BRIEF ORIGINAL

Standard basic life support training of the European Resuscitation Council versus blended training: a randomized trial of a new teaching method

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Objective. To evaluate the immediate and 9-month results of blended versus standard training in basic life support and the use of an automatic external defibrillator (BLS/AED).

Methods. Randomized trial comparing the results of standard BLS/AED training to blended training. The control group received 4 hours of standard instruction from a trainer and the experimental blended-training group received 2 hours of virtual training and 2 hours of in-person instruction.

Results. Eighty-nine students participated, 45 in the control group and 44 in the experimental group. The controls achieved better mean (SD) knowledge scores immediately after training (8.6 [0.9] *vs* 8.0 [1.14] in the experimental group, *P*=.013). The blended training group scored better on certain skill markers (hands-off time in seconds and compressions followed by complete chest recoil). Participant knowledge had decreased at 9 months without significant between-group differences. Overall, retention fell from a score of 8.31 (1.1) to 6.04 (1.6) (*P*=.001) in 9 months and the loss was similar in the 2 groups. No differences in practical skills between the groups were observed at the end of the course or 9 months later.

Conclusions. The blended training method led to better results on some skill items.

Keywords: Cardiac arrest. Cardiopulmonary resuscitation. Education. Blended training.

Estudio experimental aleatorizado de innovación docente que compara metodología mixta frente a presencial para la formación en soporte vital básico estándar del European Resuscitation Council

Objetivo. Evaluar los resultados de la formación mixta frente a la presencial en un curso de soporte vital básico/desfibrilador externo automático (SVB/DEA), así como su retención a los 9 meses.

Método. Estudio experimental aleatorizado que compara los resultados de la formación en SVB/DEA entre un grupo control (GC) que recibió formación presencial de 4 horas frente a un grupo experimental (GE) que recibió formación en metodología mixta: 2 horas virtuales y 2 horas presenciales.

Resultados. Participaron 89 alumnos (45 del GC y 44 del GE). Después de la formación, el GC obtuvo mejores puntuaciones en conocimientos [8,6 (DE 0,9) frente a 8,0 (DE 1,14), p = 0,013]. El GE obtuvo mejores puntuaciones en las habilidades del tiempo en segundos de *"hands off"* y en el porcentaje de la rexpansión completa del tórax. Los conocimientos decaen a los 9 meses, pero sin diferencias entre los dos grupos. La retención global baja de 8,31 (DE 1,1) a 6,04 (DE 1,6) (p = 0,001), en 9 meses, pero de forma similar en ambos grupos. En las habilidades prácticas no hubo diferencias entre los dos grupos ni al finalizar el curso ni a los 9 meses.

Conclusiones. Con la metodología virtual se obtienen mejores resultados en algunos parámetros de las habilidades.

Palabras clave: Parada cardiaca. Reanimación cardiopulmonar. Educación. Formación mixta.

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Introduction

The use of information and communication technologies (ICTs), together with being an effective alternative to traditional face-to-face education in basic life support and use of the automatic defibrillator (BLS/AED)[1], reduces costs[2]. The aim of this study was to assess whether training in BLS/AED using a mixed methodology (2 hours online + 2 hours face-to-face) achieves similar results to those obtained with the European Resuscitation Council's (ERC) standardized methodology of 4 hours face-to-face based on the 4-stage methodology[3] (Table 1).

Method

Experimental study comparing the results of a BLS/AED training among a control group (CG) that received 4 hours of classroom training versus a pilot group (PG) that received a mixed methodology training: 2 hours online and 2 classroom hours. Both groups used the "4 stages" teaching methodology endorsed by the ERC[4]. All participants were of legal age and signed the informed consent form.

The participants were second year dental students from the 2017-2018 academic year. Forty students in each group at the end of the academic year were suffi-

Table 1. "4-stage" teaching methodology

Stage 1: The instructor performs the task in real time.
Stage 2: he instructor again demonstrates the technique in a fragmented way and accompanied by the necessary explanations, and answers the questions of the students.
Stage 3: The student explains and comments on the technique while the instructor performs it (comprehension phase).
Stage 4: A student performs the technique while explaining it. All students then perform the technique on the dummies.

Stages described in the article by Grief et al[3].

cient to consider the representative sample[1,5,6]. Those students who had received this accredited training in the last 3 years were excluded.

Students were randomized into one of the groups using the QuickCalcs software (https:// www.graphpad.com/quickcalcs/).

