

SERIOUS MEDICAL EVENTS IN FOOTBALL

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This article is about two different medical conditions: concussion and sudden cardiac arrest. One is common and, if treated properly, usually leads to an uneventful recovery. The other is rare, but potentially life threatening. Both conditions have recently received extensive media attention in the context of football. However, there is still a great deal of debate and misunderstanding about both of these topics. The aim of this article is to clear up some of those misunderstandings and to help clinicians involved in the medical care of football players understand best practice regarding the management of concussion and sudden cardiac arrest.

CARDIOVASCULAR SCREENING IN FOOTBALL

Recently, a series of high profile sudden cardiac deaths in elite footballers has led to significant media attention and stimulated vigorous debate, prompting many sporting bodies to recommend or mandate cardiac screening. FIFA introduced a standardised

medical assessment prior to the 2006 football World Cup in Germany – the pre-competition medical assessment (PCMA) – which included a comprehensive cardiac assessment. The PCMA is now mandatory for all players, referees and assistant referees participating in FIFA competitions. The PCMA has also been adopted by other competitions around the world. For example, an annual PCMA has been mandatory for all players in the Qatar Stars League since 2011.

The cardiac portion of the current PCMA includes a detailed personal and family history, a physical examination and a resting electrocardiogram (ECG) and echocardiogram (ECHO). Other testing, such as a stress ECG or cardiac MRI should be performed as clinically indicated.

The rationale behind cardiac screening is to:

1. Identify those with medical conditions associated with sudden cardiac death.
2. Reduce the mortality rate by risk stratification of individual cases followed by appropriate disease

management and advice regarding appropriate activity levels.

Unfortunately, the marked reduction in sudden cardiac death in sport seen in the Veneto region of Italy following the introduction of a mandatory pre-sport cardiac screening programme in the 1970s has not been reproduced elsewhere. This has led to widespread debate about whether and how cardiac screening should be performed. Much of the debate has been about whether or not to include ECG as part of cardiac screening.

WHY DO YOU NEED TO SCREEN HEALTHY, FIT YOUNG PEOPLE IN THE FIRST PLACE?

Several studies have shown that approximately one in 300 people (0.3%), in a wide variety of populations, have a cardiac condition associated with sudden cardiac death.

In the United States, the generally accepted rate for sudden cardiac death/arrest (SCD/A) is 1:80,000 per year for high school athletes and 1:50,000 per year for



Figure 1: Physical examination during cardiac screening.

college athletes. However, there are higher rates of SCD/A among specific sporting populations: for example the rate of SCD/A in male Division 1 college basketball players is 1:3,000, 1:18,000 for male African-American¹ college athletes and 1:33,000 for male athletes, compared to an overall rate of 1:43,000 among all college athletes¹.

Unfortunately, rates of SCD/A are not known for many sporting populations as accurate reporting is not possible. Extrapolation of rates of sudden cardiac death from one sporting group to another may not be appropriate, since factors including ethnicity, gender, age, level of play or sport may affect risk for SCD/A².

Up to 80% of cases of SCD/A are asymptomatic or have no warning signs, so screening is needed to identify who might be at risk for SCD/A.

WHY CARDIAC SCREENING NEEDS CAREFUL PLANNING

What is often forgotten is that there is more to cardiac screening than simply performing a history, physical examination and ECG. Simply introducing a cardiac screening programme does not automatically prevent SCD/A. Like all other forms of screening, there are false positives and false negatives that must be taken into consideration when planning a cardiac screening programme.

False negatives

Studies have estimated that history and examination alone will identify only 20% of cases of medical conditions associated with SCD. The addition of an ECG improves the sensitivity to about 60%. So, although the addition of an ECG will significantly

improve the sensitivity of screening, up to 40% of conditions associated with SCD will still be missed. Furthermore, congenital coronary artery anomalies include a variety of abnormal anatomical variations of the right and left coronaries, which could be missed in the absence of imaging techniques. Another fact that is sometimes overlooked is that players wishing to sign professional contracts may purposely not report symptoms in case it affects their ability to get a contract.

