

Survival after prehospital cardiac arrest in Spain: a review of the literature

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Spanish studies on prehospital cardiac arrest are reviewed, to compare early survival rates, and to estimate the prevalence of shockable arrhythmias and cardiopulmonary resuscitation (CPR) attempts before emergency responders arrive. We first reviewed Spanish studies that evaluated prehospital cardiac arrest published between 1999 and 2011. The data extracted were as follows: number of events attended, heart rhythm on arrival of assistance, number of patients recovering circulation on site, survival on hospital discharge, times CPR had been attempted before arrival of emergency responders, and time until arrival of the responders. Relative frequencies were then compared. Eleven observational studies relevant to the objective were located. CPR success rates ranged from 9.9% to 59.4% in these studies. Ventricular fibrillation was the heart rhythm initially detected in 14.9% to 54.5% of the patients across the studies, and CPR had been tried before the emergency responders arrived in 2.3% to 36.8% of the case series. A total of 8089 patients were considered candidates for CPR in the studies reviewed; 22.4% (95% CI, 21.5%-23.4%) were alive on arrival at a hospital emergency department. Spanish emergency response services in different geographical regions vary greatly in their efficacy, but the quality is low overall. Better strategies to improve response times and reduce delays in providing defibrillation should be designed, and training in basic CPR techniques should be more widespread in the population. [Emergencias 2013;25:137-142]

Keywords: Out-of-hospital cardiac arrest. Cardiopulmonary resuscitation. Emergency health services. Ventricular fibrillation. Defibrillators. Survival.

Introduction

Prehospital cardiac arrest (PHCA) is considered an important public health problem. However, in Spain, there is a lack of reliable official data on its incidence, and even the published data on survival are limited and imprecise¹.

The chances of survival after PHCA are variable and depend on many factors. Regardless of other variables, defibrillation is currently considered the most important intervention for prognosis in cases of ventricular fibrillation/pulseless ventricular tachycardia (FV/PVT), one of the few interventions shown to improve survival outcomes^{2,3}. Legislation and implementation of the first semiautomatic external defibrillation (SAED) plans in emergency units staffed by non-medical personnel 12 years ago represented a great advance in the treatment of the CA caused by FV, the main cause of sudden death of cardiac etiology.

The objectives of this work were to review published Spanish studies on PHCA attended by emergency medical services (EMS), and compare the results obtained in terms of return of spontaneous circulation (ROSC) after cardiopulmonary resuscitation (CPR). We also wished to estimate the prevalence of shockable arrhythmias at the beginning of the life support measures and resuscitation attempts performed by bystanders before the arrival of emergency team responders.

Method

We performed a search of articles in the databases CUIDEN, IBECs, Spanish Medical Index (IME in Spanish), DIALNET and PubMed and specific search results for Elsevier journals and the Spanish journal *Emergencias*. In addition, a manual review was performed of summaries of work presented at congresses and published in *Emergencias*.

For this we used a search strategy that combined free text and MeSH terms, including "survival", "heart/cardiac arrest", "out-of-hospital" (in Spanish for Spanish data-bases) and the same terms in English, plus "Spain", for PubMed. We searched for original articles published between June 1999 and February 2012 with at least an abstract available.

We included all observational studies whose objectives included the proportion of CPR patients with ROSC after prehospital life support maneuvers applied by EMS, excluding those that did not relate to Spanish territory or periods before 1996. We also excluded those relating to the pediatric population or in-hospital situations.

We then performed an inverse search and analyzed all articles considered relevant, including the titles of all references obtained from the search strategy and subsequently evaluated the summaries to determine whether they fell within the inclusion criteria.

From the articles included in the study we extracted the absolute values referring to the total number of patients undergoing CPR, those with ROSC on hospital arrival, potentially shockable initial heart rhythms, presumed etiology of the event (cardiac or not), situations in which CPR was performed before the arrival of the EMS, response times, and *restitutio ad integrum* of the patients admitted.

