Preventing Sudden Death on the Athletic Field: The Emergency Action Plan

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Sudden cardiac arrest (SCA) is the leading cause of death in young athletes. Proper management of SCA in the athletic venue is critical. Preparation should include education and training, maintenance of emergency equipment and supplies, appropriate use of personnel, and the formation and implementation of an emergency action plan (EAP). The EAP should be specific to each individual athletic venue and encompass emergency personnel, emergency communication, emergency equipment, medical emergency transportation, and venue directions with map. With SCA, access to early defibrillation is essential. A target goal of under 5 minutes from time of collapse to first shock is strongly recommended. An automated external defibrillator should be part of standard emergency planning for coverage of athletic activities. Through development and implementation of an EAP, healthcare providers help to ensure that the athlete will have the best care provided when an emergency situation does arise.

Introduction

Sudden cardiac arrest (SCA) is the leading cause of death in young athletes [1–3]. Athletes are considered the healthiest members of our society, and their unexpected death during training or competition is a catastrophic event that stimulates the debate regarding both preparticipation screening evaluations and appropriate emergency planning for athletic events. Despite preparticipation screening, healthy-appearing competitive athletes may harbor unsuspected cardiovascular disease with a potential to cause sudden death. Athletes usually display no symptoms prior to the event and few athletes are identified as at-risk prior to the event. Death is usually associated with intense physical activity, either during the activity or immediately afterward [1–3]. Due to the relatively low incident rate of SCA in athletics, sports medicine professionals may develop a false sense of security. Proper management of SCA in the athletic venue is critical. SCA should be managed by trained healthcare personnel. Preparation should include education and training, maintenance of emergency equipment and supplies, appropriate use of personnel, and (perhaps most importantly) the formation and implementation of an emergency action plan (EAP).

SCA Case Study #1

In August of 1995, a 53-year-old white male veteran intercollegiate football official was performing a required physical performance assessment 1.5-mile run in Birmingham, Alabama, as a part of the Southeastern Conference (SEC) official's testing. Prior to the run, the patient had undergone a physical examination including baseline laboratory testing and a graded exercise test; he had been cleared by a physician to participate. The official completed the 1.5-mile run within the required time; however, shortly after the run, he sat in the stadium bleachers to cool down and suddenly collapsed with SCA. Immediate cardiopulmonary resuscitation (CPR) was initiated by certified athletic trainers. Track-side paramedics responded. The official was found to be in ventricular fibrillation. Manual defibrillation was initiated in less than 2 minutes from the time of collapse. The patient converted to a perfusing rhythm on the second shock. Oxygen was administered with bag-valve-mask and advanced cardiac life support (ACLS) was initiated on-site prior to transport with intravenous (IV) and cardiac medications. The patient was air-lifted to a cardiac care facility and underwent an emergency heart catheterization. The patient survived and achieved a full recovery with an ultimate return to football officiating [4].

This case demonstrates the effectiveness of the EAP. This testing was coordinated by certified athletic trainers and physicians from various SEC conference schools.

Due to the location of the SEC conference office in Birmingham, Alabama, the testing was performed at a small non-SEC university campus in Birmingham. The medical team made an advance visit to the site prior to the testing and evaluated the site. Locked gates were opened for access and an ambulance and paramedic crew were coordinated to be on-site for the testing. Certified athletic trainers and physicians were assigned stations on the track. Emergency communication emergency medical equipment were available.

SCA Case Study # 2

In March of 2006, a 19-year-old black male basketball player at Vanderbilt University in Nashville, Tennessee, was participating in a practice when he suddenly collapsed. The athlete had no previous symptoms of palpitations, dizziness, or syncope. He had no family history of sudden death or cardiac abnormalities. The athlete was evaluated on the court by a certified athletic trainer and found to be in cardiac arrest. An automated external defibrillator (AED) was applied and an analysis was initiated in less than 2 minutes from the collapse. The athlete was found to be in ventricular fibrillation and one shock was delivered, which converted the athlete to a perfusing rhythm. Two rescue breaths were administered following the shock and the athlete began breathing on his own. He was placed on oxygen therapy with a nonrebreather mask and transported to the hospital for further evaluation. An angiogram was performed, which revealed normal coronary arteries. Further diagnostic testing revealed hypertrophic cardiomyopathy. An implantable cardioverter fibrillator (ICD) was implanted 2 days following the SCA and the athlete was discharged the following day from the hospital. The athlete was medically disqualified from further intercollegiate athletic activity; however, he continues to be in good health [4]. This case again demonstrates the effectiveness of an EAP. A rapid emergency response was facilitated due to prior planning and quick access to appropriate emergency equipment.