False negatives can lead to the following issues:

- Players who have 'passed' cardiac screening may be falsely reassured and not report symptoms that subsequently develop.
- Doctors may also be falsely reassured and ignore symptoms that develop after a player has 'passed' cardiac screening.
- Organisations that have arranged for cardiac screening may overlook implementing measures to manage cardiac arrest during exercise, arguably the most important intervention for the prevention of SCD. Early access to a fully maintained automated external defibrillator and the preparation and practice of an emergency action plan are critical steps in the management of sudden cardiac arrest.

False positives

Cardiac screening questionnaires lead to a significant percentage of positive responses (15 to 31% in high school athletes and 27 to 37% in college athletes) that require further interpretation to determine if they are significant. Distinguishing between normal physiological adaptations to exercise and pathological changes on an ECG can sometimes be difficult. However, recent advances in the interpretation of a player's ECG have significantly reduced the false positive rate to about 2.5 to 6.6%².

Follow-up of positive screening results

Cardiac screening will produce positive results, some of which will be false positives and some true positives. Having access to resources to further investigate positive results in a timely manner should be established prior to commencing a screening programme. This will include



Figure 2: The FIFA Emergency Medical Bag.

Figure 3: Use of an Automated External Defibrillator.

Images taken from: https://resources.fifa.com/mm/document/footballdevelopment/medical/02/67/46/18/firstaidwebpdfinal2015_neutral.pdf

adequate financial resources as well as access to a sufficiently experienced sports cardiologist. The interpretation of abnormal cardiac tests in players as well as the immediate and ongoing management of players with conditions associated with sudden cardiac death is complex and can be contentious, particularly if a player's career is at stake.

Cardiac screening does not always produce black and white results

Sometimes the screening is abnormal but does not meet the criteria for a particular condition – sometimes called ‘grey cases’. Such cases need to be followed up and managed by specialists with sufficient expertise.

SUMMARY

Cardiac screening should be planned carefully. There is no one-size-fit-all solution for the cardiac screening of football players given the diverse range of situations in which football is played throughout the world. The decision on whether or not to screen or how to screen should be made on an individual basis, after first considering the underlying risk of the population being assessed and the available resources (money and access to equipment and specialist support).

MANAGEMENT OF SUDDEN CARDIAC ARREST ON THE FIELD OF PLAY

Regardless of the decision about cardiac screening, efforts should be made to minimise the risk of death by optimising the management of SCD/A on the pitch. The unexpected and well-publicised death

of Marc Vivien Foe, on the field-of-play at the FIFA Confederations Cup 2003, has not only resulted in the implementation of screening protocols but also guidelines for field-of-play medical care by FIFA³. The most likely cardiac arrhythmia responsible for SCD/A in sport is ventricular fibrillation. This arrhythmia necessitates early access to a properly maintained defibrillator and a regularly practiced emergency action plan (so that everyone involved understands and can easily perform their roles).

The key steps in the emergency action plan are:

1. **Immediate recognition of SCD/A on the field-of-play:** field-of-play medical teams should be able to recognise ‘non-contact’ collapse and ‘slow myoclonic-type’ limb movements, which together with the common signs of unresponsiveness and abnormal or absent breathing are the hallmark signs of SCD/A.
2. **Immediate response on the field, according to the rules of play:** during the FIFA World Cup Brazil 2014, the referee division agreed to a practical rule change, so that in the case of non-contact collapse (which might occur out of sight of the referee), three members of the field-of-play medical team might immediately enter the field-of-play with their resuscitation equipment to initiate cardio-pulmonary resuscitation (CPR), without waiting for the referee to give permission. The fourth medical team member is expected to inform the fourth official of the medical emergency before joining the rest of the team.

This allows for expedited CPR and particularly, early defibrillation, thereby reducing the risk of death in SCA.

