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Self-learning basic life support: A randomised controlled trial on learning conditions

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ABSTRACT

Aim of the study: To investigate whether pure self-learning without instructor support, resulted in the same BLS-competencies as facilitator-led learning, when using the same commercially available video BLS teaching kit.
Methods: First-year medical students were randomised to either BLS self-learning without supervision or facilitator-led BLS-teaching. Both groups used the MiniAnne kit (Laerdal Medical, Stavanger, Norway) in the students' local language. Directly after the teaching and three months later, all participants were tested on their BLS-competencies in a simulated scenario, using the Resusci Anne SkillReporter™ (Laerdal Medical, Stavanger, Norway). The primary outcome was percentage of correct cardiac compressions three months after the teaching. Secondary outcomes were all other BLS parameters recorded by the SkillReporter and parameters from a BLS-competence rating form.
Results: 240 students were assessed at baseline and 152 students participated in the 3-month follow-up. For our primary outcome, the percentage of correct compressions, we found a median of 48% (interquartile range (IQR) 10–83) for facilitator-led learning vs. 42% (IQR 14–81) for self-learning ($p = 0.770$) directly after the teaching. In the 3-month follow-up, the rate of correct compressions dropped to 28% (IQR 6–59) for facilitator-led learning ($p = 0.043$) and did not change significantly in the self-learning group (47% (IQR 12–78), $p = 0.729$).
Conclusions: Self-learning is not inferior to facilitator-led learning in the short term. Self-learning resulted in a better retention of BLS-skills three months after training compared to facilitator-led training.

Introduction

High quality basic life support (BLS) is essential for the survival of cardiac arrest victims because poor compliance with recommended guidelines has been associated with lower survival rates [1,2]. Long-term retention of BLS-competencies is crucial and more important than skills performance at teaching time [3]. Unfortunately, insufficient evidence exists to recommend optimal intervals or methods for BLS retraining [3,4], but skills decay within 3–12 months after initial BLS teaching [5–7]. Frequent BLS training ("Rapid Cycle Deliberate Practice") improves responder confidence [5,8], willingness to perform CPR [8], and the overall resuscitation performance [9,10].

Traditional BLS is taught in groups of various sizes, with one or more instructors. One study showed that larger groups provided significantly less hands-on time, fewer questions were asked, more unrelated conversations happened, and participants assessed their learning lower than smaller groups [11]. Alternative BLS teaching methods are via computer and/or video. Students in a computer-based BLS course performed with a significantly higher accuracy rate on 60 chest compressions, 12 ventilations, and three cycles of CPR than students in an instructor-led group[12]. Others have shown that self-learning is not inferior to instructor-led learning regarding BLS-skills [13–15].

The "2015 International Consensus on Cardiopulmonary Resuscitation and Emergency Care Science with Treatment Recommendations" describes a knowledge gap regarding skill performance in manikin-based resuscitations of students who learned BLS by self-instruction or in a traditional instructor-led course [3]. To expand knowledge about self-learning versus instructor-led teaching, we investigated possible differences in BLS skills performance in first-year medical students directly after a BLS course and three months later, when randomly assigned to a self-learning BLS-kit without any

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instructor help, versus facilitator-led teaching with the same BLS-kit.

Methods

The Cantonal Ethics Committee of Bern, Switzerland, evaluated this randomised controlled trial (KEK Req-2016.00071, decision on 23 February 2016, chairperson Professor Christian Seiler) according to the Swiss Research Act.

Participants

We included first-year medical students at the University of Bern, Switzerland, who participated in their obligatory first aid course which includes BLS. All students attending the 13 first aid courses (with 18–22 students per course) agreed to participate and gave written informed consent. Exclusion criteria were students with professional BLS experience, students unable to perform BLS, or missing informed consent. Basic BLS training, required for obtaining a driver's licence in Switzerland, was not seen as an exclusion criterion.

Randomisation

A computerised list (www.randomization.com) randomised in blocks of 10 participants and stratified for men and women to assure proper distribution in each student group, as about 70% of new medicine students are female. Study participants were randomised to learn their BLS skills either with or without a supervising facilitator.

