HOSPITAL CHRONICLES 2010, 5(4): 184–192

REVIEW

Have we Made Any Progress in Preventing Sudden Cardiac Death in the Community? A Review on Automatic External Defibrillators

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KEY WORDS: *sudden cardiac death, resuscitation, defibrillation, external defibrillator, cardiac arrest*

Abbreviations
AED = automatic external defibrillator
BLS = basic life support
CCU = cardiac care unit
CPR = cardiopulmonary resuscitation
EMS = emergency medical services
ICD = implantable cardioverter defibrillator
OOHCA = out-of-hospital cardiac arrest
PAD = public access defibrillation
SCA = sudden cardiac arrest
VF = ventricular fibrillation
VT = ventricular tachycardia

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Manuscript received March 4, 2010; Revised manuscript received May 5, 2010; Re-revised manuscript received June 3, 2010; Accepted June 24, 2010

ABSTRACT

Automated external defibrillators (AEDs) have been recognized lately as an important link in the chain of survival of patients experiencing sudden cardiac arrest (SCA), which still remains a major public health problem in the Western countries, being responsible for more than 250,000 out-of-hospital deaths annually. Due to the fact that survival rates following SCA are still unacceptably poor and that in most of the cases the underlying heart rhythm in out-of-hospital SCA is ventricular fibrillation or pulseless ventricular tachycardia, introduction of AEDs seems to open a new prospective. Since the early 1990's, when first launched, significant improvement has been made in AEDs technology and in many countries Public access defibrillation programs are now widespread. After minimal training, lay rescuers and first responder who might not be health professionals effectively provide early defibrillation using AEDs, resulting in many cases in improved survival rates. In the present review we examine the status of AEDs in clinical practice in the year of 2010 emphasizing on their key role for the widespread prevention of sudden cardiac death in the community.

CASE PRESENTATION

A 57-year-old male presented on December 2009 with sudden cardiac arrest in the arrivals' section of the international airport of Macedonia, Thessaloniki, Greece, while awaiting a relative's arrival. The medical resuscitation team of the airport responded immediately, performing cardiopulmonary resuscitation (CPR) and the patient was successfully intubated. At the same time an automated external defibrillator (AED) became available and was attached to the patient and the underlying heart rhythm was analyzed revealing ventricular fibrillation (VF). The patient was defibrillated by the physician of the team who delivered one 360-Joule biphasic shock resulting in successful conversion to spontaneous circulation. The collapse-to-shock interval was less than 5 minutes. Simultaneously with the arrival of the resuscitation team at the site of the cardiac arrest, the emergency medical services (EMS) were activated and the patient was transferred to the nearest assigned hospital where he was admitted to the cardiology intensive care unit (CCU).

Medical assessment revealed global systolic dysfunction with an ejection fraction (EF) of 25%. An acute myocardial infarction was initially suspected and the patient was transferred urgently for coronary angiography which, however, showed no coronary heart disease. The patient remained hemodynamically stable and mechanical ventilation was successfully interrupted 24 hours after admission. He remained in the CCU for 3 days. Full recovery was observed with normal cerebral function and no neurologic defects.

The patient, who is an active pharmacist, reported no history of heart disease. He had a history of arterial hypertension for which he was receiving valsartan and a history of hyperthyroidism being treated with unimazol. There was no history of smoking, alcohol or drug abuse. Additionally, no family history of sudden cardiac death or unexplained syncope was reported. However, a few days before the event he described fatigue, dizziness and mild breathlessness on walking. He also mentioned low-grade fever and symptoms of upper respiratory tract infection. He denied other cardiac symptoms.

Due to the aborted sudden death, insertion of an implanted cardioverter-defibrillator (ICD) was decided. The procedure was performed 21 days after the event during which time he remained in the hospital. His stay in the hospital was uneventful and the procedure of ICD implantation was uncomplicated. He was discharged home 23 days after the cardiac arrest episode.

The patient had regular follow-up out-patient assessments after discharge where a progressive improvement of the systolic function of the heart was observed. Surprisingly, the EF rose to 55% two months after the event. Six months after hospital admission he remains totally asymptomatic. There were no arrhythmias recorded by the implanted ICD device. He remains on medical treatment with ramipril 10 mg once a day, carvedilol 6.25 mg bid, furosemide 40 mg once a day, amiodarone 200 mg once a day and unimazole.

