

Original article

The Girona Territori Cardioprotegit Project: Performance Evaluation of Public Defibrillators

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ABSTRACT

Introduction and objectives: In recent years, public access defibrillation programs have exponentially increased the availability of automatic external defibrillators (AED) in public spaces but there are no data on their performance in our setting. We conducted a descriptive analysis of the performance of AED since the launch of a public defibrillation program in our region.

Methods: A retrospective analysis was conducted of electrocardiographic tracings and the performance of AED in a public defibrillation program from June 2011 to June 2015 in the province of Girona, Spain.

Results: There were 231 AED activations. Full information was available on 188 activations, of which 82% corresponded to mobile devices and 18% to permanent devices. Asystole was the most prevalent rhythm (42%), while ventricular fibrillation accounted for 23%. The specificity of the device in identifying a shockable rhythm was 100%, but there were 8 false negatives (sensitivity 83%). There were 47 shockable rhythms, with a spontaneous circulation recovery rate of 49% (23 cases). There were no accidents related to the use of the device.

Conclusions: Nearly half of the recorded rhythms were asystole. The AED analyzed showed excellent safety and specificity, with moderate sensitivity. Half the patients with a shockable rhythm were successfully treated by the AED.

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Proyecto Girona Territori Cardioprotegit: evaluación del funcionamiento de los desfibriladores públicos

RESUMEN

Introducción y objetivos: La desfibrilación pública ha potenciado la difusión y el uso de los desfibriladores externos automáticos (DEA) de manera exponencial, pero se carece de datos recientes sobre su uso en nuestro medio. Se realizó un análisis descriptivo del funcionamiento de los DEA desde el despliegue de un programa de desfibrilación pública.

Métodos: Análisis retrospectivo de los trazados electrocardiográficos registrados y del funcionamiento de los desfibriladores, en el marco de un programa de desfibrilación pública en la provincia de Girona, desde su inicio en junio de 2011 hasta junio de 2015.

Resultados: De 231 activaciones, se dispuso de información completa en 188, entre dispositivos móviles (82%) y fijos (18%). La asistolia fue el ritmo más prevalente (42%), mientras que un 23% de los ritmos fueron fibrilación ventricular. La especificidad de los dispositivos identificando ritmos desfibrilables fue del 100%, pero hubo 8 falsos negativos (sensibilidad del 83%). En el caso de los 47 ritmos desfibrilables, la tasa de recuperación de la circulación espontánea fue del 49% (23 casos). No hubo ningún accidente relacionado con el uso del dispositivo.

Palabras clave:

Desfibrilación pública

Parada cardiorrespiratoria

Reanimación cardiopulmonar

Fibrilación ventricular

Asistolia

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Conclusiones: Casi la mitad de los ritmos registrados fueron asistolias. Los DEA analizados presentaron excelentes seguridad y especificidad, con una sensibilidad moderada. El DEA trató con éxito a la mitad de los pacientes que presentaron ritmo desfibrilable.

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Abbreviations

AED: automatic external defibrillator
CPR: cardiopulmonary resuscitation
OHCA: out-of-hospital cardiac arrest
VF: ventricular fibrillation
VT: ventricular tachycardia

INTRODUCTION

Out-of-hospital cardiac arrests (OHCAs) are a public health issue, both due to their frequency (an estimated annual incidence in Spain of 24 000-50 000 cases)¹ and their high rates of mortality and sequelae.^{2,3}

When the OHCA is caused by ventricular fibrillation (VF) or pulseless ventricular tachycardia (VT), prompt electrical defibrillation is the only effective treatment, and its timeliness is the most important factor in patient survival.⁴⁻⁶ Automatic external defibrillators (AEDs) can identify and treat ventricular arrhythmias and are safe and effective even in the hands of untrained laypersons.⁷⁻⁹ Accordingly, public access defibrillation programs have deployed AEDs to strategic locations for use by the general public in the event of a cardiac arrest.^{8,10-13}

