ELSEVIER

Resuscitation 64 (2005) 79–85

RESUSCITATION

www.elsevier.com/locate/resuscitation

Long-term outcome of paediatric cardiorespiratory arrest in Spain☆

Jesús López-Herce, Cristina García, Antonio Rodríguez-Núñez*, Pedro Domínguez, Angel Carrillo, Custodio Calvo, Miguel Angel Delgado

for the Spanish Study Group of Cardiopulmonary Arrest in Children[1]

Servicio de Críticos y Urgencias Pediátricas, Hospital Clínico Universitario de Santiago de Compostela, Santiago de Compostela, Spain

Received 22 April 2004; received in revised form 23 June 2004; accepted 12 July 2004

Abstract

Objective: To analyse the final outcome of cardiorespiratory arrest (CRA) in children and the neurological and functional state of survivors at 1 year.

Methods: An 18-month prospective, multicentre study analysing out-of-hospital and in-hospital CRA in children was carried out; 283 children between 7 days and 17 years of age were included. CRA and resuscitation data were registered according to Utstein style. The outcome variables were: sustained return of spontaneous circulation (initial survival), and survival at 1 year (final survival). The status of survivors was evaluated by means of the paediatric cerebral performance category (PCPC) scale and the paediatric overall performance category (POPC) scale at Paediatric Intensive Care Unit discharge, at hospital discharge, and at 1 year follow-up.

Results: In 283 children, 311 CRA episodes, 73 respiratory arrests (23.5%) and 238 cardiac arrests (76.5%) were analysed. Seventeen children suffered more than one CRA episode (range: 2–6). The initial survival was 60.2% and 1-year survival was 33.2%. The final survival was significantly higher in respiratory arrest than in cardiac arrest patients (70.0% versus 21.1%) ($P < 0.0001$). After 1 year follow-up, 87.3% of patients had scores 1 or 2 on the PCPC scale and 84.0% had scores 1 or 2 in the POPC scale; these results indicate that 1 year after CRA, the majority of survivors had normal neurological and functional status or showed only mild disability.

Conclusions: Prognosis of CRA in children continues to be poor in terms of survival but quite good in terms of neurological and functional status among survivors. Additional strategies and efforts are needed to improve the short-term prognosis of paediatric CRA. However, the long-term outcome of survivors is reassuring.

Keywords: Child; Cardiac arrest; Respiratory arrest; Resuscitation; Cardiopulmonary resuscitation; Outcome

☆ A Spanish and Portuguese translated version of the Abstract and Keywords of this article appears at 10.1016/j.resuscitation.2004.07.010.

* Corresponding author. Tel.: +34 981 950596; fax: +34 981 950596.
E-mail address: antonio.rodriguez.nunez@sergas.es (A. Rodríguez-Núñez).

