

Original Article

The characteristics and evolution of extrahospitalary paediatric cardiac arrest in Galicia

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ABSTRACT

Background and aims: Cardiorespiratory arrest (CRA) is a rare event in childhood, and its characteristics are not well known. The aim of our present work was to assess the characteristics of paediatric CRA and the immediate results of cardiopulmonary resuscitation (CPR) in Galicia and to identify prognostic factors for survival.

Methods: All children aged from newborn to 16 years old who had suffered outpatient CRA and had been assisted by the Medical Emergencies of Galicia - 061 Public Foundation (Fundación Pública Urgencias Sanitarias en Galicia - 061, FPUS-061) between June 2002 and February 2006 were included in the study. Data were prospectively recorded according to the Utstein guidelines.

Results: The study population encompasses 31 cases of CRA (incidence rate: 3.4 CRA's per 100.000 children and year); 5 cases were respiratory in origin (16.1%) and 26 (83.9%) were cardiac. There were 18 cases of at-home CRA (58.1%). The CRA to CPR interval was less than 10 minutes in 10 cases (32.2%) and greater than 20 minutes in 9 (29.0%). The initial CPR was performed by a bystander in 7 cases (22.6%). The first recorded cardiac rhythm was asystolia in 21 cases (67.7%). Bag-and-mask ventilation was applied in 25 cases (80.6%), and 27 (87%) were intubated. A peripheral venous access was achieved in 21 cases (67.7%), and an intraosseous one in 5 (16.1%). Twenty-nine patients (93.5%) received adrenalin. Spontaneous circulatory recovery was recorded in 12 cases (38.7%), and 10 patients (32.2%) did not respond to CPR. Out of the 21 children who arrived at the hospital, 11 were dead on arrival (35.5%) and 10 (32.2%) were admitted. Among the latter, died while admitted (12.9%) and 6 survived until discharged (19.4%). No definite survival predictors could be identified.

Conclusions: The characteristics of paediatric CRA and the results of CPR in Galicia are similar to those reported from other areas and communities in our environment. Programs should be implemented to increase bystander CPR, to improve basic CPR skills among the general population and to update the life support training and skills among the health care personnel.

Key Words: Cardiac arrest. Cardiopulmonary resuscitation. Paediatrics. Outpatients. Management.

RESUMEN

Características y evolución de las paradas cardiorrespiratorias pediátricas extrahospitalarias en Galicia

Objtivos: Conocer las características de las paradas cardiorrespiratorias (PCR) pediátricas y los resultados de la reanimación cardiopulmonar (RCP) en Galicia e intentar identificar factores pronósticos de supervivencia.

Métodos: Se incluyeron todos los niños, con edades entre recién nacido y 16 años, que sufrieron una PCR extrahospitalaria en Galicia y fueron atendidos por el personal de la Fundación Pública Urgencias Sanitarias de Galicia-061 (FPUS-061), entre junio de 2002 y febrero de 2005. Los datos fueron recogidos de forma prospectiva siguiendo el estilo Utstein.

Resultados: 31 casos (incidencia: 3.4 PCR por 100.000 niños y año), de los cuales respiratoria en 5 (16,1%) y cardiaca en 26 (83,9%). PCR en domicilio en 18 (58,1%). Tiempo PCR-RCP inferior a 10 minutos en 10 (32,2%) y superior a 20 minutos en 9 (29,0%). En 7 (22,6%) se realizó RCP inicial por un testigo. El primer ritmo detectado asistolia en 21 (67,7%). 25 casos (80,6%) fueron ventilados con bolsa y mascarilla, y fueron intubados 27 (87%). En 21 ocasiones (67,7%) se consiguió una vía venosa periférica y en 5 (16,1%) una vía intraósea. 29 casos (93,5%) recibieron adrenalina. Recuperaron la circulación espontánea 12 pacientes (38,7%) y 10 (32,2%) no respondieron a las medidas de RCP. De los 21 niños que llegaron al hospital, 11 fallecieron antes de su ingreso (35,5%) y 10 (32,2%) fueron ingresados; de ellos, 4 fallecieron durante su estancia (12,9%) y 6 sobrevivieron al alta (19,4%). No se identificaron factores predictores de supervivencia.