The independent variable was the type of methodology applied: 1) the CG group used the 4-hour classroom training, with official ERC accreditation, based on the "4-stage" methodology (Table 2); and 2) the PG group used a mixed training in duration and content equal to that of the CG, but the 4 hours were divided into 2 hours of virtual training and 2 hours of classroom training.

The online section was designed for the student to do it independently by accessing the virtual platform "Moodle", (http://www.aulaccr.cat). It was estimated that 2 hours of self-learning, using videos for the development of skills, feedback and successive evaluation of knowledge, would be sufficient to work the first two "stages" of each of the steps of the complete sequence of the algorithm in the face of a cardiorespiratory arrest (CRA). The attendance phase was 2 hours of training with an instructor, but starting in the 3rd and following the 4th "stage" (Table 2).

The teaching material used was the same in both groups: the ERC manual on BLS/AED, a Little Anne Laerdal® dummy for every 2 students, a Resusci Anne QCPR Laerdal® dummy and an AED for every 8 students.

A sociodemographic questionnaire collected the following variables: age, sex, weight, height, tobacco habit and regular sports practice. Knowledge at the end of the training was evaluated by means of the official 10-question test and skills by means of data obtained after performing 2 minutes of CPR on the high-fidelity manikin. The ability evaluators did not know which group the trainee belonged to. The same theoretical-practical evaluation was carried out 9 months after the course, with no previous notice. Finally, the degree of satisfaction of the students was obtained at the end of the training by means of a questionnaire.

Qualitative variables are presented as absolute frequency (n) and percentage (%); quantitative variables as mean and standard deviation (SD). For statistical comparison between groups, the Student t test was used for quantitative variables (independent and paired data) and chi-square for qualitative ones. P values

Table 2. Contents and timeline of the teaching methodology according to course modality

Time	Standard ERC course On-site	Mixed ERC coure (online + on-site)
	Reading of the manual	Reading of the manual
2 hours	Introduction 15 min Demonstrationn 15 min Skils: Performance 1st, 2nd stages	**Virtual STAGE** Introduction Demonstration Skills: Demonstration 1st, 2nd stages (video) Theory assessment
2 hours	Skills: 3rd and 4th stages Conducting simulations LSP and CAO Practical and theoretical evaluation	**On-site STAGE** Questions Skilss: 3rd and 4th stages Conducting simuations LSP and CAO Practical evaluation

ERC: European Resucitation councial; LSP: lateral safety position; CAO: complete airway obstruction.

equal to or less than 0.05 were considered statistically significant differences. The software SPSS for Windows version 21 was used to perform the statistical analysis. The project was authorized by the Ethics Committee of the International University of Catalonia.

Results

The 89 students who participated in the research (45 in the CG and 44 in the PG) had an average age of 20.1 (SD 2.5) years, 70.8% were women, with a weight of 60 kg (SD 10.6) and a body mass index (BMI) of 20.7 m^2/Kg^{-1}, most (78.9%) were non-smokers and 82.1% did some kind of sport weekly. The groups were homogeneous in all socio-demographic variables.

After the training, the CG group obtained statistically better knowledge scores 8.6 (SD 0.9) compared to 8.0 (SD 1.14), p = 0.013. Knowledge declines at 9 months, but without significant differences between the two groups. Overall retention dropped significantly from 8.31 (SD 1.1) to 6.04 (SD 1.6) at 9 months with p = 0.001 (t with paired data) and similarly in both groups (Table 3).

In the overall score of the practical skills, no statistically significant differences were found between the two groups at the end of the course or after 9 months (Table 3). Instead, better scores were found, with significant differences at the end of the course, in the PG grop in complete re-expansion of the chest [65.5 (SD 37.1) versus 86.5 (SD 22.1); p = 0.002], and in "no intervention" time [or hands off of 7.2 (SD 2.1) versus 6.3 (SD 1.7); p = 0.02].

There was no statistically significant difference between sex, BMI, being a smoker or an athlete when compared to knowledge and skills in BLS/AED, both at the end of the course and at 9 months. There were also no significant differences between the groups in terms of course satisfaction. The average satisfaction was 9.5 points.