[1]Collaborators in the work: Jesús López-Herce, Cristina García, Angel Carrillo (Hospital Gregorio Marañón, Madrid), Pedro Domínguez (Hospital Valle de Hebrón, Barcelona), Maria A. García (Hospital del Niño Jesús, Madrid), Custodio Calvo (Hospital Materno Infantil, Málaga), Miguel A. Delgado (Hospital Infantil La Paz, Madrid), Antonio Rodríguez-Núñez (Hospital Clínico Universitario, Santiago), Jose A. Alonso (Hospital Virgen de la Salud, Toledo), Julio Melendo (Hospital Miguel Servet, Zaragoza), Corsino Rey (Hospital Central de Asturias, Oviedo), Teresa Hermana (Hospital de Cruces, Baracaldo), Josefina Cano (Hospital Virgen del Rocío, Sevilla), Francisco Romero (Servicio de Urgencias 061, Jaén), Servando Pantoja (Hospital Puerta del Mar, Cádiz), Carlos Lucena (061 de Almería), Pere Plaja (Hospital de Palamós, Gerona), Ana Concheiro (Hospital San Juan de Dios, Barcelona), Alvaro Díaz (Hospital de Tarrasa, Barcelona), Ricardo Martino (Hospital Príncipe de Asturias, Alcalá de Henares), Maria V. Esteban (Hospital Princesa de España, Jaén), Nieves de Lucas (SAMUR, Madrid), Esther Ocete (Hospital Clínico de Granada), Juan I. Muñoz (Hospital Reina Sofía, Córdoba), Maria A. Rodríguez (Hospital Comarcal da Barbanza, Coruña), Susana Simó (Servicio de Urgencias 061, Barcelona), Eduard Solé (Hospital Arnaú de Villanova, Lérida), Enrio Jiménez (Hospital del Mar, Barcelona), Rosario Alvarez (Hospital de Jarrio, Asturias), Víctor Canduela (Hospital de Laredo, Cantabria), Antonio Fernández (Hospital San Agustín, Linares), Amelia Sánchez-Galindo (Hospital Juan Canalejo, La Coruña), R. Closa (Hospital Juan XXIII, Barcelona), P. Villalobos (Hospital de Figueras, Gerona), Orenci Urraca (Hospital Nens, Barcelona), Federico Pérez (Hospital Josep Trueta, Gerona), Antonio Torres (Hospital San Juan de Dios, Úbeda), Miguel Labay (Hospital Obispo Polanco, Teruel), Ma Luisa Masiques (Hospital de Mollet, Barcelona), Fátima Aborto (Hospital Juan Ramón Jiménez, Huelva), Narcisa Palomino (Hospital Ciudad de Jaén, Jaén), Abadía, Hospital de la Selva, Gerona), Monserrat Miquel (Hospital San Celoni, Barcelona), Antonio Gómez Calzado (Hospital Virgen Macarena, Sevilla), Jose M Bellón and Maria La Calle (Gregorio Marañón Hospital, statistical data analysis).

0300-9572/$ – see front matter © 2004 Elsevier Ireland Ltd. All rights reserved.
doi:10.1016/j.resuscitation.2004.07.010

1. Introduction

Cardiorespiratory arrest (CRA) mortality remains very high both in adults [1–5] and children [6–10]. Besides the mortality, short- and long-term morbidity, and specifically, neuro-psychological status of patients after resuscitation, is a main concern. Some studies, restricted to adult patients, have assessed the long-term prognosis after CRA [2,11], the neuropsychological disabilities and the quality of life of survivors [12]. There are few studies including a significant number of subjects that have analysed the survival of children who experienced CRA [9,10]. Until to the present some retrospective investigations have been done to assess the long-term neurological outcome of resuscitated children [13–18], but only one prospective work that evaluated the long-term prognosis and sequelae of paediatric in-hospital CRA, in a single centre, is available [9].

We have carried out a prospective and multicentre study to know the current characteristics of paediatric CRA in Spain [19]. In this study, we report the long-term outcome of the survivors with special focus on the final cerebral and general performance status.

2. Patients and methods

An invitation to participate was sent to all the Paediatric Intensive Care Units (PICU), Paediatric Departments and out-of-hospital Emergency Medical Systems in Spain [20]. A protocol was drawn up in accordance with the Utstein style guidelines [21,22]. Patients aged from 7 days to 18 years were eligible for the study if they had presented with respiratory arrest (RA), defined as the absence of respiration requiring assisted ventilation, or cardiac arrest (CA), defined as the absence of a palpable central pulse, unresponsiveness and apnoea or severe bradycardia of less than 60 bpm with poor perfusion in infants requiring external cardiac compressions and assisted ventilation [21,22]. Patients both with out-of-hospital and in-hospital cardiorespiratory arrest were included. Neonates admitted to Neonatal Intensive Care Units were excluded.

The survivors were evaluated on discharge from the PICU, at hospital discharge, and at 1 year. The cerebral status was assessed by means of the Glasgow–Pittsburg (PCPC) score (Table 1) and general status by means of the Overall Performance Categories (POPC) scale (Table 2), a six-point scale comprising the following categories: 1 = normal or good; 2 = mild disability; 3 = moderate disability; 4 = severe disability; 5 = coma or vegetative state; 6 = brain dead [21–23]. The statistical study was performed using the version 9 of the SPSS software statistical program.

