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F-MARC: promoting the prevention and management of sudden cardiac arrest in football

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ABSTRACT

Sudden cardiac death is the most common cause of unnatural death in football. To prevent and urgently manage sudden cardiac arrest on the football field-of-play, F-MARC (FIFA Medical and Research Centre) has been fully committed to a programme of research, education, standardisation and practical implementation. This strategy has detected football players at medical risk during mandatory precompetition medical assessments. Additionally, FIFA has (1) sponsored internationally accepted guidelines for the interpretation of an athlete's ECG, (2) developed field-of-play-specific protocols for the recognition, response, resuscitation and removal of a football player having sudden cardiac arrest and (3) introduced and distributed the FIFA medical emergency bag which has already resulted in the successful resuscitation of a football player who had a sudden cardiac arrest on the field-of-play. Recently FIFA, in association with the Institute of Sports and Preventive Medicine in Saarbrücken, Germany, established a worldwide Sudden Death Registry with a view to documenting fatal events on the football field-of-play. These activities by F-MARC are testimony to FIFA's continued commitment to minimising sudden cardiac arrest while playing football.

Saarbrücken, Germany, FIFA launched a worldwide Sudden Death Registry in January 2014 to document fatal events on the football field-of-play.⁴

Prevention

The unexpected death of Marc Vivien Foé on the field-of-play at the FIFA Confederations Cup 2003, led FIFA to support all efforts to prevent SCD in football players by implementation of a standardised “pre-competition medical screening” (PCMA) programme. The PCMA is mandatory for all teams competing in FIFA and many national tournaments, with the FIFA World Cup Germany 2006 being a milestone regarding primary prevention of SCD in football⁵ as this was the first time that the PCMA became mandatory for all players in a FIFA World Cup.

Currently, the FIFA PCMA programme consists of a player's personal and family history medical questionnaire, a focused, comprehensive physical examination, a 12-lead resting ECG and, if and when necessary, an echocardiogram, laboratory tests and exercise test. The PCMA is designed to detect the majority of genetically based potentially fatal cardiac abnormalities in footballers, referees and assistant referees, man and woman, and in various ethnic groups.^{6–11}

INTRODUCTION

Sudden cardiac death (SCD) is the most common cause of unnatural death in sports.^{1–2} To prevent (wherever possible) and urgently manage (when necessary) sudden cardiac arrest (SCA) in and around the football field-of-play, F-MARC has committed to a programme of research, education, standardisation and implementation of emergency management of SCA. This strategy, with its worldwide reach, has detected a multitude of players particularly at risk who were appropriately restricted from competition and provided expert clinical care. As a result of the FIFA football emergency medicine protocols, a football player was successfully resuscitated after suffering an SCA on the football field in Nepal.³

SCA management

Despite the mandatory PCMA prior to all FIFA tournaments and other national programmes, risk of unexpected SCA remains during and after training, and during the competition. Consequently, besides the required immediate recognition of SCA, the emergent field-of-play medical team's response to the collapsed player, expeditious resuscitation at the site of collapse and removal to definitive medical care is imperative. This has required a committed FIFA strategy of protocol and policy standardisation and implementation,^{12–13} medical equipment procurement,^{10–14} as well as relevant football and football stadium personnel education and skill acquisition.^{10–15–17}

The magnitude of SCA: how many victims?

In 2012, Schmied *et al*¹ undertook a survey of FIFA member associations to estimate the frequency of SCA occurrence in football. From 126 of the 170 surveys returned, 107 cases of SCA/SCD and 5 unexplained football-associated sudden deaths were reported over the 10-year survey review period. This simple, non-validated result would indicate one SCA/SCD every month for the past 10 years. Therefore, to scientifically research the global incidence of SCA/SCD in football, in association with the Institute of Sports and Preventive Medicine in