Table 3. Comparison of knowledge and skills according to teaching methodology

	Immediately after the training			9 months after the training		
	On-site (n = 45)	Mixed (n = 44)	p	On-site (n = 29)	Mixed (n = 24)	p
Overall score in practical skills	64 (19.6)	64.7 (25.1)	0.9	50.9 (27.2)	52.3 (23.6)	0.6
Chest compressions (high quality CPR)						
Compression (%)	63.9 (25.3)	66.4 (31.8)	0.7	52.9 (32.4)	55.1 (29.2)	0.8
Hands off time (secs)	7.2 (2.1)	6.3 (1.7)	**0.02**	6.24 (1.7)	6.4 (2.4)	0.7
Correct hand position (%)	91.9 (18.7)	83.2 (32.6)	0.1	82.7 (27.5)	86.9 (21.3)	0.5
Compression depth (mm)	49.5 (7.9)	51.5 (7.2)	0.06	48.1 (10.6)	50.7 (9.9)	0.4
Complete re-expansion of the chest (%)	65.5 (37.1)	86.5 (22.1)	**0.002**	84.6 (21.2)	83.3 (27)	0.8
Sufficient depth (%)	45.3 (36.7)	57.9 (36.6)	0.1	38.8 (30.7)	47.8 (36.9)	0.3
Appropriate frequency (%)	51.8 (36.8)	55.1 (33.5)	0.6	50.3 (37.5)	40.5 (29.4)	0.3
Average compression frequency	117.7 (10.6)	114 (11.2)	0.1	114 (14.6)	113 (14.3)	0.8
Overall score in theoretical knowledge	8.6 (0.9)	8.1 (1.1)	**0.013**	6.10 (1.6)	5.9 (1.6)	**0.8**

Knowledge is measured by a score out of 10 on the multiple-choice test. Values are expressed as means and SD (standard deviation). Values of p equal to or less than 0.05 (in bold) are considered to be statistically significant differences. CPR: cardiopulmonary resuscitation.

Discussion

The use of virtual methods is rapidly being introduced into the BLS/AED[7-9] teaching. Our data show that the two types of training methodology are almost identical in terms of results. The virtual approach offers students the opportunity to manage their own learning, but requires basic computer skills, a fluid use of the Moodle training platform and easy access to suitable computers. Our group had sufficient expertise in the field of ICT.

We can confirm that theoretical knowledge was similar to that of the study by Castillo et al.[1], which obtained a score of 8.3 in the CG and 8.4 in the PG; and to that of Madden et al.[10] with 8.6 points after the training.

Regarding practical skills, the poor re-expansion obtained in both groups stands out, which is one of the criteria defined as high-quality CPR[4]. Unfortunately, we have not been able to verify this data in other courses or studies, although we believe that the enthusiasm and dedication of the students to active resuscitation causes the passive phase to be neglected. We therefore believe that instructors should take this into account in training courses.

The strength of our study lies in the random conformation of the groups of students and having a statistically sufficient sample. In addition, the two methods were comparable since the concepts taught and the cases used were identical. The training was carried out by the same group of instructors and avoids biases produced intrinsically by the same instructors.

Loss of participants at 9 months is common in almost all studies and impoverishes statistical quality. This is an intermediate period of decline, between 6 and 12 months, which are the most studied periods in the literature by other authors[1,11,12]. There is no exact turning point in the literature from which retention of skills declines, although guidelines point to between 3 and 6 months[9]. For this reason, we believe that, as a functional scheme for updating and recycling courses, the exclusive use of virtual material (or with minimum attendance) could be a solution by adapting better to the "little, but often" scheme suggested by the ERC[4].

A weakness of our study is that the practical skills were only objectified with the data monitored by the intelligent manikins, when there are other practical variables (leadership and organisation, change of rescuers, etc.) of importance in the overall quality of CPR and which may influence the final outcome of CPR. On the contrary, the greatest advantages are the involvement of the students in their training and the reduction of the teaching workload of the instructors. This has recently been demonstrated by Castillo et al.[2] in their study on the costs of a course with mixed training methodology compared to a classroom-based course. In that study, the greatest savings were observed in the teachers' budget.

As for the degree of satisfaction of the students with the respective methods, their acceptance is high, as in other studies[13,14].

Although with the virtual methodology better results are obtained in some parameters of the skills in the short term, after 9 months the results are similar with both methodologies.

In conclusion, with the virtual methodology the same results are obtained as with the use of the face-to-face methodology and, in some parameters of the skills, they are even better. Therefore, we believe that the introduction of ICT in the education of BLS/AED will lead in the not too distant future to a modification in the educational methodology of the international guidelines, progressively decreasing the exclusively face-to-face training.

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