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Football referees as first responders in cardiac arrest. Assessment of a Basic Life Support training program.

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ABSTRACT

Aim. To assess football referees´ cardiopulmonary resuscitation (CPR) skills and automated external defibrillator (AED) use in a simulated sport incident scenario, after a brief training program.
Material and Methods. Quasi-experimental study with 35 amateur league football referees. A test – retest of related samples was carried out after the training program. Theoretical and hands-on session lasted 30 minutes, with 1/10 instructor/participant ratio. CPR skills were measured using Wireless Skill Report software and AED use by means of a specific check list.
Results. A third of sample knew what an AED is but only 8% knew how to use it. After training, all participants achieved 70% or higher CPR quality scores and were able to use AED properly (54.2% without any incidence). Mean time to discharge was shorter for participants who accomplished the quality goal (p=0.022).
Conclusions. After a very brief and simple training program, football referees were able to perform a potentially effective CPR and use an AED correctly in a simulated scenario. Basic life support training should be implemented in football referees´ formative curriculum.

Key words: automated external defibrillator, referees, cardiac arrest, cardiopulmonary resuscitation, basic life support, training, sport, football

INTRODUCTION

Sport, both professional and amateur, is a social phenomenon with a large number of fans and players. This social dimension and the rising incidence of related injuries and critical situations have drawn the attention of scientific community. Thus, in 2015, recommendations for cardiopulmonary resuscitation (CPR) guidelines included cardiac arrest (CA) management in sports events for the first time. (1,2)
Around 24000 CAs with non-traumatic cause occur in Spain per year, with survival rates of around 5-7%. (3) At least half of out-of-hospital CAs (OHCA) are witnessed by bystanders. (4) Although the initiation of CPR by bystanders and early defibrillation could double or triple survival rates (4,5) and improve outcomes, (6-8) the population´s poor awareness and insufficient knowledge keep bystander CPR rates lower than 30 % in many countries. (9,10)
In the field of sport, CA is the leading cause of death in athletes during competition or training, (1,11) often associated with a normal structure of the heart, (12) although sudden death could be the first manifestation of cardiomyopathy in young people. (13) Globally, CA incidence in athletes is somewhere between 1: 65000 and 1:200000. (14)
Currently, sports most frequently related to CA are football, basketball and athletics (11,15) as they are the most popular and most played by people around the world. There are more than 260 million football players registered globally. In Spain, there are more than 600000 letters of intent, apart from no federated fans who take part in competitions and sport activities. (13)
Up to 2015, International Federation of Association Football (FIFA) had registered 23 CA death cases in professional football players; fifteen of them occurred during play match (16). Nevertheless, there are no systematic records of CAs during training sessions or during play matches in professional leagues.
With the aim of increasing the bystander CPR rates, some initiatives have been promoted, especially in football. In practice, professional leagues require health care professionals to be present during football matches, whereas in lower rank competitions the first responder´s responsibility lies with referees, trainers and other players. (1,17)
The need for an available AED or staff trained in CPR in sports facilities is not contemplated by the rules of the game; thus, the CA first response is implemented by local regulations or the sporting event organizer.
The UEFA Minimal Medical Requirements Guideline demands healthcare professionals and AED devices to be present in all Competition´s matches (18); however, this rule is not applicable to other football competitions. Currently, many football fields have AED devices installed in public areas and locker rooms.

Football referees are potentially ideal first responders in CA, especially those who take part in amateur events or lower category competitions. Each season, these referees may attend between 80 and 120 matches without health care coverage. Although they receive specific and periodic training, the referees' training programs in Spain do not include a First Aid topic. The aim of the present study was to assess the CPR and AED use skills of amateur category football referees after a very brief training session.

MATERIAL AND METHODS

Transversal study without control group for learning abilities and CPR skills assessment by means of a CA simulated scenario.

Sample

We have chosen a convenient sample of 35 amateur categories' adult, non-professional football referees, members of the Galician Referees Committee and naïve in basic life support (BLS). Participation was voluntary and without personal incentive. All of them signed the informed consent afterwards to be told about study´s objectives and methods. The study respected the Helsinki Declaration and was approved by the local Institutional Review Board.