We then estimated relative values using proportions and 95% confidence intervals (CI). For comparison of percentages we used the Z test, and differences with a P value < 0.05 were considered statistically significant. Statistical analyses were performed using SPSS v17.

Results

The CUIDEN database offered no results. The other databases provided 714 references, of which 13 were repeated entries. After reading the title and/or summary we excluded 690 items. On broadening the search using the references alluded to in these articles, one new summary met the inclusion criteria. We also added an unpublished article of relevance.

On reading of selected texts, a further two were excluded: a study with partial results of a previously included larger study, and one whose data related to the period before 1996. Finally 11 observational studies were included in the analysis, corresponding to 9 original studies and 2 conference abstracts (Figure 1).

The results published by Moreno et al for Madrid represent the highest ROSC rates on hospital arrival, with immediate survival of 45.5% (95% CI 39-52.1)³ and 59.4% (95% CI 53.5-65.1)⁴ in two consecutive studies on CPR patients initially attended by basic life support units.

Less favorable results were reported by Iglesias et al, with ROSC rates of 11.2% (95% CI 9.3-13.4)⁵ in patients treated by EMS SAED-equipped ambulance teams in Galicia. However, a previous study in the same community but with advanced life support units showed significantly better rates (P < 0.001), with immediate recovery after resuscitation of 26.4% (95% CI 23.7-29.3)⁶.

In the Basque Country there were no significant differences (p > 0.9) between the proportion of successful resuscitation achieved by Gipuzkoa ambulance teams⁷, with 9.9% (95% CI 8.3-11.6) of patients who recovered in situ, and basic life support (BLS) units equipped with SAEDs in the area "Margin izquierda" of Bizkaia⁸, with 11.5% (95% CI 5.6-20.1).

The remaining studies reviewed showed more homogeneous results, with successful resuscitation rates ranging from 21.4% (95% CI 14.2-30.2) obtained by ALS teams in Barcelona⁹ to 29.5% (95% CI 24.9-34.5) in Badajoz¹⁰, where CPR maneuvers were initiated by BLS units in all cases.

In other regions of Spain, successful prehospital CPR rates were 22.2% (95% CI 19.9-24.5) in Castilla y León¹¹, 24.8% (95% CI 22.9-26.7%) in Andalusia¹² and 25.4% (95% CI 21.9-29.2) in Madrid¹³, the latter two corresponding to medicalized ambulance teams (Figure 2).

The total number of patients undergoing prehospital CPR in the studies included was 8,089, with successful resuscitation in situ being achieved in 1815 (22.4%, 95% CI 21.5-23.4). Using only those studies providing information on initial rhythms detected (Table 1), shockable rhythm was present in 24.9% (95% CI 23.7-26.2) of all cases.

The rates of shockable rhythm reversed and ROSC in cases receiving bystander CPR before EMS arrival were 49.8% (95% CI 46.2-53.4) and 29.8% (95% CI 28.2-31.5), respectively.

Discussion

Survival rates immediately after prehospital CRP by EMS vary greatly around the world; in general, mortality is high. This disparity can reflect geographical differences or EMS management. Great variability is also found between Spanish re-

