

Semiautomatic external defibrillation plan for Galicia: results of implementation

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CONFLICT OF INTEREST:

None

Objective: To evaluate the effectiveness of a plan for implementing the use of semiautomatic external defibrillators in Galicia.

Methods: Cardiorespiratory arrests treated by ambulance attendants with semiautomatic external defibrillators in 2001, 2002 and 2003 were studied. Recovery of vital constants at the point of initial emergency service care was noted, and factors affecting survival and the efficacy of defibrillation were analyzed. Data were extracted from the ambulance attendants' defibrillation records and the computer records of the ambulance service dispatch center.

Results: Nine hundred fifty-eight cardiorespiratory arrests were treated with semiautomatic external defibrillators (26.61 arrests/month). Ambulance attendants found a shockable rhythm in 25.15%; ventricular fibrillation was restored in 11.27%. Arrests were witnessed in 50.41% of the cases, and cardiopulmonary resuscitation (CPR) was initiated by a bystander in 18.95%. Times between the arrest and reception of a call to the emergency service, first attempt at resuscitation, restoration of circulation, and first shock decreased from year to year.

Conclusions: To improve the results of cardiopulmonary resuscitation in Galicia, it is necessary to shorten the time between the arrest and the call to the emergency service, the ambulance response time, and time until the first shock. The frequency of bystander CPR is low, but has tended to rise in recent years. Basic CPR training in the general population should be improved. The plan for use of semiautomatic external defibrillators that was developed and put into practice by the ambulance service has been shown to meet the needs of our community. To improve outcomes in emergency cases, ambulance response times should be shortened. [Emergencias 2009;21:99-104]

Key words: Cardiac Arrest. Automated external defibrillator. Ventricular fibrillation. Emergency medical service.

Introduction

The most frequent cause of death in the adult population of industrialised countries is cardiac arrest due to heart disease¹. In Spain an estimated 16,000 people per year die of sudden cardiac death (SCD)², defined as natural and unexpected death due to a cardiac cause that takes place within an hour of the onset of symptoms³.

An estimated 70-80% of all SCD are a consequence of ventricular fibrillation (VF)⁴, a lethal

arrhythmia that can only be corrected by the administration of an electrical current delivered by a defibrillator. Over 60% of deaths due to heart disease occur during the prehospital phase and the majority of victims do not survive long enough to receive medical attention⁵. In those who do survive long enough to be admitted to hospital but then die, the cause of death is generally the size of the infarction. Prehospital death is generally caused by cardiorespiratory arrest (CRA) due to VF and pulseless ventri-

cular tachycardia. The time lapse from loss of consciousness to defibrillation is the main determinant of survival after CRA⁶. These data and others suggest that efforts to improve prehospital treatment of acute coronary syndrome (ACS) may have greater impact on survival outcomes than improving in-hospital treatment⁷. Reducing the time lapse between onset of CRA and defibrillation is of vital importance⁸.

In 1999, Herlitz⁹ published a study on survival data from five emergency medical systems (EMS) involving four European countries (Germany, Iceland, Finland and Norway). Survival until hospital discharge for all types of CRA ranged from 6% to 23%. However, survival in cases of CRA due to VF was higher, from 13% to 55%. Higher survival rates were found: in geographic areas with cardiopulmonary resuscitation (CPR) programs, when the time to defibrillation was reduced, when the level of training and experience of emergency staff was high. The European Resuscitation Council (ERC) and the American Heart Association (AHA) consider it necessary to extend the use of automatic defibrillation to the general population, clearly indicating that the first step is to equip ambulances with semiautomatic defibrillators (SADF), with health transport technicians (HTT) specifically trained to use them in response to cases of CRA.

A SADF is a computerized device which, on application to the patient's chest, analyzes cardiac rhythm and advises the operator whether or not to deliver an electric shock, the decision being taken by the operator. It is a most reliable system widely used in the world's most developed countries. These devices are not to be incorporated into EMS as isolated measures but rather to be integrated into a set of measures (plans) that reinforce the rest of the links in the survival chain, considering the crucial nature of prompt use. Early defibrillation is highly likely to succeed if the time lapse between the onset of CRA and CPR is less than 4 minutes and if the time lapse between CRA and defibrillation is less than 12 minutes¹⁰. If defibrillation is performed within the first minute, VF is reverted in 90% of cases¹¹. Its efficacy diminishes by 7-10% for each subsequent minute of delay. After 12 minutes, survival rate is reduced to 2-5%¹².

