Football Emergency Medicine Manual

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Preface

Dear members of the worldwide football family,

This year, the world is looking forward to what is probably the most fascinating and exciting sports event: the FIFA World Cup™. Thousands of spectators will fill the stadiums, and millions will watch the tournament on TV. The crowds will make this first-ever FIFA World Cup™ in Africa an absolutely unique experience for the players on the pitch, all the fans, the visitors and the TV audience worldwide.

It is the responsibility of the government to ensure that this event can be safely enjoyed by everyone. This manual stresses the importance of careful pre-event risk assessment, adequate preventive measures, and only thereafter the planning and organisation of adequate emergency medical services able to counteract and confine the consequences of mass disasters should they occur.

Protecting players' health has long been FIFA's priority, something which is manifested in the many initiatives of the FIFA Medical Committee and the FIFA Medical Assessment and Research Centre (F-MARC). With this manual we extend our efforts to protect the crowds in the stadiums, adding further to FIFA's comprehensive approach to prevention. The high standard of medicine in South Africa is well known and it is to my great satisfaction that the authors are South African physicians actively involved in providing medical services at the 2010 FIFA World Cup™. It is the dedication of experts quietly working in the background that ensures we can all relish this celebration of our beautiful game.

Joseph S. Blatter
FIFA President

Dear colleagues,

The FIFA Medical Committee and FIFA Medical Assessment and Research Centre (F-MARC) focus on prevention and education to protect the health of football players worldwide. "Prevention is better than cure" has long been our credo and this has been reflected in our activities over the last few decades.

The prevention of life-threatening incidents is even more important, as in these situations it might often be too late for cure. Therefore, any planning for a football event, no matter if it is a single match or a four-week competition, must start with a meticulous assessment of the individual risks in order to fully exploit any possible preventive measures.

With regard to life-threatening incidents, our main focus in recent years has been on the pre-competition medical assessment (PCMA) of players as one of the two main aspects in the prevention of sudden cardiac death (SCD). F-MARC has developed a football-specific PCMA which aims at maximum probability of detecting underlying cardiovascular disease and therefore includes personal and family history, resting ECG and echocardiography as standard for the international, elite-level player. This PCMA is recommended to teams prior to participation in a FIFA competition.

FIFA's emphasis on prevention is reflected throughout this manual on football emergency medicine, which also offers concrete and practical advice on what to do should an emergency occur. In the example of SCD, for example, this means drawing up an emergency action plan as the second aspect of preventing SCD in players who have suffered cardiac arrest.

This manual goes one step further as it not only addresses emergencies on the pitch, but also emergencies that might affect delegations, VIPs and the thousands of spectators at football matches. The history of football is littered with tragedies which have cost the lives of too many fans who went to the stadium only to celebrate their passion for the game and their teams.

The guidance given by the FIFA Medical Committee to future organisers of FIFA competitions concentrates on players and delegations as the provision of mass emergency medical services is the responsibility of the state. However, it is important that the football medical community is aware of the requirements for efficient and effective provision of these services.

We are therefore grateful to the authors from the FIFA Medical Centre of Excellence and the Department of Emergency Medicine of the University of the Witwatersrand, who have added to our list of key medical publications with this important manual.

We trust this publication will help to improve the safety and care of players, delegations and spectators at football stadiums worldwide – so that we all may fully enjoy the beautiful game.

Dr Michel D'Hooghe
Chairman of the FIFA Medical Committee
Bruges, Belgium

Prof. Jiri Dvorak
FIFA Chief Medical Officer
Zurich, Switzerland

Dear readers,

South Africa, as the host nation for the FIFA Confederations Cup 2009 and the 2010 FIFA World Cup™, has been thrust into the realities of providing for such prestigious events. Experience gained by FIFA over the years ensures that the terms of reference and levels of service required are understood by all stakeholders who are tasked with delivery. In this regard there are awesome responsibilities attached to the delivery of healthcare and the preparation of health professionals who will be involved.

Gone are the days when medical back-up consisted of a stand-by ambulance and a team of first aiders; we are now obliged to provide for all eventualities and circumstances. Preparedness for some of these situations is based on past experiences of major stadium disasters, loss of life from inadequately-trained or underprepared medical attendants, while in other cases it is simply foresight, good planning and common sense that seek to mitigate all possible risks.

The University of the Witwatersrand is extremely proud to have on its staff a number of experts who have been engaged by FIFA to be part of the process of preparing health professionals for the modern-day demands of major football events. Anticipation and appropriate responses are required, whether for the individual player with an actual or potential injury, the international spectator suffering from a contagious disease, the collapsed player or spectator, or the disastrous consequences of structural or human failures within a stadium. Based on the success of the South African programme that was coordinated by our leading staff of Sport and Emergency Medicine, FIFA considered it appropriate to export the "product" beyond our borders. We thank FIFA for the privilege, the recognition, and the opportunity to engage with colleagues in ensuring that all who participate and contribute to these international events will be in safe and competent hands.

Prof. Alan Rothberg,
School of Therapeutic Sciences, Faculty of Health Sciences, University of the Witwatersrand, Johannesburg, South Africa

Abbreviations and terms

ABCD Airway, breathing, circulation and disability in assessment of unconscious player.

ABC(D) Airway, breathing, circulation (defibrillation) in terms of cardiopulmonary resuscitation.

ABG Arterial blood gases: test used to determine the pH of the blood, the partial pressure of carbon dioxide and oxygen, and the bicarbonate level.

ACL Anterior cruciate ligament of the knee.

ALS Advanced life support: set of clinical interventions used by qualified healthcare providers above and beyond basic life support. The ALS provider has the knowledge and expertise to undertake invasive advanced life-saving skills which include endotracheal intubation, intravenous access, emergency medication administration and manual defibrillation, synchronised cardioversion and transcutaneous electrical pacing.

AED Automated external defibrillator: portable electronic device that automatically analyses the presence of life-threatening cardiac arrythmias such as ventricular fibrillation and ventricular tachycardia. It will notify the rescuer verbally of the need to defibrillate the patient, automatically charge the capacitors and then advise the rescuer when to push the "shock" button.

AMS Acute mountain sickness: unspecific symptoms occurring with unstaged ascent to >2000 MASL.

ARVD Arrhythmogenic right ventricular dysplasia (or ARVC for cardiomyopathy): common cause of SCD in athletes.

a.s.l. Above sea level

BLS Basic life support: set of clinical interventions used by basically trained healthcare providers at a level of care which does not include any advanced invasive skills. BLS providers may use AED devices but not manual defibrillators.

CCN Neuropraxia of the cervical cord: rare condition mainly described in American football players.

CPR Cardiopulmonary resuscitation

Crowd doctor A term used by The Football Association (England) for an event physician.

CT Computer tomography

Disaster An acute event which, due to the volume of acutely injured patients, overwhelms the resources of the local (or regional) emergency services requiring external assistance from adjacent emergency services and which will require activation of nearby hospitals' emergency disaster plan.

EAC Exercise associated collapse: rare in football, more common in endurance events probably due to postural hypotension as a result of sudden cessation of prolonged physical activity.

EIA/EIB Exercise-induced asthma or bronchospasm

EMS Emergency medical services

Event physician Professionally registered medical practitioner who has been appointed by the local organisers of a competition/match to provide medical services to all official personnel and guests, players and team delegations in and around a football stadium during the event. He is also responsible for ensuring that adequate medical services are provided to supporters, commercial personnel, security personnel and other patrons in and around the football stadium.

FIFA Medical Centre of Excellence Established medical centres accredited by FIFA for their medical, educational and research expertise in football.

FIFA VMO FIFA Venue Medical Officer: FIFA-specific term meaning the physician appointed by FIFA to supervise the provision of medical services at a venue/stadium.

HACE High-altitude cerebral oedema: mostly occurring with unstaged ascent to >3000 MASL.

HAPE High-altitude pulmonary oedema: mostly occurring with unstaged ascent to >4000 MASL.

Host city Any city in which there is a stadium located during a competition.

IMI Intramuscular

IVI Intravenous

LOC Local Organising Committee

LoC Loss of consciousness

LOC VMO LOC Venue Medical Officer is a FIFA-specific term referring to the physician appointed by the local organisers (or LOC) and responsible for the provision of medical services at a venue/stadium.

MCI Multiple casualty incident: any event in which the number of acutely injured patients from a single traumatic event are of such a number as to require extraordinary response from the local emergency services and which require activation of the nearby hospitals' emergency disaster plan.

MRI Magnetic resonance imaging

NSAIDS Non-steroidal anti-inflammatory drugs

PCMA Pre-competition medical assessment

PCL Posterior cruciate ligament

PEF Peak expiratory flow (rate): measurement to monitor lung function, symptom severity and treatment effect in asthma

PRICE Protection, rest, ice, compression and elevation

pMDI Pressurised multi-dose inhaler: device used to apply pressurised medications e.g. beta-2-agonist, corticosteroids in bronchoconstriction.

ROM Range of motion (joint)

SCA Sudden cardiac arrest: without precedent symptoms leading to collapse.

SCAT2 Sport concussion assessment tool: sideline and clinical assessment of concussed athletes.

SCD Sudden cardiac death: death occurring within one hour of the onset of symptoms in someone without a previously recognised cardiovascular abnormality, excluding respiratory, cerebrovascular and drug-related deaths.

Team base camp Location/hotel where a team participating in a competition stays in between matches to travel to stadiums or venues.

Team physician Professionally registered medical practitioner (or related allied professional healthcare provider) whose primary responsibility is the health and medical welfare of the members of a football team and related management.

Triage Process of sorting patients into injury severity categories in order to prioritise treatment and/or transport.

TUE Therapeutic use exemption: permission to use an otherwise prohibited substance or method based on a documented medical file and obtained from a TUE committee prior to the use of the substance or method. Retroactive approval in case of emergency treatment of an acute condition.

VOC Venue operational centre: the central operational command of an event, hosting representatives of stadium management, security, fire, medical and related services. All information, instructions and commands are relayed via the VOC, usually positioned to have a panoramic view of the field and stands.

Venue Location of a sports event, including e.g. the stadium or the host city.

WBGT Wet bulb globe temperature

1. Introduction

1.1 Football emergency medicine: the need

In 2004, South Africa was awarded the opportunity and privilege of hosting and organising the 2010 FIFA World Cup™, the largest single-sport event in the world. The general preparations for the competition include organising the medical services, for which FIFA's guidelines are specific and comprehensive.

The city of Johannesburg, the largest in South Africa, hosted the FIFA Confederations Cup 2009, and in 2010 will again be host city with two of the ten stadiums for the competition. Fifteen of the 64 matches will be played in Johannesburg, at Ellis Park (capacity 61,000) and Soccer City (capacity 87,700). Johannesburg, which is home to the Local Organising Committee (LOC), will also host the FIFA headquarters as well as most team base camps, and is close to Tshwane (Pretoria), where the referee base camp will be located. Moreover, Johannesburg is also home to OR Thambo International airport, the main gateway into the country for teams, officials, dignitaries and visitors alike.

In an analysis, it was found that the LOC, together with its LOC General Medical Officer and the ten Venue Medical Officers (VMOs; FIFA terminology) as well as local and national health authorities, will be responsible for large numbers of constituents, an extensive geographic area and a range of conditions.

It was also obvious that there are **overlapping and common interests between sports medicine and emergency medicine**, two of the many disciplines required to work together to provide the medical services at this competition. Sports physicians and other healthcare professionals working in the sporting environment tend to be competent and knowledgeable in matters of sports injuries. Similarly, emergency medicine practitioners have competencies and knowledge in their specialist field of emergencies.

In the football-playing environment, where there are players, VVIPs, VIPs, officials, spectators and vendors, either or both medical services may be required. Depending on the size of a competition, emergency medical practitioners will seldom be called upon to treat football injuries, but they may more frequently get involved in treating conditions that a football player may suffer from. So, for emergency medical practitioners to have an understanding of football matches, playing conditions and football medicine would be a distinct advantage.

On the other hand, sports and football medicine practitioners may not be knowledgeable about emergency matters, particularly mass emergency medicine, but should an emergency occur on the pitch or a major casualty incident occur at a stadium, they could and should be able to "convert" from sports practitioner to "emergency" practitioner, which would then need to be within their scope of practice.

The two Johannesburg VMOs are based at the University of the Witwatersrand (Wits). One is the Director of the Centre for Exercise Science and Sports Medicine, which is a FIFA Medical Centre of Excellence, and the other is Professor of Emergency Medicine in the Division of Emergency Medicine. When these two VMOs started preparing for their functions, the development of a preparatory education programme was discussed, originally intended for all the VMOs at the different venues (mainly sports medicine practitioners), emergency care and further healthcare providers involved in the medical services at the 2010 FIFA World Cup™, but rapidly evolving to adopt an even broader perspective. The Wits FIFA Medical Centre of Excellence already had an F-MARC (FIFA Medical Assessment and Research Centre) and university-accredited Certificate of Competence in Football Medicine, created by the centre Director together with an experienced football physician who is an honorary lecturer at the centre. Of the subjects covered on the three-day course leading to the certificate, those related to football medicine emergencies and mass gathering and major incident and disaster medicine were identified as the basis for the curriculum for a Football Emergency Medicine course.

The need for structured football emergency medicine education for all healthcare providers involved in football events of different sizes and levels arose from a number of experiences and problems that may prevail at football matches. The idea was to provide prospective event physicians, responsible for either an individual football match, several matches at a specific venue (corresponding to the VMOs at FIFA competitions) or a whole football competition at whatever level, with the required knowledge and skills to enable them to function with confidence in this position.

The objective was to provide a basic understanding and safe working knowledge in the areas of

- emergency medicine;
- mass gathering, disaster medicine and
- emergency football medicine

during football competitions at all levels of play.

The manual is **written for and from the perspective of the team and the event physician to facilitate their work in their respective functions**. It is not intended to provide a comprehensive overview of football medicine, but to focus on the emergency medicine part performed at the stadium, i.e. there is no detailed description of the diagnostic and therapeutic work-up of injuries.

Team and event physicians should familiarise themselves with the WADA Code and the FIFA Anti-Doping Regulations, as well as the FIFA Therapeutic Use Exemption (TUE) Policy. It must be noted that in relation to the conditions referred to in this manual, there should not be any withholding of emergency treatment based on potential anti-doping rule violations. There is provision for **retroactive approval of TUEs in emergencies**, which the attending physician will then need to address at a convenient time as soon as possible after treating a player.

Furthermore, the above aspects should be presented to local organisers/organising committees, healthcare practitioners, emergency medical practitioners and team physicians at any football event to alert them to the issues in relation to immediate medical care for teams, officials and spectators at football events, **to create an awareness and appreciation of the emergency medical issues around national and international football events, and to plan accordingly**.

We thank the FIFA Medical Committee and F-MARC for their support.

Johannesburg, December 2009

Demitri Constantinou
Efraim Kramer
Sello Motaung

1.2 A structured approach to planning

This section discusses the matters and needs to be considered in the planning and organisation of medical services for football events of different sizes and at different levels of play nationally and internationally.

Football stadium disasters from which lessons can be learned:

1946	Bolton, England	33 killed
1964	Lima, Peru	300 killed
1971	Glasgow, Scotland	66 killed
1982	Moscow, USSR	340 killed
1985	Bradford, England	56 burnt to death
1985	Brussels, Belgium	39 trampled to death
1989	Hillsborough, England	96 killed
1991	Orkney, **South Africa**	44 killed
2001	Accra, Ghana	120 killed
2001	Ellis Park, **South Africa**	36 killed
2009	Abidjan, Côte d'Ivoire	22 killed, 132 injured

The details of the needs are modelled on the FIFA Medical Committee's requirements as they apply to FIFA competitions. These relate to:

- Constituents
- Conditions
- Locations
- Jurisdiction
- Duration
- Services
- Personnel
- Facilities

Constituents:

The recipients of football emergency medicine services include:

1. Players
2. Referees and match officials
3. Team members and administration of the event's governing body and local organisers
4. Invited international and local dignitaries (VVIPs and VIPs)
5. Participating supporters and local spectators
6. Media
7. Commercial on-site vendors

The service providers for whom this is relevant include:

- The governing body's responsible physicians (at FIFA competitions, FIFA Medical Officers)
- The event/stadium physicians responsible for venues, matches and competitions (at FIFA competitions, LOC VMOs)
- Team physicians
- Advanced life support and equivalent healthcare providers

Locations:

Locations where emergency medical incidents may occur include:

- On the pitch
- In the medical centre(s)
- In the stadium tiers and stands
- In the areas hosting dignitaries (VIP exclusive areas)
- In and around the stadium

Conditions to cover:

The conditions that may require medical intervention include:

1. Football injuries – acute football injuries require an accurate, swift assessment with appropriate intervention and management.
2. Injuries from non-football activities – these may interfere with the players' ability to participate in either training or matches, or significantly affect the health of the player or official, or other constituent and need to be treated.
3. Medical illnesses/conditions – any acute life-threatening condition needs to be managed as expeditiously as possible, particularly when the condition is time-critical in nature, e.g. acute cardiac arrest or anaphylaxis.

Jurisdiction:

Jurisdiction refers to the physical areas and facilities that the local organisers and event physician may need to cover with respect to football emergency medicine. These naturally are at the

1. Football venues
– Competition pitches/stadiums
– Training venues
2. Team hotels and team base training camps, which may include the referees' base camp.
3. Airports/ports of entry. These may fall within the jurisdiction in certain circumstances, for example where the teams arrive and there is a player/official with pyrexia that is found on entry. Similarly, if a player/official arrives with an acute illness (e.g. acute abdomen), acute thrombosis or embolism, they would fall within the jurisdiction of the event physician.
4. Host city. Within the host city of the competition, as the constituents move from hotel to playing or training venue, or even sightseeing, they may require emergency medical care, or need assistance with an injury.

Duration:

The duration reflects the time that the relevant event physician is "operational" for the football competition.

1. During competition and training. This is traditionally when there is the greatest need for football emergency medicine service availability as this is the time of highest risk. At this time, all appropriate staff, facilities, resources and equipment must be in place.
2. Prior to competition. This is dependent on a number of variable factors, such as when the first teams start arriving at the site of the competition. It may be several weeks or days.
3. Post-competition and training. This also naturally refers to the period between training/matches, and if teams stay on for a period after the official competition has concluded. Theoretically, the time of responsibility exists until the constituents have departed from a port of exit.
4. During social activities. The constituents remain the same, even when they are not participating or watching football being played. As such, if they happen to be at a function, formal or otherwise, and they have a medical emergency, this falls within the jurisdiction and duration of responsibility and the appropriate medical services must be available.

In short, it is expected that the supervising medical services will be on operational duty and responsible 24 hours a day, 7 days a week from arrival of the first constituents until departure of the last constituent within the jurisdiction.

Services:

Acute injuries or illnesses

The approach for any serious acute/chronic injury or illness classically entails:

1. Assessment. Taking of a detailed history and focussed systematic clinical examination as required.
2. Investigations. Investigations within the stadium/hotel environment will usually be limited, and mostly require referral to a specialist centre.
3. Management. Appropriate immediate resuscitation and stabilisation within the stadium environment prior to:
4. Referral and/or evacuation (local, regional, national, international) to the nearest, most appropriate medical facility depending on the nature of the medical emergency and required medical equipment.

Personnel:

The healthcare professionals that constitute the complement of football emergency personnel are those listed above, event and governing body physicians (e.g. FIFA Medical Officers, LOC VMOs), stadium physicians and team physicians. In addition, a comprehensive team will include:

– State health officials
– Physiotherapists
– Medical specialist network for referral
– Healthcare volunteer workers

Facilities:

The facilities include the following structural locations:

– Player and dignitary medical centres at competition venues and training sites, where appropriate
– Spectator medical first aid centres at competition venues and training sites
– Medical centres at team and delegation hotels
– Ability to offer mobile medical care, e.g. house calls
– Accredited hospitals

2. Emergency situations in and around stadiums

2.1 Basic principles of multiple casualty management in football

Multiple casualty incident (MCI) management is a speciality that requires continual study and experiential, on-scene exposure before one can be considered an expert. This chapter is not intended to provide a fully comprehensive exposé of the subject but to simply present the basic principles inherent in football disaster management. The possibility of a team/event physician being present and in a position to assist at an MCI is unlikely, yet possible. The aim is therefore to provide the team/event physician with the basic practical principles of the management of an MCI in a football environment so as to be able to assist medically when the need arises.

Definitions

Team physician: a professionally registered medical practitioner (or related allied professional healthcare provider) whose primary responsibility is the health and medical welfare of the members of a football team and related management.

Event physician: a professionally registered medical practitioner who has been appointed by the local organisers of a competition/match to provide medical services to all official personnel and guests, players and team delegations in and around the environments of a football stadium during the event. He is also responsible for ensuring that adequate medical services are provided to supporters, commercial personnel, security personnel and other patrons in and around the football stadium.

MCI: a multiple casualty incident is any event in which there are so many acutely injured patients from a single traumatic event as to require an extraordinary response from the local emergency services and an activation of the emergency disaster plan of the nearby hospital(s).

Disaster: an acute event which, due to the volume of acutely injured patients, overwhelms the resources of the local (or regional) emergency services, requiring external assistance from adjacent emergency services and which will require activation of the emergency disaster plan of the nearby hospital(s).

Non-supporter MCI: an MCI which primarily has as its origin factors that are not directly related to the behaviour of the football supporters present at the football match.

Supporter MCI: an MCI which primarily has as its origin factors that are directly related to the behaviour of the football supporters present at the football match

Triage: the process of sorting patients into injury severity categories in order to prioritise treatment and/or transport.

