Original Article

A Study on the Introduction of Automated Feedback Device as an Assessment Tool for Basic Life Support (BLS) Training of Interns

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Abstract

Background : Delivery of high-quality chest compressions is the Basic Life Support (BLS) skill most likely to improve survival, and assessment of this needs to be precise. Current BLS assessment is done by an instructor using a checklist with feedback, with a risk of observer fatigue and bias. Objective data from automated recording manikins may provide more accurate information.

Hence, this study was designed to compare the efficacy of an automated feedback device with that of instructor feedback in the assessment of BLS skills among interns.

Materials and Methods : Interns posted in the Department of Emergency Medicine were enrolled in the study after getting the Institutional Ethics Committee approval.

The quality of CPR was assessed with reference to compression rate and depth, chest recoil and correct hand placement. The interns were assessed by the Instructor, as well as by the automated feedback device attached to the mannikin. The two sets of scores were compared and analyzed. Feedback was obtained from the interns and faculty about their perceptions regarding this automated assessment method.

Results : Twenty-four Interns participated in the study. There was congruence between the two methods with regard to assessment of hand placement and compression rate. The instructor method had a very low specificity and diagnostic accuracy for depth of compression and chest recoil.

Both students and faculty strongly agreed that the automated feedback device is a more objective and useful method of assessment of BLS skills.

Conclusion : Automated feedback is an effective and feasible method for assessing BLS skills.

Key words : Assessment, Automated Feedback Device, BLS Skill, CPR, Chest Compression, Interns.

Cardiopulmonary Arrest (CPA), defined as the cessation of cardiac mechanical activity is considered a public health problem. The most important determinant for survival is the presence of an individual to perform Cardiopulmonary Resuscitation (CPR)[1]. Basic Life Support (BLS) skill is considered the basis for care in cases of CPA, including immediate recognition of the condition, activation of the emergency response system, and early, high quality CPR[2].

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Editor's Comment :

- Assessment of the performance of Basic Life Support (BLS) skill, a lifesaving skill, needs to be precise. The use of automated device with immediate feedback to verify the performance added objectivity and precision to the assessment process. Therefore, this efficient and effective assessment method is recommended for the formative assessment of Basic Life Support skill.

Delivery of high-quality chest compressions is the BLS skill most likely to improve survival[2]. Appropriate assessment is mandatory to ensure that the trainees have achieved the skill required to deliver high quality CPR.

Current BLS testing methods requires an instructor, who observes and assesses the student using a checklist and gives feedback, making testing time-consuming with a risk of instructor bias[3]. There can be observer fatigue, especially when a large number of students are being trained, which makes assessment inaccurate.

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As feedback is an essential part of BLS training, several devices are available to assess CPR performance[4]. Directive or audio feedback devices are recommended within the current European Resuscitation Council guidelines to improve the ability to perform CPR[5]. Video guided and automated feedback device guided assessment will obviate the instructors' fatigue and will ensure a more objective assessment of skill acquisition. This provides more accurate information about skills mastery than instructor judgement[6]. An automated feedback device is one, that is built into the BLS manikin and senses and records the various components of the CPR skill, in real time, as the trainee is performing the CPR. It is imperative that assessment of the life- saving BLS skill needs to be precise. So, the present study was designed to compare the conventional method of assessment with an automated one for BLS skills among interns.

The hypothesis was : Acquiring objective data from recording manikins provides more accurate information about BLS skills than instructor judgement.

Aims and Objectives

To compare the assessment efficacy of an automated feedback device with that of instructor feedback for assessing BLS skills among interns.

Materials and Methods

Study design : Prospective, non-randomized, interventional study.

Setting : Skills Lab

Participants : The interns

Sampling : Convenient sampling method was used

The study was conducted between June, 2020 and December, 2020, after getting the Institutional Ethics Committee approval. Interns posted in the Department of Emergency medicine were enrolled in the study after getting their written, informed consent. BLS skills was taught by the faculty in 2 sessions – a large group interactive lecture on the concept of BLS, followed by a small group demonstration with hands on training on manikins in CPR. The interns practiced these skills on at least two occasions before they were assessed.

The quality of CPR was assessed subsequently. The conventional assessment was done by the instructor using an OSCE checklist. In addition, the students were assessed by the automated feedback device - The QCPR manikin with Laerdal PC Skill Reporting System Software (Version 2.4.1, Laerdal, Stavanger, Norway.