The objective of this study was to document the results of implementing a SADF program in Galicia and evaluate its efficacy, considering this community's socio-demographic characteristics and resources.

Method

We studied the data on CRA attended by ambulances belonging to a medical emergency transport network (RTSU) equipped with SADF, during 2001 (28 ambulances), 2002 (52 ambulances) and 2003 (93 ambulances). We studied recovery times of vital signs (heart rate, respiratory rate, and blood pressure) by the EMS on site, the factors influencing survival, and SADF device efficacy. Data were extracted from the ambulance attendants' defibrillation records and the computer records of the ambulance service dispatch centre (CCUS-061).

Potential beneficiaries of SADF devices in Galicia are all people aged > 8 years or weighing > 25 Kg. Exceptions, apart from these children, are hospital in-patients not attended by the 061 service, and people suffering CRA at home who do not meet the criteria for resuscitation or who expressly refuse to receive SADF treatment.

During the study period there were 1,132 active HT technicians staffing 93 RTSU ambulances in the different phases of SADF device implementation. All were SADF-trained in courses completed just after the HTT course final examinations. As from 2001, these SADF courses of 9h duration completed their training for ambulance work.

Data collection for the years 2001, 2002 and 2003 was performed following the recommendations of Utstein¹³ with some modifications. Data on the use of SADF devices was retrieved from the existing data base which included each event and the record produced by HT Technicians, as well as the CCUS-061 register. The latter includes all the times and is completed on finalizing the case with the HTT report when the case file is closed. It is complemented by the data contained in the memory chip of the SADF device itself. All this is used in HTT meetings after SADF use for analysis and possible error correction. When an SADF is used, a recording is automatically activated of all nearby conversations and stored in the device memory chip. Details of times were telephonically transmitted by the HT Technicians to the ambulance dispatch centre CCUS-061. Currently, this is done directly by GPS.

For the use and processing of all the data, written permission was obtained from Fundación Pública Urgencias Sanitarias de Galicia-061 (FPUS-061). This use is regulated by the laws on data protection and confidentiality: in no case was patient identity known. The data supplied was not copied or distributed in any way, and was always maintained in the form and format supplied by the FPUS-061.

Quantitative results are expressed as percentages or means and standard deviation. For the comparison of results (Epi Info 3.5.1), we applied ANOVA or Chi2 test, as appropriate. A p value of < 0.05 was considered statistically significant.

Results

The cases attended in the years 2001, 2002 and 2003 are shown in Figure 1. We found no inter-annual differences in times except for the interval between CRA and call receipt at CCUS-061, which improved significantly (p < 0.05; Figure 2). The incidence of CRA attended per 100.000 inhabitants and year went from 16.5 before SADF implementation to 28 (p < 0.01) after implementation. This practically represents a two-fold increment in the number of CRA attended annually in Galicia, either by medicalized ambulances or RTSU ambulances equipped with SADF devices. The number, general characteristics of patients attended using a SADF, results of SADF program activity and the times from onset of CRA to the alert, HTT arrival and to first defibrillation are shown in Table 1.

Discussion

Our study is the first in Spain to evaluate in a detailed manner the results of implementing a

SADF program, in this case in the Autonomous Community of Galicia. The data obtained are consistent with those reported by other authors in different areas with predominantly rural and disperse populations where attendance times are naturally longer^{14,15}. Our results are comparable to those of other EMS in different countries^{16,17} (Table 2).

A striking finding in our study was the low percentage of patients found with VF (25%), as compared to the percentages reported in the literature – around 50%, and higher in urban areas¹⁸. This only supports the notion that the earlier CRA is attended, the greater is the probability of sudden cardiac death with treatable VF¹⁹.

The percentage of patients with CRA who received bystander CPR (18%) is an aspect which could be improved in the future. Although similar in other places, it is not optimal and highlights the need for basic CPR courses for the general population; for example, school children or young adults on obtaining their driving license, as is done in Bonn²⁰.