3. Results

From 1 April 1998 to 30 September 1999 we collected 311 CRA episodes, 73 respiratory arrest (23.5%) and 238 cardiac arrest (76.5%), that occurred in 283 children, with a mean age of 48 ± 54.4 months (range: 7 days to 17 years). Seventeen children (7.1%) suffered more than one CRA episode (range: 2–6).

3.1. Short-term outcome

Return of spontaneous circulation (ROSC) was achieved in 193 children (68.2%). ROSC was not sustained in 22 (7.8%) and sustained in 171 (60.4%). In 68 children spontaneous ventilation was restored (Fig. 1).

In the assessment of the neurological status at the end of cardiopulmonary resuscitation (CPR), 8.2% of the patients were alert or responded to voice, 10.6%, reacted to tactile stimulation, 34.0% did not respond but were pharmacologically sedated, and 48.6% were unresponsive to painful stimulus without being sedated.

A total of 189 patients died (66.7%), 112 patients (39.5%) died in the initial episode and 77 (27.2%) died later (33 in first 24 h after CRA, 23 between 1 and 7 days, 17 in hospital after 7 days, and 4 after hospital discharge) (Fig. 1). Mortality was significantly lower in RA than in CA after the initial episode (12.3% versus 45.0%) as well as at 1 year (final mortality) (27.3% versus 79.9%) ($P < 0.0001$). The main cause of death was unresponsiveness to initial attempts of CPR in

Table 1
Paediatric cerebral performance category (PCPC) scale

Scale	Category	Description
1	Normal	Normal: at age-appropriate level; school-age child attending regular school classroom
2	Mild disability	Conscious, alert, and able to interact at age-appropriate level; school-age child attending regular school classroom but grade perhaps not appropriate for age; possibility of mild neurological deficit (eg. seizure disorder)
3	Moderate disability	Conscious; appropriate functioning below age; neurological disease that is not controlled and severely limits activities; sufficient cerebral function for age-appropriate independent activities of daily life; school-age child attending special education classroom and/or learning deficit present
4	Severe disability	Conscious; dependent on others for daily support because of impaired brain function; school-age child may be so impaired as to unable to attend school
5	Coma or vegetative state	Any degree of coma without the presence of all brain death criteria unawareness, even if awake in appearance, with out interaction with environment; cerebral unresponsiveness and no evidence of cortex function (not roused by verbal stimuli); possibility of some reflexive responsive, spontaneous eye-opening, and sleep-wake cycles
6	Brain death	Apnoec, areflexic, and/or electroencephalographic silence

Table 2
Paediatric overall performance category (POPC) scale

Scale	Category	Description
1	Good	PCPC normal; normal age-appropriate activities; medical and physical problems do not interfere with normal activity
2	Mild disability	PCPC mild, minor chronic physical or other medical problems minor limitations present but are compatible with normal life; preschool-age child has physical disability consistent with future independent functioning an can perform more than 75% of age-appropriate activities of daily living
3	Moderate disability	PCPC moderate; limiting medical and physical conditions, preschool-age child cannot perform most-age-appropriate activities of daily living; school-age child can perform most activities of daily living but is physically disabled
4	Severe disability	PCPC severe; preschool-age child cannot perform most-age-appropriate activities of daily living: school-age child is dependent on others for most can activities of daily living
5	Coma or vegetative responsive	PCPC coma/vegetative state
6	Death	

112 patients (59.2%), brain death in 29 (15.3%), multiple organ failure in 32 (16.9%), unresponsiveness to repeated CPR attempts in 9 patients (4.7%), and decision not to start CPR in case of a new CRA episode in 7 (2.6%).

On discharge from the PICU and from the hospital, the neurological and performance status was assessed in 95 patients (97% of those discharged from hospital) (Tables 3 and 4). At that time 83–86% of survivors had normal functional and neurological status or showed only mild disability (scores 1 or 2 on both scales), and 13–16% of patients showed moderate or severe disability (scores 3–5 on both scales). Of the children who suffered RA, 88.0% had a good neurological and performance status or presented with mild disability at hospital discharge, versus 75.0% of CA patients.