3. **Initiation of CPR and the use of automated external defibrillator (AED):** the standard protocol for CPR at FIFA tournaments is immediate hands-only external chest compressions and expeditious use of an AED. In May 2013 FIFA initiated the FIFA medical emergency bag project, which has set a global standard for consistent field-of-play emergency medical care and a fully functional AED is now mandatory in all FIFA tournaments. The aim is to achieve defibrillation within 2 minutes of SCD/A on the field-of-play. Medical teams are encouraged to use the FIFA medical emergency bag (or equivalent) and practice the emergency medical plan until this timeframe is consistently achieved.
4. **Safe transfer of the player with SCD/A from the field-of-play, before or after restoration of a spontaneous pulse:** the player with SCD/A must be transported off the field-of-play for definitive medical care, irrespective of whether spontaneous circulation has returned or not. If there is no spontaneous pulse, then CPR must be continued during the transfer, using a spinal board and the necessary monitoring and therapeutic equipment. The goal of ongoing CPR is to never cease chest compressions for more than 10 seconds at a time. This can be achieved either by using an appropriate external chest compression device or by teamwork – alternating CPR



Early access to a fully maintained automated external defibrillator and the preparation and practice of an emergency action plan are critical steps in the management of sudden cardiac arrest



providers in a well-practised routine. It is worth noting that the provision of this kind of CPR is unique to football emergency medical care and all medical providers involved with player care need to be familiar with it.

The dissemination of FIFA medical guidelines and football emergency education has included the CPR11 mobile app (available for free online at <https://play.google.com> and <https://itunes.apple.com>) and the Diploma in Football Medicine (available for free online at <http://fifamedicinediploma.com/>).

CONCUSSION

Sport-related concussion (SRC) has been a hot topic in contact sports such as American football and ice hockey in recent years. This has been driven by the suggestion of a possible link with chronic traumatic encephalopathy (CTE), a degenerative neurological condition and resulted in a multi-million-dollar lawsuit for the National Football League in the United States.

After the 2014 FIFA World Cup final, the management of SRC in football also received extensive media attention. During this match, German player Christoph Kramer received a blow to the head and was visibly unsteady. Despite this he was allowed to play on for 15 minutes before he was removed from the match. It was reported that he asked the referee “is this really the World Cup

final?”. A clash of heads between Morgan Brian (United States) and Alexandra Popp (Germany) during the FIFA Women’s World Cup final in 2015, was also well publicised.

As a result of these and other similar episodes, the FIFA Medical Committee proposed changes to allow the referee to stop the match for up to 3 minutes to allow medical staff to assess a player following a head injury. They also recommended education about concussion for players, referees, medical staff and coaches.

Despite this, little has changed with regard to the practical management of concussion in football. Three minutes is not adequate time to assess a suspected concussion (particularly while still on the pitch) and there have been no changes to the substitution rules to allow temporary replacement of a player with a suspected concussion.

The management and diagnosis of SRC is one of the most challenging tasks in football medicine for several reasons:

- There is no gold standard diagnostic test.
- There is no temporary substitution to allow a player with suspected concussion to be adequately assessed (in a quiet place without distractions with enough time).
- Symptoms and signs of SRC can be subtle and transient and can change rapidly in the acute phase.

- Players, keen to remain on the pitch, may try to hide symptoms.
- The onset of symptoms and signs may be delayed.
- A common misconception that a player has not been concussed unless there was a loss of consciousness, leading to under-reporting of symptoms.
- The head injury is often not witnessed by medical staff.
- Concussion has few visible signs such as bleeding or limping.

There have been significant advances in the understanding and management of SRC since the publication of the first concussion in sport consensus statement in 2004⁴. There have been several updates to this statement with the most recent consensus statement published in 2017 (hereafter referred to as the Berlin Statement), which contains the latest thinking on SRC and is an essential read for anyone involved in the management of SRC. The Berlin Statement is available free online⁴.

BASIC PRINCIPLES OF CONCUSSION MANAGEMENT

Assessment/diagnosis

The initial assessment of a head injury should follow the normal emergency principles (first exclude a neck injury and check Airway-Breathing-Circulation).

Once a more significant medical condition has been excluded the head injury should be assessed by a physician/

licensed healthcare practitioner using an approved assessment tool (such as the Sport Concussion Assessment Tool (SCAT5)⁶, children SCAT5⁷ or Standard Assessment of Concussion (SAC)). These are available free online^{6,7}.