SUDDEN CARDIAC ARREST

Cardiovascular Disease (CVD) remains the leading cause of death both in the United States (U.S.) and in Europe. In almost 50% of the cases these deaths are sudden and unexpected.[1] The incidence of sudden cardiac arrest (SCA) varies in different studies, but it is estimated that 300,000 to 350,000 cases occur each year in the U.S., representing an overall incidence of 1 to 2 per 1000 inhabitants (0.1% to 0.2%) annually. Similar event rates are reported in Europe.[2-5] This large population is, however, heterogeneous including totally asymptomatic patients in whom sudden cardiac death (SCD) is the first and often the last presenting symptom as well as higher risk subgroups, such as adults with coronary heart disease, for which SCD can be predicted with greater accuracy.[2] Furthermore, survival rates following SCA are very poor; estimated in just 7.9% in the U.S.[3-6]

Cardiopulmonary resuscitation (CPR) and early defibrillation is critical to survival from SCA. Indeed, the vast majority of witnessed SCD is due to the unpredictable occurrence of ventricular fibrillation (VF). In addition electrical defibrillation is well established as the only effective therapy for cardiac arrest caused by VF or pulseless ventricular tachycardia (VT). The time interval between the onset of VF/VT and the delivery of the first shock (shock delivery within 5 minutes of Emergency Medical Services (EMS) call receipt) is the main determinant of the patient survival and discharge from the hospital. On the other hand, the probability of successful defibrillation diminishes rapidly over time and eventually, successful resuscitation is unlikely once the rhythm has deteriorated to asystole. It is estimated that in these cases, survival rates decrease 7% to 10% with each minute of delay between collapse and defibrillation, if no CPR is provided. If bystanders provide immediate CPR, the decrease in survival rates is more gradual and a shockable rhythm is more likely to be maintained. However, although it can double or triple survival from witnessed SCA, basic CPR alone is not a definitive treatment and is unlikely to restore a perfusing rhythm.[2,7-9]

It was known that VF could be effectively terminated with the application of immediate electrical therapy in the animal laboratory since 1850. However, it took more than 55 years before the first human defibrillation was successfully applied within the hospital environment (Cleveland, Ohio, USA, Case Western Reserve University).[10] Since then, thousands of cardiac patients have been saved by ventricular defibrillation within the hospital premises, mostly in the setting of an acute myocardial infarction. The growing number of implantable defibrillators among high risk cardiac patients has confirmed the efficacy of this life-saving therapy when applied early by prolonging life in patients with advanced cardiac disease at very high risk for SCD. However, the benefits of such prophylactic treatment are limited by the underlying cardiomyopathy, the costs and logistics of such an approach and mostly by the fact that the majority of SCD occur outside the setting of hospital environment, in otherwise "healthy" individuals not known to have an underlying heart disease, with the cardiac arrest being the first and the "last" manifestation of such a disease.[2,7-9]

It was, thus, logical to move our efforts towards prevention of SCD in the general population by implementing new management strategies in the community. This is achieved through a still evolving program of early mobilization of EMS that involves education, research and development of the appropriate conditions for early defibrillation in places where the likelihood of an unexpected SCD event is probable. In this setting, due to the overwhelming scientific evidence, a policy of early attempted defibrillation with the automatic external defibrillators (AED) in the hands of even trained lay persons is strongly recommended by current guidelines.[2,7-9]

USING AUTOMATED EXTERNAL DEFIBRILLATORS (AEDS)

Automated external defibrillators (AEDs) are sophisticated, reliable and relatively inexpensive (cost less than $2,000) computerized devices that use voice and visual prompts to guide lay rescuers and healthcare providers to safely defibrillate VF SCA (Fig. 1).[11] The operator is required to recognize cardiac arrest in an unresponsive patient and then attach the two adhesive AED electrodes to the chest using the standard positions. AEDs analyze multiple features of the surface ECG signal, monitor the cardiac rhythm and recognise VF and other ventricular tachyarrhythmias. If a shock is indicated the defibrillator charges itself to a predetermined level of energy, indicates when the shock is ready to be delivered and delivers a shock. There are two types of AEDs: most are semi-automatic but a few fully-automatic devices are available. A semiautomatic AED advises the need for a shock, but this has to be delivered by the operator when prompted. Fully-automatic AEDs will deliver the shock automatically. Instructions are provided on a screen sometimes with synthesized voice messages. While AED electrodes are attached to the chest, CPR should ideally be performed at the same time.[2,7,8]