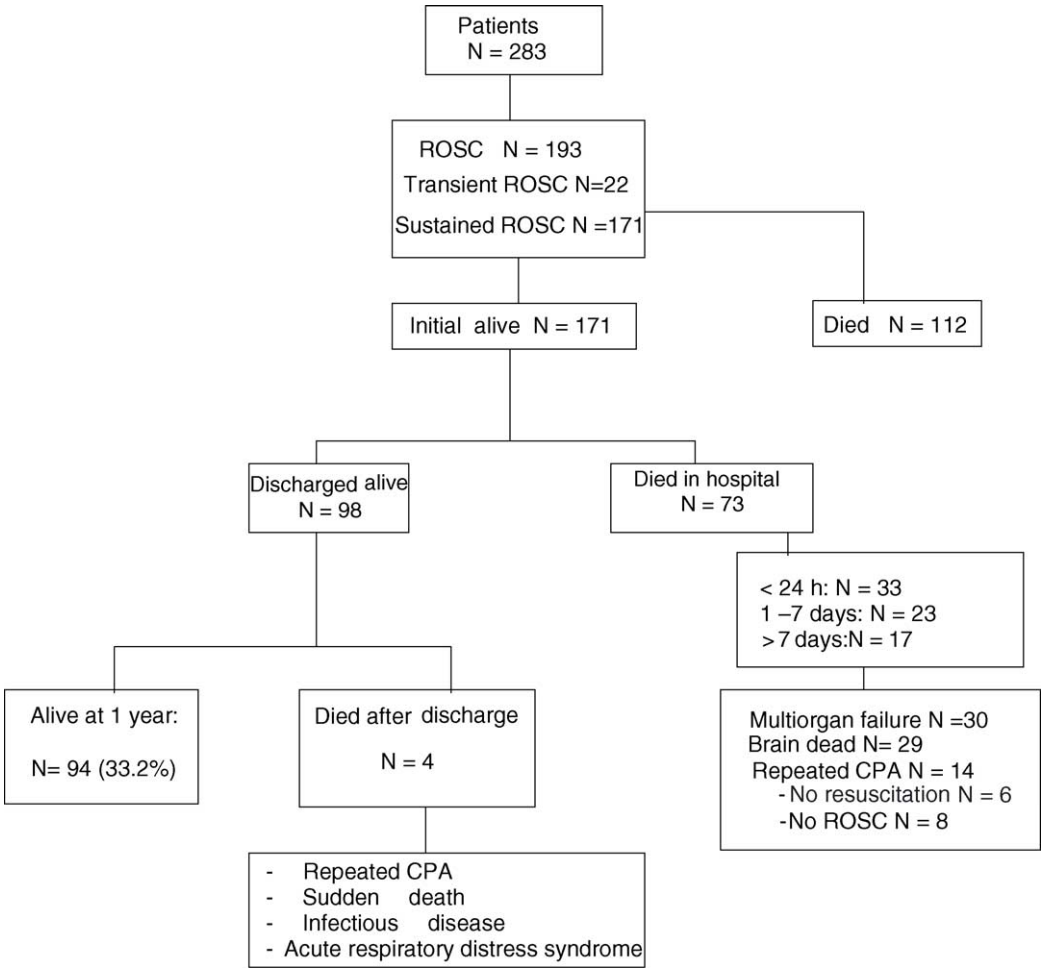

Fig. 1. Paediatric Utstein template for outcome of patients.

Table 3
PCPC scale at PICU discharge, hospital discharge and at 1 year

Score	PCPC at PICU discharge	PCPC at hospital discharge	PCPC at 1 year
	95 patients	95 patients	65 patients
1	73 (76.8%)	74 (77.8%)	54 (83.0%)
2	6 (6.3%)	5 (5.2%)	2 (3.0%)
3	5 (5.2%)	6 (6.3%)	4 (6.1%)
4	3 (3.1%)	3 (3.1%)	2 (3.0%)
5	8 (8.4%)	7 (7.3%)	3 (4.6%)

At hospital discharge, 5.9% of the RA children and 15.8% of CA children had severe neurological alterations (scores 4 or 5 on both PCPC and POPC scales).