A questionnaire was given to both the interns as well as the faculty to analyze their perceptions regarding this automated assessment method.

The following parameters were used to assess the BLS skill using the checklist :

(a) Initial Assessment :

(b) Checks for patient's response

(c) Activates the emergency response system

(d) Checks breathing and pulse (5-10seconds)

(e) High quality Chest compression:

- Correct Hand placement
- Adequate Rate- 100-120/mt
- Adequate Depth-5-6cm
- Allows complete Chest Recoil

The checklist has 7 items and the scoring is from 1-5 for each item. The first three items regarding initial assessment cannot be compared as this aspect cannot be recorded or scored by the automated feedback device. The next four items were compared with the automated feedback. Those who scored 1/2/3 were given a number of 1(No) and those with a score of 4/5 were allotted 2(Yes) – using a nominal scale to segregate the performance (1=inadequate, 2=adequate).

The Q CPR mannikin software assessed the four components of high quality CPR, congruent to the European Resuscitation Council guidelines, as indicated below[7] :

$\geq$70% correct compression depth

Average compression rate of 100-120/ min

$\geq$70% compressions with complete release

$\geq$70% of the cycle, correct hand placement

Data was compiled using MS Excel sheet for the instructor BLS check list and the skill reporting software for the automated feedback device.

SPSS version 16 (SPSS Inc released 2007. SPSS for Windows, Version 16. Chicago, SPSS Inc) was used for data analysis.

Statistical tests for Quantitative analysis :

(1) Sensitivity and Specificity (in %).

For sensitivity calculations, the number of performances correctly detected by the instructors as matching the criteria was set as the “true positives.” To identify the true positive rate (sensitivity), the proportion of true positives were calculated among all performances that were classified as correct by the Laerdal PC Skill Reporting System. Thus, the specificity or true negative rate was defined as the proportion of performances not matching the criteria which were correctly identified as such by the instructors.

(2) Descriptive analysis was done for the items on initial assessment.

Qualitative analysis :

Data was collected using the Interns’ and faculty feedback questionnaires and stored in MS Excel sheet.

(1) For the questions/items with the Likert scale ranking from 1-5, the Median, Mode and Mean score for each question were calculated.

(2) Satisfaction index was calculated for each item.

(3) The responses to the open-ended questions were subjected to a Thematic analysis.

RESULTS

A total of twenty-four (24) interns participated in the study.

Quantitative Analysis :

BLS checklist score :

The following observations were made regarding the initial assessment, using the checklist.

Only one intern (4.1%) did not check the patient’s response correctly.

13 out of 24 interns (54%) activated the EMS appropriately. Only 4 out of 24 (16.7%) interns did not check for breathing and pulse correctly.

The scores obtained by the participants on delivery of high-quality chest compressions by the two assessment methods, were compared as follows :

There was good agreement between the two methods with regard to assessment of hand placement (Table 1). The Sensitivity was 95.65%, Specificity was 100%, Positive Predictive Value 100% and Negative Predictive Value 50%.

The diagnostic accuracy of the instructor checklist method was 95.83%.

The compression rate scores were also congruent between the two methods. Sensitivity was 71.43% and Specificity 70% (Table 2). The diagnostic accuracy of the instructor checklist method was 70.83%.

With regard to the depth of compression, there were quite a number of False positives in the instructor check list method, reducing the accuracy to 58.35% (Table 3).

The specificity was as low as 37.5% with a Positive Predictive value of 44.44%.

In the assessment of chest recoil, the instructor checklist method had a diagnostic accuracy of 69.57% and specificity of only 12.5% (Table 4).

The interns’ feedback revealed that 95.8% agreed that they were satisfied with their performance of BLS. All agreed that they were confident about their BLS skill, were motivated to practice more, found the

Table 1 — *Hand Placement*

Parameter	Estimate	Lower-Upper 95%CIs
Sensitivity	95.65%	(79.01, 99.23[1])
Specificity	100%	(20.65, 100[1])
Positive Predictive Value	100%	(85.13, 100[1])
Negative Predictive Value	50%	(9.453, 90.55[1])
Diagnostic accuracy	95.83%	(79.76, 99.26[1])

Table 2 — *Compression Rate*

Parameter	Estimate	Lower-Upper 95% CIs
Sensitivity	71.43%	(45.35, 88.28[1])
Specificity	70%	(39.68, 89.22[1])
Positive Predictive Value	76.92%	(49.74, 91.82[1])
Negative Predictive Value	63.64%	(35.38, 84.83[1])
Diagnostic Accuracy	70.83%	(50.83, 85.09[1])