Rescuers should place AED electrode pads on the victim's bare chest in the conventional sternal-apical (anterolateral) position (Class IIa) or alternatively in the biaxillary or the anterior/posterior position (Class IIa) (Fig. 2).[12] Most AED pads are labelled left and right, or carry a picture of their correct placement. If, however, they are placed in reversed position, the pads should not be replaced as this wastes time.[8,13] Excessive chest hair may be removed to achieve satisfactory contact of the pads, however as little time as possible should be spent on this so that defibrillation will not be delayed.[8]

FIGURE 1. Automated External Defibrillator.[11]

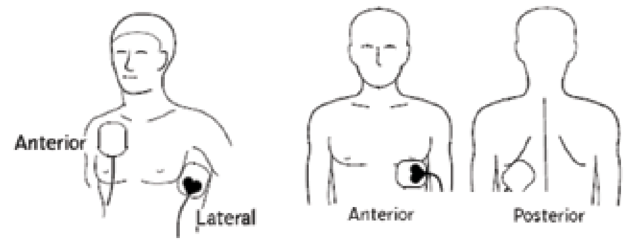

FIGURE 2. Conventional sternal-apical (anterolateral) position and anterior/posterior position for attaching the two adhesive AED electrodes.[12]

Operation of an AED must be integrated with immediate activation of the EMS system as well as with provision of CPR in order to be effective. It is recommended that in witnessed out-of-hospital cardiac arrest (OHCA) or in SCA that occurs in hospitals and other facilities when an AED is available, first responders should start CPR as soon as diagnosis is made, and attempt defibrillation when the AED becomes available. When an OHCA is not witnessed, healthcare professionals may give about 5 cycles (2 minutes) of CPR before checking the ECG rhythm and attempting defibrillation (Class IIb).[7,8,14,15] Intubation and administration of drugs may be achieved during CPR. The European Resuscitation Council's (ERC) guidelines are incorporated in an algorithm for the use of AEDs published in 2005 (Fig. 3).[7]

AEDs have been tested extensively, both in vitro and clinically in many field trials and they were found extremely accurate in rhythm analysis.[8] It is almost impossible to administer a shock inappropriately with an AED as the specificity of diagnosing a shockable rhythm is close to 100%. Sensitivity is somewhat less and fine VF is not always detected.[7]

For monophasic AEDs an energy level of 360 Joules for an initial shock is considered to be appropriate. Defibrillation using biphasic waveforms was at least as effective as with monophasic devices when equal or lower energy levels were used. However, no specific waveform has been shown to offer consistent advantages over the other. Regarding the use of second and third biphasic shocks, when VF proves refractory, energy ranges from 150J to 360J were studied without demonstrating an optimum level. Due to the insufficient evidence, guidelines do not recommend any waveform or level of energy for the initial or subsequent shocks.[2,7,8]

AEDS: OUTCOMES AND EXPERIENCE

It is recommended that an AED and properly trained personnel should be placed in every vehicle that may transport patients at risk for SCD. However, the availability of EMS within the time limitations of a cardiac arrest event in the community is jeopardized by conditions affecting unfavourably the time

