Evaluation of retention of knowledge and skills imparted to first-year medical students through basic life support training

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How We Teach

Evaluation of retention of knowledge and skills imparted to first-year medical students through basic life support training. Adv Physiol Educ 38: 42–45, 2014; doi:10.1152/advan.00102.2013.—Poor awareness among medical graduates about basic life support (BLS) is a matter of great concern. The presence of a trained rescuer is the key determinant of ultimate survival from life-threatening emergencies. To achieve this goal, early exposure to such life-saving skills is the right decision to foster these skills for medical students, which can be reinforced in succeeding years. Forty-two first-year medical students participated in this study. The entire procedure consisted of faculty training, assessment of knowledge of students by a pretest questionnaire, a lecture, a demonstration, and hands-on training using a mannequin (with special emphasis on the site, depth, rate, and sustainment of uninterrupted chest compressions). Posttest 1 was conducted to assess the knowledge gained. The retention of knowledge and skills in the second year was evaluated by posttest 2 and directly observed procedural skills, respectively. Student feedback was collected on five-point Likert scale. Analysis using a Friedman test indicated the mean rank for posttest 1 (2.81) to be significantly higher than the pretest (1.26), indicating a gain in knowledge. The mean rank for posttest 2 (1.93) was lower than for posttest 1 (2.81) but was significantly higher compared with the pretest (1.26), indicating a significant retention of knowledge during the second year. Directly observed procedural skill evaluation showed that 7% students could perform all the seven steps correctly and that 74% students could perform three or more steps correctly, signifying a good retention of skill. Two students taught BLS skills to their family members as well. The results of this study suggest that the program provides students with sound basic knowledge and adequate practical skills in BLS.

basic life support; knowledge; skill; training

DESPITE IMPORTANT ADVANCES in prevention, cardiac arrest remains a substantial health problem and a leading cause of death in many parts of the world. The reasons for this include a change in lifestyle, unhealthy eating habits, and lack of exercise. The most important determinant of survival from sudden cardiac arrest is the presence of a self-motivated trained rescuer ready to perform BLS perfectly. BLS does not require any resources. Proper knowledge, practice, and self-motivation can enable a person to effectively resuscitate a victim. Effective BLS provided immediately after cardiac arrest can increase the chances of survival of cardiac arrest victims (13).

Doctors, nurses, and paramedics must be able to resuscitate cardiac arrest victim, as they are most likely to face such events. A substantial amount of research has revealed poor awareness of BLS among doctors, interns, medical/dental students, and paramedics (4–6, 11, 13, 17). A study (8) has also revealed poor self-perception among faculty about their qualifications in BLS. Both the general public and patients expect even first-year medical students to be capable of appropriately acting in emergencies. However, the curriculum does not provide medical intervention skills to first-year medical students. The younger generation needs to grow into healthy behavior and acquire health-related knowledge and skills (2). Keeping this in mind, if BLS skills are learned right from the first-year medical curriculum along with the basics of the cardiovascular and respiratory systems, followed by reinforcement of the skills every year thereafter, then the outcome might be more fruitful, as students will have more opportunities to practice their skills on mannequins and theirs skills would be tested, thus providing a greater likelihood of internalizing the skills learned. Moreover, learning life-saving skills can become a novel experience for first-year medical students. Instead of rote theory learning, hands-on training can help them develop motor skill expertise.

There are not many studies in India to assess the effect of training programs. Hence, it was felt that students should be trained with the necessary skills of BLS, with the effectiveness of the training program assessed thereafter. With ever-increasing heart diseases, road traffic accidents, head injuries, etc., as well as the increase in morbidity and mortality following thereafter, it is very prudent to train medical graduates to administer BLS properly. Skilled students can contribute in reducing the ever-increasing problems of morbidity and mortality due to life-threatening emergencies.

This also gives first-year medical students a feel for the practice of medicine and a high motivation to learn. Early clinical exposure will help students to vertically integrate knowledge and apply basic science principles in a clinical context right from the first year of the medical curriculum. Finally, cardiac arrest victims will be the ultimate beneficiaries of the BLS skills acquired by medical students and medical graduates. This can also help in the future planning of such training programs in institutions and guide for the inclusion of BLS in the medical curriculum.