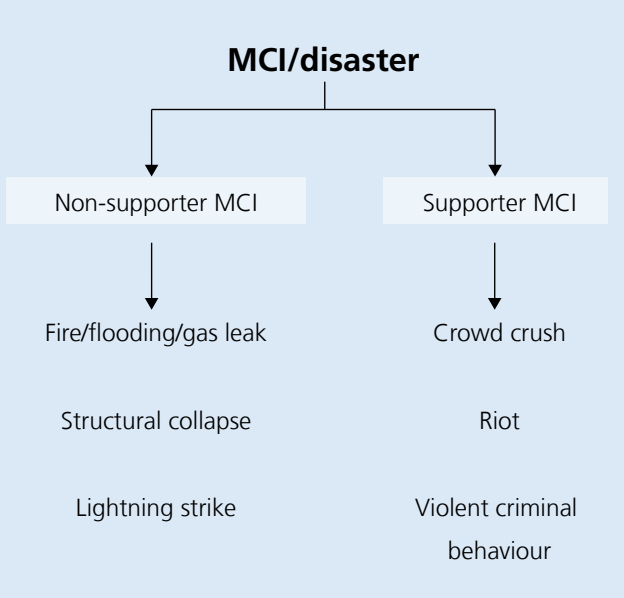

Figure 2.1.1 Classification of multiple casualty incidents

Factors known to influence the occurrence of MCI events

- Availability of alcohol for sale at football matches.
- Failure of match organisers to adhere to the applicable safety guidelines, laws and bylaws.
- Failure to confiscate potential weapons and missiles from rival supporters.
- Failure to separate rival football supporters within and outside the stadium precincts.
- Fencing around the field, when present, must be

collapsible under recommended pressure to allow emergency overflow onto the field.
- Inadequate categorisation of the expected "risk level" of the match (see 2.2).
- Inadequate medical services for the anticipated crowd volume.
- Inadequate public address system in and around the stadium.
- Inadequate turnstiles to accommodate the anticipated number of supporters.
- Inadequately functioning operations centre at a match.
- Inadequately trained, experienced and supervised security personnel on scene.
- Inadequate seats for major matches in the absence of a giant screen outside the stadium.
- Inappropriate use of tear gas as a means of crowd control.
- Matches with large crowds on weeknights after the close of business.
- Presence of financial influences when categorising the "risk level" of a match.
- Sale of tickets at the stadium prior to a match.
- Unreserved seating on a "first-come, first-seated" basis.

Minimising the risk of football disasters - aide-mémoire

N.O. P.E.N.A.L.T.I.E.S. © 2009

N - No tear gas for crowd management
O - Overall effective stadium command and control

P - Police professionalism and discipline
E - Emergency medical presence on site mandatory
N - No standing areas for supporters – all-seater stadiums
A - Alcohol prohibition on site
L - Lessons from the past put into practice
T - Ticket purchase not at stadium prior to match – pre-sale of tickets
I - Identification of troublemakers prior to any match
E - Evaluation of risk prior to match during planning stage
S - Scheduling games to minimise risk, e.g. no weeknight games after work

Figure 2.1.2 Minimising the risk of football disasters during planning

Basic plan of action for the untrained physician

Notwithstanding what may be occurring at an incident itself and the volume or severity of patients, the safety and well-being of those for whom any designated team physician or event physician has primary responsibility take absolute priority. Therefore, in the event of any incident which is potentially dangerous or which involves multiple patients, the primary function of the team/event physician is to assemble all those who are his primary responsibility, e.g. the team, at a location that is considered safe and away from spectator view. A decision will then be made as to whether these persons remain isolated in the safe location inside the football stadium or nearby environment, or whether evacuation is the preferred course of action. Once these persons have been safely accounted for and leaving them will not compromise any of them medically, the team/event physician should communicate with the incident command or venue operations centre. If unable to, he should report to the incident scene and offer medical assistance so as to be able to triage and treat any acutely injured patients accordingly. It must be emphasised that he should only respond to the scene of any incident should it be ascertained that it is safe to do so. This will depend on the nature of the particular incident and this requires both professional analysis and common sense.

Safety on scene

All MCI scenes are, by their very definition, dangerous environments and must be regarded as such until the scene has been declared safe by the attending incident commander, who is usually a member of the local emergency services or someone specially trained in disaster management. The initial priority at any MCI scene is therefore to ensure that there are no further casualties such as, for example, inexperienced volunteers who may rush to the scene to assist.

If the team/event physician has ascertained that the scene is safe for him to enter, he may proceed with evaluation, triage and treatment as appropriate. If, however, the scene is not safe, he alone is responsible, upon arrival, for securing the scene and, if necessary, he should await the arrival of the local emergency services before attending to the injured. **Securing a high-risk MCI incident scene as the initial priority and the prevention of unauthorised, inexperienced volunteer rescuers attending to the acutely injured are standard disaster management principles** and must be adhered to whenever possible. The physician must be aware of these principles and remain as a professional medical provider and not one of the acutely injured.

The various methods of securing a high-risk MCI incident scene are beyond the scope of this chapter and can be found in any standard MCI or disaster management text.

Response and chain of command

The incident commander is in total control of the incident scene and his decisions must be respected and obeyed, particularly if he is a member of an emergency service agency whose authority is legislated as such. In the majority of MCIs, inexperienced medical professionals will be advised as to what is required of them and it must never be taken as a personal affront if the service requested appears to be minor. The greater the experience of the healthcare provider, the more will be requested of them medically and vice versa.

Triage

If the incident commander does not request any special task or give directions, the first aspect of patient care is triage (sorting) of patients into various injury severity categories, thus prioritising treatment and/or transport to the nearest and most appropriate medical facility. The underlying utilitarian ethical principle of any triage methodology is **to provide the greatest benefit for the greatest number of patients**. Internationally, there are many triage methodologies. This manual will seek to present the simplest, yet not necessarily the most scientific method, for the team/event physician to acquire and remember:

This simple system, adapted from the S.T.A.R.T. triage system, is based on two overriding actions:

- the ability of the injured patient to respond to verbal commands;
- the ability (mobility) of the injured patient to evacuate the scene.

Step 1: Shout in a loud voice requesting all persons who remain on the scene, and have thus not self-evacuated, to evacuate the scene immediately, giving specific instructions as to which evacuation route must be used. Repeat this once or twice if a large number of people remain on site with little apparent response. All those who do evacuate the scene do not have a life-threatening injury and can be discounted for the time being.

Step 2: Request loudly to all those who still remain on the scene to raise their hands or shout back if they heard your instructions but are unable to leave because they are either trapped or have fractured a limb (and are therefore unable to move). All those who respond positively can also be discounted from having acute life-threatening injuries for the moment.

Step 3: The remainder of patients who do not respond and remain on scene are commonly those with acute life-threatening injuries and are either unconscious or in severe shock and need immediate medical attention. These are the highest priority patients to concentrate on.

Treatment

Treatment of acutely injured patients in a football MCI should be confined to treatment of acute life-threatening injuries using the basic principles of airway, breathing and circulation that are known internationally.

Airway:

- If the patient is unconscious and appears to be breathing adequately, turn the patient safely and appropriately into the lateral position and open the patient's mouth.
- If the patient is unconscious and breathing is not adequate, feel for a central pulse to ascertain whether the patient is in cardiac arrest. If no pulse is found or one is not sure because of the difficult environmental circumstances, then regard the patient as being pulseless and continue accordingly.
- Whether to start basic cardiopulmonary resuscitation (CPR) or not in an MCI requires further elaboration. Patients who have suffered extensive injuries that have resulted in cardiac arrest have a very poor prognosis and a decision not to resuscitate may legitimately be made if there are other patients present whose life-threatening needs require the use of on-scene expertise, assistance and equipment. If this is not the situation, then an initial period of basic CPR may be attempted.
- However, if the patient is in cardiac arrest as a result of a hypoxic mass crush-type injury scenario, then cardiopulmonary resuscitation must be initiated using whatever professional and/or volunteer resources are available. Considering that standard CPR is a basic life-saving skill that can be taught in minutes, especially if on-site supervision is provided, additional manpower must

be sought from volunteers whenever logistically possible and practical (see 2.4).

Breathing:

As stated above, in a crush-type MCI where the cause of unconsciousness and inadequate/absent breathing is asphyxia (hypoxia), there is an urgent requirement to initiate standard CPR with rescue breathing as soon as possible and for as long as possible as this is the only treatment with a chance of success.

Circulation:

Assessment of the circulation can be achieved in these basic circumstances using a variety of clinical parameters, namely:

- A patient who is alert and responsive will have adequate circulation.
- A patient with a palpable radial pulse has a systolic blood pressure around 90mmHg with a palpable brachial/femoral/carotid pulse of around 80/70/50-60 mmHg.
- A patient with a capillary refill of more than three seconds is regarded as being in shock.
- A patient with cold, clammy skin is regarded as being in shock.
- An unresponsive patient with abnormal/absent breathing is in cardiac arrest and managed accordingly as mentioned above.

Any patient who is clinically in a state of hypovolaemic shock must be positioned horizontally on their side unless there are specific medical steps that must be undertaken to improve the patient's condition, namely:

A Align conscious patient supine with feet elevated.
B Bleeding control using appropriate methods.
C Close any open chest wounds.
D Decompress actual/suspected tension pneumothorax.
E Environmental factors – keep the patient as warm as possible.
F Fluids intravenously if available and appropriate.

Whatever form of emergency medical management is performed in all acute life-threatening situations, it must be done with speed, efficiency and using the simplest of procedures, techniques and equipment so that once the patient has been attended to and temporarily stabilised, time and effort is then available for the next patient with an acute life-threatening injury and so forth.

A. F.R.E.E. K.I.C.K. © 2009

A - Always put safety first

F - Focus on the welfare and assembly of the team primarily
R - Respond to assist the acutely injured once the team is safe
E - Evaluate the scene and triage patients into injury severity categories
E - Emergency life-threatening patients take priority

K - Keep treatment to basic airway, breathing and circulation manoeuvres
I - Involve and supervise volunteers if necessary
C - Call for assistance and communicate to those in command
K - Keep treating – do not abandon hope

Figure 2.1.3 Management of disaster – physician's aide-mémoire

Summary

Basic principles of football multiple casualty management

Multiple casualty incident (MCI) management is a speciality that requires continual study and experiential, on-scene exposure. There are, however, some basic inherent principles that will help the event and the team physician to act adequately in a football disaster. All MCI scenes are, by their very definition, dangerous environments and the initial priority at any MCI scene is therefore to ensure that there are no further casualties. Triage may be simply based on the ability of the injured patient to respond to verbal commands and the ability of the patient to evacuate the scene. Treatment of acutely injured patients in a football MCI should be confined to treatment of acute life-threatening injuries using the basic principles of airway, breathing and circulation.

REFERENCES

Bateman C.
No disasters yet, please – we're catching up. SAMJ. 2008;98(5):344,346,348.

Courson RW.
Preventing Sudden Death on the Athletic Field: The Emergency Action Plan. Curr Sports Med Rep. 2007;6: 93-100.

Darby P, Johnes M, Mellor G (eds.).
Soccer and Disaster – International Perspectives. London: Routledge; 2005.

DeAngeles D, Schuur M, Harms B.
Traumatic asphyxia following stadium crowd surge: stadium factors affecting outcome. WMJ. 1998;9:42-45.

Drezner JA, Courson RW, Roberts WO, et al.
Inter-Association Task Force Recommendations on Emergency Preparedness and Management of Sudden Cardiac Death in High School and College Athletic Programs: A Consensus Statement. Clin J Sports Med. 2007;17(2):87-103.

Gebhart ME, Pence R.
START Triage: Does it Work? Disaster Manag Response. 2007;5(3):68-73.

Madzimbamuto FD.
A hospital response to a soccer stadium stampede in Zimbabwe. Emerg Med J. 2003;20(6):556-559.

Madzimbamuto FD, Madamombe T.
Traumatic Asphyxia during stadium stampede. Cent Afr J Med. 2004;50(7-8):69-72.

Ngoepe BM.
Commission of Inquiry into the Ellis Park Stadium Soccer Disaster of 11 April 2001. Available at http://www.info.gov.za/view/DownloadFileAction?id=70241. Accessed on 22 December 2009.

O'Neill PA.
The ABC's of Disaster Response. Scand J Surg. 2005;94(4):259-266.

Sivarajasingam V, Moore S, Shepherd JP.
Winning, losing and violence. Inj Prev. 2005;11(2):69-70.

Yancey AH , Fuhri PD, Pillay Y, Greenwald I.
World Cup 2010 planning: an integration of public health and medical systems. Public Health. 2008;122(10):1020-1029.

No authors listed. Football stadium defibrillators for cardiac arrest. Eur Heart J. 2009;30(7):743-744.

2.2 Principles of football stadium mass gathering medicine

It is the very nature of football competitions to have large volumes of supporters, located in the confined environment of a stadium, actively involved in supporting their team. These people of all ages with unpredictable levels of health status may require medical services if any symptoms of disease manifest themselves or injuries occur during their stay in the stadium. Some of these manifestations of disease may be acute and life-threatening and will require urgent medical attention in order to initially stabilise the patient/s before referral to the nearest most appropriate medical facility. Most commonly, however, minor complaints falling within the realm of primary healthcare or family medicine are encountered. Ultimately, whatever the nature or severity of the complaint, adequate, effective medical management must be provided to those in need.

Definition

Mass gathering medicine involves the provision of medical services to large volumes of people, usually in excess of 1,000, gathered together for a particular event (football match), in a specific location (stadium, fan park), for a defined period of time and who would generally elect to remain at the event should clinical indications of illness or injury develop.

The numbers of people who require authorised medical services so as to fall within the definition of mass gathering medicine depends on the country and its legislation and may vary from volumes in excess of 1,000 to 25,000 people or more. Whatever the exact number, medical services should always be provided in an attempt to prevent where possible, treat where applicable and transfer where appropriate all persons manifesting acute illnesses and injuries within the perimeter of the football stadium from a defined period before, during and after the scheduled matches. Additionally, whenever a security perimeter is in operation to control access to the stadium, medical service provision must include all areas within the security zone.

As a result of personal, family and peer pressures and the purchase of entrance tickets, most persons elect not to leave the environs of a football stadium once they have gained access despite clinical manifestations. This is the unusual nature of mass gathering medicine. Supporters who have purchased tickets, who have travelled long distances, those accompanying fellow supporters and vendors who are present for commercial and financial gain, all may neglect their disease process with detrimental consequences, if adequate medical services are not immediately made available on site.

The full scope of **football mass gathering medical services** may include all of the following aspects:

- Acute sports medicine – specifically for the players
- Emergency medicine – for all attendees
- Primary healthcare medicine – for all attendees
- Occupational health and safety medicine – for construction/commercial staff
- Mass casualty and disaster medicine – for all attendees

The extent to which any of the above categories of medical services are provided will depend on the risk classification of the match and its specific related elements. As an example, if a local routine match is scheduled with no additional risk factors, most of the above medical services will not be required. However, if it is an international competition with popular teams and accompanying international supporters, all of the above may be required to be available because of the nature of match.

The effective, efficient and safe provision of medical care at any football match therefore requires detailed planning of infrastructure, equipment and staff requirements sufficiently in advance of the event. This operational plan has a number of components, each of which requires varying amounts of information and resources before it can be put into action.

Information required for planning

The following questions regarding the planned football match should be comprehensively answered wherever possible. These questions attempt to provide a practical picture of what is expected from before until after the match, and thus pre-emptively plan resources and capacity.

Which teams are going to be playing?

- What is the previous history of the teams playing together?
- Is there any known rivalry between supporters?
- Do any of the teams have known "troublemakers"?
- Do any of the teams have very popular players who increase expected numbers of supporters?

What is the nature of the game being played?

- Is this a routine league match or is it classed as non-routine e.g. cup qualifier?
- Is this a possible "grudge" match between the two teams?
- Is the losing side expected to cause problems after the game?

How many supporters are realistically expected?

How long will the crowds have access to the stadium before and after the match?

Is there planned entertainment before and after the match?

What day and time of the week is the planned match?

Is the stadium all-seater, standing only or a combination of the two?

Are tickets being sold at the stadium before the match?

Are the supporter seats reserved or on a "first come, first seated" basis?

Will alcohol be available and are there any limitations on purchase?

What are the expected weather conditions?

Table 2.2.1 Information on stadium and supporters required for planning and risk assessment

These questions (Table 2.2.1) are meant to provide sufficient information in order to establish a risk classification of the respective match so that adequate mass gathering resources can be organised with respect to security personnel, stadium stewards, medical services, fire marshals and so forth.

Risk classification of football matches

Currently there are no known validated international risk scores that would enable one to accurately gauge the degree of risk prior to a football match. In their absence, historical factors must be used that are known to affect risk potential. Risk classification is usually made based upon the expected volume and nature of the expected crowd (e.g. supporter rivalry), the timing of the football match, the weather conditions predicted and all other related factors that may be relevant

Low risk: the potential for injury and/or illness, either occurring individually or on a large scale, is very low and the clinical scope of illness or injury is no different from the norm expected in any normal resident population group.

- Expected crowd: less than 33% of stadium capacity
- Time of match: weekend
- Weather: mild or usual conditions expected for the area
- Nature of match: routine / no rivalry / good history / no troublemakers expected
- Stadium seating: no tickets sold at stadium / all-seater stadium / reserved seats only

Moderate risk: the potential for individual or multiple injury/illness is higher than that expected from the normal resident population due to unfavourable factors present that increase the potential risk. These factors may be single in presentation and result in classification of the risk as "moderate", but if they occur in combination, the resulting potential risk will need to be upgraded to "high".

- Expected crowd: more than 50% of stadium capacity
- Time of match: weekday match at night
- Weather: hot humid conditions / rain expected
- Nature of match: vital match / grudge match / known rivalry / poor supporter history / troublemakers expected / popular players in attendance
- Alcohol will be available
- Stadium seating: no tickets sold at stadium / combination sitting and standing stadium / reserved seats available

High risk: the potential for illness, conflict and injury is high due to unfavourable factors, singly or in combination, and may include:

- Expected crowd: 100% of stadium capacity
- Time of match: weekday match at night
- Weather: hot humid conditions / rain and lightning expected
- Nature of match: vital match / grudge match / known rivalry / poor supporter history / troublemakers expected / popular players in attendance
- Alcohol will be available in unlimited/uncontrolled quantities
- Stadium seating: tickets will be sold at stadium / standing room mainly / unreserved seats – "first come, first seated"

Additional known factors that may further increase the risk classification include:

- Failure to effectively plan and risk categorise a match
- Failure to learn historical lessons of note
- Inadequate or non-functional stadium Venue Operations Centre
- Inadequate stadium/crowd communication system
- Inadequate training of stewards and security personnel
- Insufficient food and beverage availability for spectators
- Lack of additional capacity for large crowds on playing field when required
- Lack of adequate medical services on site
- Lack of adequate signage for emergency exits
- Lack of adequate signage for essential services
- Provision and intended use of tear gas for crowd control purposes
- Unexpected congested road and rail traffic patterns
- Slow restricted entrance flow into the stadium

Approach to mass gathering medical service provision

It is important to consider that the provision of any medical services at the stadium is undertaken because of the unusual gathering of people who would normally be dispersed in the community. In the community, all persons are provided with emergency medical care which can be summoned to the patient's side. In the case of a non-emergency medical need, the patient usually commutes to a medical centre for attention. **Because of the confines of the stadium, regulated entrance/exit and the large number of supporters gathered, the football stadium should be regarded as a small town (community).** This philosophy encompasses a number of basic principles:

- Emergency medical response must be available that can be summoned immediately to the patient's side when necessary. This implies the need to have adequate mobile personnel with equipment that can speedily move to any part of the stadium.
- There must be a fixed medical post to which any non-emergency or self-referring emergency patient can report and which must be adequately signposted.
- The category of supporter and the likely level of expectation medically will determine to a great degree the level of care that is provided. Particularly in locations where there are resource limitations to medical care generally, the standard of medical care provided to the supporter crowd should not be higher than that provided locally by the surrounding medical facilities and healthcare system. The exception to this principle is international competitions with players and dignitaries from around the world. Local organisers of such events must be prepared to deliver medical services at the level that international visitors and players are accustomed

to receiving, even if it is at a level which is far greater than the local healthcare system.
This means that basic life support care should be the minimum accepted level of emergency care at all football stadiums worldwide, capable of managing any life-threatening medical condition at a basic level immediately, with subsequent transfer to hospital if and when required. The provision of advanced life support care cannot be regarded as a required minimum level of care internationally in the football playing world but must be regarded as a requirement for those locations that apply to host an international elite competition. This implies that such potential hosts must be in a position to logistically and financially afford such level of service.

– The greater the calculated risk of a match, the larger the number of medical and related emergency service personnel either on duty inside the stadium or on standby outside the stadium. The former is operationally more effective and efficient, yet the latter may be logistically preferable because of limited resources.
– In an emergency, all patients in the stadium should have a medical person attending to them within a maximum of four minutes of the call for assistance. This time is based on the need to initiate resuscitation of a patient with sudden cardiac arrest (for on-pitch incidents, see 3.1.2).