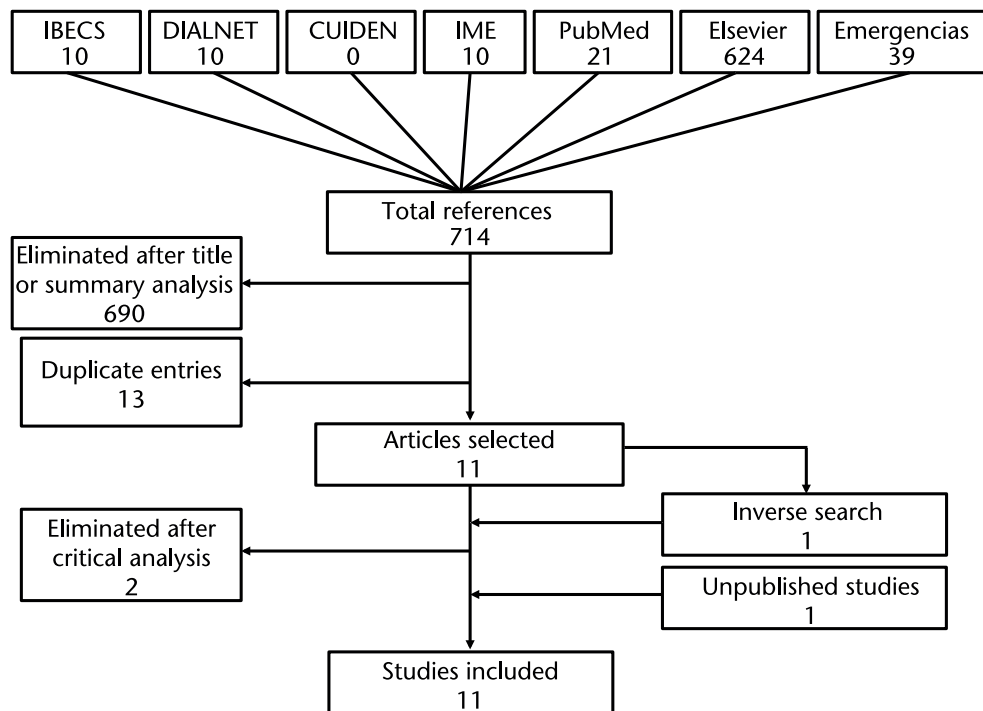


Figure 1. Results of the literature search.

gions: the limited effectiveness achieved in the Basque Country (9.9 to 11.5% of successful CPR)^{7,8} contrasts with the exemplary rates obtained in Madrid (33 to 54.4%)^{3,4}.

Studies performed in the United States between 2005 and 2010 covering 31,689 events of PHCA report successful results in 27.4% (95% CI 26.9-27.9), significantly higher than the global rate found in the present study, and despite a lower proportion of initial shockable arrhythmias in US patients of 23.7% (95% CI 23.2-24.2).

A striking finding was the low proportion of patients with VF/PVT reported in some of the studies analyzed⁸, since the rest of the literature reports that VF/PVT was found in more than 25% of patients. This finding supports the need for prompt CPR: the later it is performed, the lower the probability of finding the patient with a shockable heart rhythm. This is a particularly important considering that electrical therapy applied to PHCA patients with VF/PVT achieves successful resuscitation in approximately 50% of these events.

Early bystander CPR is the second essential link in the chain of survival. CPR is most effective when started immediately after loss of consciousness in PHCA victims. It must be performed without waiting for the arrival of the EMS. The rate of bystander attempts at resuscitation varies greatly (from 2 to 37%), but globally it is estimated at 29.7% of cases, which is an improvement over

the 12.5% achieved in national series before 1999¹. This still contrasts with the rate of American bystander intervention (32.9%, 95% CI 32.4-33.4)¹⁴.

The rates of PHCA survival including hospital discharge have not been reported in most of the studies analyzed, nor the presence and degree of neurological sequelae. And when reported, different units of measurement (from hours to days) hinder overall comparison.

Although epidemiological estimates in the present work can serve as references to determine the current status of the problem and make comparisons between regional communities, the results must be treated with caution: unfortunately, very few Spanish studies address PHCA survival and the presentation of detailed data differs considerably, despite the fact that the Utstein style¹⁵ system of data recording is well established. The information offered often fails to distinguish between events according to etiology (cardiac or non-cardiac events) as specified in the Utstein style system, nor between adult and pediatric patients. In addition, low survival rates in EHCA patients initially attended by BLS teams, without authority to decide when not to start CPR maneuvers, can be partially explained by the fact that attempts at resuscitation may be futile or unlikely to benefit certain cases, but must be carried out anyway. This may introduce a negative bias in

