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A Case Study: Sudden Cardiac Arrest in Young Athlete

Denada Florencia Leona [a*]

[a] *Andalas University, Dr. Mohammad Hatta Limau Manis, Padang, 25163, Indonesia*

A B S T R A C T

Sudden cardiac arrest (SCA) in young athletes is a devastating event that often leads to death if not promptly managed. This case report discusses the unfortunate death of a 17-year-old male soccer player who suffered a sudden cardiac arrest during a match. Despite the presence of bystanders, the lack of immediate access to an Automated External Defibrillator (AED) and delayed emergency medical response contributed to the fatal outcome. This report highlights the critical need for preparedness, including the availability of AEDs and the training of personnel in CPR and emergency response.

Keywords: Cardiac Arrest, Young Athlete, Emergency, Delayed

Introduction

Sudden cardiac arrest is a leading cause of mortality in young athletes, frequently caused by undiagnosed cardiac abnormalities. The promptness of the emergency response, including immediate CPR and defibrillation, is crucial for survival. This case underscores the severe consequences of a delayed response and the importance of AED accessibility in sports facilities. Cardiac arrest is a sudden and often unexpected cessation of heart function, leading to a cessation of blood flow to the brain and other vital organs. Without immediate intervention, cardiac arrest almost invariably results in death within minutes. This catastrophic event can strike individuals of all ages and health statuses, including young and seemingly healthy athletes. Although athletes are often regarded as paragons of physical fitness and health, they are not immune to cardiac emergencies. In fact, sudden cardiac arrest (SCA) in athletes is particularly alarming due to its unexpected nature and occurrence during peak physical activity.[1]

Sudden cardiac arrest is one of the leading causes of death in athletes, particularly among those participating in high-intensity sports. The incidence of SCA in athletes is relatively low compared to the general population; however, the impact is profound due to the typically young age of the victims and the high-profile nature of these events. The causes of SCA in athletes are diverse and often rooted in underlying cardiovascular abnormalities that may remain undetected during routine health screenings. Common etiologies include hypertrophic cardiomyopathy (HCM), arrhythmogenic right ventricular cardiomyopathy (ARVC), congenital coronary artery anomalies, myocarditis, and other inherited or acquired cardiac conditions.[1,2]

Hypertrophic cardiomyopathy, characterized by abnormal thickening of the heart muscle, is one of the most prevalent causes of SCA in young athletes. This condition can lead to obstructed blood flow and life-threatening arrhythmias, particularly during strenuous exercise. Arrhythmogenic right ventricular cardiomyopathy, another significant cause, involves the replacement of heart muscle with fatty or fibrous tissue, predisposing individuals to arrhythmias. Congenital coronary artery anomalies, where the arteries supplying blood to the heart are abnormally positioned or structured, can also precipitate SCA, especially during intense physical activity.[2]

The critical factor in improving survival rates for SCA victims is the immediacy and quality of the emergency response. The American Heart Association (AHA) emphasizes a "chain of survival," which includes early recognition and activation of emergency services, immediate cardiopulmonary resuscitation (CPR) with an emphasis on high-quality chest compressions, rapid defibrillation, effective advanced life support, and integrated post-cardiac arrest care. Each link in this chain is vital; however, early defibrillation is particularly crucial, as the chances of survival decrease by 7-10% with every minute that passes without defibrillation. Automated external defibrillators (AEDs) play a pivotal role in this context. AEDs are portable devices designed to deliver a shock to restore a normal heart rhythm in cases of SCA. They are user-friendly and intended for use by laypersons, making them essential in settings where professional medical help might not be immediately available. Despite their proven efficacy, the presence and accessibility of AEDs in sports facilities vary widely. This discrepancy underscores the need for policies mandating AED availability and comprehensive training programs for coaches, athletes, and staff in CPR and AED use. [3,4]

The preparedness for cardiac emergencies in sports settings extends beyond just having the right equipment. It involves having well-rehearsed emergency action plans that ensure a coordinated and timely response to SCA incidents. Regular training and drills for coaches, staff, and even athletes themselves can significantly enhance the effectiveness of the response, potentially saving lives. Emergency medical services (EMS) are a cornerstone of the healthcare system, designed to provide rapid and effective medical care in emergency situations. EMS encompasses a network of services, including paramedics,

emergency medical technicians (EMTs), ambulance services, and first responders, all trained to address acute health crises ranging from traumatic injuries to sudden cardiac events. The primary mission of EMS is to deliver timely, life-saving interventions and ensure the swift transport of patients to appropriate medical facilities for further treatment.[3]

The efficiency and efficacy of EMS can be a matter of life and death, particularly in instances of sudden cardiac arrest (SCA), severe trauma, stroke, and other critical conditions. Rapid response and skilled medical intervention are crucial for improving patient outcomes. For example, in cases of SCA, the chances of survival decrease significantly with each passing minute without defibrillation. EMS personnel are trained to perform cardiopulmonary resuscitation (CPR) and use automated external defibrillators (AEDs), which are vital in these scenarios.[5]

