

Retention Rates of ACLS Skills in Senior Medical Students

Onedera T¹, Nguyen M², Abrahamsen N³, Schocken D⁴, Peckler B^{1,*}

¹FACEP FACEM University of South Florida, Department of Emergency Medicine, USA

²Department of Emergency Medicine, Wellington Regional Hospital, Wellington, New Zealand

³University of South Florida, Department of Emergency Medicine Nadia, USA

⁴University of South Florida, Director of Clinical Skills Centre, USA

Abstract: *Objectives:* The aim of this study was to assess the retention rate of Advanced Cardiac Life Support (ACLS) skills in third-year medical students who had few clinical opportunities or responsibilities to use them. It was hypothesised that using high-fidelity simulation would increase skills retention.

Methods: This was a prospective observational study of 120 rising third year medical students. All students took and eventually passed a full two-day ACLS provider course. Subsequently, during the end of the year Comprehensive Clinical Performance Examination (CCPX) all students participated in a mega code with a Laerdal Hi-Fidelity Simulator. Their performance in 25 critical actions was dichotomously rated as “successful” or “not successful.”

Results: All students passed the initial ACLS course, six required standard remediation. One hundred and sixteen students took the end of year CCPX exam, and a success rate for critical actions ranged between 3.4% and 100%. Most students did well at recognition of fatal arrhythmias and cardiopulmonary resuscitation (CPR). Students performed poorly in airway/breathing assessment and management, as well as management of arrhythmias.

Conclusions: ACLS skills are an important skill set for up coming physicians, and unless they are used in practice, they deteriorate very quickly. Simulation did not increase student retention rates of ACLS skills to a great extent. Students did well in identifying problems, but did not treat these appropriately. This study suggests that educators should examine the goals of teaching ACLS to providers who have not clearly defined role in resuscitation.

Keywords: ACLS retention, simulation, medical students.

INTRODUCTION

American Heart Association, since their first publishing in 1974, has provided health care professionals the Advanced Cardiac Life Support (ACLS) course as a standardized guideline for assessment and treatment of patients with acute cardiac conditions. ACLS providers need to be re-certified every two years as the ability to retain any skill is based upon repetition and use. This study attempted to evaluate the ability of rising third year medical students who had very little clinical experience or responsibilities to maintain their ACLS knowledge and skills.

ACLS retention has been studied on physicians in training and simulation is of added educational benefit [1]. Wayne DB et al. studied the retention rate of ACLS skills in internal medicine residents. Their prospective cohort study revealed that ACLS skills were retained for 14 months with deliberate practice sessions [2]. Research supports that simulation-based ACLS courses provide better results than

textbook-based ones, including a higher adherence to the AHA guidelines [3] and better performance at the mega code testing two months after the course [4]. It is unclear why physicians (residents and fellows) maintain their ACLS skills better than nurses. Medical students have not assumed the role or responsibilities of a physician and are not qualified as nurses or paramedics. Their ability to retain ACLS skills may be more difficult because they have no clear role in a hospital setting, they may be asked to help, however have no predefined role.

There are few articles examining the ACLS retention rate in medical students. This may be based on the fact that while ACLS courses are commonly provided to medical students, assessment of the student's retention is not often done. The third year of medical school is the first intense clinical exposure they experience. They are part of the clinical teams yet they have few responsibilities. Medical students may witness a cardiac arrest during clinical rotations and occasionally, they may be asked to assist in resuscitation tasks. Students are not regularly assigned an essential role on the code teams, and therefore they're not required to be certified in ACLS for their clinical rotations. ACLS is, however, a core concept of cardiopulmonary resuscitation, and therefore needs to be a part of their curriculum.

*Address correspondence to these authors at the FACEP FACEM University of South Florida, Department of Emergency Medicine, USA; Tel: 813-627-5931; Fax: 813-254-6440; E-mail: bpeckler@health.usf.edu



Fig. (1). Case algorithm, Edward Cardia.

This study sought to evaluate the retention rates of ACLS knowledge and skills. Testing ACLS skills retention in third year medical students is unique in that students rotate through various clinical departments and have different clinical experiences. Additionally, the field of medicine that the student intends to pursue may have an impact upon a student's interest and retention of the ACLS protocols. The hypothesis of this study was the use of hi-fidelity simulation in teaching ACLS would demonstrate a higher rate of retention. Data from medical students could provide important insights into ACLS retention, including protocols well remembered and ones not. The consequences of this study could advocate for additional ACLS protocols to reinforce future curriculum development.

