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Editorial

Automatic External Defibrillator in Sudden Out-of-hospital Cardiac Arrest: In Search of Effective Treatment

Desfibrilador externo automático en la muerte súbita extrahospitalaria: en busca del tratamiento eficaz

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Out-of-hospital cardiac arrest (OHCA) is a frequent cause of death, with an annual incidence of approximately 420 000 people in the United States, 275 000 in Europe,[1] and 24 500 in Spain.[2] On the initial cardiac rhythm analysis of OHCA patients, ventricular fibrillation (VF) is seen in 23% to 64% of cases.[3,4] This percentage varies according to where the incident occurs, being lower when it takes place in the individual's home than when it occurs in a public place, although in general it has decreased in the last 20 years.[4]

Conceptually, given that the main cause of OHCA is ischemic heart disease, cardiac arrest can often be considered a failure of cardiovascular prevention and identification of at-risk patients. Nevertheless, once OHCA has taken place, given that it can occur unexpectedly, in any situation and generally outside the health care setting, the challenge lies in responding as quickly and appropriately as possible. To achieve this goal, the "chain of survival"[5] has been developed, which consists of 4 linked steps: immediate recognition of a possible cardiac arrest, early initiation of basic cardiopulmonary resuscitation (CPR) performed by bystanders, rapid defibrillation, and advanced life support. Performing early, high-quality CPR is the best predictor of increased 30-day survival and, most importantly, of a good neurological status at discharge.

In recent years, the survival rate of patients with OHCA has improved, which has been associated with 2 features: public education programs and the development, distribution, and use of external automatic defibrillator (AED) systems.[6] However, despite this improvement, overall survival remains low, as does the percentage of patients with a good neurological status at discharge (between 11.4% and 16.5%).[3,6–8]

Therefore, despite the evidence on the usefulness of developing and using AED systems,[7,8] there are still several aspects that require clarification regarding their use, such as the best and most accessible locations for these devices,[9,10] the role of training and their use by nonhealth care professionals[2] and–in particular–the optimal timing for their use and how this interacts with CPR.[1,8,11] Weisfeldt et al.[12] proposed that there are 3 phases during the cardiac arrest process that may relate to the findings when treating patients and the effectiveness of different treatments: the first of these is the electrical phase, the first 4 minutes, when immediate defibrillation is the most effective treatment; the second is the circulatory phase, from 4 to 10 minutes, when high-quality CPR is most effective, and the third, which is beyond 10 minutes, is the metabolic phase, when treatments should also aim to correct metabolic abnormalities. All this is critical to understanding the response to different treatments according to the time elapsed since the onset of the OHCA, as it is well-established that AED is most effective when used early, in the first 4 or 5 minutes,[8,11] and that, after this time, performing a period of CPR increases the number of patients with a shockable rhythm and therefore improves the outcomes of AED use.[1]

In the current issue of *Revista Española de Cardiología*, Loma-Osorio et al.[13] present data on their initial experience with the *"Girona Territori Cardioprotegit"* program, a public initiative on defibrillation implemented in the province of Girona, Spain, where 747 AEDs have been distributed, 577 of which are in fixed locations and distributed throughout the region, and 170 of which are mobile and form part of the police, fire brigade, and basic ambulance equipment. The authors highlight that, although no official lay training programs were organized for this project, there were public awareness campaigns, courses aimed at students, and an official course for the professionals who drive the vehicles carrying these devices.

The main specific objective of the study was to perform a descriptive analysis of the rhythms recorded by the AEDs in incidences of OHCA and to evaluate their performance. Independently of the results, the study provides data on real-world use that help us understand AED use in our setting and improve implementation strategies.

The first interesting finding is that 91% of AED activations were classified as correct uses, 6% as intermediate, defined as activations in a patient who had not lost consciousness or had recovered consciousness before AED use; and only 3% (7 cases) were

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classified as incorrect activations, defined by the authors as antisocial AED use. This observation is important because it supports the fact that in general, in our setting and in a broad general area, these devices are used appropriately.

