills

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ABSTRACT *We report the impact of a monthly educational exercise for residents that emphasized practical skills and equipment usage rather than knowledge of advanced cardiac life support (ACLS) protocols. Residents were divided into groups of approximately four that rotated through three stations. Each station included several objectives, most of which related to specific types of equipment. The exercise was held six times from July 2003 to June of 2004. Sixty-seven residents participated and completed a questionnaire prior to and following the exercise. The questionnaire elicited comfort level with basic tasks including using an automated external defibrillator (AED), attaching leads and paddles to read a cardiac rhythm, delivering unsynchronized shocks with monophasic and biphasic defibrillators and implementing the pacing function on a defibrillator. There were significant differences in the pre- and post-answers to each question. The largest difference was found in the question asking how comfortable participants were delivering unsynchronized shocks with a defibrillator. Importantly, responses for the question 'How comfortable are you being a code leader?' showed significant improvement. Simple skills such as attaching tubing to the oxygen tank, turning on the defibrillator and entering appropriate charge, or positioning paddles and monitor leads properly often caused significant difficulty. Cardiopulmonary arrests tend to generate anxiety among house staff, despite certification in ACLS and adequate knowledge of protocols. Exercises, such as the one presented here, will reduce anxiety by specifically addressing this skill. We conclude that residents benefit from additional teaching and practice in actual performance of basic skills used during cardiac arrests. Furthermore, our data demonstrate that comfort levels among house officers increase when they are given the opportunity to practice these skills.*

Practice points

- ACLS training may not fully prepare house officers to resuscitate patients.
- An exercise that stresses the mechanical skills of resuscitation increases a house officer's perception of competence.
- Stressing the importance of team leadership during resuscitation can increase a house officer's comfort as a resuscitation leader.
- Proper training in resuscitation needs to focus on both knowledge and practical skills.
- House officers may not possess simple skills such as the proper placement of cardioversion pads during resuscitation, setting the correct joules for cardioversion, connecting pads to the cardioversion unit, or establishing a team leader during resuscitation.

Introduction

It is widely accepted that Advanced Cardiac Life Support (ACLS) training and refresher courses for physicians improve cardiac arrest outcomes (Camp *et al.*, 1997; Lowenstein *et al.*, 1981). However, ACLS certification alone is insufficient to establish physician competence in resuscitating patients (Kaye *et al.*, 1998). Interestingly, in the United States, the rate of long-term survival to hospital discharge following in-hospital cardiac arrest did not improve between 1960 and 1993 despite the initiation of ACLS training of physicians in the mid-1970s (Kaye *et al.*, 1998). In Canada, survival following cardiopulmonary resuscitation (CPR) in hospital also failed to significantly improve between 1960 and 1999 (Brindley *et al.*, 2002). Thus, it is important to investigate non-traditional methods of teaching ACLS skills to house officers in an attempt to improve physician competence and cardiac arrest outcomes.

A 2003 survey performed among junior physicians in the United Kingdom found that the majority perceived cardiac arrests to be 'stressful experiences', and nearly half of these physicians did not believe they were adequately trained to manage resuscitations (Scott *et al.*, 2003). In US teaching hospitals, internal medicine senior house officers lead most inpatient cardiac arrests. We have observed that house staff cognitive abilities (i.e., recall of ACLS protocols) are often superior to their technical skill. In other words, knowing how to properly resuscitate an arrested patient is not the same as actually performing the resuscitation. Simple tasks such as successful manipulation of equipment often hamper the efficiency of resuscitations. Furthermore, traditional exercises in patient resuscitation usually ask the house staff to recall ACLS algorithms verbally, but do not require them to actually perform the life-saving tasks. Such exercises review and possibly improve house staff's knowledge, but do not improve their technical skill.

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There is little available data about overall competence during adult resuscitations conducted by physicians formally trained in ACLS. However, there are some important studies about specific aspects of performance in arrests. One study found that blinded physicians accurately assessed whether patients were breathing in 89.7% of attempts (Ruppert *et al.*, 1999). Similarly, in a multi-center study, the ability of health professionals to check for the carotid pulse was unreliable in the assessment of pulselessness (Flesche *et al.*, 1994). These studies demonstrate that even the most basic skills of resuscitation are sometimes performed incorrectly. This year, a case series was published reviewing CPR performance by ACLS-trained ambulance personnel during cardiac arrest. It revealed that chest compressions were not delivered half of the time, and most compressions were too shallow (Wik *et al.*, 2005). In another study among 101 physician subjects, only 65 and 22% correctly placed sternal and apical paddles during defibrillation of a manikin in ventricular fibrillation (Heames *et al.*, 2001). Finally, a study of pediatric house staff resuscitation skills determined that in spite of ACLS training, many house officers lacked familiarity with resuscitation equipment leading to loss of valuable time while attempting to 'decipher' equipment (White *et al.*, 1998). We report the impact of a monthly educational experience for house officers that emphasized hands-on skills and equipment usage rather than knowledge of ACLS protocols.