Emergency Planning in Athletics

Every organization that sponsors athletic activities should have a written and structured EAP. The EAP should be developed and coordinated in consultation with local emergency medical services (EMS) personnel, school public safety officials, on-site first responders, and school administrators, and reviewed with certified athletic trainers, team and attending physicians, athletic training students, school and institutional safety personnel, administrators, and coaches [5,6•,7]. Sports medicine staffs may be responsible for the care of others in addition to athletes, including coaches, officials, and spectators.

Components of the Emergency Plan

The EAP should be specific to each individual athletic venue and encompass the following:

1. Emergency personnel
2. Emergency communication
3. Emergency equipment
4. Medical emergency transportation
5. Venue directions with map

Emergency Plan Personnel

With athletic practice and competition, the first responder to an emergency situation is typically a member of the sports medicine staff, most commonly a certified athletic trainer, or EMS services. A team physician may not always be present at every organized practice or competition. The type and degree of sports medicine coverage for an athletic event may vary widely, based on such factors as the sport or activity, the setting, and the type of training or competition. The first responder in some instances may be a coach, strength and conditioning staff, or other institutional personnel. Certification in CPR, first aid, prevention of disease transmission, and EAP review should be required for all athletics personnel associated with practices, competitions, skills instruction, and strength and conditioning, and copies of training certificates and/or cards should be maintained.

The development of an EAP cannot be complete without the formation of an emergency team. The emergency team may consist of a number of healthcare providers including physicians, emergency medical technicians, certified athletic trainers, athletic training students, coaches, equipment managers, and possibly bystanders. Roles of these individuals within the emergency team may vary depending on various factors such as the number of members of the team, the athletic venue itself, or the preference of the team physician and the head athletic trainer. There are four basic roles within the emergency team. The first and most important role is establishing safety of the scene and immediate care of the athlete. Acute care in an emergency situation should be provided by the most qualified individual on the scene. Individuals with lower credentials should yield to those with more appropriate training. The second role, EMS activation, may be necessary in situations where emergency transportation is not already present at the sporting event. This should be done as soon as the situation is deemed an emergency or a life-threatening event. Time is the most critical factor under emergency conditions. Activating the EMS system may be done by anyone on the team. However, the person chosen for this duty should be someone who is calm under pressure and who communicates well over the telephone. This person should also be familiar with the specific location and address of the sporting event.

The third role, equipment retrieval, may be done by anyone on the emergency team who is familiar with the types and location of the specific equipment needed. Athletic training students, equipment managers, and coaches are good choices for this role. The fourth role of the emergency team is that of directing EMS to the scene. One member of the team should be responsible for meeting emergency medical personnel as they arrive at the site of the emergency. Depending on ease of access, this person should have keys to any locked gates or doors that may slow the arrival of medical personnel. An athletic training student, equipment manager, or coach may be appropriate for this role. When forming the emergency team, it is important to adapt the team to each situation or sport. It may also be advantageous to have more than one individual assigned to each role. This allows the emergency team to function even though certain members may not always be present. Preparation is the key to emergency response. The healthcare team should regularly review the EAP and rehearse SCA simulations to work effectively as a team.

Emergency Communication

Communication is the key to quick emergency response. Athletic trainers and emergency medical personnel must work together to provide the best emergency response capability and should have contact information, such as a telephone tree, established as a part of preplanning for emergency situations. Communication prior to the event is a good way to establish boundaries and to build rapport between both groups of professionals. If emergency medical transportation is not available on-site during a particular sporting event then direct communication with the emergency medical system at the time of injury or illness is necessary.