Any player with suspected concussion should be removed from the pitch and assessed in a quiet environment without distractions (in a changing room, not pitch-side).

A sound principle for first on-field responders to suspected SRC is: 'if in doubt – pull them out'.

If an SRC is confirmed

The player should never return to play the same day.

The player should immediately be assessed by a medical practitioner – that means an early referral elsewhere if there is no medical practitioner on site.

The player should undergo serial assessments over the first few hours. If sufficient recovery is made and no 'red flags' indicating more serious intracranial injuries have been identified in 2 to 4 hours, the player can be discharged into the care of a responsible adult. The player should not be left alone during the first 24 hours – written instructions should be given to the accompanying person as to when urgent medical attention should be sought. Instructions include no driving, alcohol, sleeping tablets or NSAIDs until allowed by a medical practitioner.

Recovery after a sports-related concussion

Symptoms and signs typically resolve quickly after an SRC, although this may sometimes be prolonged.

The Berlin Statement⁵ proposes that "persistent symptoms", indicating a failure of normal clinical recovery, be defined as more than 10 to 14 days in an adult or more than 4 weeks in children. Players with persistent symptoms should be managed by a multi-disciplinary team with expertise in SRC.

Prior to the Berlin Statement⁵, the cornerstone of the treatment of SRC was complete physical and cognitive rest until the player was asymptomatic. Following this, a graduated return to play protocol commenced. This advice has now changed and after a period of 24 to 48 hours rest,

even if still symptomatic, the player can cautiously be allowed to gradually return to light aerobic exercise, as long as this does not result in an exacerbation of symptoms. Exercise should be kept to a low intensity until symptoms have resolved. The optimum intensity and duration of exercise to aid recovery during this period while symptomatic has yet to be determined. Exacerbation of symptoms is currently used to judge whether the intensity is too high.

Another change in the Berlin Statement⁵ was the proposal that there might be specific treatments to target certain symptoms. These include physical therapy for cervical spine or vestibular symptoms, cognitive therapy for persistent mood or behavioural issues and a specific aerobic exercise programme.

The Berlin Statement contains a protocol for a graduated return to play, which can only be commenced once the player is asymptomatic. The protocol contains six stages, each of which are advised to last a minimum 24 hours. Progress to the next stage requires successful completion of the previous stage without recurrence of symptoms. The completion of the protocol

therefore takes a minimum of 1 week. Elite players should not be treated any differently to recreational players and should not be allowed to complete an accelerated or abbreviated return to play protocol. If symptoms occur during the return to play protocol, the player should rest until asymptomatic and can then start back again one stage earlier.

Despite the considerable attention paid to the relationship between CTE and concussion in the media and medical literature, the relationship is still not understood. In the meantime, attention should therefore be paid to the correct management of SRC using the latest guidelines.

WHAT ABOUT THE YOUNG FOOTBALL PLAYER (CHILDREN AND ADOLESCENTS)?

Children and adolescents tend to take longer to recover than adults. There is a specific assessment tool for this group – the children SCAT5⁷. It is recommended that children first follow a graduated return to school protocol (such as that contained in the Berlin statement⁵) before starting a graduated return to play process.





A sound principle for first on-field responders to a suspected sport-related concussion is: 'if in doubt – pull them out'



PRACTICAL TIPS FOR THE MANAGEMENT OF CONCUSSION

Sport-related concussion is a challenging condition to diagnose and manage. Make sure that you have read and understand the latest guidelines.

- Education of players, medical staff, coaches, match officials and parents is very important. Key messages are:
 - Awareness of the symptoms or signs of concussion.
 - The importance of early diagnosis and correct management.
- For team medical staff, it is important to establish and agree on (prior to the start of the season) the protocols for SRC, especially:
 - Who will assess the player suspected of a SRC.
 - That the team doctor alone makes the decision on whether or not a player should be removed from the pitch.
 - A graduated return to sport will be followed and monitored by team medical staff.
- Be prepared:
 - Have your sideline assessment tools to hand when at trainings and matches.
 - Having a baseline assessment on all players may be useful for comparison after an injury and will also allow team medical staff and players to be comfortable using the tool.

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