The aims and objectives of this study were as follows:
1. To assess knowledge of first-year medical students regarding BLS
2. To train students in BLS skills and study the effect of training on knowledge and skill
### Table 1. Correct responses for the pretest, posttest 1, and posttest 2

<table>
<thead>
<tr>
<th>Question</th>
<th>Pretest</th>
<th></th>
<th>Posttest 1</th>
<th></th>
<th>Posttest 2</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. What does “BLS” mean?</td>
<td>39</td>
<td>93%</td>
<td>40</td>
<td>95%</td>
<td>40</td>
<td>95%</td>
</tr>
<tr>
<td>2. An adult person has collapsed in front of you. He is not responding to commands (probably unconscious). What will be your first action?</td>
<td>11</td>
<td>26%</td>
<td>8</td>
<td>19%</td>
<td>5</td>
<td>12%</td>
</tr>
<tr>
<td>3. The correct sequence of events during resuscitation in a witnessed out-of-hospital cardiac arrest is _______.</td>
<td>12</td>
<td>29%</td>
<td>16</td>
<td>38%</td>
<td>9</td>
<td>21%</td>
</tr>
<tr>
<td>4. What is the exact site for chest compression?</td>
<td>14</td>
<td>33%</td>
<td>40</td>
<td>95%</td>
<td>21</td>
<td>50%</td>
</tr>
<tr>
<td>5. The depth of compression in adults during CPR must be at least _______.</td>
<td>4</td>
<td>10%</td>
<td>41</td>
<td>98%</td>
<td>34</td>
<td>80%</td>
</tr>
<tr>
<td>6. The rate of chest compression in adults during CPR should be _______.</td>
<td>6</td>
<td>14%</td>
<td>34</td>
<td>80%</td>
<td>17</td>
<td>40%</td>
</tr>
<tr>
<td>7. The ratio of cardiac compression to artificial respiration of a single rescuer for an adult is _______.</td>
<td>5</td>
<td>12%</td>
<td>24</td>
<td>57%</td>
<td>15</td>
<td>36%</td>
</tr>
<tr>
<td>8. What does “AED” mean?</td>
<td>10</td>
<td>24%</td>
<td>28</td>
<td>67%</td>
<td>23</td>
<td>55%</td>
</tr>
<tr>
<td>9. What does “EMS” mean?</td>
<td>31</td>
<td>74%</td>
<td>40</td>
<td>95%</td>
<td>33</td>
<td>79%</td>
</tr>
<tr>
<td>10. The postrecovery position is _______.</td>
<td>12</td>
<td>29%</td>
<td>42</td>
<td>100%</td>
<td>29</td>
<td>70%</td>
</tr>
</tbody>
</table>

n = 42 total correct responses. BLS, basic life support; CPR, cardiopulmonary resuscitation; AED, automated external defibrillator; EMS, emergency medical services.

### MATERIALS AND METHODS

Our study was designed as a prospective investigation. This was a longitudinal interventional study conducted in the Department of Physiology with the help of the Department of Anesthesia at Dr. Panjabrao Deshmukh Memorial Medical College (Amravati, MS, India). Institutional ethical committee permission was obtained.

Senior faculty members from the Department of Anaesthesia trained faculty members in the Department of Physiology to deliver simulated skills in BLS on adult mannequins as per 2010 guidelines of the American Heart Association (AHA) (3). The faculty training program was in the form of a lecture to highlight the importance of BLS and AHA 2010 guidelines (3) to be followed for BLS. A PowerPoint presentation and video clippings were used for better visual impact. This was followed by a demonstration of BLS and hands-on training on a mannequin to achieve competence. The site, depth, rate, and sustainment of uninterrupted chest compressions directly influence the outcome of cardiac arrest. These quality-determining factors were emphasized. In group discussion, the perception of faculty members was obtained.

A pre- and posttest questionnaire for students was prepared by referring standard questionnaires and following AHA 2010 guidelines (3–5, 11, 17). Ten questions for testing the cognitive domain of BLS were selected by consulting senior anesthesiologists. The prime aim was to evaluate, the correct sequence of events during resuscitation, the exact site, the depth and rate of chest compression, the ratio of cardiac compression to artificial respiration, and the postrecovery position. The pilot study was conducted with five students to validate the questionnaire. The acquisition of skills was checked by directly observed procedural skills (DOPS) by splitting the procedure into seven steps (Table 3). Feedback questionnaires were designed and modified according to suggestions from faculty and fellows from the Foundation for Advancement of International Medicine Education and Research. Student perceptions were recorded for 10 statements on a 5-point Likert scale (as “strongly disagree,” “disagree,” “not sure,” “agree,” and “strongly agree”).