Field-of-play medical care

The predominant life-threatening cardiac rhythm in SCA in sport is ventricular fibrillation. Thus, a fully functional automated external defibrillator (AED) is mandatory at all FIFA tournaments.¹³ FIFA initiated the development, procurement, distribution and education of the FIFA medical emergency bag (FMEB) in May 2013, and has set a global standard in sport for the provision of consistent field-of-play emergency medical care. Field-of-play medical teams have been advised to ensure not only the presence of the FMEB at the sideline but



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to undergo training and thus develop competence in using the FMEB for a variety of field-of-play medical emergencies, including SCA. This includes (1) the need for immediate recognition of a SCA on the field-of-play, (2) for an expeditious response on the field in accordance with the rules of the game, (3) initiation of cardiopulmonary resuscitation (CPR) and the use of an AED within the critical period of time to promote success and (4) appropriate and safe transfer of the player with SCA from the field-of-play, before or after restoration of a spontaneous pulse.

Signs and response of SCA on the field-of-play

Recognition of SCA on the field-of-play has required F-MARC to recognise the specificity of SCA diagnosis in sports and its difference from the generally taught out-of-hospital public SCA. These field-of-play signs of SCA became standard protocol and included the F-MARC initiated term 'non-contact collapse'¹⁸ and 'slow myoclonic-type' limb movements,¹⁹ which, together with the common signs of 'unresponsiveness/unconsciousness' and 'abnormal/absent breathing', became the hallmark signs of field-of-play SCA in football.^{6 20}

The most likely cause of SCA is hypertrophic cardiomyopathy and myocardial infarction due to coronary artery disease in older players and referees. As a result, it is mandatory that the response following non-contact collapse is immediate as there is a critical need for defibrillation. Owing to the fact that a non-contact collapse may occur out-of-sight of the referee, with the ball still in play, F-MARC consulted with the FIFA referee division. Thus, during the FIFA World Cup Brazil 2014, it was approved that in the event of a non-contact collapse, three members of the field-of-play medical team would enter the field-of-play immediately with all necessary medical equipment and take charge of the player who suddenly collapsed. The fourth member of the field-of-play medical team has to first inform the fourth official of the medical emergency and then rejoin the field-of-play medical team to aid with the resuscitation at hand. This change in the practical rules of the game allows access to the field of play and to the player who collapsed due to an SCA during the ongoing play, without the knowledge or permission of the referee. This innovation, agreed by all, aims to minimise the likelihood of death in cases of SCA.¹⁰

Expedient initiation of hands-only external chest compressions,²¹ timely application and use of an AED has become standard medical care for SCA at FIFA tournaments and is currently vigorously promoted by all football federations globally.

Irrespective of whether or not the player who collapsed due to SCA regains spontaneous circulation, the critically ill player will have to be transferred from the field-of-play for definitive medical care. Active resuscitation during transfer will depend on whether return of spontaneous circulation has been achieved or not. If the collapsed player has a consistent return of spontaneous circulation, the player will be clinically stabilised as is medically possible in this out-of-hospital environment, carefully placed and secured onto a spinal immobilisation device with all the attendant monitoring and therapeutic devices securely fastened, and then transferred to the awaiting emergency ambulance.

If there is no return of spontaneous circulation

If the collapsed SCA player does not have a return of spontaneous circulation after the resuscitative measures have been undertaken, the player should likewise be transferred for further critical cardiac care measures and procedures. For this transfer to be undertaken effectively and efficiently, external chest compressions should never cease for any period in excess of 10 s

from field-of-play to medical facility.²² This may be achieved by making use of an automated external chest compression device or, alternatively, requires continued, disciplined manual chest compression by alternating providers, from the field-of-play to the medical facility. This F-MARC practical protocol for transfer of players who suffer SCA, with or without a pulse, is unique to football emergency medicine education and emphasises the need for sport-specific research, sport-specific medical protocols and policies, which recognise the difference between the sports environment and others.