The truly relevant result was the number of CRA currently treated in the SADF program. At the end of the SADF implementation phase in Galicia, this had progressed from 451 to 778, which represents an increase of 72%. Moreover, this figure is expected to rise: it is the 3-year implementation average – when the total 93 ambulances equipped with SADF were operative only

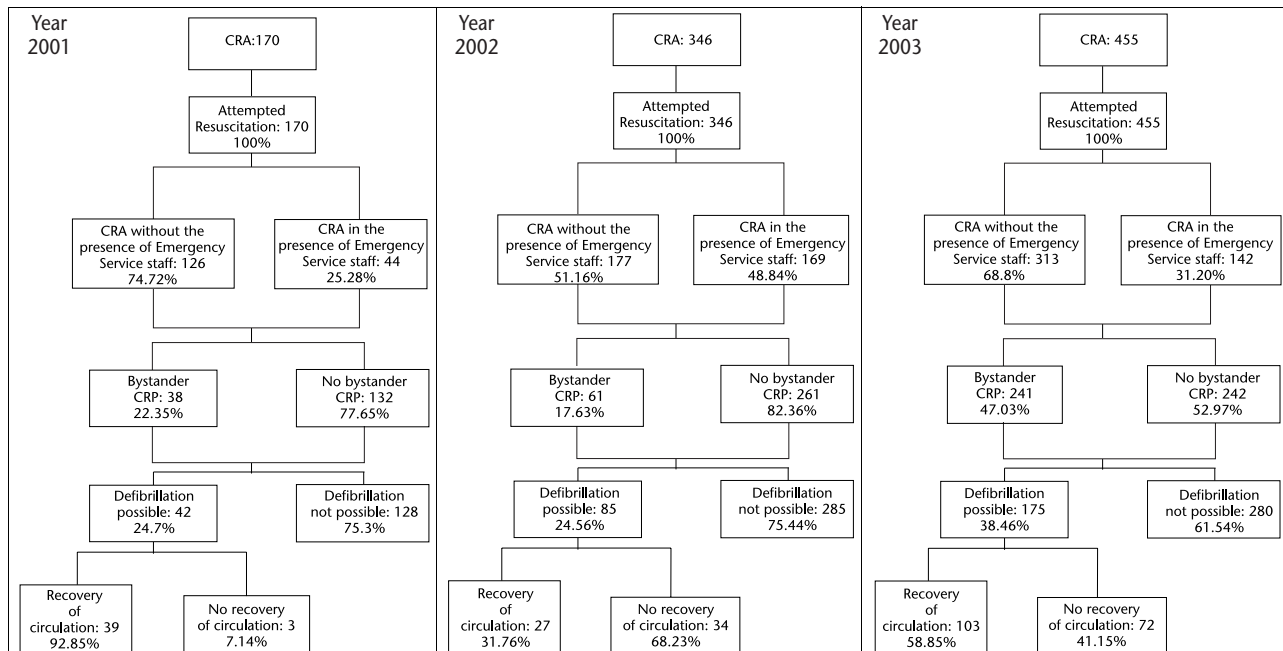


Figure 1. Utstein register of cardiorespiratory arrest (CRA) treated with semiautomatic defibrillators (SADF) in Galicia during the years 2001, 2002 and 2003. CPR: cardiopulmonary resuscitation.

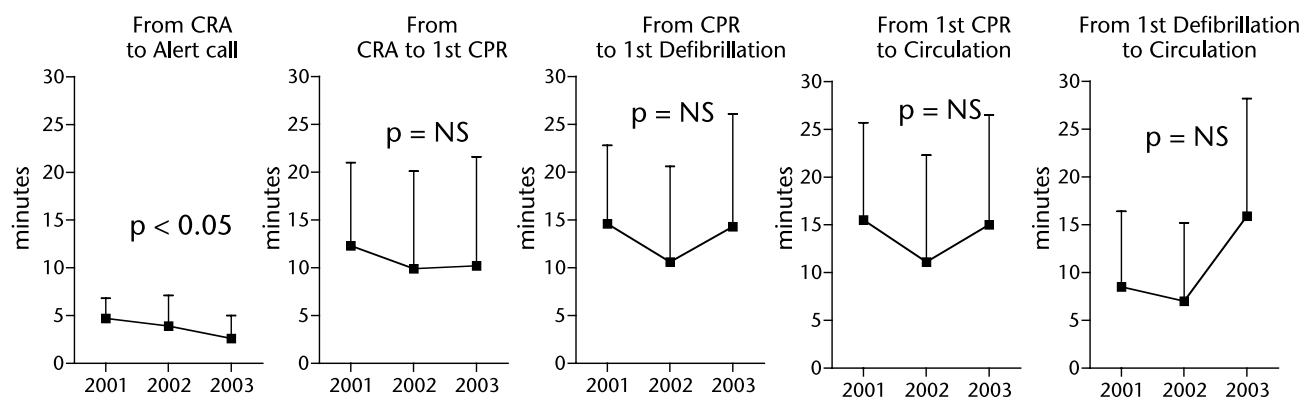


Figure 2. Evolution of the different attention times during the study period (2001-2003). CRA: cardiorespiratory arrest. CPR: Cardiopulmonary Resuscitation. NS: not significant.