Table 3 — *Depth of Compression*

Parameter	Estimate	Lower-Upper 95% CIs
Sensitivity	100%	(67.56, 100[1])
Specificity	37.5%	(18.48, 61.36[1])
Positive Predictive Value	44.44%	(24.56, 66.28[1])
Negative Predictive Value	100%	(60.97, 100[1])
Diagnostic Accuracy	58.33%	(38.83, 75.53[1])

Table 4 — *Chest Recoil*

Parameter	Estimate	Lower-Upper CIs
Sensitivity	100%	(79.61, 100[1])
Specificity	12.5%	(2.242, 47.09[1])
Positive Predictive Value	68.18%	(47.32, 83.64[1])
Negative Predictive Value	100%	(20.65, 100[1])
Diagnostic Accuracy	69.57%	(49.13, 84.4[1])

automated feedback device very useful and preferred it over the instructor check list. The satisfaction index was 100 regarding the usefulness of the automated feedback device.

All the faculty agreed that the automated feedback helped the interns to improve their performance and that it is a more objective method of assessment of BLS skills when compared with the conventional method. The satisfaction index was highest (96.67) for the feasibility, objectivity of the assessment method and for the motivation to use simulation in the curriculum.

Thematic analysis of interns' feedback revealed the following themes: "Visual feedback, Technique, Real time, Practice oriented, Precision, Learning a vital skill" (Fig 1).

Interns suggested that BLS training with the automated device should start early in the medical training with an opportunity to practice repeatedly over the years.

Thematic analysis of the Faculty feedback revealed the following themes: "Real time Feedback, technique, Precision, Reliability, Active participation". (Fig 2)

The faculty suggested that this module could be used to train all undergraduate students and healthcare workers.

Discussion

The present study sought to compare the efficacy of the conventional method of assessment of BLS skills of interns with that of an automated method using the QCPR manikin.

One of the important health problems and a leading cause of death in many countries is sudden cardiac arrest. The most important determinant of survival from sudden cardiac arrest is the presence of a trained rescuer ready to perform BLS perfectly. Effective BLS provided immediately after cardiac arrest can increase the chances of survival of cardiac arrest victims[8]. Therefore, it becomes imperative to train every medical student to perform high quality CPR. As this is a life- saving skill, it should be assessed by a rigorous assessment method.

Our study indicated that elements of CPR, such as initial assessment, minimum delay to start CPR, were accurately assessable by simple observation by the instructor. However, these aspects cannot be recorded by the skill reporter system software of the automated feedback device. Similar findings were observed by Van Dawen. *et al*[9]. This is one of the major drawbacks of the automated feedback system. This was corroborated by Mpotos, *et al* who stated that the software prototype used only focussed on testing the technical CPR components and that future