METHODS

This was a prospective observational study. We obtained exempt certification from the Institutional Review Board. All the students were informed that identification would be redacted and no individual would be identified, or adversely affected by the study. Additionally, no grades would be affected by the results of the study. Both verbal and signed consent was obtained for this study.

All rising 3rd year medical students (N=120) took a full two-day ACLS provider course. All students successfully passed the written tests and the mega code scenarios at the end of the course. Remediation was required for six students. During the end of year CCPX final exam, the students were put into a scenario where they were the code team leader. This was a non-graded station in this exam activity. The scenario consisted of managing an unstable elderly patient with chest pain (a Laerdal Hi-Fidelity Simulator). The scenario included several confederate actors in the room. An ACLS instructor, running the simulator, served as evaluator, two ACLS certified nurses also were confederates in the room to assist as members of the code team.

Fig. (1) shows the flow of the mega code case. Mr. Edward Cardia (patient) was presented as a 67 year old male with chest pain, dyspnea and diaphoresis. Vital Signs: BP 85/40 mmHg, HR 130/min, RR 30/min and T 98.2F. Students were expected to place the patient on a cardiac monitor, start oxygen and obtain intravenous access. The patient complained of pain and was in distress and unstable. The evaluator read the monitor aloud, which showed all vital signs and the cardiac rhythm. Students needed to identify the ventricular tachycardia on the monitor, and recognize the unstable tachycardia from the clinical picture and vital signs. The management plan included cardioversion after choosing the synchronized mode. The patient's condition continued to deteriorate, prompting a reassessment. The protocol called for a responsiveness check, opening of airway and beginning of CPR, following recognition of no spontaneous breathing. The confederate actors could be assigned to these roles with verbal identification from student. Subsequently, an assessment of the carotid pulse (which demonstrated as absent) would then prompt initiation of chest compressions. The rhythm on the monitor changed to ventricular fibrillation. Students were expected to both recognize the rhythm and provide immediate defibrillation at 360J. Following shock, the students were to resume CPR. After 5 cycles of CPR, it was expected the student would check the monitor and pulse (which demonstrated continued ventricular fibrillation). Following a second defibrillation, and assessment, the students were to consider medication (epinephrine). A mark was checked each time the student asked for "all clear" prior to using the defibrillator.

RESULTS

One-hundred twenty third-year medical students participated in the ACLS course at the beginning of this study. All 120 students successfully completed the ACLS course and their competency for all the ACLS skills was 100% at the end of the ACLS course. Of the 120, only 116

Table 1. All Major Actions were Checked Dichotomously and Accounted for: "Successfully Performed or not"

	Actions	Performance	
		Yes	No
1	Place monitor leads in proper position	Yes	No
2	Provide oxygen	Yes	No
3	Start intravenous lines	Yes	No
4	Identify ventricular tachycardia	Yes	No
5	Recognize unstable tachycardia	Yes	No
6	Perform immediate cardioversion	Yes	No
7	Choose synchronized shocks for cardioversion	Yes	No
8	Check the response of the patient	Yes	No
9	Open the airway using head-tilt chin-lift maneuver	Yes	No
10	Look, listen and feel breathing	Yes	No
11	Provide two rescue breathing using an ambu bag	Yes	No
12	Confirm chest rise with an ambu bag breathing	Yes	No
13	Check carotid pulses	Yes	No
14	Perform immediate chest compressions	Yes	No
15	Recognize ventricular fibrillation and defibrillate the patient	Yes	No
16	Defibrillate at 360J	Yes	No
17	Resume CPR immediately after defibrillation	Yes	No
18	Provide 5 cycles of CPR	Yes	No
19	Provide ventilation/compression at 30:2 ratio	Yes	No
20	Provide 30 compressions within 20 seconds	Yes	No
21	Provide compressions 1.5 to 2 inches deep	Yes	No
22	Identify ventricular fibrillation again	Yes	No
23	Defibrillate the patient again	Yes	No
24	Provide medications	Yes	No
25	Ensure "everyone is clear" before defibrillation	Yes	No

Table 2. Result

Actions	Yes (N=116)	Rate (%)	+/- (for 95%CI)
Place monitor leads in proper position	116	100.0	0.0
Provide oxygen	64	55.2	9.1
Start intravenous lines	77	66.4	8.6
Identify ventricular tachycardia	104	89.7	5.5
Recognize unstable tachycardia	46	39.7	8.9
Perform immediate cardioversion	66	56.9	9.0
Choose synchronized shocks for cardioversion	37	31.9	8.5

Table 2. contd...