Conclusiones: Las características de las PCR pediátricas y los resultados de la RCP en Galicia son comparables a las de otras áreas de nuestro entorno. Se deben llevar a cabo programas para incrementar la RCP testigos, mejorar la formación en RCP básica de la población general y actualizar los conocimientos del personal sanitario.

Palabras clave: Parada cardiaca. Reanimación cardiopulmonar. Pediatría. Extrahospitalario. Tratamiento.

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INTRODUCTION

Cardiorespiratory arrest is very rare among children and needs to be treated quickly and correctly to ensure that the patient recovers without developing any brain damage¹⁻⁷. Until recently, the statistics available on cardiorespiratory arrest characteristics and prognosis were retrospective and limited. In the last few years prospective studies have emerged which have improved our understanding of the characteristics of cardiac arrest and paediatric cardiopulmonary resuscitation (CPR) in Spain^{1,3} and in other countries in Europe^{4,7}.

The introduction of the Utstein style has improved the systematic recording of data related to cardiorespiratory arrest and CPR worldwide and has made it possible to compare results between different groups⁸. The study carried out by the Spanish Paediatric and Neonatal Cardiorespiratory Arrest Group (GERCPN) is ground breaking in this sense^{1,3}. However, cases were included in this study on a voluntary basis and therefore it cannot be considered a record of all cases of cardiorespiratory arrest that have occurred in Spain within a specific time period. Moreover, the cases included in that study experienced cardiorespiratory arrest between 1998 and 1999 when CPR training was scarce and there were no international paediatric life support guidelines.

Therefore, we have carried out this study with the aim of understanding the incidence and characteristics, of paediatric cardiorespiratory arrest and the immediate results of CPR in Galicia, a region with specific conditioning factors which include the geographically dispersed population. Our objective was to identify the factors that will allow prediction of survival for any given patient.

MATERIAL AND METHODS

All children from newborns to children aged 16 who had an out-of-hospital cardiorespiratory arrest and had been seen by the Emergency Medical Services in Galicia (Fundación Pública Urgencias Sanitarias en Galicia - 061, FPUS-061) between June 1st 2002 and January 31st 2005 were included in the study.

Cases involving a cardiorespiratory arrest that occurred before entering the hospital and were diagnosed and treated initially in the hospital emergency department were not included.

In Galicia, extrahospitalary emergency medical care is managed by the FPUS-061 Coordination Centre and is carried out by the Primary Medical Care teams, the ambulances that are part of the emergency medical transport network (RTSU)

and can be found throughout Galicia, and the local medically equipped ambulances in the main cities in Galicia, as well as two medically equipped helicopters that have bases in Santiago de Compostela and Orense. The Coordination Centre has 24 medical coordinators. There were 93 RTSU ambulances during the period of this study. These ambulances were equipped with one driver and one technician. Both were trained in basic CPR techniques and had passed a course for medical vehicle technicians that entailed 212 hours of training given by FPUS-061 staff. The medically equipped ambulances and helicopters have a team made up of drivers/ captains/ pilots, a co-pilot/technician, a doctor and a qualified nurse. There were 44 doctors and 43 qualified nurses. All doctors and nurses had passed at least one CPR (for adults) course and the paediatric and neonatal CPR course accredited by the Spanish Paediatric and Neonatal Cardiorespiratory Arrest Group.

The information related to the cardiorespiratory arrests and CPR procedures were recorded prospectively following the paediatric Utstein style criteria⁸⁻¹⁰.

Respiratory arrest was defined as the absence of breathing which required assisted ventilation when diagnosed. Cardiac arrest was defined as the inability to feel a central pulse, the absence of response, apnoea or severe bradycardia (less than 60 beats per minute accompanied by poor perfusion in infants), that required chest compressions (heart massage) and assisted ventilation^{1,3,8}.