Components of mass gathering medical services

The provision of adequate medical services on site requires adequately trained medical/paramedical personnel with appropriate equipment and supported by the following infrastructure and logistics:

1. The medical/paramedical personnel must be able to manage acute illness and/or injuries in this specific pre-hospital environment. **It is thus essential that on-duty personnel** are not only practically trained and experienced in the acute management of potential or actual life-threatening airway, breathing and circulation problems, but must **be able to operate in the confines of a football stadium confronting them with limited ambient light and protective shelter, difficult patient access, spatial confines, steep gradients for access and patient carriage egress and exposure to spectator noise, interest and interference.** It is thus important to adequately expose all personnel, of whatever qualification and experience, to an introductory practical course in order that each becomes familiar with the specific stadium structure (gangways, corridors, access points and exits), method of appropriate and safe patient access and evacuation, local communication procedures, stadium chain of command, and how to use equipment effectively and efficiently in the confines of this environment. To place personnel on medical duty without this orientation is to court problems and potential failure.

2. The mobile and/or fixed medical/paramedical teams on duty must have access to appropriate items of medical equipment that are suited to their qualification and training. As a minimum, each team must be supplied with a basic life support kit that can effectively manage the patient's airway, undertake manual rescue breathing, tamponade external bleeding, initiate adequate cardiopulmonary resuscitation and use a defibrillator. If a defibrillator is not supplied to each medical team, then one must become available, on request, within a maximum of four minutes from elsewhere within the stadium.

Basic life support kit

– Protective gloves in adequate supply for each member of the medical team
– Protective eyewear for at least one member of the team
– Oropharyngeal tubes of different sizes
– A pocket mask for manual mouth-to-mask rescue breathing
– An antiseptic solution or pre-medicated swabs
– A packet of gauze swabs (5) or equivalent
– Trauma-type bandages (2) of two sizes
– Burn-type gel or dressing
– Rescue-type scissors
– Glucose gel or powder
– Supply of paper and pen/pencil

Figure 2.2.2 Minimum contents of the basic life support kit

3. Adequate communications between the various medical teams and the Venue Operations Centre (VOC) is mandatory for provision of medical services within a football stadium. One of the consistent failures in medical and mass casualty incidents is in communication between various levels of authority. Adequate communication is paramount for effective control, as appropriate decisions can only be generated if comprehensive information is forthcoming from the periphery. Likewise, appropriate action can only be taken if the decisions of central command are successfully relayed back to the periphery. Therefore, whatever form of communication is chosen, it must be fully functional within the local circumstances, and this should be assessed and tested prior to each match.

4. All personnel who are on duty and involved in medical service delivery in and around a football stadium **must be clearly identifiable** by the crowd, so that they can be immediately identified within seconds, and by any person. Medical personnel must not be confused with other personnel on duty including stewards, commercial vendors, nor camouflaged within the spectator mass, thus prolonging time of activation and hence response.

5. Finally, all medical personnel must fully appreciate that they are there to serve the interests of any attending person who requires medical attention, and not for their personal entertainment. They must devote their time and energy exclusively to monitoring the spectator mass for signs of medical incidents and need, and must not under any circumstances become a spectator with attention focussed on the match. However, as this situation occurs not too uncommonly, those in control of medical services are required to adequately brief, monitor and supervise all medical and paramedical personnel to strictly adhere to their primary responsibility.

Recommended minimum standards in medical mass gathering services

As mentioned above, local resources determine what is practically available to provide mass gathering medical services at any particular football stadium. Therefore, it is prudent to determine what the minimum standard of medical services should be, and allow local organisers to improve on this standard depending on the level and scale of the competition, the confines of human resources, financial constraints and legislative or regulatory limitations.

The minimum standard should provide at least a basic emergency and primary healthcare service to all supporters and participants in the environs of the football stadium, within the capacity on hand. Beyond this capacity, all patients should be referred to the nearest appropriate hospital.

1. Ambulances:

Each football stadium should have no fewer than two fully functional and equipped ambulances, each with a minimum of two basic life support trained ambulance personnel in attendance, from one hour before the gates are opened to the supporting public until 30 minutes after any match.

2. Medical station:

Each football event shall have at least one fixed, well signposted, first aid or medical station to which any ill or injured person may present him or herself, from one hour before the gates are opened to the public until 30 minutes after the match. This facility should preferably be a permanently designated medical room but may logistically take the form of a mobile post if required, e.g. ambulance.

The medical station must be equipped so as to ensure management of any common acute life-threatening condition, at least at a basic life support level. To this end, the following must be available:

Universal precautions

- Protective gloves for all members
- Protective eyewear for at least one member of the team, if not all members
- Reflective clothing for easy identification
- Antiseptic soap solution or wipes
- Availability of water for drinking or washing

Airway equipment

- Oropharyngeal tubes of varying sizes
- Suction device – either manual or mechanical with tubing and suction catheters or a means of clearing vomitus from the patient's mouth if required

Spinal immobilisation equipment

- A wooden spinal board or equivalent for spinal column immobilisation and for patient carriage to or from the

medical station, with accompanying immobilisation straps or equivalent
- Cervical spine immobilisation devices e.g. adjustable rigid cervical collar or equivalent
- A minimum of two functional stretchers, for transferring patients in the supine or lateral position

Breathing equipment
- Reliable source of supplemental oxygen (of at least 30 minute duration at 15 litres/minute) with accompanying face masks and oxygen tubing
- Self-inflating, bag-valve mask resuscitation kit with reservoir bag and appropriate-sized masks. A one-way-valve pocket mask with oxygen inlet nipple may be substituted as a second-best equivalent.

Circulation equipment
- A manual (monophasic or biphasic) or automated external defibrillator (AED) is the minimum standard of care and should be available, preferably located at least at the side of the field near the fourth referee and at the designated medical station if more than one is present.
- Adequate selection of trauma dressings, tapes and plasters to control and dress external bleeding wounds
- Stethoscope, manual blood pressure apparatus, pupil torch

Drugs
- Primary healthcare medications – if medical or paramedical personnel are adequately qualified, it is acceptable to administer various minor medical complaint medications, notably oral paracetamol, ibuprofen, hyoscine butylbromide, loperamide or antacids as a single dose as part of the medical services provided.
- Emergency medications include:
  - Adrenaline – for use by those registered to administer medications. Indicated in cardiac arrest and acute anaphylaxis.
  - Dextrose – glucose powder, gel or equivalent forms of sugar must be available for oral or buccal administration in any patient with potential hypoglycaemia. Availability of blood glucose testing kit.
  - Antihistamine – for patients with severe allergic reactions to e.g. food or insect stings
  - Aspirin – for patients with acute chest pain of potential ischaemic origin before transfer to hospital
  - Asthma inhaler with spacer – for symptomatic asthmatics who may have forgotten their inhaler pumps or who are experiencing an acute asthma attack
  - Midazolam – for status epilepticus seizures before transfer to hospital. Although Midazolam is not recognised as a first-level anti-convulsant, the ability to administer it via a multitude of routes e.g. oral, buccal, nasal, rectal, intramuscular and intravenous, including no cold-chain requirement, makes it ideal as a universal benzodiazepine in limited resource settings.
  - Prednisolone – for oral administration in cases of acute asthma or anaphylaxis

Accompanying syringes, needles, antiseptic solution and hazard container.

Environmental-type equipment
- Selection of blankets and linen for environmental protection, comfort and privacy
- Secure area for examination and treatment that is shielded from public view
- Light source inside medical station including a torch with spare batteries
- Waste disposal bags

Fractures, sprains and strains equipment
- Set of simple immobilisation splints for various long bone fractures with accompanying straps or bandages
- Rescue-type scissors

3. Medical personnel:

The ratio of the recommended number of healthcare providers to the volume of football supporters at any match is not absolute internationally and based mainly on historical and often human resource factors. The *Guide to Safety at Sport Grounds* (Guide), published by the British Football Licensing Authority (2008), advises that a "crowd doctor, qualified and experienced in pre-hospital immediate care" should be available for all crowd volumes in excess of 2,000. Similarly, the Guide recommends the presence of suitably trained first aiders, such that there are no fewer than two on site, a ratio of one first aider per 1,000 supporters (1:1,000) up to 10,000, and thereafter one first aider per 2,000 supporters (1:2,000) in an all-seater football stadium. If, however, seating and standing accommodation is present, the ratio of first aiders increases.

Although the Guide's recommendations have not been validated, it brings to the fore a number of generic factors that require consideration.

1. The minimum level of qualification of on-duty personnel at football stadium matches are certified first aiders/basic life support providers who are all capable in providing basic life support emergency care to the acutely ill or injured. However, it is obvious that first aiders need support from a higher level of healthcare provider if and when an emergency incident presents itself. This support may be in the form of a medical doctor (crowd doctor), registered professional nurse or advanced life support ambulance paramedic inside the stadium, or in contact via mobile communication, or on standby at the nearest medical facility. Whether the ratio is based on the number of expected supporters, the physical design of the stadium or additional known risk factors, the main deciding factor is the ability of any mobile first aid medical team to respond to any patient's side and initiate any life saving care within a four-minute time period. In addition, the time it would take to medically back up any responding first aid team with advanced life support capability will determine how many of these members are required. This time period should not exceed four minutes from activation either.
2. No mention is made of specific football stadium training in order to ensure that adequate functionality exists and that there is practical knowledge regarding response to, management of and evacuation of a patient from a crowded tier. This oversight requires remediation, for no matter how qualified, knowledgeable and experienced any medical personnel may be, practical training in football stadium medicine must be a prerequisite for any official medical duties.

In view of the above, and the paucity in the literature in recommending appropriate numbers and related medical-type qualifications for mass gathering events in general, and football stadium matches in particular, the logistical recommendations below (Table 2.2.3) are provided based on the following considerations:

- Stadium gates usually open two hours before kick-off and most stadiums empty ten minutes after the final whistle. The average duration for provision of medical services inside the stadium environment is thus four hours.
- The majority of football matches are low-risk events.
- The majority of patients seeking medical assistance have minor ailments.
- Minor ailments will be treated on site, whereas anything serious will be transported by ambulance to hospital.

	Low risk	Moderate risk	High risk
Ambulance + 2 staff	2 minimum on site	2 minimum on site	2 minimum on site
Up to 10,000			2 minimum off site
25,000			as above
50,000	3 minimum on site	3 minimum on site	4 minimum on site
75,000	4 minimum on site	4 minimum on site	4 minimum on site
			2 minimum off site but nearby (5 min)
Fixed medical post			
BLS staff			
Up to 10,000	2	2	4
25,000	2	4	6
50,000	4	6	8
75,000	4	6	8
Mobile medical teams			
With 2 x BLS staff each			
Up to 10,000	4	4	4
25,000	8	8	8
50,000	16	16	16
75,000	20	20	20
Advanced life support			
(doctor, nurse, paramedic)			
Up to 10,000	1 optional	1	1
25,000	1 optional	1	2
50,000	1	2	4
75,000	2	2	4

Table 2.2.3 Recommendations on logistical requirements for medical service provision at football events

Summary

Principles of football stadium mass gathering medicine

The provision of mass gathering medical services to all who may become acutely ill or injured, singly or en masse, within the environs of a football stadium is a responsibility that must be carefully planned and prepared based on individual risk assessment. Each stadium, depending on finances, logistics, human resources, regional legislation and so forth, may opt to provide a standard of medical care which is well above the recommended minimum, with obvious benefits to those in need. However, all local organisers should provide medical services to their attendant football supporters fulfilling the minimum standard of recommended services.

REFERENCES

Arbon P.
Mass-Gathering Medicine: A Review of the Evidence and Future Directions for Research. Prehosp Disaster Med. 2007;22(2):131-135.

Boatright JR.
Emergency Medical Service - Mass Gathering Action Plans. J Emerg Nurs. 2004;30(3):253-256.

Leonard RB.
Medical Support for Mass Gatherings. Emerg Med Clin North Am. 1996;14(2):383-397.

Mass Gathering Medical Care:
A Position Paper of the National Association of EMS Physicians Standards and Clinical Practice Committee. PreHosp Emerg Care. 2000;4(4):359-360.

Milsten AM, Maguire BJ, Bissel RA, Seaman KG.
Mass-Gathering Medical Care: A Review of the Literature. Prehosp Disaster Med. 2002;17(3):151-162.

Provision of Emergency Medical Care for Crowds:
Position paper of the American College of Emergency Physicians. 1995-96. Cited 2010 Jan 20. Available at: http://www.acep.org/workarea/downloadasset.aspx?id=4846.

Sanders AB, Criss E, Steckl P, et al.
An Analysis of Medical Care at Mass Gatherings. Ann Emerg Med. 1986;15(5):516-519.

The Guide to Safety at Sports Grounds.
(2008) United Kingdom Department of Culture, Media and Sport. 5th Edition. London. Published by TSO for the Stationery Office.

2.3 Emergency medical logistics at FIFA competitions

The provision of adequate emergency and non-emergency medical services at FIFA competitions is primarily the operational responsibility of the Local Organising Committee (LOC) or delegated body, under the supervision and guidance of FIFA. The target priority for the provision of medical services, besides the supporters, media and commercial vendors, are the team players and delegations, match officials, and FIFA delegation, including related staff, guests and dignitaries.

To assist the local organisers in adequately and effectively providing the mandated complete medical services to the expected standard, the FIFA Medical Committee has developed a document entitled Organisation of Medical Services & Doping Control for FIFA Competitions, last updated in July 2009. This comprehensive document provides an all-inclusive list of the minimum standards in emergency medical equipment required at football stadiums, all of which are for the benefit of the above-mentioned team and FIFA delegations. It should be borne in mind that these are requirements for international elite competitions that should serve as a model for all levels of play.

Although the provision of a stretcher-bearer team consisting of at least one emergency physician and three paramedics located at the sideline next to each of the team benches, equipped with a comprehensive emergency medical bag, is part of these requirements, it must be acknowledged that the definition and experience of these emergency professionals may differ somewhat in different countries. It is therefore this chapter's intention to familiarise all healthcare providers, particularly football team physicians and event physicians, with these recommendations so that they are fully aware of the provisions at FIFA competitions, the necessary equipment and, most importantly, the procedures that apply in case of life-threatening incidents. At FIFA competitions, the term "LOC Venue Medical Officer" (VMO) applies to what is elsewhere in this book generally called the "event physician", meaning the physician appointed by the local organisers and responsible for the provision of local medical services at a venue/stadium.

Any acute medical emergency that involves any member of the team delegation will be treated in cooperation, association and in fact under the guidance of the accompanying team physician as the primary responsible physician, who will also have a greater knowledge of the acute and previous medical history of the patient than the local emergency personnel. In general, all accompanying team physicians will be aware of the detailed medical history of not only all team players but also of associated team officials and staff of the delegation accompanying the team for away matches. Such basic knowledge of the health status may prove invaluable, particularly with international match schedules, where travel and foreign local factors may play a substantial role in disease processes.

From the point of view of the local organisers and the designated VMO, the following aspects of medical emergency services at FIFA competitions are explained in more detail.

Hospitals

The emergency medical requirements recommend that **at least one or two hospitals** per football stadium venue should be identified by the LOC to provide, as a minimum, **a 24-hour accident and emergency department service including the ability to manage major trauma.** For this department to function effectively, all ancillary diagnostic and therapeutic services, e.g. radiology, neurosurgery, vascular surgery, orthopaedic surgery, must be immediately available when required.

All designated hospitals must be located within reasonable proximity of the football stadium, designated team hotels and FIFA headquarters so as to minimise any response time of emergency medical services to the scene of any emergency incident and/or the transfer of the patient to hospital. Regulations stipulate that transfer by road of any officially escorted medical emergency should not exceed 15 minutes, and in the event that this cannot be guaranteed due to logistical, geographical or other challenges, that helicopter evacuation and transfer be comprehensively catered for.

While these designated hospital accident and emergency departments are subject to approval by the FIFA Medical Committee, the team physicians are advised to avail themselves of the opportunity in advance, or after arrival at the host city, to visit the designated accident and emergency department so as to familiarise themselves with how it is run.

Stadium

The requirements concerning emergency medical cover at a stadium include:

- **Four ambulances, each with a fully functional defibrillator, must be stationed at every stadium** for the emergency medical care of players, team officials, VIPs and the FIFA delegation. While the provision of this service is the responsibility of the VMO, it is highly recommended that the team physician inspects the designated team/player emergency ambulance to ensure that the personnel, equipment and vehicle are within the acceptable expected operational norms and standards. This inspection does not take longer than five minutes.
- Every football stadium is required to have two fully equipped medical rooms:
  - **One emergency medical treatment room** is to be located between the team dressing rooms and the pitch for the emergency treatment of injured players and to be equipped with appropriate medical equipment that would allow for adequate advanced life support level cardiovascular or trauma management before urgent transfer to the designated accident and emergency department.
  - **A second medical room** is to be located in the vicinity of the VIP lounges and provide emergency and related medical services, in such a manner that the VIP may consult either personally, or if necessary, a mobile team can respond from the VIP emergency medical treatment room with appropriate equipment when required. Adequate access and evacuation must therefore be planned in advance.

Emergency medical equipment

Specific items of emergency equipment are required to be present and fully operational in both medical rooms at the stadium. It is the responsibility of the VMO to ensure that these items of emergency equipment are made available for the benefit of ill or injured players and team officials. It is recommended that team physicians visit the player and VIP emergency medical treatment rooms in order to familiarise themselves with the personnel and equipment, enquire as to any special individual requirements and agree on procedures in case emergency assistance is required.

Notes on the list of required equipment

- At least one medical examination couch with head elevation section.
- At least two emergency ambulance-type stretchers with head elevation and Trendelenburg positioning.
- A fully comprehensive advanced airway management tray containing equipment necessary to manage a normal, difficult or failed airway in patients of different morphologies according to internationally accepted standards.
- At least one fully functional monophasic/biphasic manual defibrillator with synchronised cardioversion, external transcutaneous pacing, three-lead (minimum) patient cardiac rhythm monitoring with paper printout and all ancillary equipment including relevant defibrillation pads/gels and patient chest electrodes, all of which must be checked for expiration dates. It is highly recommended that all VMOs and team physicians be competent in the operation of the available defibrillator, as it is possible that they may be the only physician in the vicinity during training sessions.
- A non-invasive blood pressure, pulse rate, respiration rate and oxygen saturation monitor with end-tidal carbon dioxide measuring capability if required.
- Peripheral and central intravenous access and administration consumables, including the capability to administer warmed fluids via a volumetric or pressure infusion electronic device with related ancillary equipment.
- A fully comprehensive array of emergency medications necessary to treat all serious life-threatening emergency medical incidents and which, at minimum, is available to stabilise the patient with regard to airway, breathing and circulation before transfer to the designated hospital.
- A fully functional manual resuscitator kit with reservoir bag, positive end-expiratory pressure valve (PEEP) and oxygen source that will last for at least 60 minutes at 15 litres/minute minimum.
- Mechanical suction devices, electrical and battery operated, with a minimum negative pressure of 500mmHg with a minimum container capacity of 1,000ml.

– Therapeutic sterile surgical sets for the acute management and drainage of a tension pneumothorax, haemothorax or pericardial tamponade and performance of a cricothyroidotomy. Medical personnel experienced in the use of the equipment must also be available on site during the football match.
– Spinal column immobilisation equipment including hard cervical collars, long spinal board, scoop stretcher, vacuum mattress and accompanying straps.
– Upper and lower limb fracture traction and immobilisation devices.
– Full set of linen and blankets for each stretcher and examination couch.

Emergency medical bag

The portable emergency medical bag which is required to be with the stretcher medical crew on both sides of the benches and, in case of difficult access to the medical room, at the VIP lounge, must likewise have sufficient equipment to resuscitate and stabilise the airway, breathing (oxygenation) and circulation of a player, VIP or delegation member. These items of medical equipment include but are not limited to:

Diagnostic equipment

Double-headed cardiac stethoscope, end-tidal carbon dioxide monitor, blood glucose testing equipment, plastic reflex hammer, pulse oximeter, pupil torch with spare batteries, sphygmomanometer with full set of adult and paediatric arm cuffs, thermometer, diagnostic ophthalmoscope/otoscope.

Airway

Non-latex safety gloves, safety goggles, full set of advanced airway equipment for normal, difficult and failed airway, including laryngoscope handle, set of curved and straight laryngoscope blades, set of endotracheal tubes of various sizes, 20ml syringes, water-based lubricant, McGill's forceps, endotracheal tube fixation device, flexible bougie, stylet, supraglottic devices, oropharyngeal and nasopharyngeal airways, cricothyroidotomy set, mechanical and manual suction devices with hard and soft suction catheters.

Breathing

Manual resuscitator with variety of masks, reservoir bag, PEEP valve, 5 metres of oxygen tubing, 400ml pressurised oxygen source minimum, two mouth-to-mask ventilators with oxygen inlet.

Circulation

Manual defibrillator with synchronised cardioversion, external transcutaneous pacing, three-lead (minimum) patient cardiac rhythm monitoring with paper printout and all ancillary equipment, including relevant defibrillation pads/gels and patient chest electrodes, all of which must be checked for expiration dates, selection of peripheral and central venous access consumables with administration sets, intravenous crystalloid and colloid fluids, intravenous cannulae fixation consumables, variety of bandages, trauma dressings and gauze swabs, syringes and needles, antiseptic swabs and/or solution.

The availability of an automated external defibrillator (AED) is regarded as part of basic life support and will not suffice where advanced life support level of care is required.

Drugs

A fully comprehensive medication bag with the accepted emergency medications required for primary response to a collapsed patient.

Miscellaneous

Burn dressings, appropriate surgical and suture equipment, assortment of splints, black pen, permanent marker, note pad, rescue-type scissors.