Access to a working telephone or other telecommunications device, whether fixed or mobile, should be assured. The communications system should be checked prior to each practice or competition to ensure proper working order. A back-up communication plan should be in effect should there be failure of the primary communication system. At any athletic venue, whether home or away, it is important to know the location of a workable telephone. Prearranged access to the phone should be established if it is not easily accessible. A copy of the EAP should be posted by the telephone (Fig. 1).

Emergency Equipment

All necessary emergency equipment should be at the site and quickly accessible. Personnel should be familiar with the function and operation of each type of emergency equipment. Equipment should be in good operating condition and personnel must be trained in advance to use it properly. Emergency equipment should be checked on a regular basis and its use rehearsed by emergency personnel. The emergency equipment available should be appropriate for the level of training for the emergency medical providers. Creating an equipment inspection log book for continued inspection is strongly recommended. It is recommended that a few members of the emergency team be trained and responsible for the care of the equipment. It is important to know the proper way to care for and store the equipment, as well. Equipment should be stored in a clean and environmentally controlled area. It should be readily available when emergency situations arise.

With SCA, ideally an AED should be on-site at the athletic venue at a minimum. In addition to the AED, the AED kit should include an extra set of electrodes, shears for clothing removal, a razor for hair removal if necessary, an absorbent towel to dry the skin, stick antiperspirant (with aluminum chlorohydrate) for excessive sweating in locations where electrodes may not adhere, some type of barrier device for ventilations, and gloves. Optional equipment may include oxygen, bag-valve-mask, advanced airway equipment (endotracheal tube, Combitube [Tyco-Kendall, Mansfield, MA], or laryngeal mask airway), and IV supplies and ACLS drugs, based upon physician availability.

With SCA, access to early defibrillation is essential. A target goal of under 5 minutes from time of collapse to first shock is strongly recommended [8,9••]; time from collapse to shock is the critical determinant in survival [10]. Increased survival rates have been documented in settings where first responders have been trained in AED use and AEDs are available for rapid response to SCA [11–16]. Recent studies have documented use of AEDs in intercollegiate athletic settings [17,18••,19••,20,21]. The American Heart Association [9••], National Athletic Trainers Association [17], and the 36th Bethesda Conference guidelines [8] recommend that AEDs should be available at educational facilities that have competitive athletic programs. Again, the recommended target goal of under 5 minutes from collapse to shock should be taken into consideration in determining the number of AED units and placement of these units.

Medical Emergency Transportation

Emphasis should be placed on having an ambulance on-site at high-risk sporting events. EMS response time should be factored in when determining on-site ambulance coverage. Consideration should be given to the capabilities of transportation service available (ie, basic life support or advanced life support) as well as the equipment and level of trained personnel on board the ambulance. In the event that an ambulance is on-site, there should be a designated location with rapid access to the site and a cleared route for entering and exiting the venue.

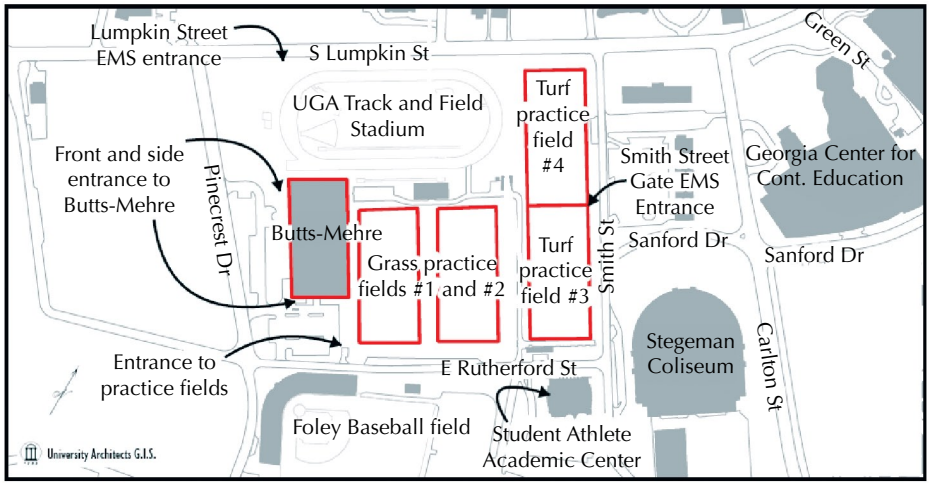
FOOTBALL EAP: Butts-Mehre Hall, Woodruff Practice Fields
Revised 8/1/06