Study design

In the first study stage, we assessed participants´ prior AED knowledge by means of a very brief questionnaire previously used for first responders (19) Do you know what an AED is? Do you know how to use the device? Have you received prior training on AED use?
Second stage consisted of a very brief chain of survival theoretical session which included both lecture and watching an educational video that tells a story of a young player who suffers a sudden collapse while playing indoor football and is resuscitated by his coach; at the end of the video, an "expert" summarizes the essentials of bystander CPR. The video is available on the web: https://www.youtube.com/watch?v=ZQdwoRf-TLg. This audiovisual material has been use in prior studies with laypeople. (19,20)
For practice we used a methodology based on demonstration and hands-on training supported by real time quality feedback, following González-Salvado et al. training model. (21) Instructor gave the participants real time quality indications about chest compressions depth, compression rate, chest recoil and hands position. Individual hands-on training took five minutes. The whole training lasted 30 minutes (theoretical session, educational video and skill training).
After practice, the participants´ skills were evaluated individually by means of a practical test in a simulated scenario: the manikin simulated a football player lying on the floor, not breathing. The study design is showed in figure 1.

Material

We used a Laerdal Resusci Anne manikin (Norway) with Laerdal Skill Reporter v.10 Software which measures chest compressions and ventilations quality and training AED, Philips Heartrestart model (Netherland). Goals were set according to the 2015 quality standard established by the European Resuscitation Council (ERC) guidelines for resuscitation (22) [chest compression depth between 50 and 60 mm and chest compression rate between 100 and 120 compressions per minute]. (22)
CPR quality metrics included: Mean compression rate (CR) in compressions /minute, mean compressions depth (CD) in millimetres, correct chest compressions percentage (CCP), correct hands position percentage (CHPP) and percentage of CPR global quality (Q-CPR). AED use was assessed by means of check list which included these issues: 1) Time to defibrillation, 2) Safety, 3) Correct shock objective, 4) Quality objective.
Time was recorded in seconds from the moment the participant touched the AED device until the shock button was pressed. For a safety performance, participant should not be in touch with the manikin at the time the shock was delivered. A safety performance, duration less than 2 minutes and defibrillation pads correctly located were required for achieving the effective discharge objective. For the quality assessment, the following variables were considered: exchange of pad electrodes, pads slightly displaced towards the longitudinal axis in the frontal plane and the order of execution, which was the following: 1- turning on the device, 2 - placing pad electrodes, 3 - inserting the pad connector into the socket, 4 - delivering the discharge. If any one of these conditions was not present, the quality objective was considered unmet.

Statistics

Statistical analysis was made with SPSS for Windows software, version 21 (SPSS Inc, IBM, Armonk, NY). Total and by gender sample age; AED total and by Q-Objective time description and CPR variables were explained by: mean, standard deviation (SD) and 95% confidence interval. Test answers and categorical AED variables were explained by relative and absolute frequencies. Shapiro-Wilk test was used for test of normality. U Mann-Whitney test was used to check differences in age by gender and in AED time by Q-Objective. A cut off p-value< 0.05 was used to determine statistical significance.

RESULTS

Out of 35 participants, twenty-eight (80%) were men and seven (20%) were women; the mean age was 25 (table 1).
Table 1 shows quality CPR variables analysis and figure 2 a graphic representation of CPR quality. Mean (+SD) compression rate was 111.2 +5 compressions per minute and mean compression depth was 51.6 + 6.6 millimetres. Software registered more than half of total compressions as correct (53.8 + 37.3 %). High percentage (91.7+ 21.2 %) of compressions was performed with correct hands position. Mean global quality of CPR (QCPR) was 73.3 + 18.6 %.
Related to AED use, all participants were capable to complete a safety practical test in less than 2 minutes time (64.7 + 17.2 seconds) and 19/35 (54.2%) accomplished also the quality objective.
Regarding prior knowledge questionnaire, 11/35 (31.4%) participants declared to know what an AED is, 3/35 (8.6%) affirmed to know how to use it and only 1/35 (2.9%) had previously attended a training.
Participants who accomplished the quality objective completed the practical test faster (58.2 + 8.9 seconds) than participants who made an error during performance (72.4 + 21.3 seconds) (p=0.010).
Sixteen (45.7%) participants didn´t accomplish the quality objective. The errors made were: 13/16 (81.3%) did not place pad electrodes at correct location, 1/16 (6.3%) exchanged the pads and 3/16 (18.8%) modified the execution order.

