ELSEVIER

Resuscitation 61 (2004) 183–188

www.elsevier.com/locate/resuscitation

Short communication

Role of semiautomatic defibrillators in a general hospital: "Naples Heart Project"

Maurizio Santomauro [a,*], Luca Ottaviano [a], Alessio Borrelli [a], Vincenzo De Lucia [b], Carla Riganti [c], Daniel Ferreira [d], Massimo Chiariello [a]

[a] *Department of Cardiology, University Federico II Naples, Pansini street 5, 80131 Naples, Italy*
[b] *Department of Anaesthesiology and Resuscitation, University Federico II Naples, Naples, Italy*
[c] *Health Management, University Federico II Naples, Naples, Italy*
[d] *Department of Cardiology, Hospital Fernando Fonseca, Amadora, Portugal*

Received 31 March 2003; received in revised form 22 December 2003; accepted 9 January 2004

Abstract

In Italian hospitals, 85% of patients hospitalized in general medical wards who experience cardiac arrest die, while the incidence is much lower in patients in intensive care units. Defibrillation, in Italian hospitals, often occurs very late, either due to a lack of defibrillators, or due to architectural and structural barriers. The object of an in-hospital emergency service is to prevent and treat cardiac arrest without subsequent complications, such as brain damage, renal failure etc. The Naples Heart Project was based on a feasibility study of the in-hospital emergency service to evaluate and analyze problems associated with type of structure, departmental and institutional dislocation, internal practicability (architectural features and preferential ways), staff numbers and distribution, the calling system for emergency, and the equipment available. The Naples Heart Project began in July 2001, since then it has already created 835 BLSD first responders among the hospital staff; 440 were physicians and physicians still in training, 310 were nurses and 85 were administrative staff.

Keywords: BLSD; Sudden death; Naples Heart Project; Early defibrillation

Resumo

Nos Hospitais Italianos, morrem 85% dos doentes que sofreram paragem cardíaca hospitalizados em enfermarias médicas gerais, enquanto que a incidência de doentes admitidos em Cuidados Intensivos é muito elevada. Nos hospitais Italianos, a desfibrilhação ocorre com frequência muito tardiamente, quer devido a falta de desfibrilhador, quer devido a barreiras arquitectónicas ou estruturais. O objectivo da emergência intra-hospitalar é prevenir e tratar a paragem cardíaca sem complicações subsequentes, tais como lesão cerebral e falência renal. O projecto no coração de Nápoles foi baseado na exequibilidade de um estudo dos serviços de Emergência intra-hospitalares para avaliar e analisar problemas associados com o tipo de estrutura, deslocação institucional e departamental, praticabilidade interna (características da arquitectura e via preferencial), número de pessoas e sua distribuição, o sistema de chamada para a emergência e o equipamento disponível. O Projecto no Coração de Nápoles começou em Julho de 2001, desde então foram ensinadas 835 pessoas que são a primeira resposta BLSD entre o pessoal do Hospital; 440 eram médicos e médicos em treino, 310 eram enfermeiros e 85 pessoal administrativo.

Palavras chave: BLSD; Morte Súbita; Projecto no Coração de Nápoles; Desfibrilhação precoce

Resumen

En los hospitales italianos, el 85% de los pacientes hospitalizados en salas de medicina que experimentan paro cardíaco súbito mueren, mientras la mortalidad por la misma causa es menor en unidades de cuidados intensivos. La desfibrilación, en los hospitales italianos, frecuentemente ocurre demasiado tarde, ya sea debido a una falta de desfibriladores, o debido a barreras arquitectónicas o estructurales. El objeto

* Corresponding author. Tel.: +39-081-746-42-96; fax: +39-081-746-22-29.
E-mail address: santomau@unina.it (M. Santomauro).

0300-9572/$ – see front matter © 2004 Published by Elsevier Ireland Ltd.
doi:10.1016/j.resuscitation.2004.01.018

de un servicio de emergencia intrahospitalario es prevenir y tratar paro cardíaco sin consecuencias subsecuentes, tales como daño cerebral, falla renal, etc. El Proyecto del Corazón de Nápoles fue basado en un estudio de factibilidad en el servicio de emergencia intrahospitalaria para evaluar y analizar los problemas asociados con tipo de estructura, dislocación departamental e institucional, factibilidad interna (aspectos arquitectónicos y modo de preferencia), numero y distribución del personal, sistemas de llamada, y equipo disponible. El proyecto corazón de Nápoles empezó en Julio 2001, y desde entonces ya ha creado 835 primeros reanimadores BLSD entre el personal del hospital; 440 de ellos son médicos y médicos en entrenamiento, 310 eran enfermeras y 85 eran personal administrativo.