The data recording sheet included the patient's variables (age, cause of cardiac arrest, history), variables related to the arrest and life support (type of arrest, place of the arrest, time elapsed between the cardiorespiratory arrest and CPR, who performed CPR, initial ECG-heart rhythm detected and the total duration of the CPR), and variables related to the prognosis (return of spontaneous circulation and survival until admission to hospital).

The qualitative variables are shown as an absolute value and percentage and the quantitative variables as means with the standard deviation. In order to compare the first variables we used Fisher's exact test and the Odds Ratio calculation with a confidence interval of 95%, and to compare the second variables the Student's-t test was used. Statistical significance was acknowledged if the value p was lower than 0.05 or the confidence interval of the Odds Ratio excluded the value 1.

The data used was from a general registry compiled by the FPUS-061 on all its services and these data are protected in accordance under the prevailing laws. The data were imaged anonymously making patient identification impossible. The FPUS-061 registry includes forms filled out by the physician and nurse in charge of each case one hand, and the corresponding file in electronic format.

TABLE 1. Procedures and treatments used during cardiopulmonary resuscitation

	n	%
Airways		
• Bag and mask ventilation	25	80.6
• Intubation	27	87.1
Venous access		
• Peripheral venous access	21	67.7
• Intraosseous access	5	16.1
• Intratracheal access	5	16.1
• Central venous access	3	9.7
• Umbilical access	1	3.2
Treatments		
• Adrenalin	29	93.5
– 1 dose	11	
– 2 doses	5	
– 3 doses	6	
– 4 or more doses	7	
• Atropine	17	54.8
• Bicarbonate	4	12.9
• Fluid therapy	10	32.2
• Neuromuscular relaxant/sedative	4	12.9

RESULTS

During the period studied, 31 children presence extrahospitalary cardiorespiratory arrest and these were included in the study. Since the population in Galicia is 2,732,926 inhabitants according to the 2002 census (317, 067 in the 0-14 years age group)¹¹, this represents an incidence of 3.4 cardiorespiratory arrests treated in an extrahospitalary setting per 100,000 children per year. Patient age ranged from newborn to 15 years of age (mean age 5 years). Five cases patients were under the age of 2, 15 patients (48.4%) were aged between 2 and 6 and 11 (35.5%) were older than 6.

The arrest was respiratory in 5 cases (16.1%) and cardiac in 26 cases (83.9%). The causes of the arrests were respiratory disease in 8 cases (25.8%), heart disease in 5 cases (16.1%), trauma in 5 cases (16.1%), drowning in 5 cases (16.1%), poisoning in 2 cases (6.4%) and 6 cases were caused by other miscellaneous factors (19.3%).

Cardiorespiratory arrest occurred in a public place in 13 of the cases (41.9%) and at home in 18 cases (58.1%). The estimated time between the arrest and the initiation of CPR was less than 4 minutes in 4 cases (12.9%), between 4 and 10 minutes in 6 cases (19.3%), between 10 and 20 minutes in 10 cases (32.2%) and over 20 minutes in 9 cases (29.0%).

CPR was performed by a bystander in 7 cases (22.6%). The initial treatment was carried out by a primary medical ca-

re centre in two cases (6.4%) and in another 2 (6.4%) it was performed by ambulance personnel continued by staff from the emergency medical service. In the remaining 27 cases (87.1%) initial treatment was carried out by staff in a medically equipped ambulance.

The heart rhythm detected when the victim was first examined was asystole in 21 cases (67.7%), whereas other heart rhythms were detected in the remaining 10 cases (32.3%). One case showed ventricular fibrillation and another showed ventricular tachycardia with a pulse.

The procedures performed during CPR are shown in Table 1. Defibrillation was carried out manually in one case (3.2%). Three of the 25 patients ventilated with a bag and mask were not intubated and 8 were intubated as the first measure of advanced airway management. Four patients were sedated with midazolam and three were also relaxed with vecuronium. Fluid therapy was administered using saline solution in 9 cases and an artificial plasma expander in 1 case.