The second important finding is the analysis of the first identified rhythm on the AED. Of the 231 AED activations, complete information was available in 188. The most prevalent first identified rhythm was asystole (42%), while a shockable rhythm was found in a relatively low proportion of patients with OHCA (22.8%), a figure in line with most current published series.

Regarding the reliability analysis for interpretation of the recorded rhythm by the AED, in this series no false positives were identified, that is, all the tracings that were interpreted as shockable rhythms were in fact episodes of VF or ventricular tachycardia, conferring a specificity of 100%. However, VF was not detected in 8 patients, representing a sensitivity of 82.9%. These data are similar to those reported in other series in the literature, with specificity between 94% and 99.9%, and lower sensitivity, between 81% and 84%.[14,15] This relatively low sensitivity is a potential cause for concern, as it may mean that patients with a shockable rhythm are left untreated. In general, as the authors discuss, the lack of sensitivity occurs particularly with fine VF. In the series reported by Loma-Osorio et al.,[13] there were no cases of false detection of VF, but in cases reported in the literature, some patients have received a shock due to erroneous detection of VF, without it causing any problems.[14,15] Ideally, we could increase the sensitivity, especially for cases of fine VF, without reducing the specificity.

Two features of the data presented by the authors deserve special reflection. The first is that, on analysis of the CPR received by these patients, most of them (80.1%) received some type of resuscitation but it could be considered of good quality in only half (51.9%). This is an important point, because AED use should be considered an additional tool in the chain of survival, but effective CPR is essential in all cases of OHCA and, in particular, in those who cannot undergo early AED application, that is, when the patient is in the metabolic phase of cardiac arrest, a phase in which defibrillation outcomes are improved by performing CPR for a period prior to AED use.[1,6,11] Therefore, any project deploying AEDs in a new setting should ideally be accompanied by a lay-person training program aimed not only at AED use, but also at the correct performance of all the steps in the chain of survival, which include identifying the potential cardiac arrest, the initial call to the emergency services, performing basic CPR, and the use of the AED, if available.

The second feature of the study that deserves special mention is the use of fixed-location vs mobile AEDs: 82% of activations corresponded to mobile devices (n = 154), and only 18% to fixed-location devices (n = 34). This leads on to one of the aspects currently under discussion, namely optimizing the locations of AEDs. It seems clear that AEDs are extremely useful in densely-populated spaces and in those where it has been possible to train the staff who work in that area, as in airports, sports centers, and large crowds of people at events. It has been reported that for AEDs to be effective, they should be located in places where there have been at least 2 OHCAs in 2 years or where more than 250 adults older than 50 years are present for more than 16 h per day.[9]

Nelson et al.[9] analyzed the use of AEDs in a rural area and compared the use of 66 fixed-location AEDs, situated in public and private locations, and 15 mobile devices. In the 12-month study period, there were 70 incidences of OHCA leading to mobile AED activation on 19 occasions, compared with no activations of the fixed-location AEDs. The authors concluded that in a rural area with a low population density, mobile AEDs are much more effective than fixed-location AEDs. The regional model in the study by Nelson et al.[9] is not at all comparable to that of the province of Girona, where, in contrast, there are areas of high population density and others with very low density. However, given the large number of fixed-location AEDs in the area, and looking forward to new regional programs, it may be worth analyzing which units have the highest or lowest performance.

Because it fell beyond the scope of its objectives, the article by Loma-Osorio et al.[13] was not able to establish the rate of AED use in the context of all the incidences of OHCA occurring in the region covered, which would be helpful for optimizing their use.

Nonetheless, we must congratulate the authors of the article, among other things, for having launched the "*Girona Territori Cardioprotegit*" program, which involved the distribution of AEDs in a wide area including both rural and urban settings, and also for providing data on the effectiveness of this provision, which will serve to improve the implementation of similar programs throughout the country.

CONFLICTS OF INTEREST

R.M. Lidón has received remuneration from AstraZeneca for consultancy, from AstraZeneca and Amgen for presentations and from Ferrer and Amgen for expert testimony.

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