

Out-of-hospital early defibrillation successfully challenges sudden cardiac arrest: the Piacenza Progetto Vita project

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Key words:

Cardiac arrest;
Defibrillation;
Ventricular fibrillation.

Background. Early defibrillation is the most important intervention influencing survival following sudden cardiac arrest (SCA). In order to improve public access to early defibrillation, in North America several experiences of out-of-hospital early defibrillation by non-medical volunteers have been successfully implemented and demonstrated to improve survival.

Methods. Since 1999, in Piacenza, we have established "Progetto Vita", the first experience of out-of-hospital early defibrillation by non-medical volunteers in a medium-size European city. Thirty-nine semiautomatic external defibrillators were placed in Piacenza, Italy (266 531 inhabitants) and distributed in 12 high-risk locations, 12 lay-staffed ambulances and 15 police-cars. A total of 1285 lay volunteers were trained by the emergency medical system to intervene in all cases of suspected SCA.

Results. During the first 15 months, 203 codes for suspected SCA were dispatched; 197 were confirmed SCA. The overall survival was 5.6% (11/197): survival improved from 2.9% (4/134) with emergency medical system intervention to 11.1% (7/63) when the "Progetto Vita" was activated ($p < 0.05$). The survival rate on "shockable" rhythm was 43.7% in the group of patients treated by volunteers vs 16.6% in those treated by emergency medical system aid ($p = 0.05$).

Conclusions. The widespread use of semiautomatic external defibrillators allows early defibrillation by non-medical volunteers and more than triples the survival rate following out-of-hospital SCA. (Ital Heart J 2002; 3 (12): 721-725)

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Received September 9, 2002; revision received October 28, 2002; accepted October 31, 2002.

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In the United States, sudden cardiac arrest (SCA) claims an estimated 350 000 lives per year and represents a major public health problem. In Europe 40% of all deaths of individuals who are 25-74 years of age are attributable to cardiovascular disease. More persons die each day of potentially reversible ventricular fibrillation than of any other cause of death, reversible or not.

Various studies have clearly demonstrated that survival rates are high when defibrillation treatment is administered within the first few minutes of SCA. In three studies of cardiac arrest occurring in supervised cardiac rehabilitation centers > 90% of victims were successfully resuscitated and these patients were discharged alive from the hospital^{1,2}.

Unfortunately, most often SCA does not occur in supervised places and in the more typical community settings victims of SCA rarely survive. Only 2-5% of victims of SCA can be resuscitated with the commonly used emergency system of ambulances. The problem cannot be resolved simply by further reducing the time to ambulance intervention. Rather, it is necessary to render defibrillation available to lay persons³.

The first European project of public access defibrillation: "Progetto Vita"

"Progetto Vita" is the first European pilot project of early defibrillation by first responders in the community. The project started on June 16, 1999 in the city of Piacenza (99 878 inhabitants) where 39 semiautomatic external defibrillators (AEDs) were dislocated according to a planned protocol involving 1285 trained lay volunteers (policemen, customs officials, civic police, firemen, railway station personnel, first-aid volunteers, post office personnel, pharmacy personnel). In particular, 12 police-cars moving around the town have the AEDs in their equipment and can be called by the emergency medical system in all cases of suspected SCA. This was coded as "code blue" call.

Figure 1 reports the dislocation of the AEDs in the town of Piacenza. The coordination of the projects is under the responsibility of the emergency department of the local hospital (Cardiology Department and 118 Service).

In the previous 3 years, before starting the "Progetto Vita", a mean of 107 episodes/



Figure 1. Map of the distribution of automatic external defibrillators in the Piacenza Progetto Vita.

year of SCA had been computed. Total survival in the overall number of SCA episodes was computed as 4.9%, with a mean time of intervention of the emergency medical system of 8 min.

Results

The “Progetto Vita” has been started on June 16, 1999. During the first 15 months, 203 codes for suspected SCA were dispatched. In 106 cases (52%), the volunteers arrived to the scene before the ambulance (mean intervention time 5 ± 1 vs 6 ± 2 min respectively, $p < 0.05$). Of the 203 cases, 197 were considered as SCA (86% at home, 73% witnessed) and 63 of these were first treated by volunteers of the “Progetto Vita”. In 40 of these 197 cases, shockable rhythms were detected, 16 of which were treated by the “Progetto Vita” volunteers: 7 were successfully defibrillated and discharged alive. Among the 24 ventricular fibrillation cases treated by emergency staff, only 4 patients were discharged alive. The overall survival was 5.6% (11/197): survival improved from 2.9% (4/134) with emergency intervention to 11.1% (7/63) when the “Progetto Vita” was activated ($p < 0.05$). The survival rate on “shockable” rhythms was 43.7% in the group of patients treated by volunteers vs 16.6% in those treated by emergency medical personnel ($p = 0.05$)⁴.