A total of 42 first-year medical students participated in the study. Informed written consent was obtained. The pretest was conducted for students on the first day. Students were then exposed to the training module in the form of a lecture using a PowerPoint presentation, with videos demonstrating BLS used for better visual impact. For the next 3 days, students were exposed to a demonstration and hands-on training using a mannequin in three batches. Trained faculty members from the Department of Physiology demonstrated the skills. The exact site, depth, rate, and sustainment of uninterrupted chest compressions were emphasized. Students performed BLS skills in the presence of faculty members who noted the correct steps. A desired competency level, as described in the DOPS table, was targeted and achieved by every student. A few students required three attempts to master all the steps correctly. Posttest 1 was conducted the next week to test student gains in knowledge. Feedback was obtained from students on a five-point Likert scale.

These students were evaluated using posttest 2 in their second year to assess their retention of knowledge. The retention of skills was tested by faculty members by observing student skills in the seven steps by DOPS.

**Data analysis.** Microsoft office Excel 2007 and SPSS (version 16) were used for data analysis. Scores are reported as means ± SD. For statistical analysis, a nonparametric Friedman test was used to compare the same group with more than two exposures. Statistical significance was assessed at a type 1 error rate of 0.05.

### RESULTS

Pretest and posttest questionnaires included 10 questions to test student knowledge regarding BLS. Answering patterns to these questions are shown in Table 1. As clearly shown in Table 1, the results of posttest 1 were best for questions 4–7 and 10, which were the most important steps to be followed, as emphasized during the demonstration. Descriptive statistics for pretest, posttest 1, and posttest 2 score differences are shown in Table 2. Our results documented a significant increase in the mean posttest 1 score compared with the mean pretest score (7.42 ± 1.10 vs. 3.42 ± 2.34). Although the mean posttest 2 score (5.38 ± 1.16) was lower than that for posttest 1, it was...
The mean rank for posttest 1 (2.81) to be significantly (P < 0.0001) higher than that for the pretest (1.26). The mean rank for posttest 2 in the second year (1.93) was lower than that for posttest 1 (2.81) but significantly higher compared with the pretest (1.26). The steps followed for DOPS are shown in Table 3. The number of steps followed correctly in the DOPS results (Fig. 1) during the second year indicate that only 7% students could perform all seven steps. However, 74% students could perform three or more steps correctly.

The feedback perceptions of students indicated that BLS helped them gain a higher level of knowledge, BLS helped them in early exposure to clinical situations, BLS developed their interest in reading related topics in physiology, and that BLS may be regularly incorporated in the curriculum. Two of the participants trained their family members with these life-supporting skills.

**DISCUSSION**

The present study assessed the baseline knowledge of first-year medical students in BLS. It also reveals the effect of training in the form of retention of knowledge and skills regarding BLS in the following year.

It is evident from the results that the pretraining knowledge regarding BLS was inadequate. Studies conducted in India by Chandrasekaran et al. (5) and Chaudhary et al. (6) have also reported poor awareness of BLS among medical, dental, and nursing students. Zaheer et al. (17) studied the awareness of BLS of medical students in Pakistan using a questionnaire only. They concluded a lack of awareness regarding BLS among medical students and suggested that resuscitation skills become a part of the undergraduate curriculum. Preprofessional students are probably living in a competitive world to get admission in professional courses. Even their parents are eager for the same. Hence, students do not bother to read anything else than the routine curriculum.

After the BLS training, student knowledge and skills improved, and there was a significant retention in the following year. This explicitly justifies the acquisition of skills by training, indicating that the training program was effective. Students asserted in the feedback that they were confident in their ability to deliver BLS in an emergency. Chaudhary et al. (6) reported that a simulation-based intervention offered a positively evaluated possibility to enhance skills in recognizing and handling emergencies. Ruessele et al. (12) also advocated that practicing BLS on mannequins enhanced students’ skills in recognizing and handling emergencies. Studies (7, 11) have also stressed the importance of reenforcement to attain adequate cardiopulmonary resuscitation (CPR) skills and maintain continued competency in the technique. Moreover, the need for reenforcement is apt due to the revision of guidelines for BLS from time to time (3). After graduation, there is hardly any time for students to practice the skill. The right time to foster any skill is during graduation. The proper time seems to be the incorporation of BLS training in the medical curriculum in the first year itself and the reenforcement of the skills every year. Zaheer et al. (17) also concluded that the inclusion of a BLS course will increase awareness and application of this valuable life-saving maneuver. Therefore, BLS and advanced cardiovascular life support training programs should be mandatory for all medical and paramedical staff. Educating medical undergraduates about BLS may turn out to be an excellent strategy to reach the community at large if students share the acquired knowledge with their families and friends.