AEDs use manufacturer-programmed and -verified algorithms to classify the cardiac rhythm and apply a therapy, if possible; nonetheless, these algorithms can make errors in the presence of artifacts related to cardiopulmonary resuscitation (CPR), due to poor positioning of the self-adhesive lead sensor, or when the programming cannot identify the cardiac rhythm.^{14,15} There is little information on the functioning of these devices in real-world conditions but some analyses have detected significant errors in rhythm detection or treatment.^{16,17}

In addition, shockable rhythms as a proportion of all OHCAs vary according to the series and might be decreasing for various reasons, such as improved treatment of coronary heart disease and more widespread use of implantable defibrillators.^{18,19}

The purpose of this study was to perform a descriptive analysis of rhythms recorded in OHCA and of the functioning of AEDs since their deployment in a public access defibrillation program.

METHODS

Patients

We prospectively recorded all AED activations in the *Girona Territori Cardioprotegit* program from June 2011 to June 2015.

This project is a public access defibrillation initiative promoted by the Girona City Council (Dipsalut) and began in 2011. The program was enabled by a change in regional law allowing AEDs to be used by any person in the event of an emergency. Although no CPR training was given to the general public, an awareness campaign was launched involving public events attended by more than 10 000 people, as well as specific school courses that reached more than 4000 students.

A total of 747 AEDs were distributed according to population density (1 per 1000 population) in either public places

(577 permanent AEDs) or as part of the equipment of police, fire department, and basic life support ambulance crews (170 mobile AEDs). These professionals received an official course on AED use.²⁰ The location of the permanent devices can be consulted on the website of the *Girona Territori Cardioprotegit* project.²¹

The AEDs distributed by the program are the PowerHeart AED G3 9300 manufactured by Cardiac Science (Bothell, Washington, United States), authorized for use in Europe by the Medical Device Safety Service. This model delivers a charge that is adapted to the patient's impedance and increases in successive defibrillations, beginning with 126 to 260 J and continuing with charges between 170 and 351 J.

Electrocardiographic tracings were obtained from the AEDs; we excluded those that were not actually OHCAs or had incomplete or unintelligible information.

Information Obtained From the Automatic External Defibrillators

The records extracted from the AEDs were saved in PDF and contain information on the time of device opening, the time of cardiac rhythm detection and interpretation, and the number of shocks administered, as well as the electrocardiographic tracings. Also recorded from each device activation were the type of AED used (mobile or permanent) and information on patients' vital status after CPR maneuvers. A retrospective descriptive analysis was performed of the data collected.

The initial rhythm recorded by the AED for each patient was used for the descriptive analysis of the arrhythmias underlying the cardiac arrest and the study of the diagnostic accuracy of the algorithms. All recorded arrhythmias were used in the analysis of the therapeutic effectiveness of the device.

Definitions

The cardiac rhythms of the electrocardiographic tracings obtained by the activated and used AEDs were classified according to the consensus document of the American Heart Association.¹⁴ Accordingly, VT, coarse VF (> 200 μ V), and fine VF (\leq 200 μ V) were considered shockable rhythms; sinus rhythm, atrioventricular block, atrial fibrillation, and other supraventricular rhythms were considered nonshockable. An AED shock was considered effective if it managed to reverse the shockable rhythm, regardless of the final rhythm.

The type of AED activation was classified into 3 categories: a) correct, involving a patient with sudden loss of consciousness who failed to respond to commands and who was administered basic CPR maneuvers; b) intermediate, involving a patient with loss of consciousness who quickly recovered and did not thus require CPR or a patient who did not lose consciousness but whose situation was considered serious by possible resuscitators; and c) incorrect, involving antisocial behavior.

CPR performance was indirectly evaluated via the chest compression waves visible on the electrocardiographic tracing. Similar to previous work,²² resuscitation maneuvers were considered to have been performed if this type of wave was visible and were considered adequate if they met the following characteristics: a) the AED instructions were followed; and b) the

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