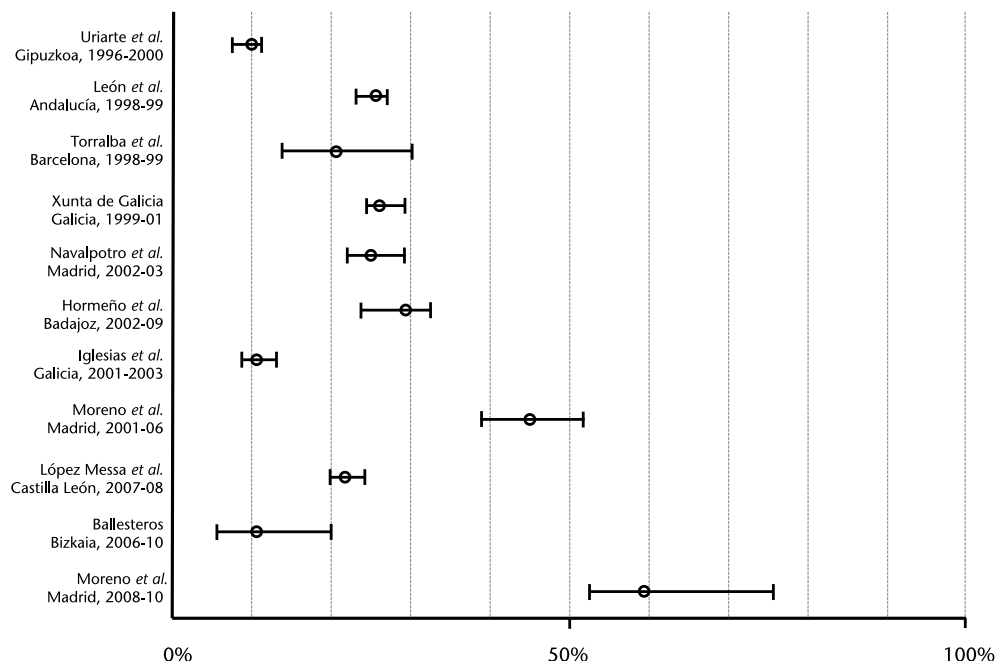


Figure 2. Proportion of patients admitted alive to the hospital emergency department after pre-hospital cardiopulmonary arrest (95% confidence intervals in brackets).

the proportion of patients successfully resuscitated and results in significantly lower rates. Furthermore, the Utstein style templates do not take this in-

to account, and the same problem may have affected the results of many studies conducted so far.

Table 1. Spanish references and main results used in the present analysis (exclusively pediatric population studies excluded)

Author, place and period	N° PHCA attended	N° CPR attempted	Non-cardiac etiology N % (95% CI)	VF/PVT N % (95% CI)	VF/PVT recovery N % (95% CI)	Bystander CPR N % (95% CI)	Response time (mean. mins) ¹	Restitutio ad integrum N % (95% CI)
Uriarte et al. ⁷ Gipuzkoa, 1996-2000	-	1248	-	-	-	-	-	34 2.7 (1.9-3.8)
León et al. ¹² Andalucía, 1998-99	-	1950	-	-	-	-	-	-
Torralba et al. ⁹ Barcelona, 1998-99	-	112	-	-	-	11.9% ²	7:34	23.2% ^{b,c}
Xunta de Galicia ⁶ Galicia, 1999-2001	-	973	-	315 32.4 (29.4-35.4)	-	283 29 (26.2-32)	-	-
Navalpotro et al. ¹³ Madrid, 2002-03	821	582	33 5.7 (3.9-7.9)	155 26.6 (23.1-30.4)	60 40.3 (32.3-48.6)	211 36.8 (32.8-40.9)	-	-
Hormeño et al. ¹⁰ Badajoz, 2002-09	651	359	42 11.7 (8.6-15.5)	102 28.4 (23.8-33.4)	57 55.9 (45.7-65.7)	50 14.5 (11-18.7)	6:00 (Me)	-
Iglesias et al. ⁵ Galicia, 2001-2003	971	971	-	302 31.1 (28.2-34.1)	169 56 (50.2-61.6)	340 35 (32-38.1)	10:08	-
Moreno et al. ³ Madrid, 2001-06	-	233	-	127 54.5 (47.9-61)	-	-	7:54	27 ^d 11.6 (7.8-16.4)
López Messa et al. ¹¹ Castilla y León, 2007-08	-	1286	0	197 15.3 (13.4-17.4)	92 46.7 (39.6-53.9)	-	11:42 (Me)	-
Ballesteros ⁸ Bizkaia, 2006-10	105	87	10 11.5 (5.6-20.1)	13 14.9 (8.2-24.2)	5 38.5 (13.9-68.4)	2 2.3 (0.3-8)	8:00 (Me)	-
Moreno et al. ⁴ Madrid, 2008-10	-	288	-	95 33 (27.6-38.7)	-	-	7:25 (Me)	62 ^e 21.5 (16.9-26.7)