Palabras clave: SVB; Muerte súbita; Proyecto del Corazón de Nápoles; Desfibrilación Temprana

Sudden death can occur as an unexpected event in a person with a known, but stable, cardiac problem, or in a person with an unknown but pre-existing problem. Frequently the cardiac arrest is primarily cardiac in origin (Table 1), but many other diseases (Table 2), can be the underlying cause of sudden death, which in 75% cases is due to ventricular fibrillation (VF) or tachycardia (VT), in 20% bradyarrythmia and 5% atrioventricular dissociation [1,5]. In Italy it strikes more than 50,000 people per year, with a 10% overall mortality; 20% of cases occur in people with no previous signs of disease at all [1]. The chance of survival after cardiac arrest depends on the rapidity of intervention and the correct execution of the four fundamental links in the "Chain of Survival" [2,3].

Since its discovery, external defibrillation has been the cornerstone of emergency cardiac care (ECC) and the principal reason for most of the successful resuscitations from cardiac arrest.

Research [4,6,7,9] shows that rapidity of defibrillation is the most important determinant of survival in arrests due to shockable arrhythmias.

Even though most events occur outside hospitals (Table 3), the problem is still a big concern inside hospital. In Italian hospitals, 85% of patients with cardiac arrest in general medicine wards die, while mortality is less for patients hospitalized in intensive care units. Survival from cardiac arrest outside critical care units remain about 15% at best, and is consistently lower in general wards than in critical care areas [14,15]. Explanations for this lack of progress usually involve comorbidity and unwitnessed arrests among patients on general wards [10,14–20].

Defibrillation in Italian hospitals, often occurs very late due to lack of defibrillators, or the presence of architectural and structural barriers. The device sometimes is available only in specific areas of the hospital, and in some cases it is non-functional or the staff lack training and experience. Mostly the intervention is carried out by a specialized team from other areas of the hospital, usually with a big delay. The problem becomes even bigger if no basic cardiopulmonary resuscitation has occurred.

Nurses in a general ward are in a difficult position. They are expected to respond immediately to an unanticipated crises. Performing basic CPR has been shown to be difficult,

Table 1
Heart disease that may cause sudden cardiac death up to 30 years and after 30 years

	(%)
Causes of sudden death <30 years	
Aortic stenosis	3–18
Eisenmenger syndrome	15
Congenital cardiomyophathy	10
Hypertrophic cardiomyopathy	1–50
Right ventricular displasia	0–26
Mitral valve prolapse	1–24
Coronary artery disease	3–20
Causes of sudden death >30 years	
Coronary artery disease	85
Cardiomyopathy	10
Valve disease	3
Conduction abnormalities	2

The most frequent disease which causes sudden death till 30 years is hypertrophic cardiomyopathy (50%), while the coronary artery disease incidence is about 3–20%. After 30 years the coronary artery disease incidence is about 85%.

Table 2
Most frequent causes of sudden death

Causes	(%)
Suffocation	1
Sudden infant death	0.8
Drowning	1
Suicide	1.1
Pulmonary disease	2.9
Accident	1.7
Overdose	1.5
Heart disease	67.1
Other	22.9

The most frequent cause of sudden death is heart disease (67.1%).

Table 3
Most frequent location in which sudden death occurs

Location	(%)
Work	1.8
Day nursery	3.7
Ambulance	4.2
Public place	11.0
Home	65.8
Other	13.6

Sudden death often occurs at home (65.8%).