Methods

The educational experience was held six times for one-hour periods from July 2003 to July 2004. Participants were internal medicine house officers on rotation at the Minneapolis Veterans Administration Medical Center. House officers were asked to complete a five item questionnaire prior to the exercise. Responses were circled on a scale from 1 (very uncomfortable) to 4 (very comfortable). The questionnaire elicited house officer comfort level with four basic tasks:

- using an AED (Automated External Defibrillator);
- attaching defibrillator leads and paddles to read a cardiac rhythm;
- delivering unsynchronized shocks with both monophasic and biphasic defibrillators;
- implementing the pacing function on a defibrillator.

In a fifth question, house officers were asked how comfortable they were being code leaders (Figure 1). Some basic principles of effective code management were reviewed prior to beginning each exercise (for example, the need for clear establishment of a code leader and use of team members' names when delegating tasks). House officers were then divided into groups of approximately four that rotated through three stations. Each station included several objectives, most of which related to specific types of equipment. The chief residents and the nurse co-chair of the CPR committee moderated the stations. At each, a manikin and all necessary resuscitation equipment were present, and the moderator provided the group with a clinical scenario involving a cardiopulmonary arrest of an adult patient. The house officers were then asked to physically perform the multiple necessary tasks involved in running the arrest successfully. The objectives at each station were basic:

- continuing a resuscitation in which an AED was already in place;
- setting up and attaching oxygen tubing to the tank on the resuscitation cart;
- attaching leads to read the cardiac rhythm with a monophasic defibrillator;
- removing locked paddles from and powering up a biphasic defibrillator;
- setting voltage, charging and correctly defibrillating with each type of machine;

1 = Very uncomfortable
2 = Somewhat uncomfortable
3 = Somewhat comfortable
4 = Very comfortable

How comfortable are you…

1. Using an AED? 1 2 3 4
2. Attaching both leads and paddles to read a rhythm with a monophasic defibrillator?
   1 2 3 4
3. Delivering unsynchronized shocks with *either* a monophasic or biphasic defibrillator? 1 2 3 4
4. Implementing the pacing function on a defibrillator with pacing capability?
   1 2 3 4
5. Being a code leader? 1 2 3 4

Figure 1. Questionnaire completed by each house officer pre- and post-exercise. House officers circled the number best describing their comfort level before and after they participated in the exercise. Questionnaires were collected anonymously. An answer was not totaled if it could not be read clearly (e.g., if the circle included two numbers).

Table 1. Questionnaire results. Values represent responses and proportion of total respondents for each question, *n*(%). The number of house staff who responded is shown in the totals row. AED = automatic electronic defibrillator.

	Using an AED		Attaching defibrillator leads/paddles to read a cardiac rhythm		Delivering unsynchronized shocks		Implementing the pacing function on a defibrillator		Being a code leader	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Very uncomfortable	3(4.6)	0(0)	4(6.3)	0(0)	4(6.2)	0(0)	8(12.7)	0(0)	13(20.3)	4(6.1)
Somewhat uncomfortable	18(27.7)	1(1.5)	17(26.5)	3(14.5)	20(30.8)	2(3.0)	2031.7)	2(3.0)	19(29.7)	17(26.2)
Somewhat comfortable	32(49.2)	21(31.8)	32(50.0)	27(40.9)	27(40.9)	28(41.8)	24(38.1)	35(53.0)	24(37.5)	23(35.4)
Very comfortable	12(18.5)	44(66.7)	11(17.2)	36(54.6)	36(54.6)	37(55.2)	11(17.5)	29(44.0)	8(12.5)	21(32.3)
Totals	65	66	64	66	65	67	63	66	64	65

