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Original article

In-hospital Pediatric Cardiac Arrest in Spain

Jesús López-Herce,[a,*] Jimena del Castillo,[a] Sonia Cañadas,[b] Antonio Rodríguez-Núñez,[c] Angel Carrillo[a] and the Spanish Study Group of Cardiopulmonary Arrest in Children[◇]

[a] Servicio de Cuidados Intensivos Pediátricos, Hospital General Universitario Gregorio Marañón, Universidad Complutense de Madrid, Instituto de Investigación del Hospital General Universitario Gregorio Marañón, Madrid, Spain
[b] Sección de Cuidados Intensivos Pediátricos, Hospital Vall d'Hebron, Barcelona, Spain
[c] Servicio de Cuidados Intensivos Pediátricos y Urgencias, Hospital Clínico Universitario de Santiago, Santiago de Compostela, A Coruña, Spain

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ABSTRACT

Introduction and objectives: The objective was to analyze the characteristics and prognostic factors of in-hospital pediatric cardiac arrest in Spain.
Methods: A prospective observational study was performed to examine in-hospital pediatric cardiac arrest. Two hundred children were studied, aged between 1 month and 18 years, with in-hospital cardiac arrest. Univariate and multivariate logistic regression analyses were performed to assess the influence of each factor on survival to hospital discharge.
Results: Return of spontaneous circulation was achieved in 74% of the patients and 41% survived to hospital discharge. The survival rate was significantly higher than that reported in a previous Spanish study 10 years earlier (25.9%). In the univariate analysis, the factors related to mortality were body weight higher than 10 kg; continuous infusion of vasoactive drugs prior to cardiac arrest; sepsis and neurological disorders as causes of cardiac arrest, the need for treatment with adrenaline, bicarbonate, and volume expansion, and prolonged cardiopulmonary resuscitation. In the multivariate analysis, the factors related to mortality were hematologic/oncologic diseases, continuous infusion of vasoactive drugs prior to cardiac arrest, cardiopulmonary resuscitation for more than 20 min, and treatment with bicarbonate and volume expansion.
Conclusions: Survival after in-hospital cardiac arrest in children has significantly improved in recent years. The factors related to in-hospital mortality were hematologic/oncologic diseases, continuous infusion of vasoactive drugs prior to cardiac arrest, the duration of cardiopulmonary resuscitation, and treatment with bicarbonate and volume expansion.

Parada cardiaca pediátrica intrahospitalaria en España

Palabras clave:
Parada cardiaca
Reanimación cardiopulmonar
Reanimación
Niños

RESUMEN

Introducción y objetivos: Analizar las características y los factores pronósticos de la parada cardiaca intrahospitalaria en España.
Métodos: Se realizó un estudio prospectivo observacional en el que se incluyó a 200 niños, de edades entre 1 mes y 18 años, con parada cardiaca intrahospitalaria. Se realizó un estudio univariable y multivariable para analizar la influencia de los factores en la supervivencia al alta del hospital.
Resultados: En un 74% de los pacientes se logró la recuperación de la circulación espontánea y el 41% sobrevivía al alta del hospital. La supervivencia fue mayor que la del estudio realizado 10 años antes (25,9%). En el estudio univariable, los factores relacionados con la mortalidad fueron el peso superior a 10 kg, el tratamiento con fármacos vasoactivos en perfusión continua antes de la parada, la sepsis y la enfermedad neurológica como causas de la parada cardiaca, la necesidad de tratamiento con adrenalina, bicarbonato y expansión de volumen, y un tiempo de reanimación cardiopulmonar largo. En el estudio multivariable, los antecedentes hematooncológicos, el tratamiento previo con fármacos vasoactivos, la duración de la reanimación cardiopulmonar superior a 20 min, el tratamiento con bicarbonato y la expansión de fluidos fueron los factores relacionados con la mortalidad.
Conclusiones: La supervivencia a la parada cardiaca intrahospitalaria en la infancia ha mejorado significativamente en los últimos años. Las enfermedades hematooncológicas, el tratamiento previo con fármacos vasoactivos, la duración de la reanimación cardiopulmonar y el tratamiento con bicarbonato y expansión de líquidos son los factores asociados con la mortalidad al alta hospitalaria.

* Corresponding author: Servicio de Cuidados Intensivos Pediátricos, Hospital General Universitario Gregorio Marañón, Dr. Castelo 47, 28009 Madrid, Spain.
E-mail address: pielvi@hotmail.com (J. López-Herce).
◇ A list of the researchers participating in the Spanish Study Group for Cardiopulmonary Arrest in Children is provided in the Appendix.