ADDRESS: 1 Selig Circle, Athens, GA

VENUE DIRECTIONS
Butts-Mehre Hall is located on Pinecrest Street (cross-street Lumpkin). Two entrances provide access to building:
1. Main entrance: front of building on Pinecrest Street (directly across from Barrow Elementary School).
2. Athletic training room entrance: rear of building, access from driveway off of Smith Street.

Football practice fields are located with two fields adjacent to Rutherford Street and two fields adjacent to Smith Street. Two gates provide access to football practice fields: Smith Street opens to artificial turf practice fields and access road. Gate on East Rutherford Street opens to grass practice fields.

GPS Coordinates (in event of the need for a medical helicopter transport): 33 56.54 / 83 22.83 (practice field 2)



Football: Butts-Mehre Hall, Woodruff Practice Field

EMERGENCY PERSONNEL
Butts-Mehre Hall: certified athletic trainers, student athletic trainers, and physician (limited basis) on site in athletic training facility, located on first floor.
Football Practice Fields: certified athletic trainers and student athletic trainers on site for practice and workouts.

EMERGENCY COMMUNICATION
Butts-Mehre Hall: fixed telephone lines in Butts-Mehre Hall **(000-000-0000)** and athletic training facility adjacent to practice fields **(000-000-0000)**.

Football Practice Fields: certified athletic trainers carry cellular telephones.
Physician #1 name @ 000-000-0000; Physician #2 name @ 000-000-0000; Physician #3 name @ 000-000-0000.
Fixed telephone line under practice shed **(000-000-0000)**.

EMERGENCY EQUIPMENT
Butts-Mehre Hall: emergency equipment (AED, trauma kit, splint kit, spine board, ProPak vital signs monitor, Philips MRx 12-lead ECG/defibrillator) located within athletic training facility on first floor.
Football Practice Fields: emergency equipment (AED, trauma kit, splint kit, spine board) maintained on motorized medical cart parked adjacent to practice shed during practice; additional supplies maintained under practice shed; additional emergency equipment accessible from Butts-Mehre athletic training facility adjacent to track.

Roles of First Responders
1. Immediate care of the injured or ill student-athlete.
2. Activation of emergency medical system (EMS).
   a. 9-911 call (provide name, address, telephone number, number of individuals injured, condition of injured, first aid treatment, specific directions, other information as requested.
   b. Notify campus police at 000-0000.
3. Emergency equipment retrieval.
4. Directions of EMS to scene.
   a. Open appropriate gates (Smith Street gate has keycard entry; other gates secured with padlocks for M60 key).
   b. Designate individual to "flag down" EMS and direct to scene.
   c. Scene control: limit scene to first aid providers and move bystanders away from area.

Figure 1. Sample emergency action plan.

In the medical emergency evaluation, the primary survey assists the emergency care provider in identifying emergencies requiring critical intervention and in determining transport decisions. In an emergency situation, the athlete should be transported by ambulance, where the necessary staff and equipment is available to deliver appropriate care. Emergency care providers should refrain from transporting unstable athletes in inappropriate vehicles. Care must be taken to ensure that the activity areas are supervised should the emergency care provider leave the site in transporting the athlete. Any emergency situations in which there is impairment in level of consciousness, airway, breathing, or circulation, or there is neurovascular compromise, should be considered a "load and go" situation with emphasis placed on rapid evaluation, treatment, and transportation.

Venue Directions with Map

The EAP should include specific directions to the venue, including the exact street address, cross streets, and any landmarks that may make the site easier for EMS to locate. Ideally, prior to the start of the athletic season, a meeting should be held at the athletic venue with sports medicine staff members and EMS personnel to familiarize everyone with the exact location and discuss emergency management issues. Considerations should be made for ambulance ingress and egress to the site in terms of gates, stadium portals, and so on. If helicopter transport is a viable option, a landing site should be designated and global positioning system (GPS) coordinates included in the EAP.