Actions	Yes (N=116)	Rate (%)	+/- (for 95%CI)
Check the response of the patient	27	23.3	7.7
Open the airway using head-tilt chin-lift maneuver	35	30.2	8.4
Look, listen and feel breathing	61	52.6	9.1
Provide two rescue breathing using an ambu bag	114	98.3	2.4
Confirm chest rise with an ambu bag breathing	65	56.0	9.0
Check carotid pulses	75	64.7	8.7
Perform immediate chest compressions	113	97.4	2.9
Recognize ventricular fibrillation and defibrillate the patient	81	69.8	8.4
Defibrillate at 360J	69	59.5	8.9
Resume CPR immediately after defibrillation	76	65.5	8.6
Provide 5 cycles of CPR	89	76.7	7.7
Provide ventilation/compression at 30:2 ratio	113	97.4	2.9
Provide 30 compressions within 20 seconds	105	90.5	5.3
Provide compressions 1.5 to 2 inches deep	92	79.3	7.4
Identify ventricular fibrillation again	98	84.5	6.6
Defibrillate the patient again	89	76.7	7.7
Provide medications	81	69.8	8.4
Ensure "everyone is clear" before defibrillation	4	3.4	3.3

students took the end of the year CCPX exam. The results, in chronological order, are presented in Table 2. We utilized normal approximation to calculate the 95% CI of the proportions.

$$p \pm Z_c \sqrt{\frac{P(1-P)}{n}}$$

DISCUSSION

Most students retained the "Circulation" part of Basic Life Support while they did poorly at "Airway" and "Breathing." Only 55.2% of students provided oxygen to the patient. Very few students (23.3%) checked the response of the patient and 30.2% of students were able to demonstrate the maneuver to open the airway. Nearly 99% (98.3%) of students demonstrated successfully providing two rescue breaths with a bag valve mask, but observation of the videos tells us that the testing nurse, expecting the next move of the students, automatically passed an Ambu bag to the students without request. Performance of chest compression, though it involved many components (frequency and depth), was one-dimensional and therefore readily performed by the students. However, the assessment of airway and breathing involves a three-dimensional understanding of the respiratory system and requires multiple actions. The skill sets of airway/breathing assessment and management deteriorate very quickly. Some BLS skills had much lower scores such as checking the response of the patient, checking

pulses, chin lift maneuver, and basic breathing evaluation. Many students did better on the advanced skills and seemed to neglect the basic skills.

All students placed the patient on cardiac monitor (100.0%) and most subsequently identified fatal arrhythmias such as ventricular tachycardia (89.7%) and ventricular fibrillation (84.5%) but a large percentage of students had difficulty in managing these rhythms and determining stable or unstable. The advance skills outlier was giving the "everyone clear" statement before defibrillation at 3.4%. This may have been due to it not being emphasized during the original training course, understanding of the potential danger of electricity, or that it was a simulated scenario and they did not think it a danger.

This study is consistent with many other studies that showed skill degradation over time without interval practice [5-13]. This may explain why these third year students who are not specifically doing these skills year scored so low on some tasks. Brennan⁴ demonstrated similar poor success rates to ours in the lay public. It is clear that interval training increases retention [1, 14-16]. Most studies did not look at specific skills within ACLS. One study however looked at a half-day "How to Save a Life" course to medical students at orientation before starting clinical rotations at the beginning of the third-year [17]. The students were assessed for their knowledge and skill retention during their 4th year EM rotations. Retention rates were great for CPR (97.1%), but they did less well for use of bag-valve mask (82.4%),

opening and maintaining airway (79.4%), use of AED (73.5%), use of airway adjuncts (70.6%), treatment of pediatric choking victim (64.7%), treatment of arrhythmias (61.8%), and identification of arrhythmias (58.8%). This was consistent with our findings.

We do not think that their poor performance was because of lack of knowledge, but rather in applying it. A high-fidelity simulation mannequin, much like an actual patient, seemed to cause difficulty in recall. Students had difficulty utilizing their one-dimensional didactic knowledge as a decision tool for managing the actual situation exhibited by the high-fidelity simulation. The large variation in results may be due to different exposures that have had during the year and any experience in using the skills. At the time of the year when the test is given students are deciding on different career choices. It is understandable that a student who chooses a field of medicine that deals with critically ill patients would have more motivation to memorize the algorithms than a doctor who chooses a field of medicine that does not deal with acute emergencies. Actions cannot take place without both the knowledge and the bridge converting the knowledge into the action. This bridge between knowledge and actions decay very quickly. It is suggested that regular re-training intervals, using simulation, would help maintain these critical skills.