DISCUSSION

CA during sports practice is a worrying reality (1,11,12) because bystander CPR (including AED use) is infrequently performed and when done, it is of low quality, thus efforts should be made in order to improve CA outcomes. Football ref-

Table 1. Sample description, test´s answers and CPR and AED variables. Results expressed by mean +SD and percentage or 95% confidence interval, as required.

Variables		All (N=35)	Men (n=28)	Women (n= 7)	P
Mean age in years+SD		25.2 + 8.6	25.9+9.4	22.3 + 4	0.26a
TEST N (%)	What is?	11 (31.4)	-	-	-
	How it is used?	3 (8.6)	-	-	-
	Prior training	1 (2.9)	-	-	-
CPR Mean+SD (CI 95%)	RM	111.2 + 5 (108.8 – 114.9)	-	-	-
	PM (mm)	51.6 + 6.6 (47.4 – 56.11)	-	-	-
	CC (%)	53.8 + 37.3 (26.68 – 79.2)	-	-	-
	MC (%)	91.7 + 21.2 (77.04 - 105)	-	-	-
	C-RCP (%)	73.3 + 18.6 (61.5 – 85.1)	-	-	-
AED	Q-Obj [N (%)]	19 (54.3)	16 (55.7)	3 (8.6)	0.5b
	Time+ SD (seconds)	64.7 + 17.2	65.1 + 18.8	63.1 + 8.5	0.8c

AED, automatic external defibrillator; CC, Correct chest compressions; CHP, Correct hands position; CPR, cardiopulmonary resuscitation; MD, Mean depth; MR, Mean rate (compressions/minute); Q-Obj, High quality shock objective; Q-CPR, CPR global quality; SD, Standard deviation.
aU Mann-Whitney b Chi Square cT Student.

erees have qualities which make them an ideal target population for CPR training and early AED use in case of CA during competition. Nevertheless, the learning effect of a brief and simple training session in a football referees' sample has not been studied in a widespread way yet. This kind of relatively low-cost, no time-consuming training could be easily implemented in referees' regular curricula and, observing our results, it should be included in referees´ specific training programs.

Prior experience shows positive effects of initiatives which endorse bystander CPR and public access defibrillation in sports events. Thus, in Italy, following the implementation of "Legge Balduzzi" (which regulates the use of AED and the equipment necessary for life support in sports facilities), the return of spontaneous circulation (ROSC) after CA has increased to 65% of cases. (23) While there is a consensus on the need to increase the bystanders' knowledge and try to raise the awareness in a significant part of society of the importance of early and high-quality CPR for CA outcomes, it is not clear which are the most effective and feasible training programs or priority target groups. (21, 24)

One of the barriers of public access defibrillation programs´ implementation is the society's lack of knowledge of what an AED is and what it is for. (9,10) In the present study, only one of three referees knew what the device was and less than one of ten declared to know how to use it. Results point out that efforts should be made to familiarize potential users with AED , and that it is not enough to simply locate defibrillators in sports areas.

González-Salvado et al. (21) have shown in a contemporary study the benefits of a practical, very brief (5 minutes) chest compressions -only CPR training, led by certificated instructors. Participants received a quality feedback during training in such a way that errors could be corrected in real time. Our results are comparable, as both mean compression rate (111 compressions per minute) and mean compression depth (52 millimetres) reached quality objective set out in the international recommendations; hands position was correct in more than 90% of performed compressions. Mostly, CPR quality overpassed 70%, the quality goal standard widely accepted in scientific literature (22) and the target usually set in CPR quality studies (25,26) as well as in chest compressions only CPR studies. (20,21)

Also, our study has shown that naïve football referees, after taking part in a very