PHCA: prehospital cardiac arrest; VF / PVT: ventricular fibrillation/pulseless ventricular tachycardia, CI: Confidence interval; CPR: cardiopulmonary resuscitation. ¹Response time from call-out to arrival on the scene. ²Absolute values unavailable. ³Survival at 24 hours of hospital admission. ⁴Survival at 7 days of hospital admission. -: No data.

From the results obtained in the present study, it can be concluded that the effectiveness of national EMS in attending PHCA is generally low, although large geographical variability was found. They also highlight the need for improved strategies to reduce delays in early defibrillation and the teaching of basic CPR maneuvers to citizens and non-medical first responders.

Finally, in view of the dearth of research papers that address the issues presented here and the methodological limitations detected, it seems reasonable to stress the need to promote research on the topic of PHCA in our environment, complying with the requirements established by the Utstein style system.

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Supervivencia extrahospitalaria tras una parada cardiorrespiratoria en España: una revisión de la literatura

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Se revisan los estudios españoles publicados sobre la atención a las paradas cardiorrespiratorias extrahospitalarias (PCR-EH) para comparar los resultados de supervivencia inmediata y estimar la prevalencia de arritmias desfibrilables y de los intentos de reanimación cardiopulmonar (RCP) realizados antes de la llegada del primer recurso asistencial. En primer lugar, se realizó una revisión sobre la producción española de trabajos relacionados con la evaluación de la asistencia a la PCR-EH publicados entre 1999 y 2011. Se extrajeron datos numéricos referidos al número de eventos asistidos, ritmos de inicio, pacientes con recuperación de la circulación *in situ* y supervivientes al alta hospitalaria, RCP practicadas antes de la llegada del equipo asistencial e intervalos de respuesta de éste. Posteriormente se estimaron sus frecuencias relativas y se compararon entre sí. Se seleccionaron 11 estudios observacionales pertinentes, de los que se desprendieron proporciones de éxito en las maniobras de RCP que oscilaron entre el 9,9 y el 59,4%. Presentaron fibrilación ventricular como ritmo de inicio entre el 14,9 y el 54,5% de los pacientes y se practicó RCP previa a la llegada de la unidad de emergencias entre el 2,3 y el 36,8% de las situaciones. La suma de pacientes asistidos y considerados para RCP descritos en la bibliografía revisada asciende a 8.089 e ingresan con vida en el hospital el 22,4% (IC95% 21,5-23,4). Concluimos que la efectividad de los servicios de emergencias españoles en la atención a la PCR-EH, si bien presenta una enorme variabilidad geográfica, es baja. Por tanto, será preciso elaborar o mejorar estrategias orientadas a disminuir los tiempos hasta la desfibrilación precoz y a enseñar las maniobras básicas de RCP a la población. [Emergencias 2013;25:137-142]

Palabras clave: Paro cardíaco extrahospitalario. Resucitación cardiopulmonar. Servicios médicos de urgencia. Fibrilación ventricular. Desfibriladores. Supervivencia.