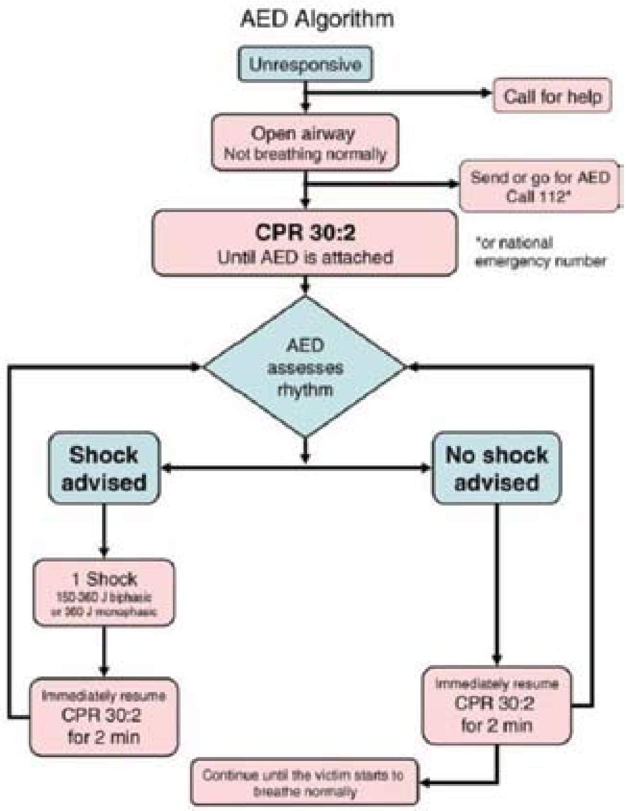

FIGURE 3. Algorithm for the use of an automated external defibrillator.[7]

interval from the call to shock responsiveness, especially in the large urban centers with heavy traffic problems. Thus, based on existing evidence, a policy of early attempted defibrillation has been suggested by the European Society of Cardiology (ESC), the American Heart Association (AHA) and National and International Resuscitation Councils by implementation of AED programs outside the EMS. These include community programs, on-site programs and home programs.

Since 1995 the AHA has recommended the development of public access defibrillation programs (PAD) (Class I).[8] The goal of PAD programs is to shorten the time from onset of VF until CPR and shock delivery, and thus to improve survival rates of OHCA, by ensuring that AEDs and trained lay rescuers are available in public areas where SCA is likely to occur.[8] Widespread CPR and AED training of the public was emphasized. Numerous studies since then, showed that the use of AEDs in persons experiencing OHCA, by both traditional and non-traditional first responders, in community-based PAD programs, is safe and effective and increases survival after sudden cardiac arrest.[2,16-24]

In the pilot Public Access Defibrillation Trial, the number of survivors from OHCA was doubled in lay rescuer combined CPR and AED programs compared with programs that provided only CPR.[20] In addition, a meta-analysis of three studies including 1,583 patients demonstrated that programs based on CPR plus early defibrillation with AEDs by trained non-healthcare professionals offer a significantly greater survival to hospital admission as well as greater survival to hospital discharge compared to CPR alone in OHCA.[25] Survival rates as high as 74% after witnessed OHCA were reported by different studies involving lay rescuer in PAD programs in airports, casinos and first-responder programs with police officers when CPR is immediately provided and defibrillation occurs within 3- 5 minutes of collapse.[7,8] A survival rate as high as 55% was observed in 2 large-scale airplane studies involving AEDs in the management of witnessed SCA. Reported results are impressive in locations such as on airplanes, in casinos and airports when SCA is often witnessed and an AED is immediately available.[19,26-32] An important finding, however, is that survival rates were not improved in programs that fail to reduce time to defibrillation.[33,34] Moreover, school-based AED programs provide a high survival rate for both student athletes and older non-students who suffer SCA on school grounds.[35] It has been proposed that schools, clubs and organizations sponsoring athletic events should have an established emergency response plan for SCA including access to early AEDs.[36] Furthermore, on-site programs with AEDs installed permanently in busy public places might prove a more effective strategy compared to community first responders who travel to the casualty equipped with mobile AEDs.[37]

PAD programs are now widespread in many countries. In September 2008, the International Liaison Committee issued a 'universal AED sign' to be adopted throughout the world to indicate the presence of an AED (Fig. 4).[38] To maximize the effectiveness, community lay rescuer AED programs

FIGURE 4. An automated external defibrillator stand in an Airport in Japan (left) and the 'universal AED sign' adopted by the International Liaison Committee in 2008 to indicate the presence of an AED (right)[39].

should be integrated into an overall EMS strategy for treating patients in cardiac arrest. Sites that deploy AEDs should establish a response plan, train candidate rescuers to recognize emergencies and use the AED but also to support ventilation and circulation with CPR, maintain equipment, coordinate with local EMS systems and maintain a process of continuous quality improvement that uses both routine inspections and post-event data to evaluate responder performance.[7,8,39,40] Additionally, a reasonable public health strategy would be to encourage the development of lay rescuer AED programs, protects lay rescuers and organizations implementing these programs from liability, support the development of less expensive, more user friendly AEDs and undertake public education campaigns.[41,42] In addition, small reductions in response intervals that have an impact on many residential victims may be more cost effective than the larger reductions in response interval achieved by PAD programs that have an impact on fewer SCA victims.[7]