Interventions

All participants were advised in advance to bring their personal laptop and a MiniAnne kit (Laerdal Medical, Stavanger, Norway) to the teaching session. This BLS teaching kit consists of a manikin, a 30-min instructional DVD in the students' local language, knee pads, a cardboard training AED (automated external defibrillator), and a cardboard telephone. The manikin "clicks" when the compression is correct and the "chest" rises when ventilation is sufficient. Both groups were given about 35 min in two different rooms according to randomisation. The participants in the self-learning group started immediately to watch the instructional video of the BLS learning kit individually. They were not allowed to communicate with each other during the entire session.

The group with a facilitating instructor watched the instructional video together on a big screen while they learned BLS. The facilitators corrected the psycho-motor performance of the students during the session, and underlined important aspects mentioned in the DVD. There were between 9 and 11 participants in each group.

Measurements

Directly after the teaching session, all participants were tested in their BLS competencies. Before the test was started, participants were asked how competent they felt in BLS on a visual analogue scale (VAS) from 0 to 100 mm where 0 mm = "completely incompetent, I have no clue what to do" and 100 mm = "totally competent, cannot be done better".

To test their BLS competencies, students performed BLS in a simulated scenario as a first responder on a Resusci®Anne CPR & AED (Laerdal Medical, Stavanger, Norway) over three cycles of two minutes as recommended by the current resuscitation guidelines [16]. We measured BLS competencies with a Resusci®Anne SkillReporter (Laerdal Medical, Stavanger, Norway), and a checklist for BLS items not recorded with the skill reporter (e.g. checked for responsiveness, called for help, checked breathing, correct use of an AED, and correct placement of pads). An AED was delivered when study participants asked for it. Specific time intervals were recorded with a stop-watch, e.g. from the beginning of the test to call for help, first compression, first ventilation, and first shock.

After the test, the study personnel assessed the overall performance of the study participants on the same VAS scale as the students assessed themselves on before the test, where 0 mm = "completely incompetent, no clue what to do" and 100 mm = "completely competent, cannot be done better".

Three months later, all study participants were invited to a follow-up test, where the same scenario over the same time interval with the same parameters was tested. After this second testing, participants received a short feedback on their BLS/AED competencies to improve further resuscitation practice. Participants who came back to the follow-up testing were reimbursed for the costs of the Mini-Anne purchase.

Outcomes

The primary study outcome was the percentage of correct compressions out of the total number of compressions; the SkillReporter defines a correct compression as having a depth of 50–60 mm on the lower half of the sternum with full chest-wall recoil. This was reported directly after the course and three months later.

The secondary outcomes were: All the subcomponents of the report from the SkillReporter (average ventilation volume, average number of ventilations/minute, percentage of correct ventilations, compressions to ventilations relationship (30:2), average compression depth, average number of compressions/minute, average compression frequency, percentage of too shallow compressions, percentage of false hand placement during compressions, and percentage of incomplete decompressions) as well as the parameters check for responsiveness, called for help, checked breathing, mask ventilated, used an AED, followed the AED-instructions, and placed the AED-pads correctly. We also measured the time from test-start to call for help, to first compression, to first ventilation, and to first shock. Another secondary outcome was the comparison of the BLS competence measurements after three months. We also recorded the demographic data: age, gender, height and weight, and CPR experience.

Sample size

Based on a pilot study with 13 participants, we calculated a median of 84% correct compressions with an interquartile range of 47% to 93%. It was agreed that a 15% decrease of correct compressions would have clinical impact. The null-hypothesis was that the self-learners would be inferior to the facilitator-led group by at least 15 percentage points ($m_{\text{facilitator-led}} - m_{\text{self-learner}} \geq 15$). A two-sample comparison of means with an α-level of 0.025 calculated that it required 152 subjects to reach a power of 80%. To compensate for dropouts over the three months and uncertainties of assumption, we aimed to include at least 200 participants in the study.

Statistical methods

All data was first summarised for each participant and then summarised for the study population. Non-parametric data are presented as median, interquartile range, and range. Non-parametric data were compared with Mann-Whitney *U* test for non-paired data and Wilcoxon signed-rank test for paired data. Proportions were compared with Pearson's Chi^2, Fisher's exact for small numbers, and McNemar's Chi^2 for paired proportions. All calculations were executed with Stata/SE 14.1 (Stata Corp. LP, College Station, TX, USA). A $p < 0.05$ is considered statistically significant.

Results

A total of 240 medical students were included between 9 February 2017 and 6 April 2017 (Demographics, Table 1); 122 students were