Communications

No VMO should move anywhere within the football stadium without some form of functioning electrical communication device, either portable two-way radio or cell phone, in order to be contactable and to be able to make contact should the need arise. It is thus imperative that these devices be tested as soon as the VMO arrives at the stadium so that any inadequacies may be remedied.

Summary

Emergency medical logistics at FIFA competitions

With international match schedules, elite teams and their accompanying management will regularly travel away from their home country. As a result, it is mandatory that adequate medical services are provided to the team delegations when away from home. This responsibility is assigned to the respective team physician and at FIFA competitions to the FIFA and LOC Venue Medical Officer, and can only be adequately undertaken with effective planning, adequate resources and professional cooperation of all healthcare providers tasked with the provision of medical services in and around the stadium. The requirements for medical services at FIFA competitions refer to international elite events and might serve as a model that can be adapted according to the level of play.

REFERENCES

Organisation of Medical Services & Doping Control for FIFA Competitions, updated July 2009, Fédération Internationale de Football Association, Zurich, Switzerland.

2.4 The basics of managing life-threatening incidents

2.4.1 Introduction

This chapter will highlight some of the common life-threatening medical emergencies that may be encountered by the event/team physician at any football competition, requiring him to react appropriately and without any delay. The management principles presented are brief and basic as in most cases the physician may not be adequately equipped to manage the medical emergencies at anything more than a basic level. His positive therapeutic contribution will be made in the first few minutes of the emergency, before the patient is transported to the nearest appropriate medical facility. More advanced medical techniques can be obtained from relevant medical texts.

The goals of this chapter are:

- to provide a basic theoretical knowledge of acute life-threatening medical emergencies that might occur in the football environment;
- to give the physician the basic and practical life-saving skills required for initial resuscitation of patients afflicted with various medical emergencies;
- to provide a basic plan for administration of medication during life-threatening medical emergencies.

A full-seater football stadium, which is designed to accommodate the maximum number of spectators in a limited space, poses various challenges when acutely ill or injured patients require medical evacuation and treatment. All of the following factors should be considered in the pre-event operational planning of on-site medical personnel, equipment and transportation:

- **Patient access** – including ramps, lifts, gangways, the design of steps and related elevations, seat spacing, physical partitions and barriers.
- **Operational restraints** – including stadium noise and communications, ambient lighting, electrical availability, volume of spectators.
- **Patient management** – including privacy and confidentiality and, though less related to the stadium environment but to the nature of emergency care for an international crowd speaking foreign languages and having unknown previous detailed medical history.

2.4.2 Acute cardiac arrest

The frequency of cardiac arrest in patients in a football stadium environment is difficult to assess. However, it is safe to say that a player, official, manager or spectator may suffer a cardiac arrest at any time. Therefore it is mandatory that the team/event physician be able to commence immediate basic life support/resuscitation in the case of cardiac arrest until advanced life support personnel arrive on scene to assist or until transfer to the nearest appropriate medical facility where advanced life support/resuscitation can be undertaken.

There are basically two causes of cardiac arrest:

1. **Ischaemic:** the most common cause of cardiac arrest is a sudden ischaemic cardiac event from one of three life-threatening, non-perfusing cardiac rhythms, notably ventricular fibrillation, ventricular asystole or pulseless electrical activity. The most frequent of these three is acute ventricular fibrillation.
2. **Asphyxial:** the overall incidence of asphyxial cardiac arrest is not known. When it occurs, it is commonly the result of airway obstruction by a foreign body, with lightning as a less frequent cause. However, asphyxial cardiac arrest is the major, acute life-threatening incident when supporters suffer chest crush injury from stampedes.

D.A.R.T. management principles

Management of a cardiac arrest can be divided into the following phases:

1. **D**iagnosis
2. **A**ssess likely cause
3. **R**esuscitation
4. **T**ransport

1. Diagnosis: the diagnosis of a patient in cardiac arrest is made on the basis of three clinical criteria, namely:

- unconsciousness – lack of response to any type of stimulus;
- abnormal or absent breathing – a pulseless patient may have abnormal breathing for one or two minutes before breathing becomes apnoeic;
- failure to detect a palpable carotid pulse in ten seconds.

2. Assess likely cause: it is important to assess whether the likely cause of the cardiac arrest is ischaemic or asphyxial in nature as this will determine which management course to follow. In the absence of any crush-type injury, it can be assumed that the cause is ischaemic and that the most likely underlying non-perfusing rhythm is ventricular fibrillation.

3. Resuscitation: depending on the likely cause of the cardiac arrest, the patient should be managed in the following manner:

A. Ischaemic cardiac arrest

During the first ten minutes of collapse

– Call for immediate assistance and emergency medical service back-up – it is vital to summon assistance quickly using whatever form of communication is appropriate at the time. It is vital for the away team's physician to have the telephone numbers of all emergency contacts on hand at all of the team's locations so that he can summon emergency assistance if and when required.

– Commence effective continuous external chest compressions – the rescuer can either undertake:

- the standard CPR technique of 30 compressions to 2 rescue breaths; or
- compression-only CPR, which involves continuous compression of the chest without any interruption for rescue breathing.

Both of these measures currently have the same clinical outcomes, therefore if the rescuer is reluctant to undertake unprotected mouth-to-mouth rescue breathing in an ischaemic-type cardiac arrest patient, then he **may elect to undertake compression-only CPR for the first ten minutes,** by which time emergency medical service back-up should have arrived on the scene with additional medical equipment and personnel.

In order to ensure that the chest compression **generates adequate coronary blood flow** between the aorta and right atrium, the following elements must be strictly adhered to when performing manual external chest compression:

– The patient must be placed in as horizontal a position as is practically possible. This positioning may be easy to achieve in an open area such as the field of play, dressing rooms or VIP lounge, but may present difficulties if it occurs in the seated, tiered spectator areas of the stadium, where there is limited space. The manual efforts and cooperation of up to eight assistants working quickly and efficiently may be required to place a cardiac arrest patient seated in the stands into a safe and appropriate horizontal position and thus minimise the delay in initiating CPR.

Figure 2.4.2.1 Positioning for external chest compression

– The physician must position himself on his knees right next to the patient's chest so as to be in the most appropriate position to undertake effective chest compressions. (see Figure 2.4.1). Therefore, if the patient is lying on the ground, the physician must position himself on the ground next to the patient's chest. However, if the patient is lying on a bed or stretcher, then the physician must position himself either on portable steps (or the equivalent) or on the bed or stretcher itself, so as to be at the correct height and position.

The physician should place the palm of his dominant hand (thenar and hypothenar eminence) onto the centre of the sternum between the nipples, and interlock the fingers

of both hands (see Figure 2.4.2), ensuring that all fingers are lifted off the chest, to maximise the downward compression force into and not around the chest.

Figure 2.4.2.2 Interlocking of hands for external chest compression

The physician should ensure that his elbows are locked straight and that his shoulders are positioned directly above the chest so that the downward force is applied with maximum force perpendicular to the chest (see Figure 2.4.3).

Figure 2.4.2.3 Positioning above chest for external chest compression

– The physician should push down as hard as he can on the chest to ensure maximum compression, and then allow the chest to relax completely without taking his hands off the chest and losing contact. Repeat in a rhythmic manner so that each complete compression is followed by a complete relaxation.
– The **rate of compression/relaxation cycles** should be approximately **100 per minute,** which can practically be achieved by counting during compression and saying the word **"and"** during relaxation, namely: 1 **and**, 2 **and**, 3 **and**, 4 **and**, etc.
– Compression/relaxation cycles should not be interrupted unless absolutely necessary in order to avoid decreasing the coronary perfusion pressure, which is mandatory for life-sustaining blood flow.
– It is advisable to swap active compression cycles every two minutes with another person, if possible in practice, to avoid fatigue, which impacts on the coronary perfusion pressure generated.

Obtain a defibrillator as soon as practically possible. The defibrillator that is available may either be an automated external defibrillator (AED), which is a biphasic defibrillator that instructs the rescuer when and how to defibrillate (shock) the patient with either voice and/or written prompts, or a manual defibrillator, which requires the rescuer to make all decisions regarding rhythm recognition and shock. These devices are currently regarded as the international standard of care and should be present at every football match attended by a large number of supporters so that defibrillation shocks can be performed within the recommended five minutes of a cardiac arrest. **Great emphasis is placed on the presence and use of a defibrillator, as this is the international standard of care at basic life-support level.**

When a patient collapses and ischaemic cardiac arrest is diagnosed, defibrillator analysis and shock should be performed as soon as is practically possible because the probability of success from defibrillation decreases with time. If the defibrillator is available within the first five minutes of the onset of cardiac arrest, it should be used immediately, interrupting chest compressions if necessary. If the defibrillator is only available five minutes after the onset of cardiac arrest, the defibrillator should only be used after an initial two minutes of chest compressions.

AED use

1. Diagnose cardiac arrest.
2. Open AED carrying case.
3. Connect the AED cable to the machine, if not already attached.
4. Attach the patient electrode pads onto the patient's bare chest by removing all clothing covering the chest, according to the positions illustrated on the pads (wipe off any moisture, water or perspiration if necessary).
5. Switch on the AED if it is not already on.
6. Allow the AED to analyse the patient's cardiac rhythm, following the voice prompts exactly.
7. If prompted by the AED voice prompt, deliver the required shock by pressing the flashing red button.
8. If a shock is not required, or after any delivered shock, immediately commence chest compressions.
9. Re-analyse the cardiac rhythm after every two minutes of cardiac resuscitation, if signs of life have not occurred in the interim.

Figure 2.4.2.4 Steps for the use of an average AED

After ten minutes of CPR

In a patient who has been treated with compression-only (with or without defibrillation) cardiac resuscitation, as described above, for ten minutes without success, standard compression/ventilation (30:2 ratio) resuscitation should be considered.

B. Asphyxial cardiac arrest

If the likely cause of the cardiac arrest is asphyxial in origin (including lightning strike cardiac arrest), then **always initiate cardiac resuscitation using the standard method of alternating 30 chest compressions with two rescue breaths.** As the cause of cardiac arrest in these asphyxiated patients is lack of oxygen from inability to breathe, the most probable cardiac rhythm in these patients will be a non-perfusing bradycardia, ventricular asystole or pulseless electrical activity. In these patients, continuous efficient cardiac resuscitation with chest compressions and rescue breaths will provide the best possible chances of success. In many tragic football disasters where patients have been crushed against physical structures, thus prevented from breathing, initiation of CPR has been slow in onset or absent. These patients are usually young, healthy individuals, and attempts at resuscitation should always be made, using whatever voluntary manpower is immediately available. In this situation, instant life-saving CPR training and supervision is possible and resuscitation should not be terminated until either cardiac electronic monitoring indicates lack of cardiac activity or experienced emergency medical personnel advise termination.

Manual rescue breaths may be performed on the non-breathing (apnoeic patient), be they in the form of mouth-to-mouth rescue breaths, mouth-to-mask rescue breaths or bag-valve mask resuscitation ventilation – whichever is the most appropriate, logistically available and acceptable method at the time. The method of choice is the mouth-to-mask rescue ventilation method, as it is cheap to acquire, simple and safe to perform, and easily stored in a medical bag. The mask can also be purchased with a small oxygen nipple which allows high flow supplemental oxygen to be added, thus ensuring as high a concentration of additional oxygen administration as possible (see Figure 2.4.5).

Figure 2.4.2.5 Mask for mouth-to-mask ventilation with oxygen nipple

4. Transport: once local emergency medical service ambulance personnel have arrived on the scene to assist with treatment and transport, a decision must be made regarding transportation of the patient to the nearest medical facility. Adequate chest compressions and manual rescue breathing is very difficult to perform in a moving ambulance and it is therefore more appropriate to undertake the initial resuscitation with the assistance of a defibrillator on location in the stadium for the first ten minutes, and only then to consider transportation to a hospital if no signs of life have occurred. If the cardiac arrest is considered to be ischaemic in origin and a defibrillator has not been available in the first place, it is mandatory to either immediately bring a defibrillator to the patient or take the patient to a defibrillator – whichever is more appropriate, safe and practical. If it

is decided to transport the patient to a defibrillator, then compression-only cardiac resuscitation will probably be the most practical technique in a moving ambulance.

2.4.3 Acute anaphylaxis

Anaphylaxis is an acute life-threatening allergic reaction, usually but not always mediated by an immunologic type I hypersensitivity mechanism that results from the sudden systemic release of mediators from mast cells and basophils. The clinical presentation may be varied, but **respiratory and cardiovascular symptoms cause the most concern, as they are the most frequent causes of fatalities if not managed adequately.**

The clinical presentation of acute anaphylaxis is usually diagnosed when signs and symptoms involve the skin and two other body systems, particularly the respiratory and/or cardiovascular systems, namely:

- Oral: pruritis of lips, tongue, and palate; oedema of lips and tongue
- Skin: flushing, pruritus, urticaria, angioedema
- Gastrointestinal: abdominal colic, nausea, vomiting, diarrhoea
- Respiratory: cough, tightness of throat/chest, hoarseness/dysphonia, dysphagia, dyspnoea, wheezing
- Cardiovascular: syncope, feeling of faintness, chest pain, dysrhythmia, hypotension, cardiac arrest

Management

1. Initial emergency management of any patient diagnosed with acute anaphylaxis involves the immediate administration of **adrenaline** (epinephrine) intramuscularly (IMI) into the antero-lateral thigh (vastus lateralis muscle) so as to be absorbed and take effect as quickly as possible after onset:
   - If doubt exists about the diagnosis of anaphylaxis, treat with at least one dose intramuscularly as described below.
   - If the diagnosis of anaphylaxis has been made clinically, administer adrenaline 1:1,000 immediately into the antero-lateral thigh, every five minutes if necessary, until symptoms improve.

     Dose (adults): 0.5mg IMI = 0.5ml of 1:1,000

     Dose (children): 0.25mg IMI = 0.25ml of 1:1,000
   - If the patient displays severe symptoms or if the symptoms do not improve adequately with IMI adrenaline, consider intravenous (IVI) adrenaline as a bolus of 2.5ml of a 1:10,000 dilution (1 ampoule of 1:1000 adrenaline with 9ml of normal saline or other equivalent diluents). Administer another dose of 2.5ml intravenously in five minutes if necessary. In preloaded or prefilled syringes, adrenaline 1:10,000 is available immediately and does not require manual dilution.
   - If adrenaline is only available in auto-injector syringes which administer 0.3mg per dose (adults) when thrust against the antero-lateral thigh, then administer quickly.
2. If available, a **beta-2-agonist** e.g. salbutamol, may be administered for bronchospasm/wheezing either by inhalation (puffer) or nebulisation. Repeat as often as necessary.
3. If the patient is hypotensive, i.e. there is no radial pulse, position the patient supine and elevate the legs. If available, establish intravenous access as rapidly as practically possible and consider administering lactated Ringers or equivalent to obtain a systolic pressure of 90mmHg. Colloids may also be required to assist in elevating the blood pressure. Note that up to 50% of the intravascular volume can be lost within ten minutes, thus initially requiring potentially large volume replacement.
4. The patient should be transferred to the nearest medical facility as soon as possible after the initial dose of adrenaline has been administered, so that further advanced life support may be undertaken, including the administration of intravenous antihistamines and glucocorticoid steroids, e.g. 100mg of hydrocortisone (IVI) or equivalent.

2.4.4 Acute hypoglycaemia

The occurrence of hypoglycaemia in any patient can have devastating neurological results if not diagnosed and adequately treated as soon as possible. The brain depends on the constant provision of glucose from the blood to maintain normal function and any decrease to hypoglycaemic levels will affect neurological function detrimentally. Almost all known neurological signs and symptoms may be a clinical manifestation of acute hypoglycaemia and therefore the

possibility of this condition must always be considered in any patient who has a decreased level of neurological function, especially those that are unconscious.

Measuring any patient's blood-glucose level entails taking a minute sample of blood, usually from a finger prick, which is collected onto a test tape which is then either compared visually with a coloured scale indicating different glucose levels or by introducing the test tape into a digital glucose meter which analyses the level. **Any blood-glucose level below 4mmol/L or 50mg/dL in an adult must be regarded as hypoglycaemia and treated accordingly.** If, for whatever reason, it is not practically possible to measure the blood-glucose level in any patient with neurological symptoms, especially if unconscious, then hypoglycaemia must be diagnosed by default and treated accordingly.

Management

1. As a priority, if the patient is unconscious, or conscious but unable to open and protect their own airway, turn the patient laterally onto his side before undertaking any other procedure.
2. If the patient is conscious and able to follow verbal commands and thus either suck, swallow or drink orally, then request the patient to drink any liquid that has a high sugar content, or suck/swallow any form of glucose containing gel, syrup, honey or equivalent that you can provide.
3. If the patient is unconscious or unable to follow verbal commands, then you can administer glucose to the patient via a variety of routes depending on what is readily available:
   - Rub small amounts of sugar granules, syrup or honey on the inner buccal surface of the patient's cheek until the patient resumes consciousness and can then swallow, under medical orders.
   - Inject 1mg glucagon IMI, if available.
   - Slowly administer 50ml of 50% dextrose intravenously through a free-flowing vein if logistically possible. This form of glucose can also be used to rub onto the buccal surface of the patient's cheek.

The goal is a fully conscious patient who is able to provide a detailed medical history and, if necessary, ingest glucose to correct any further hypoglycaemia. If a patient is unconscious and the blood glucose cannot be ascertained,

ensure that adequate amounts of glucose-containing substances are administered before any further decision is made.

2.4.5 Acute generalised seizure

Generalised tonic/clonic (grand mal) seizures are not uncommon in large-attendance spectator sports for a host of reasons, including stress, hypoglycaemia, failure to take routine medications and alcohol intake. **In many occurrences of tonic/clonic seizures, the seizure will terminate spontaneously after a few minutes.** Rescue medication is only required in those situations where the seizure has not abated in five minutes.

Management

1. If not already positioned in a safe horizontal position, place the patient gently onto a horizontal surface, so that no harm will occur to the patient from any active movements of the head or body against any solid structure. If possible, place something soft under the patient's head to cushion any convulsing movements. It is best to attempt to place the patient into the lateral position in order to protect the airway, but this may not always be possible.
2. Do not attempt to restrain the patient in any form, unless absolutely necessary, so as not to increase the force of contractions by the patient.
3. Do not attempt to force any object into the mouth or between the teeth, as this can cause severe bleeding and/or breakage of teeth, all of which have the potential to be aspirated into the respiratory tract and cause airway obstruction or related pathology.
4. It is always essential to determine the blood-glucose level of any patient who is convulsing or who may be post-ictal in order to exclude hypoglycaemia and to appropriately manage such if it is present, as described above. **If, for whatever reason, the blood glucose cannot be determined, hypoglycaemia must be regarded as being present by default and treated pre-emptively by glucose administration** via an appropriate route.

If the seizure continues for longer than five minutes and glucose has already been administered without termination of the seizure, then administration of an anti-convulsant, preferably benzodiazepines, is indicated. In the football stadium environment, the most appropriate benzodiazepines are those which can be administered via multiple routes, do not require "cold chain" refrigeration and can be administered repeatedly if necessary. Midazolam fulfils these criteria as it can be administered intravenously, but also, as appropriate, via the intramuscular, nasal, buccal and rectal routes.

Administration of midazolam:

- Intravenous: 5mg over 30 seconds, repeat every three minutes until the seizure terminates. Doses in excess of 20mg are not advised in an out-of-hospital location for safety reasons.
- Intramuscular: 10-15mg as a single dose into the antero-lateral thigh. Wait five minutes for an effect and repeat the dose if necessary.
- Nasal: A single dose of 10-15mg is squirted into the nasal cavity slowly using a small syringe. Close the nostrils after administration.
- Buccal: A single, undiluted dose of 10mg is rubbed onto the inside cheek.
- Rectal: 20mg: for rectal administration of the injection solution, attach a plastic applicator or plastic needle cap protector onto the end of a syringe and gently push the plastic applicator through the anus into the rectum before injecting the contents. Remove immediately after administration. If the volume of medication to be administered rectally is too small, water may be added to increase the intended volume of the injection to 10ml.

The administration of other benzodiazepines, namely, diazepam, clonazepam and lorazepam, is completely acceptable and indicated if they are available and can be safely and effectively administered.

2.4.6 Acute potential spinal injury

The potential of an acute spinal column injury with resultant neurological fallout is a possibility that must always be considered in any patient whose mechanism of injury has resulted in either acute spinal acceleration/deceleration movements, severe distortions of the spinal column, direct trauma or severe spinal muscular spasms. All of these

movements may result from injuries caused by heading the ball, player collisions, falling from a height, being trampled on and lightning injuries, to name but a few.

Whenever the mechanism of injury or the presenting clinical signs or symptoms indicate the possibility of an acute spinal column injury, the patient must be managed and hence moved with particular care and concern, so as not to cause any initial or further neurological damage to the vulnerable spinal cord. Therefore, spinal column stabilisation is mandatory in all of the aforementioned situations and must be undertaken by a team adequately trained in spinal immobilisation techniques. Patients with potential spinal injuries may be found in a number of positions, all of which require appropriate forms of spinal immobilisation, e.g. standing vertically, lying prone, supine or crumpled up.

Spinal stabilisation manoeuvres are described in detail in 3.1.4 Cervical spine injuries.

Summary

The basics of managing life-threatening incidents

The occurrence of acute, life-threatening illnesses and/or injuries, although infrequent, requires that adequately trained and equipped personnel be available in the football stadium before, during and after a match so as to provide potentially life-saving care, or at least basic life support, immediately. It is the responsibility of the event physician to ensure the provision of these services. Preparation and planning are key to patient prognoses. The team physician should be aware of the most common acute, life-threatening incidents and their management in order that he may provide assistance if he arrives first on the scene.