Table 4
Percentage of survival (ROSC) with and without immediately BLSD

Action	Success rate of survival (%)
Early activation of ACLS team (no immediately BLSD (7–10 min))	20
Early activation of ACLS team (no immediately BLSD (>10 min))	2–8 + brain damage
Early activation of ACLS team (BLSD immediately)	80–90

Percentage of survival is strictly connected to the execution of BLSD immediately. If BLSD does not occur immediately and ACLS team arrives in 7–10 min, success rate of survival is about 20%. If BLSD does not occur immediately and ACLS team arrives later than 10 min, success rate of survival is very low (2–8%) and is associated with irreversible brain damage. The gold standard is if there is an early activation of ACLS team and BLSD immediately, the success rate of survival is about 80–90%.

even in non-stressful classroom simulations [21,22]. Performance in an actual cardiac arrest is harder and takes longer. In the emotionally stressful setting of an actual arrest, several preparatory steps must be taken: acquiring a respiratory barrier device, bringing a crash cart with cardiac board to the scene, and placing the cardiac board under the patient (a two-person task) [23,24]. Starting ventilations, chest compressions and defibrillation, generally requires the coordinated actions of at least two people, because the use of pocket masks and most other barrier devices makes effective one-person CPR difficult. Given these obstacles, effective CPR is rarely initiated before the emergency team arrives [25]. Expecting the general unit nurse to perform an excessively complex and difficult task in an emergency situation may cause a state of "learned helplessness" and increased dependence on the emergency team.

Early defibrillation programs can improve survival rates significantly by shortening the time from arrest to defibrillation. Improving the speed of in-hospital defibrillation may produce better results (Table 4) and was the object of the Naples Heart Project.

The Naples Heart Project [26,27] began in July 2001, and since then it has created about 835 BLSD first responders; 440 were physicians or physicians in training, 310 were nurses and 85 were administrative staff. We organized courses [11] based both on theory and practice [12,13], so that the participants could develop psychomotor ability and automation. The teaching programmes develop the rational base of the "Chain of Survival", providing courses in basic cardiopulmonary resuscitation and defibrillation with hands on practice to make the rescuer feel much more comfortable when aiding the victim. The courses differed in equipment, content, duration and the final test, and adopted simple intervention training for non-medical personnel and more advanced training for the physicians. All the courses were held over one day, the course for administrative staff had a total duration of 6 h, equally divided between theory and practice. They were trained to use a semiautomatic defibrillator, with no ECG monitor, and with a voice system that guided the rescuer through the sequential steps of the "Chain of Survival". These were the only defibrillators which they were allowed to use, in accordance with Monteleone's Law of 3 April 2001, which allows non-medical personnel [7] to use defibrillators but only semiautomatic devices. Courses for nurses (Fig. 1) were held over 8 h; they were given more information on physiopathology and were trained in all the basic life support techniques, and in defibrillator use. The courses for physicians were held over 10 h, spending more time on physiopathology, epidemiology and specific patterns of cardiac arrest. For all the groups we used biphasic waveform defibrillators [8], as they use less energy than monophasic, and appear to have a comparable effectiveness at lower energy levels.

All three groups had to take a final test, with basic questions but no ECG to be interpreted for administrative staff and nurses, while for paramedics and doctors an ECG analysis was also included. Even though they all showed interest, not all were able to obtain a good grade at the final test. Forty candidates had to be retrained and re-tested, this time with positive results. We plan to keep training continuous for all personnel, with retraining after 1 year.

The Naples Heart Project training centre also provides advanced cardiac life support (ACLS) courses, for members of the hospital emergency response team. ACLS courses ran for 2 days of 8 h, during which physicians were trained to use manual defibrillators with external pacing capacity, drug administration for treatment of tachyarrhythmias and bradyarrhythmias, and airway intubation.

Fig. 1. Naples Heart Project BLSD first responder course. Phase of nurses BLSD training.

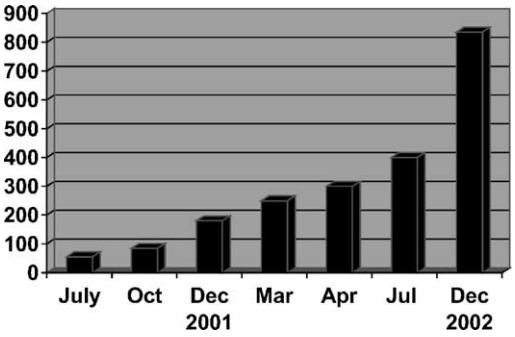

Fig. 2. Naples Heart project's BLSD first responders. Naples Heart Project (9–10, 31–33) was begun on July 2001, since then it has already created about 835 BLSD first responders among the Hospital staff, 440 were specialist physician and physician in training, 310 nurses and 85 were administrative staff.

Up to now we have already organized several sessions with 25 participants per day, the number of participants has increased from the month of July 2001 to December 2002 (Figs. 2 and 3).