Of the 16 patients with moderate-severe deficit at PICU discharge (PCPC scores 3–5), four had a previous severe encephalopathy that had not worsened after the CRA, and other five patients with mild-moderate disabilities (PCPC scores 2–3) had slight to moderate previous encephalopathy that did not change in three cases (Table 5).

3.2. Long-term outcome

During the year after hospital discharge four patients died. At hospital discharge these four patients were rated with PCPC and POPC level 1 in one case, with PCPC and POPC level 4 in another case, and with PCPC and POPC level 5 in two instances. At 1 year follow-up 94 patients (33.2%) were alive and data from 65 of patients were obtained (71.4%). Follow-up was lost in the 26 remaining (28.6%). At hospital discharge, the scores of lost patients were: PCPC and POPC level 1 in 22 cases; PCPC and POPC level 2 in two cases; PCPC and POPC level 5 in two cases.

At 1 year evaluation most of children analysed presented with a good neurological and performance status (86% were rated with scores 1 or 2 in the PCPC scale and 83% were rated with scores 1 or 2 in the POPC scale) (Tables 3 and 4). The 1 year score was unchanged in all the patients with scores 1 or 2 in both scales at hospital discharge.

No patient showed an impairment of functional or neurological status after hospital discharge. Only one patient in coma at PICU discharge (PCPC and POPC score 5) showed some recovery of the neurological status up to a score of 3 during the hospital stay, and to level 2 at the 1 year assessment. In the patients with pre-existing encephalopathy, no change in their previous status was detected (Table 5).

Table 4
POPC scale at PICU discharge, hospital discharge and at 1 year

Score	POPC at PICU discharge	POPC at hospital discharge	POPC at 1 year
	95 patients	95 patients	65 patients
1	72 (75.8%)	72 (75.8%)	52 (80.0%)
2	6 (6.3%)	6 (6.3%)	2 (3.0%)
3	4 (4.2%)	5 (5.2%)	6 (9.2%)
4	5 (5.2%)	5 (5.2%)	2 (3.0%)
5	8 (8.4%)	7 (7.3%)	3 (4.6%)

No correlation was found between neurological and performance status at 1 year follow-up and type of arrest, place of arrest, life support duration or immediate post-resuscitation neurological status.

4. Discussion

As far as we know, this is the first prospective multicentre study that analyses the long-term functional outcome of in-hospital and out-of-hospital CRA in children. Only one previously published study, done in a single centre, has analysed in-hospital paediatric CRA following the Utstein style, including long-term outcome aspects [9]. Survival of paediatric CRA has been dismal in most studies in the past; however, the crude long-term survival in this study has been 33%, a figure slightly higher than previously reported in other series [6,8–10,24,25].

In our study, follow-up of the survivors showed that patients who were discharged from the PICU had a low mortality during the following year. More importantly, even though PCPC and POPC scales do not have enough sensitivity to detect subtle neurological disabilities, the majority of survivors had a long-term good functional and neurological status with no or only mild disability. This status should permit the reintegration of patients and families to normal life and is encouraging in terms of the expected quality of life.

Survival without sequelae in our study was higher than the figures reported for adults [1,2] and was comparable with the results of other paediatric studies [9,15–17]. Final survival and neurological status at 1 year follow-up was better in children who had suffered a RA than in those who suffered a CA. It is remarkable that after the hospital discharge the changes in functional or neurological state were minimal (Fig. 2). No patient developed new sequelae and all maintained their scores over time, with the exception of a child who improved his neurological status slightly.