REFERENCES

2005 The International Consensus on Cardiopulmonary Resuscitation (CPR) and Emergency Cardiovascular Care (ECC) Science with Treatment Recommendations.
Circulation. 2005;112(Suppl I):III-5-III-24.

2005 American Heart Association guidelines for cardiopulmonary resuscitation and emergency cardiovascular care.
Circulation. 2005;112(suppl I):IV-58–IV-66.

Bailes JE.
Petschauer M, Guskiewicz KM, Marano G. Management of cervical spine injuries in athletes. J Athl Train. 2007 Jan-Mar;42(1):126-134.

Kreimeier U, Dirks B, Arntz R, et al.
Chest compression without ventilation during basic life support? Confirmation of the validity of the European Resuscitation Council (ERC) guidelines 2005. Anaesthesist. 2008 Aug;57(8):812-816.

De Lorenzo RA.
A Review of Spinal Immobilisation Techniques. J Emerg Med. 1996 Sept-Oct;14(5):603-613.

Ewy GA, Kern K, Sanders A, et al.
Cardiocerebral Resuscitation for Cardiac Arrest. Am J Med. 2006;119:6-9.

Ewy GA, Kern KB.
Recent advances in cardiopulmonary resuscitation: cardiocerebral resuscitation. Journal of the American College of Cardiology. 2009;53:149-157.

Garza GA, Gratton MC, Salome JA, et al.
Improved patient survival using a modified resuscitation protocol for out-of-hospital cardiac arrest. Circulation. 2009; 119(19):2597-2605.

Ghiselli G, Schaadt G, McAllister DR.
On-the-field evaluation of an athlete with a head or neck injury. Clinics in Sports Medicine. 2003 Jul;22(3):445-465.

Hallstrom A, Cobb L, Johnson E, Copass M.
Cardiopulmonary resuscitation by chest compression alone or with mouth-to-mouth ventilation. New England Journal of Medicine. 2000;342:1546-1553.

Kirk SE.
Hypoglycaemia in Athletes with Diabetes. Clinics in Sports Medicine. 2009 Jul;28(3):455-468.

Martin DE.
Glucose Emergencies: Recognition and Treatment. J Athl Train. 1994 Jun;29(2):141-143.

Sayre MR, Berg RA, Cave DM, et al.
Hands-only (compression-only) cardiopulmonary resuscitation: a call to action for bystander response to adults who experience out-of-hospital sudden cardiac arrest: a science advisory for the public from the American Heart Association Emergency Cardiovascular Care Committee. Circulation. 2008;117(16):2162-2167.

Scott RC, Besag FMC, Neville BGR.
Buccal midazolam and rectal diazepam for treatment of prolonged seizures in childhood and adolescence: a randomised trial. Lancet. 1999;353:623–626.

Simons FE.
Anaphylaxis: Recent advances in assessment and treatment. J Allergy Clin Immunol. 2009 Oct;124(4):625-636.

Smith M, Carley S.
Best evidence topic report. Intranasal midazolam in patients with fits. Emerg Med J. 2005 Jun;22(6):436-437.

SOS-KANTO Study group.
Cardiopulmonary resuscitation by bystanders with chest compression only (SOS-KANTO): an observational study. Lancet. 2007;369:920 –926.

3. Emergency situations on the pitch

3.1 Potentially life-threatening injuries and incidents

While team physicians with a sports medical background will feel perfectly competent to deal with any kind of football injury, the management of more severe traumata not necessarily expected within the usual setting of a football match, or of life-threatening events such as sudden cardiac arrest, might at times be beyond their clinical experience and expertise. They might also not be readily equipped for such situations. It is particularly these situations when preparation by the event physician is vital in providing the necessary infrastructure and adequately trained sideline medical personnel to support and even take over the management of players.

In order to be fully prepared for such situations on the pitch, the possible spectrum of medical emergencies on the pitch must be known by the event physician and the respective planning done in advance of the competition. Apart from ensuring that the required infrastructure, equipment and staff are in place at the sideline, it is important to discuss and agree with the team physicians on the responsibilities and tasks to be assumed by the different care providers in due time before the warm-up starts.

REFERENCES

Courson R.
Preventing sudden death on the athletic field: the emergency action plan. Curr Sports Med Rep. 2007 Apr;6(2):93-100.

Drezner JA, Courson RW, Roberts WO et al.
Inter-Association Task Force Recommendations on Emergency Preparedness and Management of Sudden Cardiac Arrest in High School and College Athletic Programs: a Consensus Statement. Journal of Athletic Training. 2007; 42(1):143-158.

Harmon KG, Drezner JA.
Update on sideline and event preparation for management of sudden cardiac arrest in athletes. Curr Sports Med Rep. 2007 Jun;6(3):170-6.

3.1.1 The collapsed player

Introduction

It is not an uncommon scene to find a football player lying on the pitch with the ball not in play. There are several reasons why football players may collapse or appear to have collapsed on the field of play. It is most commonly the result of an injury which might be feigned, imagined, minor or severe. In a controlled game environment (Laws of the Game applied), the referee would decide when the match would be stopped before medical attention can be given to the collapsed player.

Causes of collapse in a football player

There are essentially two broad categories of causes of collapse, namely, contact and non-contact injuries or conditions. Table 3.1.1.1 below lists a summary of possible causes of collapse in a football player.

Contact injuries commonly occur as a result of contact or tackle with another player, either in a foul or non-foul situation, with or without the ball in play.

Almost 50% of all contact injuries in men and one third in women occur as a result of foul play and about 75% of the contact injuries are sustained by the tackled whilst about 25% are sustained by the tackling player.

1. Contact injuries
- Head injury
  - Concussion
- Spine injuries
- Musculoskeletal conditions
  - Muscle contusions
  - Ligament sprains/ruptures
  - Fractures/dislocations
- Other less common causes
  - Chest wall injuries
  - Blunt abdominal trauma
  - Blunt groin trauma
  - Subdural haematoma
- Disasters
  - Natural – lightning
  - Spectator riot

2. Non-contact injuries/conditions
- Musculoskeletal conditions
  - Muscle strains/tears
  - Ligament sprains/tears
  - Muscle cramping
  - Dislocations
- Other (less common) medical conditions
  - Sudden cardiac arrest
  - Hyperthermia/heatstroke
  - Hypoglycaemia
  - Hypothermia
- Exercise-associated collapse (postural hypotension)

Table 3.1.1.1 Possible causes of collapse in a football player

Although most of the contact injuries are minor in nature, some may be very severe and career- or even life-threatening. Cervical spine injuries, though very rare in football, can have catastrophic consequences, especially if not properly managed in the acute phase. If mishandled on the pitch, an unstable fracture of the cervical vertebra may puncture and injure the spinal cord, resulting in permanent quadriplegia and the end of a career as a football player.

Head and neck injuries occur as a result of head-to-head, elbow-to-head or, less often, head-to-ground contact/clashes. The incidence of head injuries increases with the level of play. At elite level competitions, they account for about 14% of all injuries and are mostly minor in nature, resulting in mild concussion (defined as a subset of mild traumatic brain injury) but may in rare cases be severe, resulting in severe cervical spine injuries and/or subdural haematoma and death. The incidence of severe head injuries with concussion is fortunately very low (approximately less than 2%).

Contact injuries may less commonly also involve other body parts such as the chest wall, resulting in bruised or fractured ribs, especially with violent clashes (see 3.1.5 Chest injuries). Another possible type of chest wall injury is commotio cordis: a direct blow to the chest wall (over the precordium) can, without causing rib fractures, trigger ventricular fibrillation and sudden death (see 3.1.2 Sudden cardiac arrest and 3.1.5 Chest injuries). Other body parts that may be affected by blows resulting in collapse of a player are the abdomen and groin. Injuries to these areas are usually minor.

Some of the contact-type injuries may be caused by contact with objects other than fellow players, e.g. goal posts or, in rare circumstances, a player might be injured by flying debris from spectators or, even more rarely, from around the

pitch during natural disasters. This occurred in a recent football match played at Ellis Park stadium, Johannesburg, where just before a storm a sudden gust of wind ripped out advertising billboards around the pitch, striking and injuring a player and a referee. In another match, also in Johannesburg, a number of players collapsed on the pitch after being struck by lightning, with the football match being stopped as a result of the storm.

Non-contact injuries/conditions occur without contact with another player or physical object. The majority of these involve injuries to ligaments and muscles (ligament sprains/tears, frequently occurring in the anterior cruciate ligament in female players, and muscle strains). These non-contact conditions may range from mostly minor conditions such as mild muscle cramps to life-threatening cardiac arrest and even sudden death on the pitch.

Muscle cramping is a common phenomenon in football. The cause of cramping is not well understood. However, a popular hypothesis is that cramping occurs as a result of altered neuromuscular control in a fatigued muscle. This theory is supported by the fact that football players usually suffer from cramps at the end of the second half or during extra time of matches, i.e. when muscles are fatigued.

The non-musculoskeletal and non-contact type conditions, e.g. exercise-associated collapse (EAC), are very rare in football and more common in endurance-type events like marathon running. Collapse in EAC is thought to be due to postural hypotension as a result of sudden cessation of prolonged exercise activity.

Heat-related conditions like hyperthermia/heatstroke, although rare, can occur if football is played under extreme environmental conditions (high temperatures and humidity), especially if players are not acclimatised to such environments (see 4. Environmental factors).

Although not a common condition amongst football players, a poorly controlled diabetic player may collapse due to hypoglycaemia or hyperglycaemia associated with periods of heavy exercise.

Of all the non-musculoskeletal and non-contact conditions, sudden cardiac arrest (SCA) is the most serious cause of collapse as it results in death within minutes (see 3.1.2 Sudden cardiac arrest). Sudden cardiac death (SCD) on the pitch is fortunately rare. However, when it does occur, it is a tragic, distressing and uncomfortable experience for the team physician, the team, spectators and the TV audience alike, and attracts a lot of media attention.

Management of the collapsed player

For the team physician, management of a collapsed player does not start with on-pitch assessment and first-aid treatment. **The team physician's primary role is to care for the player even before the collapse. It is important, therefore, to have screened all players through a pre-competition medical assessment** with a focus on cardiac conditions, and to have cleared all players before each match.

For example, a comprehensive cardiology screening at age 16-17 or at entry into the team will go a long way in reducing the chances of collapse and sudden death due to SCA.

Paying attention to all potential risk factors for musculoskeletal injuries will also reduce chances of non-contact causes of collapse. These include, for example, ankle taping before games for high-risk players (e.g. those with

previous ankle sprains) and adequate rehabilitation of muscle strain injuries before allowing players to return to full play.

The team physician also needs to be prepared for any eventuality before any match is played and needs to have adequate knowledge and experience of emergency sports medicine in order to anticipate and administer emergency treatment for these conditions. Depending on the size of an event, he will be supported by an event physician and/or an emergency care team with specific training positioned at or close to the sideline (ideal situation, requirement at FIFA competitions).

It is important, therefore, for the team physician on the bench or at the sideline to have full view of the playing field so that he can clearly observe all circumstances around a player collapsing. By the time the team physician is called onto the pitch, he should have reasonable answers to the following questions with regard to the cause of collapse of the player:

a. What was the mechanism of injury?
b. Was there contact with another player/object?
c. What is the possible differential diagnosis?

Rules for entering the pitch

Like any other sport, football is governed by specific rules and regulations (Laws of the Game). There are also rules applicable to members of the technical team, including the team physician. These rules, amongst others, dictate that members of the technical team behave in a responsible manner and that the team physician or physiotherapist can only enter the pitch at the invitation of the referee.

In the event that a player collapses, the referee will stop the game and signal for the medical team to proceed onto the pitch. With the exception of severe injuries/conditions and/or any injury involving the goalkeeper, the medical team must stabilise and transfer the player from the field of play as soon as possible. A player is not allowed to receive treatment on the field of play and a more comprehensive assessment and definitive treatment can only be undertaken on the sidelines or in the stadium medical centre (Law 5 – The referee).

Assessment of a collapsed player

The first phase of assessment of any collapsed player consists of the observation of circumstances around the physical collapse. When the team physician arrives at the player's side, there should be certain clues pointing to a differential diagnosis. With more serious causes, e.g. head injuries, the on-site assessment will include a quick assessment of level of consciousness, status of airway, breathing and circulation.

With these severe injuries, the referee would normally allow enough time for the medical staff to assess and safely remove the collapsed player from the field of play. In one incident in Cape Town, South Africa, a helicopter was allowed to land on the field of play to evacuate a seriously injured player to hospital.

Any player that suddenly collapses without contact with another player or object and lies unconscious on the pitch should be presumed to be having a cardiac arrest until proven otherwise. Such a player should have cardiopulmonary resuscitation (CPR) started immediately. Ideally, an automatic external defibrillator (AED) should be made available at the sideline for instantaneous use. Defibrillation administered in less than two to three minutes can provide survival outcomes of about 50%; however, rates fall sharply with each minute thereafter.

A collapsed player with possible concussive brain injury should have a quick neuropsychological examination. Simple questions to test short-term memory can be administered to the player. These include the naming of the opposing team, the score, whether it is the first or second half, the score in the last game played, etc. (e.g. SCAT2, see 3.1.3 Head injuries and concussion).

For players with serious head, neck or cervical spine injuries, extra care must be taken to ensure that the neck is safely secured before the player can be loaded onto an appropriate spinal board and moved from the pitch. The neck must be stabilised in such a way that any unnecessary movement of the vertebral column is avoided, for example by applying a rigid cervical collar. Importantly, motor and sensory neurological function should be quickly assessed as a baseline for further management.

The following points detail **steps to follow in spinal stabilisation** of players suspected of having severe cervical spine injuries (see also 3.1.4 Cervical spine injuries):

- If conscious, the player must be instructed not to move from the position in which he is found upon arrival of the team physician.
- One healthcare provider must be requested to stabilise the player's head and neck by placing one hand on either side of the player's head and preventing any uncontrolled movements.
- If practical and appropriate, an attempt must be made to gently place a rigid cervical collar or equivalent around the player's neck in order to stabilise the cervical spine.
- If the player is standing in the vertical position, he must be fully secured to a long spinal board (or equivalent) before being slowly and carefully lowered into the horizontal, supine position on the pitch.
- If the player is lying in the prone position, he must be carefully logrolled onto a long spine board (or equivalent) so that he becomes positioned horizontally in the supine position. The player is then adequately secured in this position before being transferred.
- If the player is found in the supine position, the team of emergency care providers must simultaneously lift the player while a long trauma board is positioned under the player, who is then lowered gently onto the board for adequate securing prior to transfer.

Role of the event physician

The event physician plays a critical role in ensuring that:

- Appropriate emergency equipment for neck stabilisation and transportation of injured players off the pitch is immediately available at the sideline. In addition to a normal stretcher, the minimum requirements would be:
  - a spinal board or any equivalent hard surface
  - straps to secure a player onto the board
  - a rigid cervical collar
- There is a fully functional manual or automated defibrillator available at the sideline.
- There are appropriately experienced emergency medical personnel available at the sideline. These need not be highly qualified personnel with advanced cardiac or trauma life support, but must be experienced in handling severely injured persons or emergency medical conditions.
- There is an appropriate emergency ambulance on standby to evacuate a seriously injured player to hospital.
- The receiving hospital is notified well before the game and is on standby to receive a seriously injured player.

Where there is no event physician, the team physician would need to, as part of the preparation, check that all these matters have been attended to.

Return to play

The decision to allow the (collapsed) player to continue with play is often not a straightforward one for the team physician. This will depend largely on the severity of the injury and every case should be treated on its own merit. This decision, however, needs to be undertaken very quickly (within a minute or two) so as to notify the team coach and allow him to make decisions regarding possible substitutions and/or rearrangement of player positions.

General principles for musculoskeletal injuries that allow the player to be returned to the field of play include:

- There is pain-free range of motion around the joint(s) involved.
- There is no joint instability or significant weakness of muscles involved.
- Continuing with play will not worsen the injury sustained.
- The injury is unlikely to adversely affect performance.

This may, however, often be complicated by other factors such as:

- A player masking pain in order to be allowed to continue playing.
- All substitutions being exhausted at the time of injury.

The team physician should always be guided by sound ethical principles of always acting in the best interest of the player and not taking any decision that will be of further harm to the player.

Any players exhibiting signs and symptoms of concussion should not be allowed to continue to play. Such players need to be further evaluated in hospital.

Summary

The collapsed player

Most of the causes of collapse in players are fortunately minor. The majority of these are due to minor contact or non-contact musculoskeletal injuries. Although rare, more serious contact injuries such as cervical spine injuries can be career- or life-threatening. Careful sideline assessment and management of these severe cases is important to avoid further injury and/or permanent loss of function.

The more serious causes of collapse can be averted or attenuated by a collaborative effort from the players, support personnel (team physician, event physician, emergency medical personnel, security personnel, etc.) in ensuring that there is meticulous planning for matches and that the players have been cleared fit to play.

REFERENCES

American College of Sports Medicine.
Sideline Preparedness for the Team Physician: A Consensus Statement. 2001. Cited 2010 Jan 20. Available from: http://www.acsm.org.

Banerjee R, Palumbo MA, Fadale PD.
Catastrophic cervical spine injuries in the collision sport athlete, part 1: epidemiology, functional anatomy, and diagnosis. Am J Sports Med. 2004 Jun;32(4):1077-1087.

Banerjee R, Palumbo MA, Fadale PD.
Catastrophic cervical spine injuries in the collision sport athlete, part 2: principles of emergency care. Am J Sports Med. 2004 Oct-Nov;32(7):1760-1764.

Bethesda Conference Report
36th Bethesda Conference: Eligibility Recommendations for Competitive Athletes with Cardiovascular Abnormalities. J Am Coll Cardiology. 2005;45(8).

Borjesson M, Pelliccia A.
Incidence and aetiology of sudden cardiac death in young athletes: an international perspective. Br J Sports Med. 2009;43:644-648.

Dvorak J, Junge A , Grimm K (eds).
Prevention of sudden cardiac death. In: F-MARC Football Medicine Manual. Zurich: Fédération Internationale de Football Association; 2009.

Laws of the Game.
Cited 2010 Jan 20. Available from: http://www.fifa.com/worldfootball/lawsofthegame.html

FIFA
Football for Health. 15 years of F-MARC Research and Education. 1994-2009. Zurich: Fédération Internationale de Football Association; 2009.

Holtzhausen L.
Review article. Emergency medical cover for road races. ISMJ. 2003;Vol. 4 (1). Cited 2010 Jan 20. Available from: http://www.esportmed.com

Luke A, Micheli L.
Sports Injuries: Emergency Assessment and Field-side Care. Pediatr Rev. 1999;20:291.

Noakes TD.
The forgotten Barcroft/Edholm reflex: potential role in exercise associated collapse. Br J Sports Med. 2003;37:277-278.

Schwellnus MP.
Cause of Exercise Associated Muscle Cramps (EAMC) altered neuromuscular control, dehydration or electrolyte depletion? Br J Sports Med 2009;43:401-408; originally published online 3 Nov 2008.

Whiteside JW.
Management of Head and Neck Injuries by the Sideline Physician. Am Fam Physician. 2006 Oct 15;74(8):1357-1362.

3.1.2 Sudden cardiac arrest

Sudden cardiac arrest (SCA) is the most important cardiac emergency in football with players collapsing on the pitch. Without immediate resuscitation, it will lead to sudden cardiac death (SCD). Sudden cardiac death during a football match is a catastrophe that is to be avoided at all costs.

Definition of SCD

SCD is defined as "death occurring within one hour of the onset of symptoms in someone without a previously recognised cardiovascular abnormality, excluding respiratory, cerebrovascular and drug-related deaths".

Incidence

The true incidence of SCA in football is unknown. SCA in sport is fortunately very rare and said to occur in 0.5/100,000 high-school and college athletes to 3.6/100,000 professional athletes per year, with the incidence being disproportionately higher in males. However, when it does occur, it is devastating for the football family as a whole and it can attract a great deal of negative media attention. The collapse and death of Marc-Vivien Foé in 2003 and Miklós Fehér in 2004 was followed by four incidents involving well-known young players in 2007, almost inevitably raising questions among the public, media and officials alike on the safety and risks of playing football.

Causes

The most common cause of SCA in people under the age of 35 is an underlying cardiac abnormality such as hypertrophic cardiomyopathy and arrythmogenic right ventricular dysplasia (ARVD). Other common causes include dilated cardiomyopathy and congenital coronary artery anomalies. Less common causes include aortic rupture in Marfan syndrome, myocarditis, valvular disease (aortic stenosis, mitral valve prolapse) and ion channelopathies (long QT syndrome, Brugada syndrome, catecholaminergic polymorphic ventricular tachycardia) as well as blunt chest trauma causing malignant arrhythmia (commotio cordis).

In people over the age of 35, the primary cause of SCA is coronary artery disease.