After the initial CPR the recovery of spontaneous circulation (ROSC) was achieved for over 20 minutes in 12 cases (38.7%). CPR was performed on 9 children until admitted into hospital and in the 10 remaining cases (32.2%) there was no response to CPR. Of the 21 patients who arrived at the hospital (with spontaneous circulation or who maintained alive by CPR) 11 died in the emergency department before hospital admission (35.5%), while 10 (32.2%) were admitted to a paediatric ICU. Of these, 4 died during hospitalisation (12.9%) and 6 survived until discharge (19.4%) (Figure 1).

Tables 2 and 3 describe the results of a comparison of variables between the patients who died and those who survived. As shown, none of the variables were statistically associated with a better survival prognosis.

DISCUSSION

Cardiorespiratory arrest is a clinical event that requires immediate and continuous care to achieve the recovery of neurological function. This care should include a series of actions that are linked and which include resuscitation carried out by bystanders and post-resuscitation intensive care. These actions are known as the "chain of survival"¹². The prognosis for cardiorespiratory arrest is poor, both for adults and for children. Therefore, for several decades, many international and multidisciplinary initiatives have been promoted to improve the care to these victims provided by the general public as well as medical staff¹³.

Therefore, it is crucial to know the epidemiological factors and the results of CPR in specific scenarios where medi-

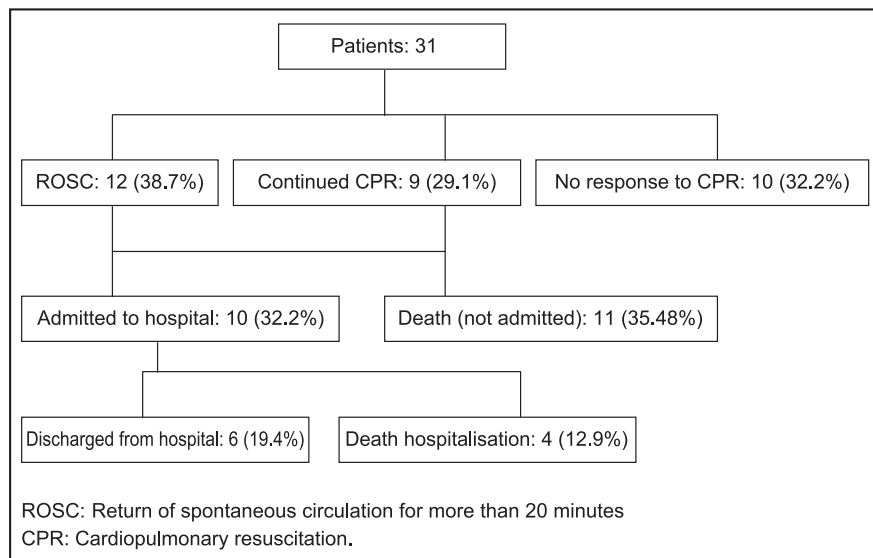


Figure 1. Patient outcome.

cal care is provided. This is the first study to prospectively collect every case of extrahospitalary paediatric cardiorespiratory arrest in Galicia during a specific period of time following the Utstein style guidelines for uniform data registration.

Our results may be compared to those obtained in a previous study carried out by GERCPN^{1,3} and other international studies^{6,7,9,10}.

The incidence of extrahospitalary cardiorespiratory arrest is not well known. Various studies from different areas have presented figures of between 1.6 and 19.7 cases a year per 100,000 children^{4,5,7,14}. The incidence in this study is within the low range of the values.

The place where cardiorespiratory arrest occurs may have an important effect on the prognosis since it may determine the amount of time that elapses before CPR is performed¹⁷. When compared with the GERCPN¹ study, almost twice as many cardiorespiratory arrests occurred at home in Galicia. This may be related to the amount of time between CPR and the cardiac arrest, since our study shows that only 32% (10) of cases received CPR during the first 10 minutes, while in the Spanish study it was 62%¹. An important aspect to take into consideration with regard to Galicia is the dispersion of the population. This is illustrated by the fact that Galicia is home to 6.7% of Spain's population and also has 51.6% of Spain's population nuclei¹¹. As a result of the population being scattered, a significant percentage of people are far from emergency medical services despite their large numbers and good distribution throughout the region.