The Naples Heart Project has the objective to provide the optimum in-hospital survival rate, with a better prognosis for all people with cardiac arrest. The aim is to make the Chain of Survival as fast and effective as possible, in every part of the hospital.

The University "Federico II" General Hospital is provided with about 1200 beds, divided into separate and independent institutes and departments. Everyday several thousand people (patients, doctors, technical and administrative staff, visitors, students, etc.) are in the general hospital. To enhance awareness of the hospital emergency service we have created a brochure for patients and visitors to be distributed in waiting rooms and at the main entrance. There are posters in every department and we have organized meetings and conferences directed at future BLSD providers like physician, nurses, administrative and technical staff.

We are planning to implement a series of signs (Fig. 4), throughout the hospital with directions to the nearest defibrillator.

Fig. 4. Defibrillation point. The Naples Heart Project provides a series of road signs, all through the Hospital with all the directions to the nearest defibrillation point.

The project provides a rational distribution of semiautomatic defibrillators (Fig. 5) and emergency equipment to have a defibrillator and a full organized trolley for emergencies, available on all floors, so that the delay due to access and transport is decreased. The equipment on the emergency trolleys will be checked regularly.

To administer and coordinate the project, we will create an in hospital emergency system leader who will mediate contacts between the emergency team, training centre, and the BLSD and ACLS providers, and the emergency coordination group (composed of a general manager, a medical manager and a nurse manager).

In conclusion, the in hospital emergency service should be an organized chain with standard protocols known by all staff with organized training following a well defined programme with a fixed term giving theoretical and practical knowledge of emergencies.

The Naples Heart Project based on courses for BLSD and ACLS responders, addressed to physicians, nurses and working staff belonging to the general Hospital, has this

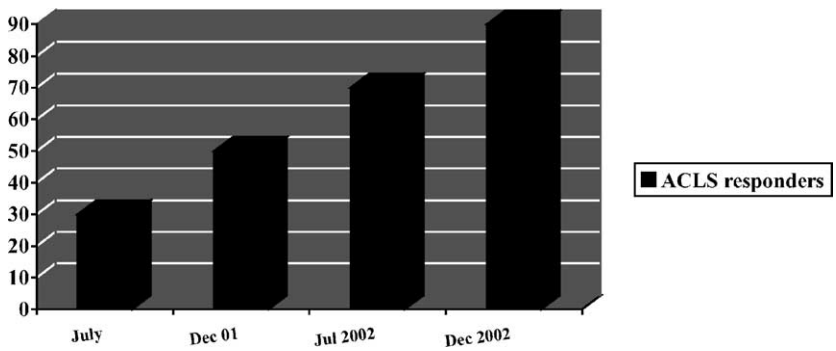

Fig. 3. Naples Heart project ACLS responders. Naples Heart Project training centre provides advanced cardiac life support (ACLS) courses, to create an ACLS team offering an advanced cardiac life support any time and everywhere in the hospital. We have now trained 90 ACLS responders.

Fig. 5. Defibrillator rational distribution. The Naples Heart Project provides a rational distribution of semiautomatic defibrillators and materials, in order to have a defibrillator and a full organized trolley for emergencies, available on all floors, so that the delay due to access and transport of the equipment is strongly decreased.

goal. It is the first project in Italy of such dimension and purpose and lays the basis for the development of a medical emergencies response culture for both in-hospital and out-of-hospital scenarios.