EAP Tip From the Field: Pocket Emergency Card

Sports medicine healthcare professionals should consider preparing pocket emergency cards. This index card-sized item can be laminated and carried on-person in the event of an emergency. The EAP cards should include on one side the EAP with written directions and highlighted map, and on the other side pertinent medical information of athletes, such as medical conditions, allergies, and medications.

Recognition of SCA

Recognition of SCA in athletes may be difficult due to the relatively low overall occurrence. High suspicion of SCA should be maintained for any collapsed and unresponsive athlete. Barriers to recognizing SCA in athletes may include inaccurate assessment of pulse or respirations, agonal gasping, and myoclonic or seizure-like activity [18••,19••,20–22]. Additionally, athletes who suddenly collapse following a blow to the chest should be suspected of commotio cordis [23–27].

Emergency Treatment of SCA

CPR is critical to maintaining the supply of oxygen to vital organs, but the single most effective treatment for cardiac arrest is defibrillation. Access to early defibrillation and an AED should be part of standard emergency planning for coverage of athletic activities [8,9••,17,22]. The American Heart Association uses four links in a chain (the "Chain of Survival") to illustrate the important time-sensitive actions for victims of SCA.

1. Early recognition of the emergency and activation of the EMS or local emergency response system: "phone 911."
2. Early bystander CPR: immediate CPR can double or triple the victim's chance of survival from ventricular fibrillation (VF) SCA.
3. Early delivery of a shock with a defibrillator: CPR plus defibrillation within 3 to 5 minutes of collapse can produce survival rates as high as 49% to 75%.
4. Early advanced life support followed by postresuscitation care delivered by healthcare providers [28••].

Management of SCA

Initiation of CPR

Victims of cardiac arrest need immediate CPR. CPR provides a small but critical amount of blood flow to the heart and brain. CPR prolongs the time VF is present and increases the likelihood that a shock will terminate VF (defibrillate the heart) and allow the heart to resume an effective rhythm and effective systemic perfusion. CPR is especially important if a shock is not delivered for 4 or more minutes after collapse. Defibrillation does not "restart" the heart; defibrillation stuns the heart, briefly stopping VF and other cardiac electrical activity. If the heart is still viable, its normal pacemakers may then resume firing and produce an effective electrocardiographic rhythm, which may ultimately produce adequate blood flow.

Rescue breaths should be given with a barrier device, pocket mask, or bag-valve-mask, delivering two breaths, each over 1 second, producing visible chest rise. Effective chest compressions are essential for providing blood flow during CPR. To give effective chest compressions, "push hard and push fast." Compress the adult chest at a rate of about 100 compressions per minute, with a compression depth of 1 to 2 inches (approximately 4–5 cm). Allow the chest to recoil completely after each compression, and allow approximately equal compression and relaxation times. Minimize interruptions in chest compressions. Rescuer fatigue may lead to inadequate compression rates or depth. Significant fatigue and shallow compressions are seen after 1 minute of CPR, although rescuers may deny that fatigue is present for 5 minutes. When two or more rescuers are available, it is reasonable to switch the compressor about every 2 minutes (or after five cycles of compressions and ventila-

tions at a ratio of 30:2). Every effort should be made to accomplish this switch in under 5 seconds. If the two rescuers are positioned on either side of the patient, one rescuer will be ready and waiting to relieve the working compressor every 2 minutes [28••,29–31].

Application of AED

An AED should be applied as soon as possible and turned on for rhythm analysis in any collapsed and unresponsive athlete. CPR should be implemented while waiting for an AED if one is not immediately available. Interruptions in chest compressions should be minimized and CPR stopped only for rhythm analysis and shock. CPR should be reinitiated immediately after the first shock with repeat rhythm analysis following 2 minutes or five cycles of CPR [28••,29–32].