The type of arrest is a clear prognostic factor, being much more favourable in the case of respiratory arrests^{1,3,7}. In our study 84% of cases involved cardiac arrests when CPR

was performed, which may indicate that medical care was delayed and it also highlights the importance of detecting the warning signs of cardiorespiratory arrest and early resuscitation by bystanders and medical staff^{15,16} in our study CPR was performed by bystanders in only 22.6% (7) of cases, a figure that is slightly higher than that found in the Spanish study¹, but lower than that of international studies⁷ (Table 4). Bearing in mind that CPR performed by bystanders is associated with an increased rate of survival⁷, be made to ensure that citizens know how to carry out basic CPR techniques and perform them immediately¹⁷. Therefore, we hope that the universal instructions for CPR (for children and adults), recommended in the new international CPR guidelines, will promote CPR performed by bystanders, regardless of the age of the victim¹⁵⁻¹⁸.

With regard to the initial rhythm detected during CPR, asystole is the most common in all studies (Table 4) because of the hypoxic mechanism of arrest in children and also, in part, because of the delay in receiving medical treatment⁷. On the other hand, ventricular fibrillation and ventricular tachycardia are heart rhythms that respond to electric treatment and were less common in our study compared with others (Table 2), although it could be speculated that the incidence could be higher if the time between cardiorespiratory arrest and monitoring were lower.

The clinical-epidemiological characteristics of the patients were analysed in accordance with the final result of the CPR: death or survival. There were no significant differences either when survival on arrival at the hospital was taken into consideration (Table 2) or on discharge from hospital (Table 3). We believe that this is because of the small size of the sample and

TABLE 2. Comparison of clinical-epidemiological parameters between extrahospitalary deaths and survivors on arrival at the hospital

	Survivors on arrival at the hospital (n = 10)	Extrahospitalary deaths (n = 21)	Odds Ratio (CI 95%)	Value of p
Age (years)	4.4 ± 4.3	7.2 ± 5.1	–	0.14
Time between cardiorespiratory arrest and 1 st attempt at CPR (minutes)	5.4 ± 5.7	9.0 ± 14.0	–	0.44
Cardiac cause	8 (80%)	18 (86%)	0.66 (0.09-4.80)	1.00
Cardiorespiratory arrest at home	5 (50%)	13 (62%)	0.61 (0.13-2.82)	0.70
CPR carried out by bystander	3 (30%)	4 (19%)	1.82 (0.32-10.35)	0.65
Initial heart rhythm asystole	5 (50%)	16 (76%)	0.31 (0.06-1.54)	0.22
Cardiorespiratory arrest in the presence of emergency personnel	3 (30%)	8 (38%)	0.70 (0.14-3.50)	1.00
Bag and mask airway management	7 (70%)	18 (85%)	0.74 (0.14-3.93)	1.00
Need for intubation	10 (100%)	17 (81%)	5.40 (0.26-110.76)	0.63

The results show the number of cases (%), except the age and times which are reflected as an means ± standard deviation.

TABLE 3. Comparison of clinical-epidemiological parameters between extrahospitalary deaths and survivors at the time of hospital discharge

	Survivors on arrival at the hospital (n = 6)	Extrahospitalary deaths (n = 25)	Odds Ratio (CI 95%)	Value of p
Age (years)	3.3 ± 3.0	6.9 ± 5.2	–	0.12
Time between cardiorespiratory arrest and 1 st attempt at CPR (minutes)	5.8 ± 5.6	8.5 ± 13.0	–	0.77
Cardiac cause	5 (83%)	21 (84%)	0.95 (0.09-10.50)	1.00
Cardiorespiratory arrest at home	3 (50%)	15 (60%)	0.67 (0.11-3.99)	0.68
CPR carried out by bystander	2 (33%)	5 (20%)	2.00 (0.28-14.20)	0.60
Initial heart rhythm asystole	4 (67%)	17 (68%)	0.94 (0.14-6.26)	1.00
Cardiorespiratory arrest in the presence of emergency personnel	1 (17%)	7 (28%)	0.51 (0.05-5.22)	1.00
Bag and mask airway management	4 (67%)	21 (84%)	0.38 (0.05-2.83)	0.57
Need for intubation	6 (100%)	21 (84%)	2.72 (0.13-57.53)	0.56