Concerns about cost versus benefit still serve as barriers to widespread implementation of AEDs, but with their cost declining and increased public awareness, many communities have initiated PAD programs.[42] A "fire extinguisher model" has been proposed by some authors, in which AEDs should prominently displayed in public places for use by laypersons, much like fire extinguishers in order to widely disburse life-saving technology. Cost-effectiveness of this model has been questioned however, in terms that distributing AEDs this widely would be prohibitive and may not be more effective than more targeted placement.[43]

Lay rescuer AED programs will have the greatest potential impact on survival from SCA if the programs are created in locations where the risk of SCA is highest (Class I) in order to justify the cost of training and maintenance of these programs.[7,8] Such places could be: schools, airports, airplanes, casinos, sports facilities, police and fire department vehicles, high-density residential complexes.[2,7,8,39,40,44] Establishment at sites with a history of at least 1 OHCA every 2 years or where at least 1 OHCA was predicted during the study period (ie, sites having >250 adults over 50 years of age present for >16 h/d) has been proposed.[7,20] AEDs are increasingly being deployed at places where people gather or work, such as train stations, office buildings, factories, shopping malls, recreational facilities and restaurants and state, municipal and commercial buildings. However, as PAD programs become more widespread, there might be not enough AEDs and persons trained in using AEDs and performing CPR, resulting in lost opportunities to save more lives.

In Greece, special legislation is enacted on the use of AEDs, since 2007.[45] Accordingly, anybody who has been trained in using AED is allowed to do so. This population includes medical and paramedical personnel as well as anybody in the general population who has attended a "BLS plus AED" course certified by the National Resuscitation Council. It is important to mention however, that in cases where "non-trained lay rescuers use an AED in an attempt to save a SCA victim in a good will" there are no legal consequences. It is also stated that AEDs should be deployed at sites "such as public services, ports, airports, airplanes, ships, sport faculties, hotels, schools, malls, rail and bus stations". "Any site with estimated SCA incidence of >2 OHCA/year or sites where >1 OHCA occurred in the last 2 years or sites having >250 adults over 60 years of age present for >16 h/d are considered eligible". "AEDs should be in a 1- 1.5 min walking distance from any event, in an easily accessible site, next to a telephone". Despite legislation and the regular provision of courses consistent with ERC Guidelines, by the National Resuscitation Council, AEDs in Greece are not as widespread as in other countries. In a European Survey,[46] it was revealed that although first-tier ambulances are equipped with AEDs, non-emergency vehicles that carry patients are not. Moreover use by non-physicians is implemented in a few cases, reflecting probably the inadequate level of public education campaigns. In addition, early defibrillation is hardly provided by community or on-site responders, there are no school or home PAD programs and only in a few cases of SCA in hospitals are AEDs used. Although there are a few case reports,[27] only sporadic CPR registries (including AED use) and inventories of AEDs are reported and there are hardly any epidemiologic or/ and economic evaluations when planning AED programs.[46] It seems that most airplanes are now equipped with AEDs. However, only central airports have adopted a PAD strategy and only a few train and underground stations and ships have such devices.[46] Additionally, only 4 of 16 Greek football fields included in a recent European study were equipped with AEDs.[47]

FIRST RESPONDERS

The concept of public access defibrillation with implementation of community programs outside the EMS as previously mentioned requires training in AED use of volunteers who should be able to recognize a cardiac arrest victim, use effectively the closest available AED and cooperate with the local EMS system appropriately. Development of automated equipment has made attempted defibrillation available to a much wider range of healthcare professionals (medical, nursing, paramedical) but also expanded defibrillation beyond conventional EMS and ambulances to non-medical groups.[2,7,8]

Several authors have pointed to improved survival rates in OHCA by the use of trained lay rescuers ("first responder defibrillation") using the AED and calling the EMS. "First responders" represent designated personnel in certain public settings and could include police officers, fire-fighters, security personnel, lifeguards, and flight attendants, sport marshals and many other volunteer first aiders. After minimal training in the use of AEDs, achieved much more rapidly and easily than for manual defibrillators, lay workers are able to use defibrillators in the workplace with lifesaving effects. Adjustment of cardiac arrest algorithms in order to accommodate use by first responders has been made. AEDs should be deployed within a medically-controlled system under the direction of a medical adviser.[7,8,14,25]