Our results are in concordance with those reported by Horisberger et al. in a retrospective study that included 52 children; in this series, four children died after hospital discharge, 54% of the survivors had normal neurological status,

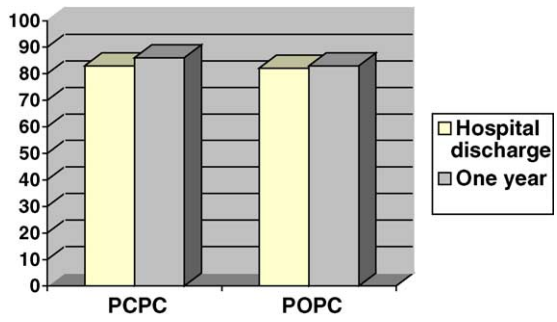

Fig. 2. Patients with PCPC and POPC scores 1 or 2 (normal or mild disability) at hospital discharge and at one year (values in percentages of patients analysed).

Table 5
Characteristics and evolution of children with moderate-severe disability

Age	Sex	Diagnosis	Site of arrest	Arrest	Life support total time (min)	Post-resuscitation neurological status	PCPC previous	PCPC PICU	PCPC hospital	PCPC 1 year	Evolution
5 year	F	Respiratory failure	PICU	RA	<5	Sedated with drugs	1	3	3	3	Moderate disability
12 month	M	Preterm, hypoxic-ischaemic encephalopathy, broncho-pulmonary dysplasia	Primary health care	RA	20–29	Do not respond to stimulus	4	4	4	+	Dead one month after hospital discharge due to infection
4 year 6 month	F	Hurler's disease, aortic stenosis, pneumonia	PICU	CA	10–19	Do not respond to stimulus	4	4	4	4	
20 month	M	Foreign body airway obstruction	In-hospital	CA	20–29	Sedated with drugs	1	5	5	5	Persistent vegetative state
27 month	F	Severe cranial trauma (motor vehicle accident)	Out-of-hospital (road)	CA	10–19	Do not respond to stimulus	1	5	5	5	Persistent vegetative state
13 year	M	Polimalformative syndrome, moderate encephalopathy, pulmonary hypertension, difficult airway	PICU	CA	5–9	Sedated with drugs	3	3	3	3	Similar to the present prior to the arrest
7 month	F	Down's syndrome, congenital heart disease, respiratory obstruction	PICU	CA	30–60	Sedated with drugs	3	4	4	4	Hypertonia, seizures, few external contact
14 month	M	Intractable diarrhoea, severe malnutrition	PICU	RA	10–19	Sedated with drugs	2–3	5	5	+	Vegetative state; sudden death 15 days after hospital discharge
6 year	M	Drowning	Out-of-hospital (pool)	CA	30–60	Sedated with drugs	1	5	5	5	Persistent vegetative state
5 year	M	Holoprosencephaly, severe psychomotor delay, ventriculo-peritoneal shunt malfunction	In-hospital	RA	10–19	Do not respond to stimulus	5	5	5	–	Persistent vegetative state
12 year	F	Long QT syndrome, drowing	Out-of-hospital (swimming pool)	CA	10–19	Response to tactile stimulus	1				
12 year	M	Severe aortic stenosis and syncope, VF after physical activity	Out-of hospital (school)	CA	20–30	Response to tactile stimulus	1	5	3	3	Behaviour problems, hypertonia, hyperreflexia, clonus, dysmetria, tremor, problems for reading and writing
14 year	M	Severe neonatal anoxic encephalopaty (persistent vegetative state and spastic tetraparesis), respiratory infection	In-hospital	CA	<5	Sedated with drugs	5	5	5	–	Similar to the present prior to the arrest
11 year	M	Fragile X syndrome, respiratory arrest after seizure	PICU	RA	<5	Sedated with drugs	3	3	3	3	Without sequelae
6 year	F	Cerebral palsy, respiratory arrest after seizure	PICU	RA	30–60	Sedated with drugs	3	3	3		Similar to the present prior to the arrest and disartria
16 year	M	Cystic fibrosis, cardiac arrest during lung transplant	In hospital (operating room)	CA	10–19	Sedated with drugs	1	3	3	2	Left hemiparesis and facial palsy