The results show the number of cases (%), except the age and times which are reflected as means ± standard deviation.

that if it were to be increased, relevant differences would be found in some of the parameters that other studies have proved are predictors of increased survival^{9,10,14}, such as CPR by a bystander or immediate intubation without using bag and mask ventilation beforehand.

The CPR procedures performed in our patients are comparable to those highlighted in the Spanish study¹. The high percentage of intubated patients is of note (27 cases: 87%), and indicates the high level of trained and competent FPUS-061 medical staff in Galicia. In contrast, the percentage of intraosseous venous accesses (5 cases: 16%) is clearly below that found in the Spanish study (29%), which may indicate that this technique and its relevance with regard to CPR is less known, or that these professionals achieve peripheral venous access more often (67% versus 52.6% in the Spanish study), which means they would not have to use intraosseous

access as an alternative very often. It is also worth noting that atropine, which is a drug that has a crucial role in CPR for adults but is less important in paediatrics, was given in 55% of cases (17). This may be explained by the fact that FPUS-061 medical staff in Galicia are trained in treating adults and also because cardiorespiratory arrest occurred predominantly in older children. In contrast, bicarbonate was used on very few occasions (4 cases: 13%) in comparison with the Spanish study (44%) for reasons that are unclear from the information available.

One of the crucial aspects to measure the effectiveness of CPR is the evaluation of survival rates. This study showed a lower percentage of ROSC, survival until hospital admission and survival at discharge compared to the GERCPPN results. However, our results were higher than those of the meta-analysis of the international studies¹⁷ (Table 4). The data should be



TABLE 4. Comparison of our results with those of other reference studies. Results are expressed as percentages

	Present study (Galicia)	GERCPPN ¹ study (Spain)	Meta-analysis (International) ⁷
CPR performed by bystanders	22.6	15.9	30.7
Initial heart rhythm			
– Aystole	67.7	64.2	78
– VF/VT	6.4	9.5	8
Result of CPR			
– ROSC	38.7	47.3	27.8
– Survival until admission to hospital	32.2		23.9
– Survival until discharged from hospital	19.4	28	12.1

VF/VT: Ventricular fibrillation/ Ventricular tachycardia.
ROSC: Return of spontaneous circulation maintained for more than 20 minutes.

interpreted with caution since, on one hand the time between cardiorespiratory arrest and CPR was higher in Galicia and, on the other, the meta-analysis⁷, included many retrospective studies dating before 1995 with a wide range of values related to survival at the time of discharge (between 0 and 31%).

Our study has some limitations that should be considered. On the one hand, the number of cases recorded was too small

to carry out a detailed and reliable analysis of the different factors involved in the response to CPR and survival. Given the low incidence of cardiorespiratory arrest among children, this kind of analysis is only possible in multicentre studies, with the consequent variability among the different areas or long-term data collection which may produce a bias related to the changes in the available resources or in treatment guidelines.

On the other hand, bearing in mind that the aim of CPR is not only to save a life or recover vital functions but also to ensure survival without neurological side effects^{1,7}, it is important to know long term neurological status of the survivors. We do not have this information given that the FPUS-061 records in Galicia were used and no follow-up was carried out of the patients after they were admitted to hospital. Therefore it is crucial that future studies on this subject include evaluation of the neurological status of survivors after at least one year^{1,3}.

In conclusion, the characteristics of paediatric cardiorespiratory arrest and the results of CPR in Galicia are comparable those reported in other studies in Spain, even though some particular findings related to the specific circumstances in this region were found. Initiatives to promote CPR performed by bystanders should be designed. Training in basic CPR for the general population should be improved and the life support knowledge and skills of medical personnel that may have to deal with paediatric arrest should be updated.