Causes of Sudden Death in 387 Young Athletes*

Cause	No. of athletes	Percent
Hypertrophic cardiomyopathy	102	26.4
Commotio cordis	77	19.9
Coronary artery anomalies	53	13.7
Left ventricular hypertrophy of indeterminate causion †	29	7.5
Myocarditis	20	5.2
Ruptured aortic aneurysm (Marfan syndrome)	12	3.1
Arrhythmogenic right venticular cardiomyopathy	11	2.8
Tunneled (bridged) coronary artery ‡	11	2.8
Aortic valve stenosis	10	2.6
Atherosclerotic coronary artery disease	10	2.6
Dilated cardiomyopathy	9	2.3
Myxomatous mitral valve degeneration	9	2.3
Asthma (or other pulmonary condition)	8	2.1
Heat stroke	6	1.6
Drug abuse	4	1.0
Other cardiovascular cause	4	1.0
Long QT syndrome §	3	0.8
Cardiac sarcoidosis	3	0.8
Trauma causing structural cardiac injury	3	0.8
Ruptured cerebral artery	3	0.8

* Data are from the registry of the Minneapolis Heart Institute Foundation (3). † Findings at autopsy were suggestive of HCM but were insufficient to be diagnostic. ‡ Tunneled coronary artery was deemed the cause of death in the absence of any other cardiac abnormality. § The long QT syndrome was documented on clinical evaluation. Source: Reproduced from Maron B.J. (3) with permission of the Massachusetts Medical Society.

Table 3.1.2.1 Causes of SCD. Source: Maron BJ. Sudden death in young athletes. N Engl J Med 2003;349:1064–1075

Other non-cardiac causes of arrhythmia may cause SCA and these include drugs such as stimulants (antihistamines, strychnine, cocaine, etc.).

Physical activity, especially of an outburst nature such as football, can precipitate an event in someone with known underlying genetic diseases. The causative mechanism is thought to be a **triggering of malignant arrhythmias** (ventricular tachycardia/fibrillation).

The contributory mechanisms are thought to be:

- Ventricular tachyarrhythmias (abnormal myocardium/ fibrous tissue)
- Brady-arrhythmias (conduction defects)
- Dissection of great vessels (Marfan syndrome)

When SCA occurs in previously apparently healthy individuals, there are usually no symptoms of note. The possible warning symptoms (if they do occur) are palpitations, dizziness, angina, dyspnoea or syncope. Some of these symptoms may occur as a one-off and will most often be ignored. Meticulous history-taking with specific questions in this regard is essential.

SCA does occur in previously apparently healthy and fit young individuals but it can also occur in recreational players as well as coaches. As mentioned above, in people over the age of 35, the most frequent cause is coronary artery disease, therefore preceding symptoms with exercise are more likely in this group.

Prevention of SCD

Prevention of sudden cardiac death can be divided into primary and secondary prevention.

- Primary prevention entails a thorough medical screening of all young football players as in the pre-competition medical assessment (PCMA).
- Secondary prevention entails expeditious management of SCA on the pitch – immediate cardiopulmonary resuscitation and defibrillation within the shortest possible space of time (emergency action plan).

It is logical, therefore, to emphasise primary prevention of SCD rather than secondary prevention (treatment of SCA) as by the time SCA occurs, it may already be too late and chances of survival are heavily restricted and further deteriorate by the minute.

Primary prevention of SCD

Ideally, all players aged 16 or 17 should have a **thorough cardiovascular screening by a cardiologist.** Later, the pre-competition or pre-season medical assessment is always very important to identify players at risk as this might be the only opportunity for a player to be examined by a doctor. Here, again, particular emphasis should be placed on a thorough evaluation of the cardiovascular system.

Depending on the individual situation and access to medical care, the FIFA Medical Committee encourages preventative screening based on a thorough history (Lausanne recommendations of the IOC) and a physical examination, wherever possible supported by a 12-lead resting ECG and further examinations such as echocardiography as indicated by positive history, examination and/or ECG findings.

According to the Lausanne recommendations and the European Society of Cardiology recommendations, in an ideal setting, such cardiovascular screenings should be conducted at least once every two years.

High-risk individuals should go through a thorough screening that may include a DNA analysis of the player and the player's close relatives, ECG and Echo. High-risk individuals include:

- Those with a family history of cardiac disease;
- Those with a family history of sudden death at a young age;
- Those with tall stature, long limbs and fingers (Marfarnoid features).

In hypertrophic cardiomyopathy, as mentioned one of the most common causes for SCA and SCD in young athletes, the muscle mass in the left ventricle hypertrophies and presents an electrically unstable myocardial substrate, increasing the risk of ventricular fibrillation. In over half of the cases, this heart disorder is hereditary and is relatively common in the general population (1:500).

It is thought that there is a genetic basis for the occurrence of the disease, as often demonstrated by DNA tests of victims and close family members. This condition is usually diagnosed by a combination of the following factors:

- A history of recurrent episodes of syncope, chest pain and dizziness.
- Positive family history of a similar condition or sudden death at a young age (below the age of 45).
- Physical examination signs such as a systolic murmur

– Positive changes on an electrocardiogram (ECG) – this usually shows signs of left ventricular hypertrophy.
– Changes on the echocardiography – wall thickness and left ventricular outflow obstruction. These changes are often only obvious in subjects older than 13-15. At a younger age, therefore, the echocardiography may be completely normal (a false negative).

Educating players about the risks is another important part of prevention. Players need to be discouraged from excessive use of supplements containing caffeine and ephedrine. The message must be very clear that these can lead to sudden death on the pitch.

Management of SCA (secondary prevention of SCD)

One of the most important components of SCA management on the pitch is quick recognition of the condition. Direct observation of the injury mechanism from the sidelines by the team physician and/or the sideline emergency care team therefore remains critical.

Any player who suddenly collapses without contact with any other player or object and is non-responsive should be regarded as having SCA until proven otherwise. This emergency situation calls for swift action from the sideline medical personnel, and an emergency action plan should be in place and exercised beforehand. It is the task of the event physician to ensure such a plan is in place, and that the sideline medical personnel are sufficiently trained and qualified to pursue it.

The Laws of the Game state that medical personnel can only enter the field at the invitation of the referee. However, the exception to the rule is if there is a serious (life-threatening) injury. During a football match, the referee will always concentrate on the area where the ball is located at any given point in time. A player who suddenly collapses in a non-contact situation may very often happen to be out of the sight of the referee and there may consequently be a delay in the referee becoming aware of this emergency situation.

It would therefore appear acceptable under those very rare and exceptional circumstances of a non-contact collapse for the team physician to run onto the field even before the referee instructs him to do so to get to the player as swiftly as possible **to start resuscitation and defibrillation in a bid to save the player's life.** The team physician must be aware that he might be required to act on his own at lower-level competitions or in training situations. If additional sideline medical personnel are supporting him, responsibilities and task-sharing in the event of SCA should be agreed upon before the match/competition.

The most definitive and effective form of treatment for SCA is immediate defibrillation as the mechanism is mostly ventricular fibrillation. Defibrillation administered in less than two to three minutes can provide survival outcomes of about 50%; however rates fall sharply with each minute thereafter. By four to five minutes, survival is 25% or less, and less than 10% after ten minutes. Time is therefore of the essence. The general recommendation is to strive for defibrillation within 1–2 minutes in order to achieve greater survival rates. It is important, therefore, that an external defibrillator (automated [AED] or manual) is available on the sidelines for the duration of any football match.

Cardiopulmonary resuscitation (CPR) must be started immediately if the defibrillator is not immediately available. **In these circumstances of SCA, it is only necessary to do chest compressions without ventilation as the oxygen supply will suffice in the first few minutes.**

Role of the event physician

All team medical personnel must be proficient in the CPR technique and the use of an external defibrillator. However, resuscitation of a player with SCA is best left to experienced emergency medical personnel. In high-level international competitions, the presence of a trained emergency care team on the sideline of each half of the pitch is a requirement (see chapter 2.3).

As part of preparation for any football match, the event physician needs to ensure that:
– there are appropriately experienced emergency medical personnel available on the sidelines;
– there is an emergency action plan that has been communicated to all sideline personnel and team physicians;
– there is a fully functional automated or manual external defibrillator available on the sidelines;
– there is an appropriate emergency ambulance on standby to evacuate a seriously injured player to hospital;
– the receiving hospital is notified well before the game and is on standby.

Summary

Sudden cardiac arrest

The most effective way of preventing SCD in SCA is cardiovascular screening through a thorough pre-season or pre-competition medical assessment, supported by an emergency action plan that has been carefully communicated to all medical personnel and exercised prior to the event. The most definitive and effective form of treatment for SCA is immediate defibrillation within one to three minutes.

REFERENCES

American College of Sports Medicine.
Sideline Preparedness for the Team Physician: A Consensus Statement. 2001. Cited 2010 Jan 20. Available from: http://www.acsm.org.

Borjesson M, Pelliccia A.
Incidence and aetiology of sudden cardiac death in young athletes: an international perspective. Br J Sports Med 2009;43;644-648.

Dvorak J, Junge A, Grimm K (eds).
Prevention of sudden cardiac death. Football Medicine Manual. Zurich: Fédération Internationale de Football Association;2009.

Laws of the Game.
Cited 2010 Jan 20. Available from: http://www.fifa.com/worldfootball/lawsofthegame.html.

Hazinski MF et al.
Response to Cardiac Arrest and Selected Life-Threatening Medical Emergencies: The Medical Emergency Response Plan for Schools. A Statement for Healthcare Providers, Policymakers, School Administrators, and Community Leaders. Paediatrics 2004;113:155-168.

Kenny A, Shapiro LM.
Sudden cardiac death in athletes. BMB 1992;48:534-545.

Link MS, Estes III NAM.
Sudden cardiac death in athletes. Progr Cardiovascular Diseases, Vol. 51, No. 1 (July/August), 2008:pp44-57.

Lorvidhaya P, Stephen Huang SK.
Sudden Cardiac Death in Athletes. Cardiology 2003;100:186-195.

Maron BJ, Thompson PD, Ackerman MJ et al.
Recommendations and considerations related to preparticipation screening for cardiovascular abnormalities in competitive athletes: 2007 update. Circulation 2007; 115:1643-1655.

Maron BJ.
Zipes D P. 36th Bethesda Conference: Eligibility Recommendations for Competitive Athletes with Cardiovascular Abnormalities. J Am Coll Cardiol 2005;45:1312-75.

Maron BJ.
Sudden death in young athletes. N Engl J Med 2003;349:1064–1075.

Maron BJ et al.
Blunt Impact to the Chest Leading to Sudden Death from Cardiac Arrest during Sports Activities. N Engl J Med 1995;(6)333:337-342.

Maron BJ et al.
Prevalence of sudden cardiac death during competitive sports activities in Minnesota High School athletes. J Am Coll Cardiol, 1998;32:1881-1884.

Terry GC et al.
Sudden Cardiac Arrest in Athletic Medicine. J Athlet Training 2001;36(2):205–209.

Thünenkötter T, Schmied C, Grimm K, Dvorak J, Kindermann W.
Pre-competition cardiac assessment of football players participating in the 2006 FIFA World Cup Germany™. Clin J Sports Med 2008;19:322-325.

Thompson PD et al.
Exercise and Acute Cardiovascular Events. Placing the risks into perspective: a scientific statement from the American Heart Association Council on Nutrition, Physical Activity, and Metabolism and the Council on Clinical Cardiology. Circulation. 2007;115:2358-2368.

3.1.3 Head injuries and concussion

The incidence of head injuries increases with age and the level of play. At elite level, injuries to the head occur about four times more often (14% of all injuries) than at amateur level. The vast majority of these injuries are minor, with structural brain damage being extremely rare. While the total frequency of head injuries is not substantially different in men as compared to women, injuries leading to concussion occur about two to three times more often in female players.

In football, studies have shown that more than half of head injuries occur in aerial duels (60%) primarily due to either upper limb (usually the elbow)-to-head contact or head-to-head contact. Fair play and respect for opponents are ethical values that must be encouraged, not only in players, but also in coaches, parents and managers. This will result in reducing concussion and head injuries in football. This educational approach to the prevention of head injuries is supported by enforcement of the Laws of the Game. Referees are supposed to sanction deliberate elbow-to-head action by a player with a red card, a rule that was introduced at the 2006 FIFA World Cup™ based on the findings of a study conducted by F-MARC.

Types of head injury

The most simple differentiation of head injuries is by distinguishing structural from non-structural injuries with reference to the brain tissue. In football, the most common head injury is soft-tissue contusion followed by lacerations.

In general, if there is a bleeding head wound, one should always suspect a possible underlying fracture. In this situation, if controlling the bleeding with pressure is attempted, avoid depressing any bone fragments by applying pressure to the outer edges of the bone. Otherwise one would apply direct digital pressure to curtail bleeding. Universal precautions should be always be observed with bleeding wounds and exposure to other bodily fluids. Lacerations should be cleaned, debrided of grass and dirt if necessary and sutured using sterile techniques.

A detailed neurological evaluation is necessary in all players with head injuries and it follows the approach to concussion outlined below with respect to who should be sent for further evaluation to the closest appropriate medical facility.

Concussion

Concussion can be defined as "a clinical syndrome characterised by immediate and post-traumatic impairment of neural function, such as alteration of consciousness and disturbance of vision" or as a "complex pathophysiological process affecting the brain, induced by traumatic biomechanical forces" – both definitions stressing the traumatic cause as opposed to the lack of structural damage.

In football, it has been reported that the incidence of concussion is more than two times higher in female players as compared to male players.

Mechanism of injury

- Acceleration of brain within a closed space (skull) from sudden contact or motion causes compressive, tensile and shearing forces.
- These abnormal forces may result in an altered level of consciousness.
- Head injury must be considered in any player in whom contact results in confusion or disorientation.

Concussion has the following features:

- It is defined as a diffuse, reversible brain injury that occurs at the time of trauma.
- It is characterised by the rapid onset of a change in mental status, which may or may not include loss of consciousness (LoC).
- LoC usually resolves quickly, although it may extend for up to six hours in more severe cases.
- Typical signs are confusion and amnesia.
- Associated findings are headache, nausea, vomiting, dizziness and a lack of awareness of surroundings.
- Caused by inertial forces from the traumatic injury that lead to shear strain.

– Concussion results in increased energy demands on the brain and transient diffuse cerebral dysfunction, which involves the reticular formation in the brain stem.
– One of the post-concussion dangers repeatedly described is second-impact syndrome. This condition seems to occur very rarely when a player who has not fully recovered from a previous concussive episode or head injury suffers another incidental or relatively minor head injury. Some authors prefer the term "diffuse cerebral swelling" and object to the theory of the first event. Fatal diffuse cerebral swelling may even occur without an obvious history of a concussive episode, and clinicians should have a high level of suspicion. This is observed primarily among younger players below the age of 21. One theory is that repetitive head trauma can result in acute severe brain swelling in the absence of an intracranial mass lesion and can lead to death. A common story is that of an adolescent football player who sustains a second head injury before symptoms of the first have cleared. The second injury may appear mild, or may not even be reported.
No matter what theory is believed, concussion management has to focus on not only the current concussive episode and its immediate management, but also on an evaluation of any previous concussive episode as rapid neurological deterioration of the player, and even death, may occur. Therefore, the attending team or event physician or sideline medical personnel must explicitly enquire about any previous concussive episode that a concussed player has been exposed to and then manage it accordingly with appropriate advice on symptoms and the signs to look out for, and to arrange for medical follow-up if necessary.

Another potentially life-threatening injury that may occur concurrently with concussion is the possibility of an acute cervical spine injury due to the common mechanism of injury. As mentioned above, collision injuries may result in lacerations and underlying skull fractures, which must be assessed and managed. Additionally, a sudden deceleration of the brain on impact may disrupt cerebral blood vessels resulting in life-threatening intracranial bleeding. Rapid on-field evaluation and appropriate stabilisation must be performed to prevent any further compromise to the injured player.

Signs and symptoms

Diagnosis of acute concussion will normally require the assessment of a number of parameters including clinical symptoms, physical signs, behaviour, balance and cognition (Table 3.1.3.1).

As already mentioned, a detailed concussion history is an important part of the evaluation, both in the pre-participation examination and in the injured player. A suspected diagnosis of acute concussion can include one or more of the following:
– Somatic: headache
– Cognitive: feeling like being in fog
– Emotional symptoms: lability
– Physical signs: loss of consciousness, amnesia
– Behavioural changes: irritability
– Cognitive impairment: slowed reaction times

If one or more of these symptoms is present, concussion should be diagnosed and an appropriate management strategy instituted. Several basic principles guide the medical team through this process.

SYMPTOMS OF CONCUSSION

- Loss of consciousness
- Severe headache
- Amnesia
- Seeing stars or spots
- Dizziness
- Weakness
- Double vision
- Nausea/vomiting

SIGNS OF CONCUSSION

1. Glasgow Coma Scale
2. Unequal pupil size
3. Paralysis or muscle weakness
4. Muscle extremity power
5. Mental function
6. Eye movement, pupil size
7. Neck pain and stiffness
8. Assess for fractures, dislocations, bleeding
9. Balance deficiency – Rhomberg test
10. Cerebellar dysfunction – finger to nose test
11. Reflex tests – Babinski, deep tendons
12. Cerebrospinal fluid in external ear canal or nostrils

1-8 may be conducted on the field.
9-10 may be done on the field/at field-side after removing the player.
11-12 may be reassessed at field-side.

Table 3.1.3.1: Symptoms and signs of concussion

Role of the event physician

Pre-injury planning

- Appoint a team leader.
- Acquire appropriate equipment for stabilisation.
- Establish lines of communication to emergency medical services (EMS).

Field-side management

I. Unconscious players

- The team leader should proceed to quickly assess airway, breathing, circulation and deformity (level of consciousness – ABCD).
- Unless there is a threat to the airway, breathing or circulation, the player should be left in the position in which he is found.
- If the player is unconscious and there is a risk of vomiting, e.g. after having had fluids or having eaten, it may be necessary to logroll the player onto his side in order to maintain and protect the airway. When this is performed, always protect the cervical spine simultaneously with a dedicated healthcare provider controlling the head and all movements (see Figures 3.1.4.2 – 3.1.4.4).
- The injured player is then placed onto a long board spinal immobilisation device using either a commercial spinal board or a scoop stretcher. Players lying in the supine position are lifted as a single unit by the medical team, allowing the board to be placed underneath and then slowly lowering the injured player onto it. If a scoop stretcher is used, the player does not need to be lifted or logrolled but "scooped" onto the stretcher. Players lying in the prone position are logrolled onto the spinal board into a supine position.
- If logrolling is necessary, make use of at least three other trained healthcare providers with another, the leader, providing constant control and in-line stabilisation to the head to avoid any unnecessary neck extension, flexion or lateral rotation.
- Once placed onto the relevant immobilisation board, the injured player is then secured with appropriate strapping to the board for safe transport including application of head blocks and a semi-rigid cervical collar.
- Stabilise the head and neck immediately.
- Neurological assessment includes:
  - checking the pupils for symmetry, size and reaction to light;
  - motor testing being evaluated by having the player move each limb;
  - speech being assessed by asking the player his name.

After the player has been removed from the pitch, reassess using the ABCD principles:

Ia. If consciousness is not regained:

- Refer to hospital immediately (see Table 3.1.3.2).
- The player should not be left alone and serial monitoring for deterioration is essential over the initial few minutes following injury including during transport to a hospital, if required.

Ib. If consciousness is regained:

- Only once all basic emergency medical issues have been appropriately and urgently managed should an assessment of the concussive injury be made using either the Pocket SCAT2 or another similar examination tool (Pocket SCAT, Figure 3.1.3.1).

Urgent referral to hospital

Any player who has or develops the following:

1. A fractured skull.
2. Deterioration in conscious state following injury.
3. Focal neurological signs.
4. Confusion or impairment of consciousness for more than 30 minutes.
5. Loss of consciousness for more than five minutes.
6. Persistent vomiting or increasing headache post-injury.
7. Any convulsive movements with neurological signs.
8. More than one episode of concussive injury in a match or training session.
9. Children below the age of ten with head injuries.
10. High-risk patients, e.g. haemophilia, anticoagulant use.
11. Inadequate post-injury supervision.

Table 3.1.3.2 Indications for urgent referral to hospital for assessment, special investigation and management

II. Conscious players

If the concussed player is conscious, use the Pocket SCAT 2 or another similar examination tool (Pocket SCAT, Figure 3.1.3.1) to assess the player's immediate cognitive function.

Pocket SCAT2

Concussion should be suspected in the presence of **any one or more** of the following: symptoms (such as headache), or physical signs (such as unsteadiness), or impaired brain function (e.g. confusion) or abnormal behaviour.

1. Symptoms

Presence of any of the following signs & symptoms may suggest a concussion.

- Loss of consciousness
- Seizure or convulsion
- Amnesia
- Headache
- "Pressure in head"
- Neck Pain
- Nausea or vomiting
- Dizziness
- Blurred vision
- Balance problems
- Sensitivity to light
- Sensitivity to noise
- Feeling slowed down
- Feeling like "in a fog"
- "Don't feel right"
- Difficulty concentrating
- Difficulty remembering
- Fatigue or low energy
- Confusion
- Drowsiness
- More emotional
- Irritability
- Sadness
- Nervous or anxious

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Figure 3.1.3.1 Pocket SCAT 2

2. Memory function

Failure to answer all questions correctly may suggest a concussion.

"At what venue are we at today?"
"Which half is it now?"
"Who scored last in this game?"
"What team did you play last week/game?"
"Did your team win the last game?"

3. Balance testing

Instructions for tandem stance

*"Now stand heel-to-toe with your **non-dominant** foot in back. Your weight should be evenly distributed across both feet. You should try to maintain stability for 20 seconds with your hands on your hips and your eyes closed. I will be counting the number of times you move out of this position. If you stumble out of this position, open your eyes and return to the start position and continue balancing. I will start timing when you are set and have closed your eyes."*

Observe the athlete for 20 seconds. If they make more than 5 errors (such as lift their hands off their hips; open their eyes; lift their forefoot or heel; step, stumble, or fall; or remain out of the start position for more that 5 seconds) then this may suggest a concussion.