Training. Learning to use an AED is intuitive and surprisingly simple. The AED courses usually last about 6-8 hours (according to the American Heart Association)

and allow ample time for hands-on practice thus contributing to increase user competence and confidence with AEDs and basic life support. In our project no basic life support training has been proposed to lay rescuers, in order to simplify training for personnel, who is usually not duty-bound to offer sanitary aid. The lessons of “Progetto Vita” are held by 22 experienced instructors who organize daily AED training courses for lay persons. The program focuses on hands-on practice and scenarios that are tailored to the needs of specific audiences according to the American Heart Association guidelines. The duration of training is about 4 hours. In our experience, the trained volunteers showed high competency in AED and a remarkable ability to retain the information received: at the retraining course, only 16 volunteers of the 1285 originally trained (1.2%) failed the review test.

Public awareness and support are crucial for the success of community AED programs. Cultivating community consciousness and action takes effort, but a dedicated task force can spearhead a campaign that targets citizens and political leaders alike and brings the media in as a strong and influential ally. Increased awareness can inspire implementation of community AED programs.

Discussion

The vast majority of episodes of SCA are attributable to ventricular fibrillation (74%), which can be reversed only by electrical defibrillation. The incidence

of ventricular tachycardia/ventricular fibrillation is higher in bystander-witnessed SCA than when no witnesses are present, due to the shorter time interval from the event to the recording of the first electrocardiogram when witnesses are present. In fact, when no witness is present events are recognized too late after cardiac arrest. By the time aid arrives, a higher proportion of cases would have already progressed to the final asystole. In the MONICA study it was calculated that the initial incidence of ventricular tachycardia/ventricular fibrillation was approximately 60% in the whole population and 80-85% in those with probable cardiac disease⁵. The electrical shock eliminates ventricular tachycardia/ventricular fibrillation and enables the heart to resume coordinated, rhythmic beating so that effective pumping of blood can resume. The likelihood of successful resuscitation decreases by approximately 10% with each minute following SCA. After 10 min, very few resuscitation attempts are successful (0-2%)⁶.

The poor survival outcomes in out-of-hospital cardiac arrest appear to be due to:

- the low percentage of cardiac arrest patients whose arrest was bystander-witnessed and who were found to be still in “shockable” rhythm;
- the time interval between the event and the arrival-at-the scene of a dispatcher provided with a defibrillator (ambulance driving interval) considered as a proportion of the complete response interval. In fact, most victims do not have immediate access to prompt, definitive treatment and too much time elapses before the defibrillator arrives, if it arrives at all³.

In New York for example, the average emergency system response time is relatively long (about 12 min). This is partly due to the traffic congestion and partly to the logistic problems in getting to victims in high-rise buildings. Consequently, only 5% of witnessed victims (1-2% of all cardiac arrest victims) survive⁷. Some studies have suggested that, in comparison with a single-tier system that aims to deliver a fully trained paramedic in 8 min, a two-tier system involving a “first responder” with an automatic external defibrillator – who can arrive within 4-5 min – may improve survival⁸. Seattle has achieved an average response time of 7 min and a ventricular fibrillation survival rate of 30%⁹. In Rochester, Minnesota, the response time averages 6 min and 45% survive¹⁰ (Table I).

Every minute counts. The key to fight SCA in an out-of-hospital setting is to be as quick as possible. Early defibrillation has been called the critical link in the “chain of survival”. Numerous scientific studies conducted during the past two decades have proven that rapid defibrillation is the single most important factor affecting survival through SCA. Since early defibrillation is so critical for survival, it stands to reason that defibrillators should be as widely available and accessible as possible¹¹⁻¹³.

The scientific evidence of improved survival with rapid defibrillation coupled with important technological advances (AED) has led to an international movement for an increased use of early defibrillation.

Every effort to achieve a better survival rate seems to be useless when resuscitation in the community relies predominantly upon the ambulance service. Recently, the data of the United Kingdom experience with a better training of the ambulance crews has been published. The chances that a patient survives through SCA and is discharged from hospital alive did not appear to be affected by the paramedic’s experience. The growing number of trained paramedics does not seem to improve the survival rate (14% in 1987 to 1989 to 11.4% in 1992 to 1993) neither in Scotland¹⁴ nor in England¹⁵.

Lay persons are the most likely to arrive first at the scene of an arrest.

Public access defibrillation. Public access to defibrillation is the concept of placing AEDs in public and/or private settings where large numbers of persons are found or where individuals generally considered at high risk for heart attacks live or are found. All emergency first responder’s vehicles and ambulances should be equipped with an AED. One of the goals of the American Heart Association is to help business and other facilities establish public access to defibrillation programs, in order to reduce the time to defibrillation^{12,13}.