EMS systems operate on the principle of the "chain of survival," which includes early recognition and activation of the emergency response system, immediate initiation of CPR by bystanders, rapid defibrillation, advanced life support, and integrated post-cardiac arrest care. Each link in this chain is essential, and any delay can adversely affect the patient's chances of survival and recovery.Accessibility and response time are critical components of an effective EMS system. The ability of EMS to reach the scene quickly, initiate appropriate medical interventions, and transport patients efficiently to hospitals significantly impacts outcomes. Factors influencing EMS response times include the density and distribution of EMS units, traffic conditions, geographic challenges, and the efficiency of the communication systems coordinating these responses.[6]

Moreover, the preparedness and training of EMS personnel are paramount. Continuous education and drills ensure that EMTs and paramedics are equipped with the latest knowledge and skills to handle a wide array of emergencies. Advanced training in trauma care, cardiac life support, and pediatric emergencies, among other areas, enhances their capability to provide high-quality care under pressure. This introduction sets the stage for a deeper examination of the vital role of EMS in the healthcare system. It highlights the importance of rapid response, skilled intervention, and the continuous need for training and system improvements to ensure the best possible outcomes for patients in emergency situations.[6]

Case Presentation

During a high school soccer match, A 17 years old male soccer athlete collapsed suddenly while sprinting. Teammates and spectators initially thought he might have tripped or suffered a minor injury. However, it quickly became apparent that the situation was more serious when he did not respond to verbal cues and appeared unresponsive. The athlete was found unresponsive, not breathing, and without a pulse. Cyanosis was noted around the lips and fingertips. He had no known medical conditions or previous cardiac issues. He had no history of sudden cardiac death or known cardiac abnormalities.

A coach began CPR approximately 5 minutes after collapse. Emergency Call was placed immediately, EMS dispatched approximately 2 minutes after the incidence. EMS arrived 12 minutes after emergency call. The coach, trained in basic CPR, initiated chest compressions but struggled to maintain effective ventilations without proper equipment. There was no AED available at the sports facility. The delay in advanced life support significantly impacted the chances of survival.

Upon arrival, EMS personnel took over resuscitation efforts. Initial Rhythm Analysis of the patient was Ventricular fibrillation (VF). Defibrillation Attempts were Multiple shocks delivered. Medications Administered to patient were Epinephrine, amiodarone. Advanced Airway Management was with Endotracheal intubation. Despite aggressive resuscitative efforts, including high-quality CPR and defibrillation, ROSC was not achieved. After 30 minutes of continued attempts, the decision was made to cease resuscitation efforts, and the athlete was pronounced dead on the scene at 5:14 PM. Post-mortem examination revealed the presence of hypertrophic cardiomyopathy (HCM), a common cause of SCA in young athletes. HCM is characterized by abnormal thickening of the heart muscle, which can obstruct blood flow and lead to arrhythmias.

Discussion

A 17 years old male athlete suddenly fell while playing soccer. Teammates and spectators initially thought he might have tripped or suffered a minor injury. However, it quickly became apparent that the situation was more serious when he did not respond to verbal cues and appeared unresponsive. The athlete was found unresponsive, not breathing, and without a pulse. Cyanosis was noted around the lips and fingertips. He had no known medical conditions or previous cardiac issues. He had no history of sudden cardiac death or known cardiac abnormalities.

Sudden cardiac arrest (SCA) in athletes is a rare but catastrophic event that underscores the vulnerability even of seemingly healthy individuals engaged in rigorous physical activity. In the presented case, the young athlete's death due to delayed emergency help is a tragic illustration of the broader issues surrounding the identification and management of underlying cardiac conditions in athletes.[7]

Post-mortem examination in this case revealed hypertrophic cardiomyopathy, a condition often associated with SCA in young athletes. HCM is characterized by the abnormal thickening of the heart muscle, particularly the interventricular septum. This thickening can obstruct blood flow and predispose the heart to arrhythmias, particularly under the stress of intense physical exertion. Many cases of HCM remain asymptomatic until a sudden cardiac event occurs, as regular physical examinations often fail to detect the condition. Genetic screening and echocardiography can be crucial in identifying individuals at risk, but these are not standard practice for all athletes.[4]

While HCM was identified in this case, other potential causes of SCA in athletes include arrhythmogenic right ventricular cardiomyopathy (ARVC), congenital coronary artery anomalies, and myocarditis. ARVC involves the replacement of myocardial cells with fibrofatty tissue, leading to arrhythmias.