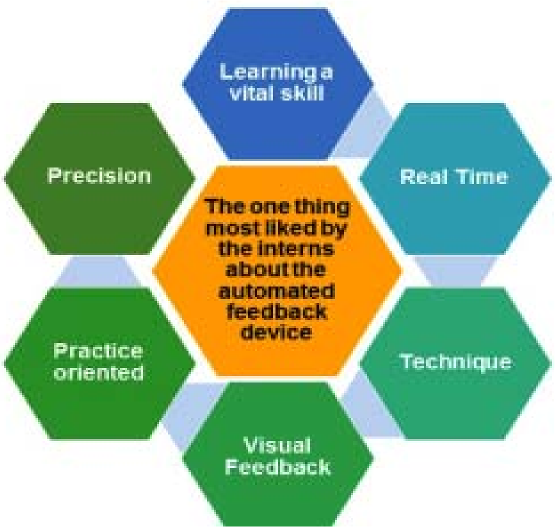

Fig 1 — Thematic Analysis of Interns feedback

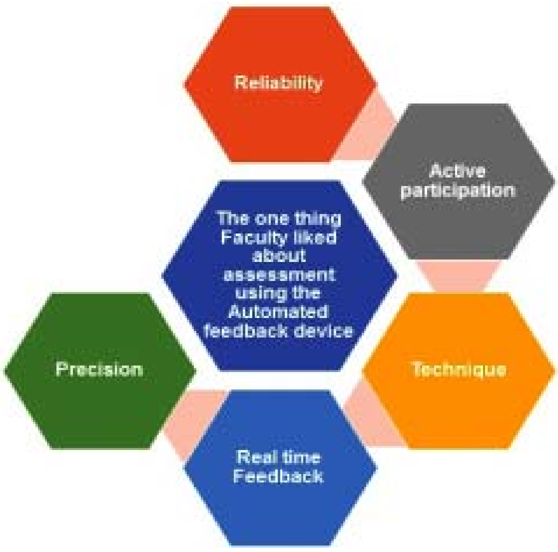

Fig 2 — Thematic Analysis of Faculty feedback developments could embed interactive components allowing the trainee to call for help and assess the pulse and respiratory status of the victim (manikin)[6].

The assessment of hand placement was comparable in both the techniques, with a sensitivity of 95.65% and specificity of 100% in our study. This was similar to the results of a study done in Brazil for nursing students[10].

Regarding the assessment of the correct compression rate, the instructor checklist had a sensitivity of 71.43% and specificity of 70%. Similar results were obtained by Johanna van Dawen, *et al*, in their study involving first year medical students[9].

The present study revealed a sensitivity of 100% and specificity of 37.5% for assessment of the depth of chest compressions, by the instructor check list method. This has also been observed in a study by Mpoto, *et al*[6]. Assessing compressions visually on a scale of inches or millimetres is a complex task, and sources of assessment error include, inconsistent criteria, short-term memory limitations and personal biases in assessing learners. Instructors without access to assistive technology, such as recording manikins, may increase greatly their chances of both false positive and false negative errors[3].

The low specificity of 12.5% and reduced diagnostic accuracy of 69.7% for complete chest recoil between compressions suggests that this item is not accurately identified by simple observation and benefits from automated device. It is similarly difficult to judge the depth of compression accurately by observation, as shown by our results.

It was observed by Johanna van Dawen, *et al* that, the sensitivity and specificity of the different checklist items were also highest for the item "correct compression rate", while the item "complete release between compressions" had the lowest sensitivity and specificity[9].

Furthermore, the comparison of the sensitivity and specificity suggests that correct performance was easier for the instructors to identify, whereas incorrect performance was more difficult to detect. It is possible that a good performance for most items on the checklist might lead the instructor to be more indulgent with an inaccurate performance for other items. In addition, an altogether poor performance could bias the instructor to more negatively evaluate each criterion.

Delivery of chest compressions is the CPR skill most likely to improve survival from out-of-hospital cardiac arrest. Accordingly, the American Heart Association (AHA) guidelines increasingly emphasize simplification of CPR instruction to focus on competence in the small set of skills most strongly associated with the victim's survival[11].

Evidence from a systematic review, in 2009, indicated positive aspects in the use of devices of immediate feedback in the CPR manoeuvres, supporting learning and retention of learned knowledge and skills, with recommendations to investigate the impact on patient survival[12].

Feedback on performance is a crucial component of the learning processes associated with simulation and has been shown to improve CPR quality during simulated cardiac arrest on manikins[13]. The interns as well as the faculty were of the opinion that the automated feedback device improved the interns' performance of BLS by giving real time feedback about the crucial steps of CPR. The faculty also recommended that BLS training and assessment using the automated feedback device should be made mandatory for all undergraduate students and health care workers.

Thematic analysis of the interns' feedback revealed themes like "Real time & Visual Feedback, Technique, Precision". This was similar to a study by Sa Couto, *et al*, in which, the following aspects were pointed by the students as most positive about the automated feedback device:" Immediate feedback," "Rapid learning curve," and "Feedback on compressions performance"[14].

Limitations :

Our study was not a randomised study. The convenience sample used was another limitation of this study, which was influenced by the COVID pandemic. The other limitation was that the initial components of BLS cannot be recorded by the automated feedback device. Qualitative feedback (as would be given by the instructors) is lacking in this device.

Conclusion

The use of automated device with immediate feedback was a valuable support to assess the measurement of depth of chest compression and chest recoil, which are generally subjectively evaluated. These parameters, evaluated with the device, gave greater objectivity and precision. The interns as well as the faculty were satisfied with the assessment by the automated feedback device and the interns preferred it over the conventional method of assessment by the instructor.

We conclude that objective feedback on compression performance during BLS sessions would be beneficial for both instructors and learners. Automated testing is an effective and efficient method for assessing BLS skills in interns and has the potential to innovate traditional resuscitation training.

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Conflict of Interest : None

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