CONCLUSION

It was not surprising that students with little actual emergent clinical experience would have difficulties managing the more complex aspects of ACLS. Airway management and determining the stability of a patient are some of the cornerstones of resuscitation, but also some of the more complex aspects. Unless a practitioner has routine exposure to acute clinical situations, such as cardiac arrest, ACLS skills can quickly deteriorate over time. Students did well identifying the problem, but not in following the necessary treatment protocols. This study suggests that ACLS skills deteriorate over time without deliberate practice or use.

CONFLICT OF INTEREST

The authors confirm that this article content has no conflicts of interest.

ACKNOWLEDGEMENTS

Declared none.

REFERENCES

- [1] Wayne DB, Butter J, Siddall VJ, *et al.* Mastery learning of advanced cardiac life support skills by internal medicine residents using simulation technology and deliberate practice. *J Gen Intern Med* 2006; 21(3): 251-6.
- [2] Wayne DB, Siddall VJ, Butter J, *et al.* A longitudinal study of internal medicine residents' retention of advanced cardiac life support skills. *Acad Med* 2006; 81(10): S9-12.
- [3] Wayne DB, Didwania A, Feinglass J, Fudala MJ, Barsuk JH, McGaghie WC. Simulation-based education improves quality of care during cardiac arrest team responses at an academic teaching hospital. *Chest* 2008; 133(1): 56-61.
- [4] Schwid H, Rooke GA, Brian R, Sivarajan M. Use of a computerized advanced cardiac life support simulator improves retention of advanced cardiac life support guidelines better than a textbook review. *Crit Care Med* 1999; 27(4): 821-4.
- [5] Brennan RT, Braslow A. Skill mastery in public CPR classes. *Am J Emerg Med* 1998; 16: 653-7.
- [6] Wollard M, Whitefield R, Smith A, *et al.* Skill acquisition and retention in automated external defibrillator (AED) use and CPR by lay responders: a prospective study. *Resuscitation* 2004; 60: 17-28.
- [7] Kaye W, Mancini ME, Rallis SF. Advanced cardiac life support refresher course using standardized objective-based mega code testing. *Crit Care Med* 1987; 15: 55-60.
- [8] O'Steen DS, Kee CC, Minick MP. The retention of advanced cardiac life support knowledge among registered nurses. *J Nurs Staff Dev* 1996; 12: 66-72.
- [9] Moser DK, Dracup K, Guzy PM, Taylor SE, Breu C. Cardiopulmonary resuscitation skills retention in family members of cardiac patients. *Am J Emerg Med* 1990; 8: 498-503.
- [10] Donnelly P, Assar, Lester C. A comparison of manikin CPR performance by lay persons trained in three variations of basic life support guidelines. *Resuscitation* 2000; 45: 195-9.
- [11] Chamberlain D, Smith A, Woollard M, *et al.* Trials of teaching methods in basic life support (3): comparison of simulated CPR performance after first training and at 6 months, with a note on the value of retraining. *Resuscitation* 2002; 53: 179-87.
- [12] Anthonypillai F. Retention of advanced cardiopulmonary resuscitation knowledge by intensive care trained nurses. *Intensive Crit Care Nurs* 1992; 8: 180-4.
- [13] Kaye W, Mancini ME. Retention of cardiopulmonary resuscitation skills by physicians, registered nurses, and the general public. *Crit Care Med* 1986; 14: 620-2.
- [14] Ko PY. Comparison of a modified longitudinal simulation-based advanced cardiovascular life support to a traditional advanced cardiovascular life support curriculum in third-year medical students. *Teach Learn Med* 2011; 23(4): 324-30.
- [15] Wayne DB, Butter J, Siddall VJ, *et al.* Mastery learning of advanced cardiac life support skills by internal medicine residents using simulation technology and deliberate practice. *J Gen Intern Med* 2006; 21(3): 251-6.
- [16] Lo BM Comparison of traditional versus high-fidelity simulation in the retention of ACLS knowledge. *Resuscitation* 2011; 82(11): 1440-3
- [17] Ander DS, Heilpern K, Goertz F, Click L, Kahn S. Effectiveness of a simulation-based medical student course on managing life-threatening medical conditions. *Simul Healthcare* 2009; 4(4): 207-11.