The effectiveness of a planned training program has been documented by Parashar (10). A study of first aid and BLS training by Altintas et al. (2) has also reported the training programs to be successful. Sodhi et al. (14), in their study, revealed that the formal training of CPR drastically improved survival rates and survival to hospital discharge rates after the resuscitation of cardiac arrest victims. They determined that formal certified BLS and advanced cardiovascular life support training courses with hands-on practice and their periodic renewal are crucial in improving the outcomes of CPR.

Although our training program facilitated students to increase their knowledge related to BLS and helped them acquire skills for providing BLS, some important practical problems erupted during the study. It was difficult to pursue the students

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**Table 3. Steps followed during directly observed procedural skills**

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Exact site of chest compression</td>
</tr>
<tr>
<td>2</td>
<td>Position of hands for chest compression</td>
</tr>
<tr>
<td>3</td>
<td>Depth of chest compression</td>
</tr>
<tr>
<td>4</td>
<td>Rate of chest compression</td>
</tr>
<tr>
<td>5</td>
<td>Head tilt and chin lift</td>
</tr>
<tr>
<td>6</td>
<td>Observed rise in chest during mouth-to-mouth respiration</td>
</tr>
<tr>
<td>7</td>
<td>Mouth-to-mouth respiration</td>
</tr>
</tbody>
</table>

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**Fig. 1.** Directly observed procedural skill results (during the second year) showing the percentage of students following the correct steps in basic life support.
in their second year. When students were inquired as whether they tried to add to their knowledge and skills after the first exposure, none of them answered affirmatively. Although the study revealed improvement in students’ knowledge and skills, the implication of such a training program is difficult in private institutions. The reasons could be late admissions, less time (students hardly get 7–8 mo to prepare for a qualifying examination), and no additional advantages for extra training such as this, apart from the curriculum in passing final exams. Pitfalls can be corrected by suggestions such as giving weightage to training and making it mandatory for healthcare workers, with certificates awarded on successful completion of the training. These skills can be included in the medical curriculum and should be duly assessed during qualifying examinations. In the future, a scientific laboratory should be established in all medical college to teach CPR and motivate students to learn and teach these skills to laypersons.

If we, as healthcare workers, really want to reduce the morbidity and mortality of a cardiac arrest victim, the training of BLS and reinforcement every year thereafter during medical graduation is a must (1, 7, 9, 15, 16). Acquisition of knowledge and BLS skills will reduce psychological inhibitions and increase our competency to revive a cardiac arrest victim confidently.

The main strength of this study was the willingness of faculty members to learn and then impart these skills to students. This training enabled them to acquire a new role to guide students with skills to handle a cardiac arrest victim, which are different from those of a conventional preclinical medical teacher. Faculty members were highly motivated to teach these life-saving skills. The cooperation of all faculty members is very helpful in the implementation of new ideas. We are, in fact, planning to teach these skills to other nonmedical college students, so as to make them aware of BLS.

Conclusions and implications. This study sought to reveal the existing knowledge of first-year medical students regarding BLS and train them in BLS. The results of this study suggest that the program provides students with sound basic knowledge and adequate practical skills in BLS. The retention of knowledge was significant in the second year. Students should undergo training again in paraclinical and clinical postings so as to help them retaining knowledge of BLS and skills satisfactorily. The repetition of training will increase its effectiveness. A limitation of our study was its small sample size. However, our findings serve as a stimulus for future studies in clinical skill development for undergraduate students.

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DISCLOSURES

No conflicts of interest, financial or otherwise, are declared by the author(s).

AUTHOR CONTRIBUTIONS

Author contributions: S.S.P. and V.P. performed experiments; S.S.P., Santosha Pande, V.P., Sanket Pande, and N.S. drafted manuscript; S.S.P., Santosha Pande, V.P., Sanket Pande, and N.S. edited and revised manuscript; S.S.P. and Santosha Pande approved final version of manuscript; Santosha Pande conception and design of research; Santosha Pande, Sanket Pande, and N.S. interpreted results of experiments; V.P. and Sanket Pande prepared figures; N.S. analyzed data.

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