during the last two months. Although these patients showed no greater recovery rates, the mere increase in percentage and thus CRA attended represents an increase of 13.4% in recovery that would not have occurred before implementation of the SADF program. On analysis of recovery in patients with treatable arrhythmia, year two showed an important decrease compared to year one of implementation with predominantly urban cases, but increased again in the third year.

Response times may be considered as relatively prolonged²¹. Time from CRA to patient attention with a defibrillator was a mean 10.8 minutes. Times from CRA to alert call showed progressive reduction, which indicates that bystanders increasingly recognise the signs of pulseless CRA and, moreover, know the emergency service telephone number. Compared with alert call times reported in other places, these times approach or even improve them (Table 2). In Amsterdam²², 75% of bystanders called within 2 minutes, and in Seattle²³ mean time was 2.2 minutes, while in Hong Kong²⁴, with a lower percentage of VF than ours, the mean time from CRA to alert call was 8.8 minutes in cases who subsequently died.

Regarding times from alert call to EMS arrival on the scene, ambulances with SADF should require longer times than medicalized ambulances since their area of operation is more extense, including rural areas, but both types of ambulance arrival times are similar to those published in the literature. The shorter arrival times observed in the first year are due to the fact that the SADF program was implemented first in more urban areas.

The percentage of vital signs recovery at the scene of attention is comparable to that reported in other rural areas (Iowa 19%¹⁶, Minnesota 7.4%²⁵, Wisconsin 11%³⁷; Table 2) and lower than those reported for airlines²⁶ and casinos²⁷.

This is explained by faster reponse times and greater percentage of patients with VF. Thus, of 29 CRA reported by American Airlines, 55% had VF²⁸; and of 14 CRA reported by Chicago airport, 85.7% were due to VF, with a discharge survival rate of 75%²⁹.

From an overall perspective, the main problems detected were late activation of EMS, low percentage of bystander-administered CPR³⁰, and prolonged ambulance arrival times. The first two of these problems can be addressed by increasing CPR training courses for the general population. Regarding prolonged attention times, and considering the dispersion of the population in Galicia, we must seek to reduce CRA localization time and improve communications, although for the latter we can only make recommendations to the competent authorities. Regarding CRA localization, the most efficient solution involves the use of GPS

Table 1. Overall data on cases of cardiorespiratory arrest (CRA) attended by the health transport network of ambulances and treated with semiautomatic defibrillators (SADF)

| Total number of patients receiving treatment with SADF 958 | |
|---|-------------|
| Age (years) (mean ± SD) | 69.2 ± 11.4 |
| Female sex [n (%)] | 304 (68) |
| CPR by bystander [n (%)] | 173 (18) |
| Patients defibrillated [n (%)] | 241 (25) |
| Supported by medicalised resource | 387 (40) |
| Supported by primary attention | 461 (48) |
| Arrest in the presence of emergency staff [n (%)] | 483 (50) |
| Recuperación de circulación espontánea en el punto | |
| Spontaneous on-site recovery of circulation [n (%)] | 108 (11) |
| On-site recovery of all defibrillated patients [n (%)] | 108 (45) |
| Response and attention times (minutes) | |
| From CRA to receipt of alert call (mean ± SD) | 5.7 ± 4.9 |
| From CRA to initial CPR attempt (mean ± SD) | 11.0 ± 10.0 |
| From CRA to first debibrillation (mean ± SD) | 13.4 ± 10.4 |
| From initial CPR to recovery of circulation (mean± SD) | 13.6 ± 11.0 |
| From first defibrillation to recovery of circulation (mean± SD) | 9.3 ± 9.5 |

CPR: cardiopulmonary resuscitation.