Any athlete with a suspected concussion should be IMMEDIATELY REMOVED FROM PLAY, urgently assessed medically, should not be left alone and should not drive a motor vehicle.

Based on the results of your assessment:

IIa. If the player is confused without amnesia and no loss of consciousness

– Remove the player from the pitch.
– Allow up to 20 minutes of observation for evaluation before allowing the player to return to play if appropriate.

IIb. If there is confusion with amnesia but no loss of consciousness

– Remove the player from the pitch, and do not allow him to return to play.

Return to play

Any player with diagnosed concussion or another head injury should not be allowed to return to play on the day of the injury. If the player is not referred to hospital, or if the player is discharged from the hospital, he is given an information sheet (Table 3.1.3.4) containing symptoms that the player or player supervisor should monitor and, if necessary, summon medical assistance if or when any symptoms appear (e.g. late-onset symptoms are indicative of subdural haematomas or other intra-cranial bleeding).

It is essential for all return-to-play protocols that the medical team confirms the following criteria, carefully considering the pre-injury status of the player:

– The status of anatomical and functional healing
– The status of recovery from acute illness and associated sequelae
– The status of chronic injury or illness
– That the player poses no undue risk to the safety of other participants
– Restoration of football-specific skills
– Psycho-social readiness

Same day return to play

Only in certain situations, and in adult players only, should a player be allowed to return to play on the same day. The attending physician should be experienced enough in the first instance to make this clinical decision. The criteria would be the same as for other return-to-play states, and it implies that there are no clinical and cognitive compromises.

Patient discharge information

Please note:
A NORMAL X-RAY or head scan DOES NOT EXCLUDE CONCUSSION.

You may be sent home after being assessed. In this case:

– Always make sure that you are in the presence of a responsible adult for 48 hours.
– Record and monitor any symptoms of concussion including headache, nausea, dizziness, fatigue, sleep disturbances, memory lapses, mood swings, poor concentration or any other feeling that concerns you.
– Complete rest and sleep will help recovery.

DO NOT:

– Drive a motor vehicle or motor cycle if symptoms occur
– Consume any alcohol
– Take excessive amounts of painkillers (follow your doctor's orders)
– Place yourself in an environment of loud noise and excessive light
– Study
– Work on a computer
– Exercise until re-evaluation by a doctor

DO:

Either you or a family member/friend who witnesses any of the symptoms below should contact the nearest emergency department immediately if:

– Any of the symptoms intensify or get worse
– A headache becomes severe or does not respond to mild analgesics, e.g. paracetamol
– You have a seizure (fit)
– You experience excessive irritability
– You experience visual disturbances
– You experience balance problems
– You or anyone else is concerned about your condition

Decisions regarding returning to football will be made by taking into consideration your individual circumstances including medical history, previous head injuries and current symptoms.

You must receive clearance from a doctor before returning to football!

Table 3.1.3.3

Summary

Head injuries and concussion

The most simple differentiation of head injuries is by distinguishing structural from non-structural injuries with reference to the brain tissue. In general, if there is a bleeding head wound, one should always suspect a possible underlying fracture. A neurological evaluation at the sideline using one of the established tools (e.g. SCAT2) is necessary in all players with head injuries and concussion with respect to who should be sent for further evaluation to the closest appropriate medical facility. Field-side management differs in conscious and unconscious players. Return to play on the same day is generally not encouraged.

REFERENCES

Andersen T, Arnason A, Engebretsen L, Bahr R.
Mechanisms of head injuries in elite football. Br J Sports Med. 2004 Dec;38(6):690-696.

Barnes BC, Cooper L, Kirkendall DT, McDermott TP, Jordan BD, Garrett WE Jr.
Concussion history in elite male and female soccer players. Am J Sports Med. 1998 May-June;26(3):433-438.

Boden BP, Kirkendall DT, Garrett WE Jr.
Concussion incidence in elite college soccer players. Am J Sports Med. 1998 Mar-Apr;26(2):238-241.

Cantu RC.
Return to play guidelines after a head injury. Clin Sports Med. Jan 1998;17(1):45-60.

Cantu RC.
Second-impact syndrome. Clin Sports Med. Jan 1998;17(1):37-44.

Covassin T, Elbin R, Stiller-Ostrowski JL.
Current sport-related concussion teaching and clinical practices of sports medicine professionals. J Athl Train. 2009 Jul-Aug;44(4):400-404.

Delaney JS, Frankovich R.
Head injuries and concussion in soccer. Clin J Sports Med. 2005 Jul;15(4):216-219.

Delaney JS, Vishal P, Rouah F.
Mechansims of injury for concussions in university football, ice hockey and soccer: A pilot study. Clin J Sports Med. 2006 March;16(2):162-165.

Dvorak J, Junge A, Grimm K (eds).
Head and brain injuries. In: Football Medicine Manual. Zurich: Fédération Internationale de Football Association; 2009.

Dvorak J, McCrory P, Kirkendall DT.
Head injuries in the female football player: incidence, mechanisms, risk factors and management. Br J Sports Med. 2007;41(Suppl I):i44-i46.

Jordan SE, Green GA, Galanty HL, Mandelbaum BR, Jabour BA.
Acute and chronic brain injury in United States National Team soccer players. Am J Sports Med. 1996 Mar-Apr;24(2):205-210.

Matser EJ, Kessels AG, Lezak MD, Jordan BD, Troost J.
Neuropsychological impairment in amateur soccer players. JAMA. 1999 Sep;282(10):971-973.

McCrory P, Meeuwisse W, Johnston K, Dvorak J et al.
Consensus Statement on Concussion in Sport: the 3rd International Conference on Concussion in Sport held in Zurich, November 2008. Br J Sports Med. 2009;43(Suppl I):i76-i84.

McCrory P, Makdissi M, Davis G, Collie A.
Value of neuropsychological testing after head injuries in football. Br J Sports Med. Aug 2005;39(Suppl I):i58-i63.

McCrory P, Johnston K , Meeuwisse W, Aubry M, Cantu R, Dvorak J, Graf-Baumann T, Kelly J, Lovell M, Schamasch P.
Summary and agreement statement of the 2nd International Conference on Concussion in Sport, Prague 2004. Br J Sports Med. 2005;39:196–204.

McCrory P.
Does second impact syndrome exist? Clin J Sport Med. 2001 Jul;11(3):144-149.

McCrory PR, Berkovic SF.
Second impact syndrome. Neurology. Mar 1998;50(3):677-683.

3.1.4 Cervical spine injuries

Cervical spine injuries are potentially catastrophic but are fortunately very rare in football. They are more common in American football and rugby, where the incidence can be as high as 15% of all injuries.

The team physician must be well versed in the following about cervical spine injuries:

- Normal cervical alignment and architecture of the cervical spine;
- Comprehension of the mechanics exerted during a football match, which may result in these injuries, as well as
- Prevention, evaluation, stabilisation and treatment of cervical spine injuries.

Mechanisms of injury

The natural architecture of the normal cervical spine assumes a lordosis of the vertebrae. This lordosis allows for controlled motion and the transmission of forces to the supporting muscles and soft tissues. When the neck is slightly flexed, at approximately 30°, the normal lordosis is straightened and the forces of the axial load are transmitted to the bones and discs. If the impact force is greater than the yield strength of the vertebrae, a fracture and possible dislocation with cord injury can occur (see Figure 3.1.4.1).

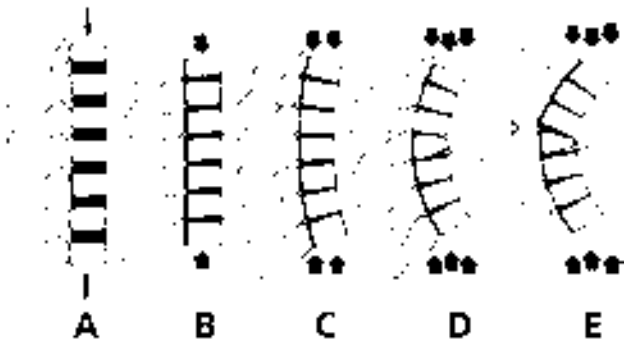


Figure 3.1.4.1 Axial loading of the cervical spine (A) first results in compressive deformation of the inter-vertebral discs (B). As the energy input continues and maximum compressive deformation is reached, angular deformation and buckling occurs (C). The spine fails in a flexion mode, with resulting fracture, sublaxation or dislocation (D and E). Compressive deformation leading to failure, with a resultant fracture, dislocation or sublaxation occurs in as little as 8.4 milliseconds.
Source: Torg JS., Guille JT., Jaffe S. Injuries to the Cervical Spine in American Football Players. J Bone Joint Surg Am. 2002;84:112-122.

This type of injury mechanism occurs in a "spearing" type of tackle with the head. This type of tackling has been banned in American football because of the catastrophic effects (quadriplegia) it results in. In football, any tackle situation (e.g. head collision/butts in a diving header) that results in axial loading of a slightly flexed neck can potentially result in such an injury. Axial trauma to the cervical spine combined with flexion/extension might result in a stable fracture of the vertebral endplate and the corresponding articular process.

Types of injuries

Most of the injuries that affect the neck are fortunately self-limiting and rarely catastrophic in resulting in quadriplegia. The following are different types of injuries that may affect the cervical spine:

1. Nerve root or brachial plexus injuries
   - Stingers/burners
   - Neuropraxia of the cervical cord (CCN)
   - Burning hands syndrome (a variant of CCN)
2. Cervical muscle strain
3. Cervical sprain – stable/unstable
4. Inter-vertebral disc injury
   - With/without neurologic deficit
5. Cervical fractures/dislocations
   - Stable/unstable
   - With/without neurologic deficit
6. Subluxation without fracture
   - With/without neurologic deficit
7. Cervical stenosis

Signs and symptoms

Symptoms may range from minor neck pain and stiffness (as with strains and sprains) to complete paralysis of both the upper and lower limbs.

Burners and stingers occur with quick movements resulting in compression or pinching of the nerve root and usually result in unilateral shoulder and arm weakness and a "burning sensation" radiating down the arm. Symptoms usually last for about two to ten minutes followed by complete resolution in the vast majority of cases.

Neuropraxia, on the other hand, results in bilateral transient neurologic deficit with mainly sensory symptoms (burning, tingling and numbness) but may also have motor symptoms from weakness to quadriplegia. Parts affected are either the upper extremity or both upper and lower

extremities. Resolution of symptoms is usually after about 10–15 minutes.

Fractures can affect any of the cervical vertebrae and, if unstable, can transact the spinal cord and result in permanent quadriplegia. It is therefore important for the team physician or the sideline medical personnel to stabilise the neck before attempting to move the injured player.

Field-side management of cervical spine injuries

The first component of field-side management of cervical spine injuries is recognising the mechanism of the injury. Observation of the mechanism of injury from the sidelines is therefore critical as it can provide clues as to the possible diagnosis even before reaching the injured player.

The next step is to determine whether the injury is minor or serious through a quick assessment of the injury mechanism, signs and symptoms.

All minor injuries such as neck muscle strains, ligament sprains and nerve root or brachial plexus injuries are self-limiting and require no urgent field-side treatment. In most of these cases, the player may either report symptoms after the match or, if acutely injured, may be transported off the pitch as with any other minor musculoskeletal injuries.

However, the more serious injuries require careful handling of the cervical spine in order to avoid any further injury to the spinal cord. Such injured players must be stabilised securely and evacuated to hospital for further assessment. These injuries include all suspected cervical vertebral fractures (stable/unstable) or any serious injury with neurological signs.

Procedure for spinal stabilisation

The following points detail the approach to such injuries and the **procedure to follow in spinal stabilisation as the third component of field-side management** that should be exercised by the team physician/sideline medical personnel (Figure 3.1.4.2 – 3.1.4.4):

- If conscious, the player must be instructed not to move from the position in which he is found upon arrival of the team physician.
- One healthcare provider must be identified and requested to stabilise the player's head and neck by placing one hand on either side of the player's head and preventing any uncontrolled movements (Figure 3.1.4.2).
- If practical and appropriate, an attempt must be made to gently place a rigid cervical collar or equivalent (if available) around the player's neck in order to stabilise the cervical spine.
- If the player is standing in the vertical position, he must be fully secured to a long spinal board (or equivalent) before being slowly and carefully lowered into the horizontal, supine position on the pitch (Figure 3.1.4.3).
- If the player is lying in the prone position, he must be carefully logrolled onto a long spinal board (or equivalent) so that he becomes positioned horizontally in the supine position. The player is then adequately secured in this position before being transferred.
- If the player is found in the supine position, the team of healthcare providers must simultaneously lift the player while a long trauma board is positioned under the player, who is then lowered gently onto the board for adequate securing prior to transfer.

Figure 3.1.4.2 Stabilising a player's head and neck in a player who is unconscious/suspected to have suffered a head or spine injury

Role of the event physician

The event physician plays a critical role in ensuring that:

– Appropriate emergency equipment for neck stabilisation and transportation of injured players off the pitch is immediately available on the sidelines. The minimum requirements would be, in addition to a normal stretcher, a spinal board (or any straight hard board), straps to secure the injured player and a rigid cervical collar.
– There are appropriately experienced emergency medical personnel available on the sidelines. These need not be only personnel with advanced trauma life support but should be well versed with spinal stabilisation manoeuvres.
– There is an appropriate emergency ambulance on standby to evacuate a seriously injured player to hospital.
– The receiving hospital(s) is (are) notified well before the match/competition and on stand-by to receive and prioritise a seriously injured player.

Return-to-play guidelines

Assessment principles for all apparently minor neck injuries are that all players must have pain-free, full range of motion in the neck before being allowed to return to play.

Figure 3.1.4.3 Securing a player in a vertical position who is suspected to have suffered a head or spine injury to a horizontal position without spinal board

If neck movements are limited and/or painful, the player must be withdrawn, the diagnosis reviewed and a more serious injury such as an unstable cervical vertebral fracture must be excluded.

In the event that a player has a more serious head injury (e.g. concussion) accompanying a minor cervical spine injury, the more serious injury must take priority over the less serious injury with respect to return-to-play guidelines.

Before any player can be allowed to return to play, therefore, the following criteria must be met:

- **Full cervical range of motion**
- **Full upper limb strength**
- **Absence of neurological symptoms and/or signs**

When in doubt, it is always safer to make the player sit out and monitor him over a period of time rather than take a chance.

Summary

Steps in the management of cervical spine injuries

1. The first step in field-side management of cervical spine injuries is recognition of the mechanism of the injury. Observation from the sidelines is critical as it can provide clues as to the possible diagnosis even before reaching the injured player.
2. The next step is to determine whether the injury is minor or serious through a quick assessment of the injury mechanism, signs and symptoms. All minor injuries such as neck muscle strains, ligament sprains, nerve root or brachial plexus injuries are self-limiting and require no urgent field-side treatment. More serious injuries require careful handling of the cervical spine in order to avoid any/further injury to the spinal cord. These injuries include all suspected cervical vertebral fractures or any serious injury with neurological signs.
3. The third step in these seriously injured players is careful and secure stabilisation of the player in a coordinated team effort according to a standard procedure that has been exercised before, and his safe evacuation from the pitch and transport to the nearest hospital for further assessment.

Figure 3.1.4.4 Securing a player in a vertical position who is suspected to have suffered a head or spine injury to a horizontal position with spinal board

REFERENCES

American College of Sports Medicine.
Sideline Preparedness for the Team Physician: A Consensus Statement. 2001. Cited 2010 Jan 20. Available from: http://www.acsm.org.

Bailes JE, Petschauer M, et al.
Management of Cervical Spine Injuries in Athletes. J Athletic Train. 2007;42(1):126–134.

Banerjee R, Palumbo MA, Fadale PD.
Catastrophic cervical spine injuries in the collision sport athlete, part 1: epidemiology, functional anatomy, and diagnosis. Am J Sports Med. 2004 Jun;32(4):1077-1087.

Banerjee R, Palumbo MA, Fadale PD.
Catastrophic cervical spine injuries in the collision sport athlete, part 2: principles of emergency care. Am J Sports Med. 2004 Oct-Nov;32(7):1760-1764.

Dvorak J, Junge A, Grimm K (eds).
Spinal injuries. In: Football Medicine Manual. Zurich: Fédération Internationale de Football Association; 2009.

Ghiselli G, Schaadt G, McAllister DR.
On-the-field evaluation of an athlete with a head or neck injury. Clin Sports Med. 2003 Jul;22(3):445-465.

Luke A, Micheli L.
Sports Injuries: Emergency Assessment and Field-side Care. Pediatr Rev. 1999;20:291.

McAlindon RJ.
On field evaluation and management of head and neck injured athletes. Clin Sports Med. 2002 Jan;21(1):1-14.

Sama A, Girardi FP, Cammisa F.
Cervical Spine Injuries in Sports. eMedicine Updated 2005 July 1st. Cited 2010 Jan 20. Available from http://www.emedicine.com/orthopedic/topic370.htm

Sanchez AR 2nd, Sugalski MT, LaPrade RF.
Field-side and prehospital management of the spine-injured athlete. Curr Sports Med Rep. 2005 Feb;4(1):50-55.

Torg JS, Guille JT, Jaffe S.
Injuries to the Cervical Spine in American Football Players. J Bone Joint Surg Am. 2002;84:112-122.

Vaccaro AR, Klein GR, Ciccoti M, Pfaff WL, Moulton MJ, Hilibrand AJ, Watkins B.
Return to play criteria for the athlete with cervical spine injuries resulting in stinger and transient quadriplegia/paresis. Spine J. 2002 Sep-Oct;2(5):351-356.

Whiteside JW.
Management of Head and Neck Injuries by the Sideline Physician. Am Fam Physician. 2006 Oct 15;74(8):1357-1362.

Windsor RE, et al.
Cervical disc injuries. eMedicine Updated 8 April 2005. Cited 2010 Jan 20. Available from: http://www.emedicine.com/sportstopic18.htm.

3.1.5 Chest injuries

Chest injuries are relatively rare in sport but occur more frequently in sports involving high-velocity impact. In football, chest injuries seldom occur. At international level, injuries to the chest are categorised as injuries to the trunk, which in total account for less than 10% of all injuries.

Mechanism of injury

Chest injuries in football players usually result from direct contact with other players, a goal post, the ball or other moving or steady objects.

Signs and symptoms

Chest injuries may be minor, or they may cause significant pain and necessitate removal of the player from the field of play, all depending on the injured structures as described below. Although very rare, severe injuries have been observed, e.g. secondary myocardial infarction in a young player caused by total obstruction of a coronary artery after direct trauma by a football.

Types of injuries

Acute rib fractures

Contact with opposing players or collision with a goal post can lead to rib fractures. Fractures of the first and second ribs imply a high energy transfer and can be associated with underlying injuries to the thoracic aorta, brachial plexus or subclavian vein. These are therefore not to be taken lightly and can have serious consequences. The player usually has sharp pain in his chest, made worse by deep breathing or coughing, or by compression of the chest wall during examination (which can be a clinical sign).

Suspected rib fractures are usually referred for radiology, even though they are easily missed on a chest X-ray and a substantial portion are in fact invisible and only diagnosed clinically. The X-ray is nevertheless important as it may reveal underlying chest pathology (see below). **In most cases, treatment is only symptomatic for the pain. Local infiltration with local anaesthetics will bring about immediate relief.** Preferably, this should only be performed by experienced clinicians to avoid complications. If local infiltration is performed, it should be remembered that the approach is posterior and below the rib to avoid the neurovascular bundle behind the ribs. Additional oral analgesics may be necessary.

Although the rib injury itself may be quite trivial, there is the possibility of an underlying haemothorax, pneumothorax, tension pneumothorax, pulmonary contusion and visceral injury (liver or spleen).

Once the injury has been confirmed as being an isolated rib injury, it is advisable to avoid physical activity that causes pain for a period of up to four to six weeks. A return to training (non-contact) may take up to ten weeks, but the physician and the player should be guided by the pain symptoms. Rehabilitation with breathing exercises is then advised.

The costal cartilages

Fracture of the costal cartilage is rare, but can occur with a sudden forceful contraction of the external oblique muscles, which may lead to an audible clicking. There is localised tenderness over the costal margin. Pain management is required for players who suffer this injury.

Sternal fractures

Sternal fractures are caused by direct, high-energy impact and may occur in football. Sternal stress fractures can also be the result of repetitive hyper-flexion of the torso, as in vigorous sit-ups over a long period of time. These are over-use injuries (stress fracture) and not traumatic in nature.

In the case of traumatic sternal fractures, the underlying myocardium is occasionally damaged and care should be taken not to miss this in patients with significant injury. With either an undisplaced fracture or stress fracture, treatment is non-operative. This will include avoidance of movements that cause pain for four to six weeks. Thereafter strength rehabilitation is required.

If there are displaced fragments, surgery will be needed and recovery time ranges from two to 12 months.

Sternoclavicular dislocation

This injury, which is more commonly a subluxation than a dislocation, usually results from a fall or a blow to the front of the shoulder, or a fall onto an outstretched hand. In football players, it is more common in goalkeepers, but can occur in any player falling in this way.

The impact forces the medial end of the clavicle inferiorly and anteriorly. Clinically, there is local tenderness and step deformity.

Gross displacements will require surgical reduction and fixation, after which the player will wear a brace and broad arm sling for four to five weeks.