References

[1] Vital statistics of the United States. Yattsville, MD: National Center for Health Statistics; 1988:2A.
[2] Cummins RO, Ornato JP, Thies WH, Pepe PE. Improving survival from sudden cardiac arrest: the "chain of survival" concept. A statement for health professionals from the Advanced Cardiac Life Support Subcommitee and the Emergency Cardiac Care Committee. American Heart Association. Circulation 1991;83:1832–47. Special report.
[3] Guidelines for cardiopulmonary resuscitation and emergency cardiac care. I. Introduction. JAMA 1992;268:2172–83.
[4] Myerburg RJ, Kessler KM, Zaman L, Conde CA, Castellanos A. Survivors of prehospital cardiac arrest. JAMA 1982;247:1485–90.
[5] Bayes de Luna A, Coumel P, Leclercq JF. Ambulatory sudden cardiac death: mechanism of production of fatal arrhythmia on the basis of data from 157 cases. Am Heart J 1989;117:151–9.
[6] Grotta JC. The importance of time. In: Proceedings of the National Symposium on rapid identification and treatment of acute stroke. The National Institute of Neurological Disorders and Stroke; 1996. p. 1–9.
[7] Stoddard FG. Public access defibrillation comes of age. Currents. Winter 1996;7:1–3.
[8] Kerber R, Becker L, Bourland J, et al. Automatic external defibrillators for public access defibrillation: recommendation for specifying and reporting arrhythmia analyses, algorithm performance, incorporating new wave forms, and enhancing safety. Circulation 1997;95:1677–82.
[9] Capucci A, Aschieri D, Piepoli MF, Bardy GH, Iconomu E, Arvedi M. Tripling survival from sudden cardiac arrest via early defibrillation without traditional education in cardiopulmonary resuscitation. Circulation 2002;106(9):1065–70.
[10] Skrifvars MB, Castren M, Kurola J, Rosenberg PH. In-hospital cardiopulmonary resuscitation: organization, management and training in hospitals of different levels of care. Acta Anaesthesiol Scand 2002;46(4):458–63.
[11] American Heart Association in collaboration with the International Liason Committee on Resuscitation (ILCOR). Guidelines 2000 for cardiopulmonary resuscitation and emergency cardiovascular care. An international consensus on science. Circulation 2000;102(Suppl I):I-l-I-384.
[12] Handley JH, Monsieurs KG, Bossaert LL. European Resuscitation Council Guidelines 2000 for adult basic life support. Resuscitation 2001;48:199–205.
[13] Monsieurs KG, Handley JH, Bossaert LL. European Resuscitation Council Guidelines 2000 for automated external defibrillation. Resuscitation 2001;48:207–9.
[14] McGrath PB. In-house cardiopulmonary resuscitation-after a quarter of a century. Ann Emerg Med 1987;11:1365–8.
[15] Dans PE, Nevin KL, Seidman CE, McArthur JC. Inhospital CPR 25 years later: why has survival decreased? South Med J 1985;78:1174–8.
[16] Tunstall-Pedoe H, Bailey L, Chamberlain DA, Marsden AK, Ward ME, Zideman DA. Survey of 3765 cardiopulmonary resuscitations in British hospitals (the BRESUS study: methods and overall results). BMJ 1992;304:1347–51.
[17] Lazzam C, McCans JL. Predictors of survival of in-hospital cardiac arrest. Can J Cardiol 1991;7(3):113–6.
[18] Bedell SA, Delbanco EF, Cook EF, Epstein FH. Survival after cardiopulmonary resuscitation in the hospital. N Engl J Med 1983;309:569–76.
[19] Hershey CO, Fisher L. Why outcome of cardiopulmonary resuscitation in general wards is poor. Lancet 1982 Jan 2;1(8262):31–4.
[20] Grauer K, Cavallaro D. ACLS-A comprehensive review. St. Louis, MO: Mosby Lifeline; 1993.
[21] Berden HJ, Hendrick JM, van Doornen JP, Willems FF, Pijls NH, Knape JT. A comparison of resuscitation skills of qualified nurses and ambulance nurses in The Netherlands. Heart Lung 1993;22(6):509–15.

[22] Flesche C, Neruda B, Breuer S, Tarnow J. Basic cardiopulmonary resuscitation skills: a comparison of ambulance staff and medical students in Germany. Resuscitation 1994;28:S25 [abstract].
[23] Kaye W, Mancini ME, Giuliano KK, et al. Strengthening the in-hospital chain of survival with rapid defibrillation by first responders using automated external defibrillators: training and retention issues. Ann Emerg Med 1995;25(2):163–8.
[24] Brown J, Latimer-Heeter M, Marinelli A, Rex E, Reynolds L. The first 3 min: code preparation for the staff nurse. Orthop Nurs 1995;14(3):35–40.
[25] Brenner BE, Kauffman J. Response to cardiac arrests in a hospital setting: delays in ventilation. Circulation 1995;92(8,S1):i-761 [abstract].
[26] Santomauro M, Ottaviano L, Borrelli A, et al. Organization project for precocious semiautomatic in hospital defibrillation (heart project) Progress in Clinical Pacing, Rome; 3–6 December 2002. p. 46.
[27] Santomauro M, Ottaviano L, Borrelli A, et al. Sudden cardiac death prevention through hospital early defibrillation Naples experience. PACE 2003;26:S186.