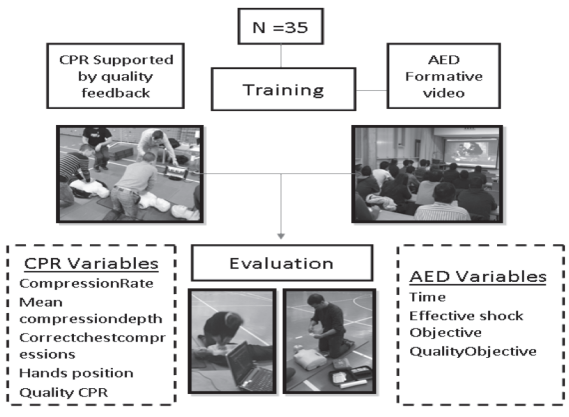

Figure 1. Study design. Theoretical and hands-on training stages and recorded variables during practical test in simulated scenario. AED, automatic external defibrillator; CPR, cardiopulmonary resuscitation.

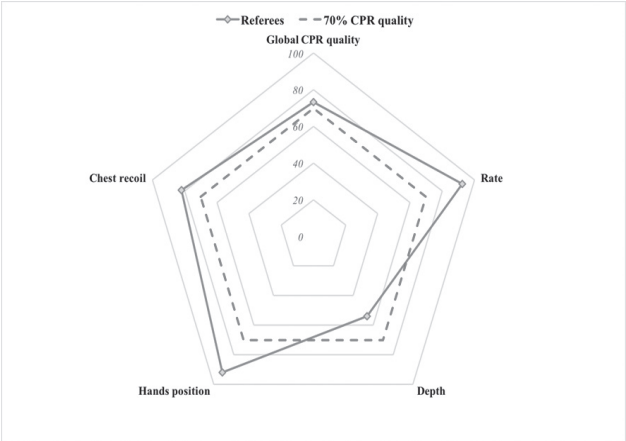

Figure 2. Graphic representation of compressions performed by sample quality. Percentage of correct compressions overall, by hands position, re-expansion and compression rate. The figure also shows the CPR quality standards.

simple and brief training program, were capable of performing an effective and safe defibrillation in less than one minute and more than half of them did it without errors, thus accomplishing the quality objective. Similar results were obtained in other studies with participants of different profiles. In this way, 75% of a sample formed by 103 first course Pharmacy students were capable of delivering an effective defibrillation in 74 seconds (25) after a brief theoretical and hands-on training, and in a prior study developed in Sao Paulo subway, trained security staff completed the chain of survival procedure in 4 minutes and 8 seconds from CA detection to defibrillation. (26)

Early defibrillation is an essential prognostic factor after OHCA, although critical timing for the efficacy of AED implementation has not yet been established. Several studies have shown that laypeople are capable of dispatching an effective shock in less than 2 minutes and it has been assumed that this time would be reasonable. (3,9,22)

We observed that all referees were able to complete AED use procedure in less than 2 minutes; furthermore, the group that did it in less time, made fewer mistakes. Although we do not know what this result is due to, we suppose it may be related to the fact that the best way to use a defibrillator quickly and correctly is to strictly follow its visual and auditory indications.

In relation to the errors in the procedure, the most common ones were displaced pads followed by a modified execution order. This result differs from those obtained in a prior study with naïve schoolchildren where a modified execution order was the most prevalent error (76.4%) followed by exchanged pads (14.3%) and pads slightly displaced towards the longitudinal axis in the frontal plane (10.9%). (27) This fact should be considered by instructors in order to strengthen training and avoid the most common errors.

Our study presents some limitations. First, the sample was formed by football referees belonging to the same delegation, thus all of them received the same training. It is possible that the results would have been different if the referees had belonged to another territorial delegation. Study participation was voluntary and it is possible that only those who were motivated towards this content attended and this fact may influence the learning. Also, the test was carried out under simulated conditions, so results could not be directly extrapolated to real-life situations where dramatic and stressful factors play an important role. Anyway, it is obvious that this kind of study cannot be performed in real patients. Our study is based on a single training session. Other strategies, which combine different materials, last longer and perform hands-on sessions repetitively, might result in an even better learning and retention.

CONCLUSION

A brief and specific CPR and AED use training program was effective in improving the skills of football referees naïve in BLS. Therefore, referees´ training is feasible and should be implemented within the regulated training programs for sport judges as they are target subjects to act as first responders in the event of cardiac arrest during a sporting event.

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