Medical guideline development and football emergency medicine education

In 2012, F-MARC was part of a milestone in PCMA cardiac screening, when it sponsored some of the world's most acknowledged experts in the field in developing a set of internationally accepted guidelines for the interpretation of an athlete's ECG, at the 'Seattle Conference'.^{23–26} F-MARC was also a major contributor to the international expert panel that met again in February 2015 to adapt the 'Seattle Criteria' according to latest scientific data.

These afore mentioned aspects of education and training relate to standardising field-of-play medical equipment, namely the FMEB and aspects of SCA recognition, response, resuscitation and player's transfer. In addition, F-MARC has committed to an international programme of football medicine education and training, which specifically includes football emergency medicine.²⁷

The F-MARC football emergency medicine 2-day theoretical and hands-on practical course has been presented regularly^{28 29} to FIFA venue medical officers, football team physicians and physiotherapists. In December 2014, F-MARC introduced basic emergency medical training on the football field-of-play for referees, physical instructors and technical instructors, with an emphasis on recognising SCA and the need for beginning immediate resuscitation. FIFA also simultaneously promoted the launch of the free CPR11²² mobile application training and treatment video designed as a guide to SCA in football. F-MARC has recently launched a distance education, e-learning, F-MARC Diploma in Football Medicine to provide a benchmark for football medicine knowledge and skills among football physicians worldwide. Football emergency medicine is integral to the curriculum.

CONCLUSION

Prevention of SCA within the football environment primarily requires (1) ongoing research into the causes and circumstances that surround the life-threatening cardiac dysthymias that characterise SCA in otherwise healthy, young, fit football athletes and (2) implementation of current knowledge. F-MARC has been, and continues to be, committed to study the biological basis of SCA. Critically, FIFA has executed a substantial volume of emergency management and medical education, wherever, whenever and to whomever appropriate.

Competing interests None.