25% mild disability, 15% moderate disability, and 6.3% showed severe disability [16]. At 1-year assessment, 77% of the survivors had the same status as before to resuscitation and, as in our study, 1-year PCPC scores did not differ from status at hospital discharge [16]. The same finding has been reported in other retrospective paediatric studies that included fewer patients [13,17,18]. Shaffner et al. in an unpublished study of 86 survivors of cardiac arrest reported sequelae in 28% of children [15]; they reported that site of arrest, time elapsed from arrest to start of life support, duration of resuscitation, asystole as the initial rhythm, low Glasgow coma score at 24 h and PaO_2 less than 50 mmHg were the risk factors for neurological sequelae. In our sample, despite the fact that similar risk factors (out-of-hospital arrest, more than 8 min elapsed from arrest to resuscitation attempts, total duration of resuscitation longer than 20 min and asystole or slow initial rhythms) were associated with mortality [19], they were not clearly associated with long-term neurological status.

Suominen et al., in a retrospective study on 118 children with in-hospital CRA, reported an 1-year survival of 17%. Patients with respiratory arrest had a significantly higher survival (50%) than those with cardiac arrest (17.9%). When risk factors were analysed, duration of resuscitation was the only one associated with 1-year survival and with a good neurological prognosis [10]. Our results are in concordance and also showed that, in children, duration of resuscitation efforts is the main prognostic marker for 1-year survival [19]. Reis et al., in a prospective study, analysed the neurological outcome of 22 children who were alive after an in-hospital cardiorespiratory arrest; 83% of the 19 patients evaluated at 1-year had no demonstrable change from pre-CPR status in the cerebral performance category [9]. These results are similar to the reported by Horisberger et al. [16] and agree with the data of our study.

One limitation of our study was the loss of follow-up at 1 year of 28.6% of patients. This could introduce a significant bias in our results if a disproportionate number of children with bad outcomes were lost. However, this possibility can reasonably be ruled out having in mind that the vast majority of this group, 24 of 26 patients, had scores 1 or 2 in both assessment scales at hospital discharge. Besides, it is rare to lose the follow-up of disabled patients because generally they demand and need continued and multidisciplinary medical assistance. If the status of the patients who were lost was parallel to that of those finally assessed, the percentage of children with good functional status would be even higher.

We conclude that the mortality of CRA in children continues to be high, but the majority of survivors have a long-term normal or near-normal functional and neurological status. Although additional strategies and efforts seem to be needed to improve the short-term prognosis of paediatric CRA, the good long-term outcome of survivors should be a boost for life support teams. After hospital discharge, the changes in the functional and neurological status are minimal, and therefore, the long-term outcome can be anticipated and the families should be informed accordingly.

Acknowledgment

This study has been supported by a grant from the Fondo de Investigaciones Sanitarias 00/028.