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Abbreviations

CA: cardiac arrest
CPR: cardiopulmonary resuscitation
PCPC: pediatric cerebral performance category

INTRODUCTION

In-hospital cardiac arrest (CA) is an important cause of death in children.[1–14] Every 5 years, the International Liaison Committee on Resuscitation updates the recommendations for cardiopulmonary resuscitation (CPR), but the effect of this technique on survival has not been clearly demonstrated.[15–17] A number of studies have analyzed the causes and prognostic factors of in-hospital CA in children and have found that survival after CA varies depending on where the event took place, the underlying disease, the initial electrocardiographic rhythm, and the duration of CPR.[18] However, there are few prospective studies that include a sufficiently large number of patients and have been carried out following the guidelines for Utstein style reporting,[5–11] and there are no studies that analyze the changes in survival after CA in children in a single country.

The main objective of this study was to analyze the prognostic factors that influence mortality associated with in-hospital CA in children in Spain and evaluate the outcomes of CPR since the application of the 2005 recommendations, comparing them with those of a Spanish study carried out 10 years earlier.

METHODS

We performed an observational multicenter study based on an international prospective registry of in-hospital CA in children.[19]

The study was approved by the local ethics and research committee, and the data were collected according to the international guidelines for Utstein style reporting.[20,21] The study population included children ranging in age from 1 month to 18 years who had experienced a CA during a hospital stay between December 2007 and December 2009 in 24 hospitals in 11 Spanish autonomous communities. CA was defined as the absence of a response to stimuli, apnea, the absence of signs of circulation and of palpable central pulse, or bradycardia (heart rate less than 60 bpm) accompanied by poor perfusion in infants that required external cardiac massage and ventilation.

The following variables were recorded: age, sex, body weight, cause of CA, previous history of CA, personal and family history, previous neurological status according to the pediatric cerebral performance category (PCPC), previous functional status according to the Pediatric Overall Performance Category, type of CA, area of the hospital in which the CA took place, variables monitored, assisted ventilation, vasoactive drugs, time to initiation of CPR, initial electrocardiographic rhythm, CPR maneuvers applied, duration of CPR, and in-hospital course. The variables were defined in accordance the guidelines for Utstein style reporting.[20,21]

The findings were compared with those for in-hospital CA from the database of a previous Spanish study performed 10 years earlier.[3]

The statistical analysis was carried out using version 18.1 of the SPSS software package (SPSS Inc.; Chicago, Illinois, United States) and Stata. Comparisons of the results between different groups of patients and of the findings in the present study with those of the previous report were performed using the chi-square test or Fisher's exact test. Univariate logistic regression analysis was carried out and, to evaluate the influence of each factor on hospital mortality, we built a multivariate logistic regression model that included all the variables that reached statistical significance ($P<.15$) in the univariate analysis. A P value less than .05 was considered to indicate statistical significance.

RESULTS

We studied 200 patients with in-hospital CA (54% boys). Return of spontaneous circulation was achieved in 74% of the patients; in another 7 patients (3.5%) without restoration of spontaneous circulation, recovery was achieved with extracorporeal membrane oxygenation. In all, 41% of the patients survived to hospital discharge; 5 of the 7 patients resuscitated by means of extracorporeal membrane oxygenation survived to discharge, although 3 subsequently died. Overall, 77.9% of the survivors had a good neurological outcome (PCPC of 1 or 2). The Figure illustrates the course and outcomes in this patient population.

Patient Characteristics and Clinical Status Prior to Cardiac Arrest

Table 1 shows the patient characteristics and the results of univariate survival analysis.

The mean age was 47.5 months (range, 1-207 months) and the mean body weight, 16.2 kg (range, 2-93 kg). There were no differences in mortality related to age or sex. The mortality rate was lower among children weighing less than 10 kg than among those whose weight was 10 kg or over.

In all, 79.5% of the patients had underlying diseases. The mortality rate was lower in children with a history of heart disease and was higher in those with oncological diseases.

In 76.5% of the patients, the available data included functional and neurological status prior to CA, assessed using the pediatric overall performance category and PCPC scores, and 94.8% of them had good neurological status (PCPC score of 1 or 2). Mortality in the 8 patients with severe neurological disorders (previous PCPC greater than 2) was 100%, significantly higher than that of the remainder of the patient population.

In all, 11% of the patients had experienced CA previously. The mortality rate among these children was somewhat higher than that among the patients who had not, but this difference was not significant.

At the time of CA, 94.3% of the patients were being monitored, 92.9% required mechanical ventilation, and 64.6% were receiving vasoactive drugs. The mortality rate was significantly higher among the children receiving vasoactive agents.

Characteristics of Cardiac Arrest and Cardiopulmonary Resuscitation

Table 2 summarizes the univariate analysis of the relationship between the characteristics of CA and CPR and mortality.

Cardiac and respiratory diseases were the main causes of CA. However, the mortality rate was significantly higher among the patients with neurological disorders and sepsis.

The majority of CA episodes took place in the pediatric intensive care unit. The mortality rate associated with CA that occurred in the emergency department was higher than that recorded for any other area of the hospital, although the differences were not statistically significant.

There were no differences in mortality between episodes that began as respiratory arrests and those presenting as CA.