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REFERENCES

- 1 Schmied C, Drezner J, Kramer E, *et al.* Cardiac events in football and strategies for first-responder treatment on the field. *Br J Sports Med* 2013;47:1175–8.
- 2 n.a. List of association footballers who died while playing. http://en.wikipedia.org/wiki/List_of_association_footballers_who_died_while_playing (cited on 22 Jan 2015).
- 3 n.a. FIFA equipment helps save player's life. <http://www.fifa.com/aboutfifa/footballdevelopment/medical/news/newsid=2172478/>. (cited on 22 Jan 2015).
- 4 n.a. FIFA and Saarland University team up. <http://www.fifa.com/aboutfifa/footballdevelopment/medical/news/newsid=2294124/>. (cited on 22 Jan 2015).
- 5 Dvorak J, Grimm K, Schmied C, *et al.* Development and implementation of a standardized precompetition medical assessment of international elite football players—2006 FIFA World Cup Germany. *Clin J Sport Med* 2009;19:316–21.
- 6 Kramer E, Botha M, Drezner J, *et al.* Practical management of sudden cardiac arrest on the football field. *Br J Sports Med* 2012;46:1094–6.
- 7 Corrado D, Schmied C, Basso C, *et al.* Risk of sports: do we need a pre-participation screening for competitive and leisure athletes? *Eur Heart J* 2011;32:934–44.
- 8 Dvorak J, Grimm K, Schmied C, *et al.* Feasibility of precompetition medical assessment at FIFA World Cups for female youth players. *Br J Sports Med* 2012;46:1132–3.
- 9 Bizzini M, Schmied C, Junge A, *et al.* Precompetition medical assessment of referees and assistant referees selected for the 2010 FIFA World Cup. *Br J Sports Med* 2012;46:374–6.
- 10 Dvorak J, Kramer E, Schmied CM, *et al.* The FIFA medical emergency bag and FIFA 11 steps to prevent sudden cardiac death: setting a global standard and promoting consistent football field emergency care. *Br J Sports Med* 2013;47:1199–202.
- 11 Drezner J, Dvorak J, Kramer E, *et al.* The FIFA® 11 Steps to prevent sudden cardiac death during football games. *Eur Heart J* 2013;34:3594–5.
- 12 n.a. On-field cardiac arrests discussed in Budapest. <http://www.fifa.com/aboutfifa/footballdevelopment/medical/news/newsid=1641076/index.html>. (cited on 22 Jan 2015).
- 13 n.a. Decision of the FIFA Executive Committee from 3–4 October 2013 re: Automatic External Defibrillator. http://www.fifa.com/mm/document/affederation/administration/02/22/91/52/circularno.1393-reautomaticexternaldefibrillator_neutral.pdf. (cited on 22 Jan 2015).
- 14 n.a. Sudden cardiac arrest emergency bags to be sent worldwide. <http://www.fifa.com/aboutfifa/organisation/bodies/congress/news/newsid=2088881/>. (cited on 22 Jan 2015).
- 15 n.a. New FIFA Publication: The Football Emergency Medicine Manual. http://www.fifa.com/mm/document/affederation/administration/01/36/34/59/circularno.1245-newfifapublication_the_football_emergency_medicinemanual.pdf. (cited on 22 Jan 2015).
- 16 Constantinou D, Kramer E, Motaung S. In: Dvorak J, Grimm K, eds. *FIFA football emergency medicine manual*. Zurich: Federation Internationale de Football Association (FU+IFA), 2010.
- 17 n.a. Medical teams undergo World Cup training. <http://www.fifa.com/worldcup/news/y=2014/m=3/news=medical-teams-undergo-world-cup-training-2305582.html>. (cited on 22 Jan 2015).
- 18 n.a. Miklos Feher Death, live game on the 25th January 2004 [Internet]. <https://www.youtube.com/watch?v=i0BqMSlqODU>. (cited on 22 Jan 2015).
- 19 Clawson J, Olola C, Scotta G, *et al.* Effect of a medical priority dispatch system key question addition in the seizure/convulsion/fitting protocol to improve recognition of ineffective (agonal) breathing. *Resuscitation* 2008;79:257–64.
- 20 Kramer E, Dvorak J, Kloeck W. Review of the management of sudden cardiac arrest on the football field. *Br J Sports Med* 2010;44:540–5.
- 21 n.a. American Heart Association. Hands-only™ CPR. http://www.heart.org/HEARTORG/CPRAandECC/HandsOnlyCPR/Hands-Only-CPR_UCM_440559_SubHomePage.jsp#. (cited on 22 Jan 2015).
- 22 n.a. New app hoping to help prevent Sudden Cardiac Death. <http://www.fifa.com/aboutfifa/footballdevelopment/medical/news/newsid=2487197/>. (cited on 22 Jan 2015).
- 23 Drezner JA, Ackerman MJ, Anderson J, *et al.* Electrocardiographic interpretation in athletes: the 'Seattle Criteria'. *Br J Sports Med* 2013;47:122–4.
- 24 Drezner JA, Fischbach P, Froelicher V, *et al.* Normal electrocardiographic findings: recognising physiological adaptations in athletes. *Br J Sports Med* 2013;47:125–36.
- 25 Drezner JA, Ashley E, Baggish AL, *et al.* Abnormal electrocardiographic findings in athletes: recognising changes suggestive of cardiomyopathy. *Br J Sports Med* 2013;47:137–52.
- 26 Drezner JA, Ackerman MJ, Cannon BC, *et al.* Abnormal electrocardiographic findings in athletes: recognising changes suggestive of primary electrical disease. *Br J Sports Med* 2013;47:153–67.
- 27 Kramer E. Football emergency medicine. *CME* 2010;28:208–12.
- 28 Seifbarghi T, Hasemi A, Halabchi F. Travelling fellowship programme for football medicine: report on an experience. *Asian J Sports Med* 2012;3:216–24.
- 29 n.a. Football Emergency Medicine Course: 15–16 November 2012. <http://www.sasma.org.za/?p=1473>. (cited on 22 Jan 2015).

Correction

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