References

[1] Andréasson A-Ch, Herlitz J, Bang A, et al. Characteristics and outcome among patients with a suspected in-hospital cardiac arrest. Resuscitation 1998;39:23–31.
[2] Fischer M, Fischer NJ, Schüttler J. One-year survival after out-of-hospital cardiac arrest in Bonn city: outcome report according to the "Utstein style". Resuscitation 1997;33:233–43.
[3] Kette F, Sbrojavacca R, Rellini G, et al. Epidemiology and survival rate of out-of-hospital cardiac arrest in north-east Italy: the F.A.C.S study. Resuscitation 1998;36:153–9.
[4] Tadel S, Horvat M, Noc M. Treatment of out-of-hospital cardiac arrest in Ljubljana: outcome report according to the "Utstein" style. Resuscitation 1998;38:169–76.
[5] Waalewijn RA, de Vos R, Koster RW. Out-of-hospital cardiac arrest in Amsterdam and its surrounding areas: results from the Amsterdam resuscitation study (ARREST) in Utstein style. Resuscitation 1998;38:157–67.
[6] Young KO, Seidel JS. Pediatric cardiopulmonary resuscitation: A collective review. Ann Emerg Med 1999;33:195–205.
[7] Sirbaugh PE, Pepe PE, Shook JE, et al. A prospective, population-based study of the demographics, epidemiology, management and outcome of out-of-hospital pediatric cardiopulmonary arrest. Ann Emerg Med 1999;33:174–84.
[8] Schindler MB, Bohn D, Cox PN, et al. Outcome of out-of-hospital cardiac or respiratory arrest in children. N Engl J Med 1996;335:1473–9.
[9] Reis AG, Nadkarni V, Perondi MB, Grisi S, Berg RA. A prospective investigation into the epidemiology of in-hospital pediatric cardiopulmonary resuscitation using the International Utstein reporting style. Pediatrics 2002;109:200–9.
[10] Suominen P, Olkkola KT, Voipio V, Korpela R, Palo R, Räsänan J. Utstein style reporting of in-hospital paediatric cardiopulmonary resuscitation. Resuscitation 2000;45:17–25.
[11] Parish DC, Dane FC, Montgomery M, Wynn LJ, Durham MD, Brown TD. Resuscitation in the hospital: relationship of year and rhythm to outcome. Resuscitation 2000;47:219–29.
[12] Pubwald G, Fertl E, Faltl M, Auff E. Neurological rehabilitation of severely disabled cardiac arrest survivors. Part II. Life situation of patients and families after treatment. Resuscitation 2000;47:241–8.
[13] Parra DA, Totapally BR, Zahn E, et al. Outcome of cardiopulmonary resuscitation in a pediatric cardiac intensive care unit. Crit Care Med 2000;28:3296–300.
[14] Gillis J, Dickson D, Rieder M, Steward D, Edmonds J. Results of inpatient pediatric resuscitation. Crit Care Med 1986;14:469–671.
[15] Shaffner RH, Nichols DG, Tchetgen M-B. Neurologic outcome of pediatric survivors of cardiac arrest. Crit Care Med 1999;27(Suppl 1):81.
[16] Horisberger T, Fischer JE, Fanconi S. One-year survival and neurological outcome after pediatric cardiopulmonary resuscitation. Intens Care Med 2002;28:365–8.
[17] Torres A, Pickert CB, Firestone J, Walker WM, Fiser DH. Long-term functional outcome of inpatient pediatric cardiopulmonary resuscitation. Pediatr Emerg Care 1997;13:369–73.
[18] Goetting MG, Paradis NA. High-dose epinephrine improves outcome from pediatric cardiac arrest. Ann Emerg Med 1991;20:22–6.
[19] López-Herce J, García C, Domínguez P, Carrillo A, Rodríguez-Núñez A, Calvo C, Angel Delgado M, the Spanish Study Group of Cardiopulmonary Arrest in Children. Characteristics and out-

come of cardiorespiratory arrest in children. Resuscitation, 2005; in press.
[20] López-Herce J, Domínguez P, Grupo Español de Reanimación cardiopulmonar pediátrica y neonatal. Estudio epidemiológico sobre la parada cardiorrespiratoria en la infancia. An Esp Pediatr 1998;48:332–3.
[21] Zaritsky A, Nadkarni V, Hazinski MF, et al. Recommended guidelines for uniform reporting of pediatric advanced life support: the pediatric Utstein style. Resuscitation 1995;30:95–115.
[22] Cummins R, Chamberlain D, Hazinski MF, Nadkarni V, Kloek W, Kramer E. Recommended guidelines for reviewing, reporting, and conducting research on in hospital resuscitation: the in-hospital "Utstein style". Resuscitation 1997;34:151–83.
[23] Fiser DH. Assessing the outcome of pediatric intensive care. J Pediatr 1992;121:68–74.
[24] Suominen P, Korpela R, Kuisma M, Silfvast T, Olkkola KT. Paediatric cardiac arrest and resuscitation provided by physician-staffed emergency care units. Acta Anesthesiol Scand 1997;41:260–5.
[25] Engdahl J, Axelsson A, Bäng A, Karlson BW, Herlitz J. The epidemiology of cardiac arrest in children and young adults. Resuscitation 2003;58:131–8.