Alternatively, few authors have presented promising results when PAD was performed by untrained lay rescuers, with survival increase up to 36% when bystanders performed CPR and operated an AED compared to CPR alone in OHCA. It is estimated that bystander CPR plus use of an AED in the United States and Canada saves 522 lives a year. In most cases, untrained users were able to adequately use the AED.[48,49,50]

A third strategy could be defibrillation by first responders via simultaneously paired dispatches of emergency medical responders and dual dispatch defibrillation by trained first responders. SALSA pilot project resulted in shortened response times and improved survival, especially in witnessed OHCA where one month survival rose from 5.7% to 9.7%.[51]

TRAINING

Several studies suggest that PAD by rescuers with minimal previous AED training is feasible. Thus, organized AED training should focus on community and on-site responders, and must be provided by appropriately qualified individuals who have clinical expertise in resuscitation (e.g. resuscitation training officers, medical or nursing staff) with periodic refresher retraining. Basic life support (BLS) skills must also be taught, assessed, and refreshed in accordance with current guidelines.

On average, the length of an instructor-led course in Europe is 3 hours 15 minutes for CPR and 2 hours 45 minutes for use of an AED and training organisations often provide a certificate of course completion or course attendance.[52] There is, however, a move towards shorter courses and combining CPR and AED training in one session. Newer teaching techniques, particularly video-based self-instruction, appear to be effective and to reduce the time needed to acquire resuscitation skills. For these reasons, it is not possible to recommend an optimum duration for a CPR/ AED course.[52] Since VF becomes more treatable and durable, when the time to shock is delayed, if appropriate BLS has been initiated promptly and sustained until the AED arrival, it seems reasonable to support the view that combined BLS and AED training should be recommended. Skill maintenance at an effective level is very important, and individual employers and organizations should make arrangements in order lay rescuers to obtain frequent retraining. The frequency will depend on the individual but refresher training is encouraged at 6 to 12 months intervals.[7,52]

AEDS IN PRIVATE RESIDENCE

Approximately 80% of OHCA occur in private or residential settings,[53] and thus placement of AEDs at home appears to be a reasonable and potentially attractive option in those cases where an implanted cardioverter-defibrillator (ICD) will not be available. However, due to the lack of evidence documenting the effectiveness of home AED deployment there is no recommendation at present for or against personal or home deployment of AEDs (Class Indeterminate).[8] In a recent study access to a home AED did not significantly improve overall survival, as compared with reliance on conventional resuscitation methods.[54] It is suggested that home programs are still in a preliminary phase of implementation with primary targets for pilot projects on home defibrillation being families with a genetic predisposition to SCD or families with high risk patients not scheduled or unable to receive an implantable device. AEDs for home use have been approved in the U.S. for families with high-risk inherited arrhythmias such as the long-QT syndromes and hypertrophic cardiomyopathy with appropriate training of close family members.[2]

IN-HOSPITAL AEDS

Many cardiac arrests occur in visitors or staff members within the hospital's public areas or in non-monitored hospital beds. Survival outcomes of hospital visitors compared unfavourably to that of recently published experience with OHCA victims.[55,56] Furthermore, in a study it was reported that only 53% of patients suffering in-hospital cardiac arrest were in monitored wards.[56] Additionally, it was revealed that, the median collapse-to-shock interval was 1 minute in monitored wards and 5 minutes in non-monitored wards.[56]

There are only a few data comparing efficacy of AEDs versus manual defibrillators reflecting the limited existence of in-hospital early defibrillation programs. However, two studies indicated higher rates of survival to hospital discharge when AEDs were used to treat adult VF or pulseless VT in the hospital.[57,58] Despite limited evidence, the placement of AED in hospital settings with concurrent training of all medical and non-medical personnel will probably improve unacceptable collapse-to-first shock intervals still observed today in such places. Early defibrillation capability should be available throughout lobbies, cafeterias or parking lots, ambulatory care facilities as well as unmonitored wards (e.g. outpatient and diagnostic facilities, inpatient clinics) especially where staff has no rhythm recognition skills or defibrillators are used infrequently. Collapse-to-first shock interval should be enabled within 3 minutes in all areas of the hospital, consistent with goals established in the out-of-hospital setting. An effective system for training and retraining as well as monitoring collapse-to-first shock intervals and resuscitation outcomes should operate in hospitals.[7,8,14,39]

SPECIAL CONSIDERATIONS

The AHA guidelines on use of AEDs by trained individuals require additional actions in 4 special situations, namely: victims in water, infants or children less than 8 years of age or less than 25 kg, those with transdermal medication patches and those with implanted devices.