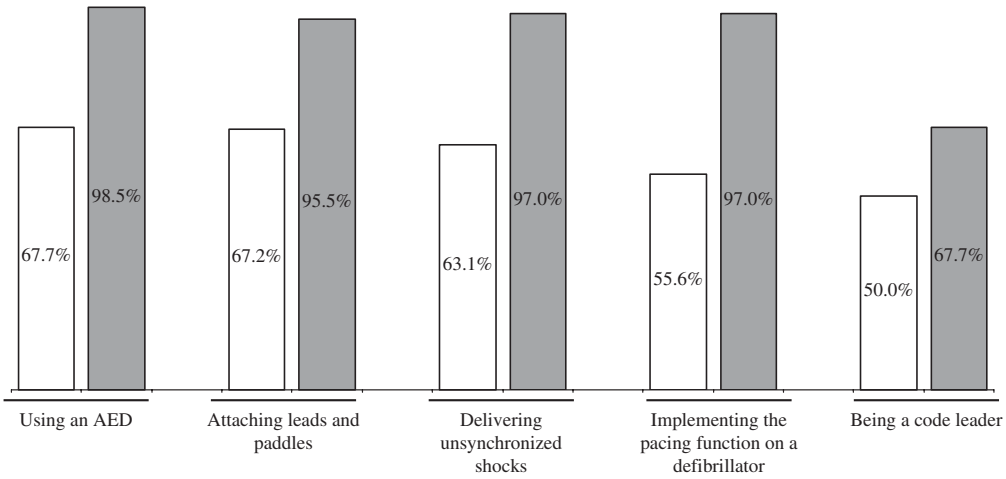

Figure 2. Comparison of difference in house staff responses to the five questions pre- and post-exercise. Values within each bar represent the combined percentage of residents responding positively overall ('somewhat comfortable' and 'very comfortable'). White and grey bars correspond to pre- and post-exercise responses, respectively. Favorable responses increased within each group following the educational exercise, indicating improvement in resident perception of performance. AED = automatic electronic defibrillator.

- repositioning pads properly for pacing and using the pacing function on each machine.

The moderator of each station was responsible for verifying that the group demonstrated mastery of the objectives assigned to his or her station. At the end of the 60 minute session, participants repeated the questionnaire. Results were recorded, and the pre- and post-exercise responses were compared at the end of the six sessions by totaling the numbers for each category of participant responses to each question (Table 1).

Results

The exercise was attended by a total of 67 house officers. There were meaningful differences in the pre and post answers to all five questions (Figure 2). The largest difference was seen in the question relating to how comfortable participants were delivering unsynchronized shocks with either a monophasic or biphasic defibrillator (question 3). Prior to the exercise, 37% of respondents felt somewhat or very uncomfortable with this task, but only 3% felt this way after the practicum. Importantly, response rates for the question 'How comfortable are you being a code leader?' showed significant improvement. It is notable that response rates of 'very uncomfortable' fell to 0% in four out of five categories following the session.

The exercise also yielded several unmeasured, yet interesting observations. Repeatedly, house officers fumbled with resuscitative equipment in spite of clearly knowing what needed to be done with it. In several of these cases, the equipment had simple instructions labeled '1, 2, 3' from the manufacturers in plain view that went unnoticed by trainees. Simple skills such as turning off the AED once a manual defibrillator was in place, attaching tubing to the oxygen tank, turning on the defibrillator and entering the appropriate charge, or positioning paddles and monitor leads properly, often caused significant difficulty. Frequently, additional time was necessary to allow each house officer further opportunity to handle equipment and complete each objective for that station. Upon completion of the session, participants regularly reported that they found the experience practical and useful.

Discussion

We conclude that house staff benefit from additional teaching and practice in actual performance of basic skills used during cardiac arrests. Furthermore, our data demonstrate that comfort levels among house officers increase when they are given the opportunity to exercise and practice these skills. Our study, while showing impressive and consistent differences in house officer comfort levels before and after a hands-on code practicum is limited. While one may hypothesize that increased comfort level leads to increased competence, this is not proven with our study. Furthermore, an increase in the level of house staff competence in running arrests does not necessarily translate to improved patient outcomes due to the multitude of variables contributing to resuscitation results. However, by describing an additional exercise for improving house staff comfort level in arrest situations, our findings do strongly suggest that house officers benefit from additional educational innovations in ACLS training.

Prior to our study, it has been recognized that knowledge and skills are learned differently than they are maintained, and that cognitive knowledge is actually retained more easily than skill (White *et al*., 1998). Thus, some difficulty in running arrests may come from being temporally distant from one's most recent ACLS training course. Stross (1983) found that following an intervention to reinforce previously mastered ACLS knowledge, the physicians demonstrated enhanced knowledge retention but not motor skills. He proposed changes in ACLS re-certification for physicians from every two years to yearly. His findings do support the conclusion that at least the motor skill portion of training should be practiced more frequently. In the 1980s, Kaye *et al*. (1988) designed a core ACLS course for junior house officers based on a premise similar to ours: that traditional ACLS training focuses on cognitive knowledge more than practical skills. He emphasized several years later that, in spite of the effectiveness of repetitive skill practice, traditional ACLS training still includes too little time for acquisition and practice of psychomotor skills (Kaye *et al*., 1998). Our project and its results support this view and offer a partial solution by supplementing rather than repeating traditional ACLS training sessions.

In summary, cardiopulmonary arrests tend to generate anxiety among house staff, despite certification in ACLS and adequate knowledge of protocols. Contributing to this anxiety is a lack of technical skill specifically relating to the use of resuscitation equipment. Exercises, such as the one presented here, will reduce anxiety by specifically addressing this skill. The success of this project should encourage the use of similar innovations in house officer training curricula. In the future, studies that objectively measure changes in trainee skill levels and even changes in cardiac arrest outcomes resulting from such endeavors will further demonstrate their utility.

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