Healthcare providers must practice efficient coordination between CPR and defibrillation. When VF is present for more than a few minutes, the myocardium is depleted of oxygen and metabolic substrates. A brief period of chest compressions can deliver oxygen and energy substrates, increasing the likelihood that a perfusing rhythm will return after defibrillation (elimination of VF). Analyses of VF waveform characteristics predictive of shock success have documented that the shorter the time between a chest compression and delivery of a shock, the more likely the shock will be successful. Reduction in the interval from compression to shock delivery by even a few seconds can increase the probability of shock success [33–35].

The rescuer providing chest compressions should minimize interruptions in chest compressions for rhythm analysis and shock delivery and should be prepared to resume CPR, beginning with chest compressions, as soon as a shock is delivered. When two rescuers are present, the rescuer operating the AED should be prepared to deliver a shock as soon as the compressor removes his or her hands from the victim's chest and all rescuers are clear of contact with the victim. The lone rescuer should practice coordination of CPR with efficient AED operation [28••,29–31].

Shock first versus CPR first

When any rescuer witnesses SCA and an AED is immediately available on-site, the rescuer should use the AED as soon as possible. When the SCA is not witnessed and/or the time interval from collapse to first shock is greater than 5 minutes, 2 minutes of CPR should be performed prior to defibrillation [28••,29–31].

Advanced airway

Once an advanced airway (endotracheal tube, Combitube, or laryngeal mask airway) is in place, two rescuers no longer deliver cycles of CPR (ie, compressions interrupted by pauses for ventilation). Instead, the compressing rescuer should give continuous chest compressions at a rate of 100 per minute without pauses for ventilation. The rescuer delivering ventilation provides 8 to 10 breaths per minute. The two rescuers should change compressor and ventilator roles approximately every 2 minutes to prevent compressor fatigue and deterioration in quality and rate of chest compressions. When multiple rescuers are present, they should rotate the compressor role approximately every 2 minutes [28••,29–31].

Provisions to Coordinate with Local EMS

In the event of a cardiovascular emergency, the 911 emergency medical system should be activated as quickly as possible. It is critical that the individual making the 911 call provide as much information as possible, as ambulance routing and emergency medical technician (EMT)-paramedic response are based upon this information. For example, a 911 call for "an athlete passed out" may trigger an ambulance response and the EMT-paramedics arriving with a jump bag, whereas, a 911 call for "an athlete in cardiac arrest with CPR administered on scene" may trigger an ambulance and an additional rescue unit, placing multiple EMT-paramedics at the scene who, with advance knowledge of the situation, arrive with defibrillator, oxygen/airway equipment, and ACLS drugs in hand. Emergency management of SCA requires multiple healthcare providers, with needs for CPR, assisted ventilations with bag-valve-mask, defibrillation, starting IVs for ACLS drugs, and so on. The first responders should provide initial care as appropriate to the situation and coordinate with other EMS providers upon their arrival in the provision of CPR, defibrillation, basic life support, and advanced life support.

Special Situations

AEDs may be used in a wet environments such as rain or snow. They may be used on athletes wearing sweat-soaked athletic equipment or lying on a wet surface. For example, with a football, hockey, or lacrosse player in SCA, the healthcare provider should not take time for equipment removal. He or she should simply cut through the front of the pads, exposing the chest for AED electrode application. However, SCA victims in a pool or body of water should be removed from the water prior to defibrillation. SCA victims lying on metal conducting surfaces should be moved to a nonmetal surface or placed on a spine board before defibrillation. Medical coverage for remote locations or large area events, such as a cross-country meet or a road race, must be considered. Provisions such as rapid response teams on bicycles, golf carts, or all-terrain vehicles may be viable options. Scene safety must additionally be considered. For example, SCA may occur following lightning strike. If the lightning storm is on-going, the healthcare professionals should ensure their personal safety by moving the SCA victim indoors if possible.

Conclusions

The importance of being properly prepared when athletic emergencies arise cannot be stressed enough. An athlete's survival may hinge on how well trained and prepared athletic healthcare providers are. It is prudent to invest organizational ownership in the EAP by involving the athletic administration and sport coaches, as well as sports medicine personnel. The EAP should be reviewed at least once a year with all athletic personnel, along with CPR and first aid refresher training. Through development and implementation of an EAP, healthcare providers help to ensure that the athlete will have the best care provided when an emergency situation does arise.

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