When defibrillators were first developed, operators determined whether or not to deliver a shock by reading complex ECGs to interpret the patient’s heart rhythm. This was simplified in 1980s with the development of the AED. The AED automatically interprets the victim’s heart rhythm, identifies the “shockable” ones and advises the operator whether or not shock is appropriate, and eventually guides him/her in the resuscitation procedure^{16,17}.

Table I. Differences in the intervention time in case of a sudden cardiac arrest event affect survival rates.

	Time from notification to defibrillation	Survival rate (%)
Rehabilitation centers	Immediate defibrillation (1-2 min)	90
Model community	Early defibrillation project (6 min)	45
	Early defibrillation (7 min)	30
Typical community	Delayed defibrillation (> 10 min)	< 5

These technological advances greatly decreased the amount of training required to use an AED; responders using defibrillators no longer needed to be physicians or highly trained paramedics. Indeed, in the United States lay persons have successfully saved lives by using AEDs^{16,17}.

Therefore, most AEDs are designed to be used by non-medical personnel such as police, fire service personnel, flight attendants, security guards and other lay rescuers who have been properly trained. If the fight against SCA is to be successful, as many persons as possible should be trained in early defibrillation and provided with an AED to be used whilst awaiting the arrival of the emergency system personnel. Early defibrillation gives the heart an opportunity to resume beating effectively. Certainly, an AED only treats a fibrillating heart. In cardiac arrest without ventricular fibrillation the heart does not respond to electrical current but requires medication and breathing support instead. Besides, AEDs are less successful when the victim has been in cardiac arrest for longer than a few minutes.

Preliminary experience on public access defibrillation. During the last 20 years, several experiences of external defibrillators in North American communities have been presented. An increased discharge survival rate was demonstrated after out-of-hospital SCA in case of early defibrillation by police and paramedics. Table II summarizes the beneficial effects of this intervention. The lowest survival rates occurred in single-response systems and the highest rates in double-response systems, although there was considerable variation within each type of system. Hypothetical survival curves suggest that the ability to resuscitate is a function of time, type, and sequence of therapy. Survival appears to be higher in double-response systems because external defibrillation is started early: the institutional emergency medical system is supported by and coordinates the activation of organizations formed by lay volunteers equipped with an AED who can provide first rescue and early defibrillation within 4-5 min. The development of this two-tier system of early defibrillation has allowed the city of Seattle to achieve an average re-

sponse time of 7 min and a survival rate of 26% for those with witnessed ventricular fibrillation⁹. In Rochester, Minnesota, the average response time was 6 min with a 45% survival rate for witnessed ventricular fibrillation¹⁰.

If Rochester and Seattle's high survival rates could be achieved in Italy, as many as 10 000 unnecessary deaths could be prevented each year.

The recent publication of Pell et al.¹⁸ confirms the preliminary data of our project. The predicted increase in survival following the targeted provision of public access defibrillators is less than the increase achievable through the expansion of first responder defibrillation to non-ambulance personnel, such as police or firefighters, or of bystander cardiopulmonary resuscitation. Besides, in our experience (prospective study) fixed-place AEDs positioned in public locations were never used.

In conclusion, the importance of AED programs has been well documented in the literature. The project of Piacenza can help other communities to create a community system of early defibrillation in order to reduce the number of victims of SCA. The Italian law (April 3, 2001 no. 120) should favor the organization of other two-tier systems in Italy where policemen are coordinated by the 118 system in early defibrillation interventions. This actually represents the system that is more likely to yield better results in fighting SCA outside the hospital. The high percentage of home SCA may explain why fixed-place AEDs are seldom used.

Acknowledgments

The association "Il Cuore di Piacenza" who sustained the organization of Progetto Vita is grateful to Dr. Adamo Gulì, Ten. Col. Mauro Santonastaso, Com. Carlo Sartori and Ing. Francesco Di Iorio as chief of the local police corps and security systems, who strongly supported the project and allowed their agents to participate in training programs in the use of the AEDs.

Table II. High discharge survival rates after out-of-hospital ventricular fibrillation with early defibrillation by police and paramedics^{9,10}.

Year	Location	Before (%)	After (%)	Survival increase
1980	Seattle, Washington	7	26	3.7
1984	Rural communities	3	19	6.3
1984	Iowa	3	19	6.3
1986	Southeast Minnesota	4	17	4.3
1986	Northeast Minnesota	2	10	5.0
1989	Wisconsin	4	11	2.8
1996	Rochester	–	49	–
1998	Indianapolis	8	14	1.7
1998	Pittsburgh	3	26	8.6
2001	Piacenza	16	43	3.6

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