Congenital coronary artery anomalies can impair blood flow to the heart muscle, particularly during exercise. Myocarditis, an inflammation of the heart muscle, often due to viral infections, can also precipitate arrhythmias and SCA.[8]

The "chain of survival" concept is critical in the management of SCA, emphasizing the importance of early recognition, immediate CPR, rapid defibrillation, advanced life support, and post-resuscitation care. In this case, the chain was broken at multiple points, most critically in the absence of an AED and the delay in CPR initiation. Bystander CPR, initiated promptly, can double or even triple the chances of survival after SCA. However, in this case, CPR was initiated five minutes after the collapse, which significantly diminished its effectiveness. The absence of an AED at the sports facility further compounded the delay in providing life-saving defibrillation. Each minute without defibrillation decreases the survival rate by 7-10%, highlighting the crucial need for AED accessibility in all sports venues.[9]

Many states and sports governing bodies have recognized the importance of AEDs and have implemented regulations requiring their presence at athletic events and facilities. Compliance with these regulations, along with regular maintenance and accessibility of AEDs, is vital. Policies should also mandate regular CPR and AED training for all staff, coaches, and even players to ensure a swift and effective response. Continuous education and regular drills for CPR and AED use are essential. In this case, although a coach attempted CPR, the lack of immediate and effective intervention points to the need for more frequent and comprehensive training. Drills should simulate real-life scenarios to ensure that all individuals involved in sports events are prepared to act swiftly and effectively.[10]

The implementation and regular rehearsal of emergency action plans (EAPs) are crucial. These plans should outline specific roles and responsibilities, ensuring a coordinated response during emergencies. The lack of a well-practiced EAP in this case highlights a significant gap in preparedness that needs to be addressed.[10,11]

Beyond those directly involved in sports, there is a need for broader public education on recognizing and responding to cardiac emergencies. Parents, spectators, and athletes themselves should be aware of the signs of SCA and the steps to take in an emergency. Public awareness campaigns can help disseminate this knowledge, potentially saving lives. Implementing cardiovascular screening programs for young athletes can help identify those at risk of SCA. These programs might include detailed family history, physical examination, electrocardiograms (ECGs), and echocardiograms. While not without controversy due to cost and the potential for false positives, these screenings can be a valuable tool in preventing sudden cardiac events.[12,13]

Continuous research into the causes and prevention of SCA in athletes is essential. Advancements in genetic testing, imaging techniques, and wearable technology that monitors cardiac health can provide new avenues for early detection and intervention. Adequate funding for EMS, public health initiatives, and school sports programs is vital. Resources should be allocated to ensure that all sports facilities are equipped with AEDs and that staff and volunteers receive regular, high-quality training. The tragic death of the young athlete in this case underscores the critical importance of preparedness and immediate response in managing sudden cardiac arrest. Ensuring that sports facilities are equipped with AEDs, providing regular and comprehensive training for CPR and AED use, implementing effective emergency action plans, and increasing public awareness and education are all essential steps in preventing such tragedies. Furthermore, systemic improvements in screening, research, and resource allocation can help protect the health and lives of athletes. This case serves as a poignant reminder of the stakes involved and the urgent need for continued efforts to improve emergency response systems in sports settings.[12]

Survival rates for SCA victims significantly improve with immediate bystander CPR and early defibrillation. The American Heart Association (AHA) guidelines emphasize the "chain of survival," which includes[3]:

1. Immediate recognition of cardiac arrest and activation of the emergency response system

2. Early CPR with an emphasis on chest compressions

3. Rapid defibrillation

4. Advanced life support

5. Integrated post-cardiac arrest care

In this case, the absence of an AED and the delay in defibrillation were critical factors contributing to the fatal outcome. Studies have shown that each minute without defibrillation reduces the chance of survival by 7-10%. The lack of an AED at the venue significantly delayed the administration of a life-saving shock. AEDs are portable devices that can be used by bystanders with minimal training to treat SCA by delivering a defibrillation shock to restore normal heart rhythm. Many sports organizations and schools have begun to implement AED programs, but gaps remain.[5]

Training for coaches, staff, and even players in CPR and AED use is crucial. Regular drills and emergency action plans can ensure preparedness and a swift response during emergencies. Several states and sports governing bodies have enacted laws and policies requiring AEDs at school athletic events and sports facilities. Compliance with these regulations and regular maintenance of AEDs are vital for ensuring they are functional when needed. The tragic death of this young athlete highlights the critical importance of immediate response and AED accessibility in managing sudden cardiac arrest. Ensuring that all sports facilities are equipped with AEDs and that personnel are trained in CPR and emergency response can prevent similar outcomes.[7]

Recommendations[9]:

1. Mandatory AEDs at Sports Venues: Legislation or policies should mandate the presence of AEDs at all athletic facilities, with regular maintenance checks.
2. Regular Training: Coaches, staff, and athletes should undergo regular CPR and AED training, including simulated emergency drills.
3. Emergency Action Plans: Implementation and regular rehearsal of comprehensive emergency action plans for all sports events to ensure prompt and coordinated responses.
4. Awareness Campaigns: Educate the public, including parents and athletes, on the importance of recognizing and responding to cardiac emergencies
5. Screening Programs: Consider implementing pre-participation cardiovascular screening programs for young athletes to identify those at risk of SCA.

Conclusion

The tragic death of the young athlete in this case underscores the critical importance of preparedness and immediate response in managing sudden cardiac arrest. Ensuring that sports facilities are equipped with AEDs, providing regular and comprehensive training for CPR and AED use, implementing effective emergency action plans, and increasing public awareness and education are all essential steps in preventing such tragedies. Furthermore, systemic improvements in screening, research, and resource allocation can help protect the health and lives of athletes. This case serves as a poignant reminder of the stakes involved and the urgent need for continued efforts to improve emergency response systems in sports settings.

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