Table 2. Comparison of results obtained with those of other emergency medical services

| Place | Area type | CPR by | Authors | Years | % VF | % Recov. VF | % bystander | CPR-Defib (min.) | Alert-Defib (min.) |
|--------------------|-----------|------------|--------------------------|-----------|-------|-------------|-------------|------------------|--------------------|
| FPUS-AVSU | Mixed | Physicians | – | – | 33.8 | 32.9 | 39 | – | 15.8 |
| RTSU-SADF | Mixed | HTT | Present study | 2001-2003 | 25.1 | 11.3 | 18.05 | 14.0 | 10.8 |
| Iowa | Rural | HTT | Stults ¹⁶ | 1984 | 58 | 19 | 20 | 6 | – |
| Minnesota | Rural | HTT | Bachman ¹⁷ | 1986 | 66 | 7.4 | 36.7 | – | – |
| Seattle | Urbano | Firemen | Weaver ²³ | 1988 | 87 | 30 | 36 | – | 4 |
| Ontario | Urban | HTT | Stiell ³¹ | 1999 | 37.5 | 11.9 | 45 | – | 8 |
| Charlotte | Urban | Firemen | Sweeney ³² | 1998 | 57 | – | 45 | – | 11 |
| Amsterdam | Urban | Paramedics | Waalewijn ²² | 1993 | 62 | – | 54 | 9 | – |
| Memphis | Urban | Paramedics | Kellermann ³³ | 1993 | 49 | 9.8 | 12 | – | 6 |
| Rochester | Urban | Paramedics | White ²⁶ | 1996 | 53 | 49 | 43 | – | – |
| Allegheny | Mixed | Paramedics | Mosesso ³⁴ | 1993 | 44 | 26 | 28 | – | – |
| 5 European regions | Urban | – | Herlitz ²⁰ | 1999 | 46-61 | 27-55 | 27-67 | 7-11 | – |
| Hong Kong | Urban | HTT | Lui ²⁴ | 1999 | 22 | 6 | 8.9 | 23 | 6.4 |
| London | Urban | Police | Ross ³⁵ | 2001 | 52 | 15 | – | – | 9 |
| Sweden | – | – | Holmberg ³⁶ | 1998 | 61 | 9.5 | 32 | 13 | – |
| Wisconsin | Mixed | HTT | Olson ³⁷ | 1989 | 54 | 11 | 49 | – | 7 |

CPR: cardiopulmonary resuscitation; VF: ventricular fibrillation; Recov.: recovery; Defib: defibrillation; CRA: cardiorespiratory arrest; HTT: health transport technicians; FPUS: Fundación Pública Urgencias Sanitarias de Galicia-061; AVSU: advanced vital support unit; RTSU: Emergency health transport unit; SADF: Semiautomatic defibrillator. –: no data available.

and indications to ambulance staff on the best possible route to the scene of the incident.

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Plan de desfibrilación externa semiautomática en Galicia. Resultados finales de su implantación

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Objetivo: Conocer los resultados del plan de implantación de un programa de desfibriladores semiautomáticos (DESA) en Galicia y valorar su eficacia.

Método: Se estudian las paradas cardiorrespiratorias (PCR) atendidas por las ambulancias de la red de transporte sanitario urgente (RTSU) con DESA durante los años 2001, 2002 y 2003, la recuperación de constantes en el punto de la atención inicial por los sistemas médicos de emergencias (SEM), los factores que influyen en la supervivencia y la eficacia del DESA. Se analizó la hoja de registro DESA de los técnicos en transporte sanitario (TTS) de las ambulancias de la RTSU y la hoja DESA informatizada de la Central de Coordinación de Urgencias Sanitarias-061 (CCUS-061).

Resultados: 958 PCR atendidas con DESA (26,6 PCR/mes). El 25,1% se encontraban en un ritmo desfibrilable. Se recuperaron el 11,3% del total. El 50,4% de las PCR fueron presenciadas y se inició resucitación cardiopulmonar (RCP) por testigo en el 18,9%. Los intervalos temporales desde la PCR hasta la recepción de la llamada, primer intento de RCP, retorno de circulación y primera desfibrilación en general han tendido a disminuir con los años, aunque el descenso sólo resultó significativo para el intervalo desde la PCR hasta la recepción de la llamada en la CCUS-061.

Conclusiones: El programa de implantación del DESA, desarrollado y puesto en marcha por la Fundación Pública Urgencias Sanitarias de Galicia (FPUS-061), ha demostrado estar adaptado a las necesidades de nuestra comunidad. Aunque se ha observado una mejoría en los últimos años, aún deben acortarse más los tiempos de alerta, respuesta y desfibrilación, así como aumentar la tasa de RCP por testigos. [Emergencias 2009;21:99-104]

Palabras clave: Parada cardíaca. Desfibrilación externa semiautomática. Fibrilación ventricular. Servicios de emergencias médicos.