REFERENCES

- 1- López-Herce J, García C, Domínguez P, Rodríguez-Núñez A, Carrillo A, Calvo C, Delgado MA, and Spanish Study Group of Cardiopulmonary Arrest in Children. Outcome of out-of-hospital cardiorespiratory arrest in children. *Pediatr Emerg Care* 2005;21:807-15.
- 2- López-Herce J, Domínguez P, y Grupo Español de Reanimación cardiopulmonar pediátrica y neonatal. Estudio epidemiológico sobre la parada cardiopulmonar en la infancia. *An Esp Pediatr* 1998;48:332-3.
- 3- López-Herce J, García C, Domínguez P, Carrillo A, Rodríguez-Núñez A, Calvo C, et al. Characteristics and outcome of cardiorespiratory arrest in children. *Resuscitation* 2004;63:311-3.
- 4- Engdhal J, Axelsson A, Bang A, Karlson BW, Herlitz J. The epidemiology of cardiac arrest in children and young adults. *Resuscitation* 2003;58:131-8.
- 5- Sirbaugh PE, Pepe PE, Shook JE, Kimball KT, Goldman MJ, Ward MA, 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.
- 6- Young KD, Gausche-Hill M, McClung CD, Lewis RJ. A prospective, population-based study of the epidemiology and outcome of out-of-hospital pediatric cardiopulmonary arrest. *Pediatrics*. 2004;114:157-64.
- 7- Donoghue AJ, Nadkarni V, Berg RA, Osmond MH, Wells G, Nesbitt L, Stiell IG, for the Can Am Pediatric Cardiac Arrest Investigators. Out-of-hospital pediatric cardiac arrest: An epidemiologic review and assessment of current knowledge. *Ann Emerg Med* 2005;46:512-22.
- 8- Zaritsky A, Nadkarni V, Hazinski MF, Foltin G, Quan L, Wright J, et al. Recommended Guidelines for Uniform Reporting of Pediatric advanced Life Support: The Pediatric Utstein style. *Resuscitation* 1995;30:95-115.
- 9- Young KO, Seidel JS. Pediatric Cardiopulmonary resuscitation: A collective review. *Ann Emerg Med* 1999;33:195-205.
- 10- Suominen P, Korpela R, Kuisma M, Silfvast T, Olkkola KT. Paediatric cardiac arrest and resuscitation provided by physician-staffed emergency care units. *Acta Anaesthesiol Scand* 1997;41:260-5.
- 11- Instituto Gallego de Estadística. Datos poblacionales del padrón municipal por edades, años 2001 a 2005. (En Internet: www.ige.es).
- 12- Nolan J. European Resuscitation Council Guidelines for Resuscitation 2005. Section 1. Introduction. *Resuscitation* 2005;67S1:S3-6.
- 13- International Liaison Comité on Resuscitation. 2005 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science with Treatment Recommendations. *Resuscitation* 2005;67:157-341.
- 14- Thompson JE, Bonner B, Lower GM. Pediatric cardiopulmonary arrest in rural populations. *Pediatrics* 1990;86:302-6.
- 15- Biarent D, Bingham R, Richmond S, Maconochie I, Wyllie J, Simpson S, et al. European Resuscitation Council Guidelines for Resuscitation 2005: Section 6. Paediatric life support. *Resuscitation* 2005;67(Suppl1):S97-S133.
- 16- American Heart Association. 2005 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. Part 11: Pediatric Basic Life Support. 2005;112SI:156-66.
- 17- International Liaison Committee on Resuscitation. 2005 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science with Treatment Recommendations. *Resuscitation* 2005; 67:157-341.
- 18- Handley AJ, Koster R, Monsieurs K, Perkins GD, Davies S, Bossaert L. European Resuscitation Council Guidelines for Resuscitation 2005. Section 2. Adult basic life support and use of automated external defibrillators. *Resuscitation* 2005;67(Suppl1):S7-27.