Water, as a good conductor of electricity, may be associated with a small possibility that rescuers may receive shocks or minor burns if they are within the AED and the wet victim. If an unresponsive victim is lying in water or if the victim's chest is covered with water or the victim is extremely diaphoretic, it is recommended to remove the victim from freestanding water and dry the victim's chest before using the AED. Particular care should be taken to ensure that no one is touching the victim when a shock is delivered. As long as there is no direct contact between the operator and the victim there is no direct pathway that the electricity can cause the user to experience a shock. AEDs can be used when the victim is lying on snow or ice.[7,8]

Cardiac arrest is less common in *children*. Additionally VF is observed in only 5%- 15% of pediatric and adolescent arrests. In these patients rapid defibrillation may improve outcomes. Both the lowest energy dose for effective defibrillation and the upper limit for safe defibrillation in infants and children are not known. Recommended manual defibrillation (monophasic or biphasic) doses are 2 J/kg for the first attempt (Class IIa) and 4 J/kg for subsequent attempts (Class Indeterminate). However, doses as high as 9 J/kg have effectively been used with no significant adverse effects. Biphasic shocks appear to be at least as effective as monophasic shocks and less harmful.[8] AEDs have also been successfully used in children.[8,59] Smaller, paediatric, self-adhesive pads, some equipped with pediatric attenuator systems, to reduce the delivered current during defibrillation to a dose suitable for children are available. Standard AEDs are suitable for use in children older than 8 years. For children 1 to 8 years of age, a pediatric dose-attenuator system should be used if available, otherwise a standard AED should be used. There is insufficient data to support a recommendation for or against the use of AEDs for infants less than 1 year of age (Class Indeterminate). Currently there are no recommendations for or against AED placement in locations where children are present.[8] Ideally healthcare systems that routinely provide care to children at risk for SCA should have available manual defibrillators capable of dose adjustment.[8,59] In this group of patients priority should be also given to the airway support, oxygenation and ventilation.

In case transdermal patches (e.g., containing nitroglycerin, nicotine, analgesics, hormone replacements, antihypertensives) are present on the victim's chest, these should be removed and the area wiped clean before the AED electrode is attached. Patches may block delivery of energy from the electrode pad to the heart and may cause small burns to the skin if AED electrode pads are directly applied on them.

In order to avoid block delivery of energy from the electrode pad to the heart as well as small burns to the skin, the electrode pad should be placed at least 2.5 cm away from a pacemaker or ICD (Class Indeterminate), to maximize effectiveness of defibrillation attempts in victims equipped with such devices. If the victim has an ICD that is delivering shocks allow 30- 60 seconds for the ICD to complete the treatment cycle before attaching an AED.[8]

CONCLUSIONS

It is increasingly recognized that the call-to-shock time interval is crucial for the successful resuscitation of the most commonly encountered VF cardiac arrest victim in the community. The goal is to achieve times less than 5 min in duration. The use of automated external defibrillators by trained traditional and non-traditional emergency medical providers and by laypersons in community-based public-access defibrillation programs has been shown to increase survival after OHCA, due to earlier access to defibrillation. AEDs have proven to be safe, reliable, and efficacious in the diagnosis and treatment of ventricular arrhythmias in a variety of outpatient settings.

In summary, use of AEDs is rapidly expanding in many parts of the world and in many cases it has become an important component of emergency medical systems. Further development requires a well performing EMS system but also the development of on-site community and home programs with the availability of AEDs to appropriately trained rescuers. Additionally, supportive government measures are required in order objections in providing defibrillation therapy by non-medical professionals lay persons that still exist in some countries be raised and to achieve a cost effective approach with significant impact in the prevention of SCD with further improvements in survival in the general population.

The case we presented in the introduction demonstrates the tremendous impact of early defibrillation in the community. It was proven a "life saving procedure" in a middle aged man with a firstly diagnosed case of reversible acute myocarditis. Indeed a large number of unsuspected cardiomyopathy patients of otherwise different treatable causes could be "rescued to life" with a supporting community program incorporating EMS, BLS and AEDs.

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