In the diagnostic work-up, CT scans, if available, are more useful than X-ray, especially with posterior dislocation. A posterior dislocation, which is fortunately less common, is an emergency as there is a danger of injury to the large vessels located posteriorly. Posterior dislocation needs to be reduced, as a matter of urgency, under general anaesthesia, and should therefore be referred to the closest appropriate facility immediately.

In the case of minor subluxations, the player should avoid painful activities for two to four weeks. Immobilisation with an arm sling is helpful for pain and for restricting movement over the soft tissues that require healing. Thereafter, activity can be started gently. The outcome in time may be no pain, but there is often a bony prominence, which is, however, merely an aesthetic issue. After surgery, the player will require immobilisation and then rehabilitation for range of motion and strength, and he should be able to return to play within six to 12 weeks.

Pneumothorax

Pneumothorax in sports occurs most commonly as a result of blunt trauma to the chest. Air filling the pleural space raises intra-pleural pressure and prevents maximal lung expansion. Although rare in football, there has been at least one reported case of traumatic pneumothorax occurring in a 19-year-old player who collided with another player during a match. The case description below illustrates the need for a high index of suspicion in such potential cases, the typical symptoms and signs, and the early diagnosis and management that is required to prevent persistent pneumothorax, which may debilitate players:

"He presented with pain in the left side of his chest and breathlessness on exertion. There was a history of contact with another player during a football match six days previously. In fact he was unable to continue playing at the time due to the intense stabbing-type pain. Initially he was treated with analgesics. The pain persisted and also radiated to his left shoulder. Clinically he was found to have normal vital sounds, but decreased expansion of the chest on the left side and auscultation revealed diminished air entry. The chest X-ray showed bilateral pneumothorax (25% on the left side and 10% on the right). The patient had an intrathoracic chest tube inserted on the left side, with a successful outcome. Within a week chest X-rays revealed full expansion of both lungs. Six weeks later the patient returned to football."

The occurrence of a tension pneumothorax is a medical emergency that requires immediate relief of the tension using a chest tube.

Commotio cordis

Commotio cordis is a very rare, but real, cause of sudden unexpected non-penetrating traumatic death. It occurs most usually in young people. It is something that team/event physicians should be aware of and aim to manage appropriately when it occurs.

Commotio cordis means "concussion of the heart". It is the condition that is now accepted as "instantaneous cardiac arrest produced by non-penetrating chest blows in the absence of heart disease or identifiable morphologic injury to the chest wall or heart" (Maron, Curfman). Sudden death resulting from this condition has been reported in medical literature since the late 1970s.

The following factors increase the chance of commotio cordis in the event of direct impact:

1. The direction of impact: over the precordium (precise area, angle of impact);
2. The total energy applied: area of impact versus energy, i.e., speed of the projectile multiplied by its mass;
3. The impact occurring within a specific 10-30 millisecond portion of the cardiac cycle, during the ascending phase of the T-wave, when the ventricular myocardium is repolarising and moving from systole to diastole.

The overall survival rate currently in known victims of commotio cordis is only 15% even though most victims are young in age, usually have excellent health and there is no

structural heart disease. Sudden death is the most common outcome, but successful outcomes are possible with cardiopulmonary resuscitation and quick action by using a defibrillator and cardioactive drugs.

Field-side management

It is imperative that the event physician ensures that the sideline medical personnel at football matches

- are aware of the condition and react quickly when a player has an impact injury to the chest and collapses;
- have an AED or defibrillator charged and ready to use;
- have emergency cardiac resuscitation drugs available.

There is evidence that a precordial thump is ineffective in treating this condition, even when witnessing the collapse of the player. Early resuscitation (<three minutes) is essential, as human statistics show that in cases where resuscitation is delayed for more than three minutes, there is only a 3% rate of survival. In the animal model, defibrillation with an automated external defibrillator (AED) within one or two minutes of ventricular fibrillation resulted in successful resuscitation in 100% and 92% of animals respectively. Only 46% of shocks were successful after four minutes, and a further 25% reduction in survival was noted after six minutes ($p<0.0001$). **The initiation of early resuscitation and defibrillation appears to be the most important determinant of survival,** as is the case with other causes of ventricular fibrillation.

Role of the event physician

Preparation for chest injuries at football matches is consistent with that described in chapter 3.1.2 Sudden cardiac arrest and it is the responsibility of the event physician to ensure the same.

Summary

Chest injuries

The spectrum of chest injuries in football ranges from minor contusions to acutely life-threatening situations. Observation of the injury mechanism helps in determining the urgency of treatment. The occurrence of a tension pneumothorax is a medical emergency that requires immediate relief of the tension using a chest tube. Commotio cordis requires immediate resuscitation within minutes and external defibrillation is the most important determining factor for survival.

REFERENCES

Curfman D.
Fatal impact: concussion of the heart. N Engl J Med. 1998;338:1841–1843.

Espinosa R, et al.
Acute posteroinferior wall myocardial infarction secondary to football chest trauma. Chest 1985;88:928-930.

Geddes LA Roeder RA.
Evolution of our knowledge of sudden death due to commotio cordis. Am J Emerg Med.2005;1(23):67-75.

Kohl P Nesbitt AD, Cooper PJ, Lei M.
Sudden cardiac death by Commotio cordis: role of mechanoelectric feedback. Cardiovasc Res. 2001 May;2(50):280-289.

Link MS.
Mechanically induced sudden death in chest wall impact (commotio cordis). Prog Biophys Mol Bio. 2003;82:175-186.

Link MS, Song CP, Garan AR, Maron BJ, Estes N.
III. Precordial thump ineffective in terminating ventricular fibrillation initiated by chest wall impact (commotio cordis). Heart Rhythm. 2005;5(2):S23.

Maron BJ.
Sudden death in young athletes. N Engl J Med. 2003;1064-1075.

Maron BJ, Link MS, Wang PJ, et al.
Clinical profile of commotio cordis: an under appreciated cause of sudden death in the young during sports and other activities. J Cardiovasc Electrophysiol. 1999;10:114–120.

McCrory P.
Commotio Cordis. Br J Sports Med 2002;36:236–237

Sadat-Ali M, Al-Arfaj AL, Mohanna M.
Pneumothorax due to soccer injury. Br J Sports Med 1986; 20:91.

3.1.6 Acute asthma

Asthma is a reversible airways disease, characterised by hyperresponsiveness of the bronchial tree to a variety of stimulants. These include, among others, allergens (such as house dust mites, pollen, mould and animal dander), viral infections, cigarette and other smoke inhalation, cold air and exercise. In the football environment, grass pollen, dust and cold air exposure may all precipitate or contribute to asthma symptoms.

Exercise-induced asthma (EIA) or bronchospasm (EIB) is reversible airway obstruction that occurs during or soon after physical activity. The stimulus of exertion leads to post-exertional bronchoconstriction. 80-90% of known asthmatics will also have EIA and it is found in 40% of individuals with allergic rhinitis, atopic dermatitis or eczema. A number of individuals may have the condition associated only with exercise. The exact prevalence of asthma is difficult to ascertain, but is estimated to be around 15% in the general population and varies considerably in different athlete populations.

Prevention of acute asthma attacks

The cornerstone of management of persistent asthma is inhaled steroids. **All players with persistent asthma need inhaled steroids.** Asthmatic players should be managed appropriately to prevent acute severe attacks, **given guidelines on monitoring their symptoms and measuring peak flows, and provided with a home emergency management plan.** The team physician should monitor asthmatic players on an ongoing basis. They need to ensure there is regular medication use, compliance with the medication prescription, and that inhaler devices are used correctly. Exposure to known allergens should be monitored, and managed wherever possible. All of these measures are aimed at optimising performance, minimising symptoms and of course avoiding acute asthma attacks, which may even be life-threatening.

The clinical manifestations of asthma are usually a triad of symptoms characterised by paroxysms of cough, dyspnoea and wheezing. It is usually episodic, with acute exacerbations interspersed with symptom-free periods.

Triggers of acute asthmatic episodes:

- Allergens: pollen
- Pharmacological stimuli such as aspirin, NSAIDS, ß-adrenergic blockers, preservatives, colourant agents
- Environment pollution: ozone, SO^2, NO^2
- Occupational: metal salts, biological enzymes
- Infection: respiratory viruses
- Exercise: especially inhalation of cold dry air → thermally-induced hyperaemia and micro-vascular engorgement
- Emotional stress
- Induction and exacerbation of asthma: allergic, weather changes, exercise

The onset of life-threatening asthma may be slow or fast. In the latter case, it can be fatal within two hours. If a player presents with an acute asthma attack following exercise for the first time, a diagnosis of exercise-induced asthma/bronchoconstriction may need to be made (Table 3.1.6.2). This is important to prevent future acute attacks.

Factors in the development of acute asthma include:

- Inadequate objective monitoring
- Failure to refer earlier for specialist advice
- Inadequate treatment with steroids

Life-threatening risks may be posed by previous life-threatening asthma, severe disease, recent hospitalisation or emergency room treatment, non-compliance with and confusion about treatment, under-treatment with corticosteroids, discontinued treatment, and severe airway hyperreactivity.

Clinical diagnosis of acute severe asthma

Clinical features, symptoms and respiratory and cardiovascular signs are helpful in recognising severe asthma, but none of them are specific, and their absence does not exclude a severe attack:

- Patient is seated in an upright position
- Use of accessory respiratory muscles
- Unable to complete sentences in one breath
- Tachypnoea > 25/min
- Tachycardia > 110/min
- Peak expiratory flow (PEF) < 50% of predicted or known best value
- Pulsus paradoxus

– Chest hyperresonance
– Prolonged expiration
– Breath sounds decreased
– Inspiratory and expiratory rhonchi
– Cough

Differential diagnosis of acute asthma:
– Upper airway obstruction – glottic dysfunction
– Acute LV failure – pulmonary oedema
– Pulmonary embolism
– Endobronchial disease
– Chronic bronchitis
– Eosinophilic pneumonia
– Carcinoid syndrome
– Vasculitis

Field-side management

1. **Administer beta-2-agonist** (e.g. salbutamol 5mg) via a nebuliser.
   If no nebuliser is available: salbutamol inhalation, 10-20 puffs, using a spacer. Inhale one puff and allow for four breaths between puffs (administering salbutamol via a spacer is as effective as using a nebuliser).
   One can make a spacer device using a 500ml plastic bottle (Figure 3.1.6.1). Cut a hole in the bottom to fit the pressurised multi-dose inhaler (pMDI). Add ten sprays into the bottle. Allow the patient to breath in the medication by placing their lips around the screw-top end and inhaling.
2. In severe cases, however, nebulisation is essential since oxygen can also be given via the nebuliser.
3. **Administer corticosteroids** orally, intravenously or even intramuscularly.

General principles of treatment

1. Start treatment immediately.
2. Provide oxygen: use 40-60% via mask or cannula and set at a high flow rate. Pulse oximetry and arterial blood gases (ABG) should be performed once at the hospital. This is necessary to determine the adequacy of the oxygen therapy and the need for arterial blood gas measurement. The aim of oxygen therapy is to maintain SpO_2 ≥92%.
3. Place the player in Fowler's position (seated with back rest).
4. Administer beta-2-agonist (salbutamol 5mg) via nebuliser.
5. Administer prednisone tablet (30-60mg) and/or hydrocortisone (200mg IV).
6. In the case of life-threatening signs or no improvement, add 0.5mg ipratropium to nebulised beta-2-agonist.
7. All sedatives are absolutely contra-indicated.
8. If poor fluid intake or dehydrated: dextrose 5 %, IV, 100 mL per hour (adult dose).

Please note: Aminophyllin 250mg IV is no longer recommended as a first-line medication (no evidence base). If it is used, it must be administered at a dose of 5mg/kg over 30 minutes minimum.

Subsequent treatment

1. Nebulisation with beta-2-agonist on a six-hourly basis.
2. Administration of prednisone (30-60mg) tablet daily or hydrocortisone (200mg) intravenously on a six-hourly basis.
3. Administration of 40-60% oxygen via mask.

Figure 3.1.6.1 Spacer device made from plastic bottle for effective inhalation

Player's response to treatment

- Peak expiratory flow rate (PEFR) should be measured 15-30 minutes after the start of treatment, two hours after, and before and after each treatment with nebulised beta-2-agonist.
- Review current treatment, compliance and possible factors causing acute attack.
- Advise patient or caregiver on further care at home, danger signs and follow-up required.
- Caution patient on the high chance of further wheezing in the weeks following an acute attack.

If there is a deterioration with life-threatening signs (Table 3.1.6.1), the player will need to be admitted to an ICU, intubated and ventilated with a muscle relaxant.

- PEF < 33% of predicted or best
- Silent chest
- Cyanosis
- Bradycardia/arrhythmia
- Hypotension
- Feeble respiratory effort
- Exhaustion
- Confusion
- Coma
- PaO2 < 60
- PCO2 normal or increased
- Acidosis (low pH or high [H+]). (may not be possible to perform at stadium or field side)

Table 3.1.6.1 Life-threatening signs of acute asthma attack

A chest X-ray should be performed in the case of:

- suspected pneumomediastinum or pneumothorax;
- suspected consolidation;
- life-threatening asthma.

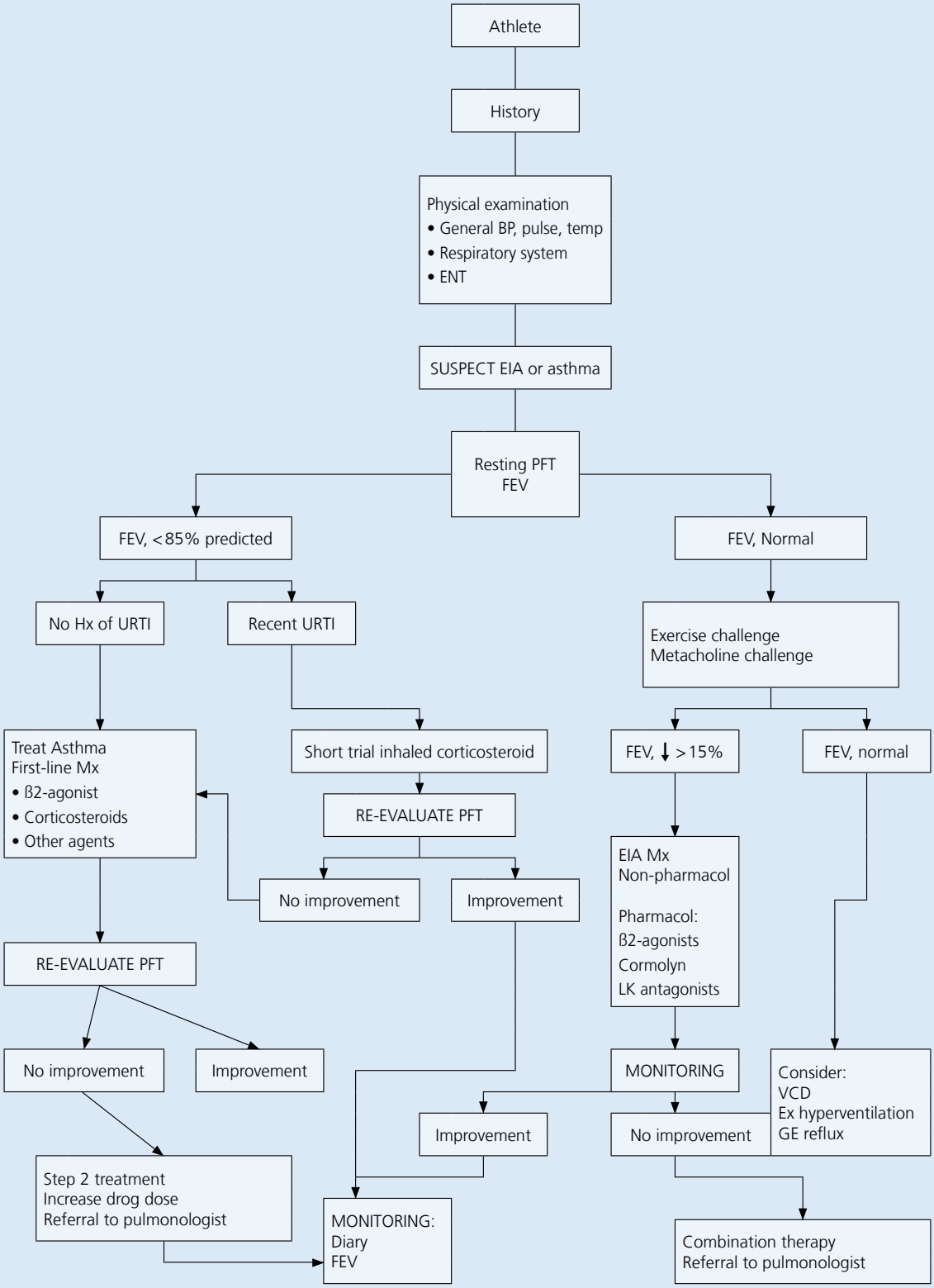
Monitoring after acute asthma attack

The following is important to prevent future acute status asthmaticus:

- Once the player has been on discharge medication for 24 hours and has had his inhaler technique checked and recorded.
- PEF >75% of best or predicted and PEF diurnal variability <25% unless discharge is agreed with respiratory physician.
- Treatment with oral and inhaled steroids in addition to bronchodilators.
- Own PEF meter and written asthma action plan.
- Follow-up by team physician/GP within two working days.
  - Monitor symptoms and PEF.
  - Check inhaler technique.
  - Written asthma action plan (including non-pharmacological methods – Table 3.1.6.2).
  - Modify treatment according to guidelines for chronic persistent asthma.
  - Address factors that could have contributed to admission.
- Follow-up appointment in respiratory clinic within four weeks.

Table III: Non-pharmacological management of EIA	
Management	**Mode of action**
Maintaining aerobic fitness	Can exercise at lower ventilatory rate for given workload Perhaps reduced airway responsiveness
Adequate warm-up/pre-competition exercise	To induce refractory period
Avoid exercise in excessively cold and/or dry air	Reduced responsiveness of airways
Avoid exercise/intense exercise when related symptoms present	Rhinitis, sinusitis, allergies indicate hyperresponsive state in airways
Adequate warming down	Avoids rebound warming and reduces oedema
Change of exercise/sport	With severe symptoms, changing activities to sports less likely to induce EIA
Wearing of face mask	Reduces inhalation of pollutants and irritants
Avoiding known allergens or irritants	Prevents allergic reactivity

Table 3.1.6.2 Non-pharmacological management of EIA. Reproduced with the permission of Constantinou D, Derman EW, 2004



(EIA = Exercise-induced asthma; ENT = ear nose and throat; FEV, = forced expiratory volume in one second; PFT = pulmonary function tests; Hx = history; Mx = management; URTI = upper respiratory tract infection; VCD = vocal cord dysfunction; GE = gastrointestinal; LK = leukotrine.)

Figure 3.1.6.2 Diagnostic and therapeutic algorithm of asthma in the work-up of the athlete with EIA. Reproduced with the permission of Constantinou D, Derman EW, 2004

Summary

Acute asthma

Exercise-induced asthma (EIA) or bronchospasm (EIB) is reversible airway obstruction that occurs during or soon after physical activity. Prevention of acute attacks is essential, with the cornerstone of management of persistent asthma being inhaled steroids. All players should monitor their symptoms and have a home emergency management plan. The onset of life-threatening asthma may be slow or fast. Field-side management includes beta-2-agonist administration (nebulisation or spacer), oral or intravenous glucocorticosteroids and oxygen in severe cases. Monitoring after an acute attack is essential in prevention of further incidents.

REFERENCES

Constantinou D, Derman EW.
Exercise-Induced Asthma. CME; 2004 March;22(3):126-132.

Kloeck WGJ (ed).
A guide to the management of common medical emergencies in adults. 2007/2008. 8th ed. ISBN: 1-874856-20-6, Faculty of Health Sciences, University of Witwatersrand, Johannesburg, South Africa.

Rodrigo GJ, Rodrigo C, Hall JB.
Acute asthma in adults: a review. Chest. 2004 Mar; 125(3):1081-1102.

Rowe BH, Spooner C, Ducharme FM, Bretzlaff JA, Bota, GW.
Early emergency department management treatment of acute asthma with systemic corticosteroids. Cochrane database syst rev. 2000;(2):CD002178.

3.1.7 Abdominal injuries

Significant abdominal injuries in football are rare. Like chest injuries, they account for less than 10% of the trunk injuries reported at international level. As such, when they do occur, unless the physician has a high index of suspicion, observes the mechanisms of injury and pays the necessary attention to them, they may be missed or diagnosed late.

Mechanism of injury

Exactly this risk compensates for what abdominal injuries lack in frequency with regard to their importance: **in football, they are naturally non-penetrating contact injuries which may have serious outcomes, especially when missed or diagnosed late.**

With football being a contact sport, abdominal injuries probably occur more frequently than reported, but the majority will be minor or subclinical with no long-term consequences. When a player has suffered a contact abdominal injury, he must be appropriately assessed, monitored and managed.

High-impact injuries are less likely to be missed, e.g. in cases of serious foul play or when goalkeepers suffer impact in-flight with an outfield player when attempting to prevent a goal. The collision between the two players at high velocity results in a high-energy contact injury.

Other than direct trauma with a resultant intra-abdominal organ impact injury, some players' circumstances may further increase their risk of serious outcomes. In such cases, a very mild trauma may suffice to induce severe injury. These include:

1. Intra-abdominal organomegaly
   - Liver, e.g. viraemia (especially post-infectious mononucleosis), malaria, cysts (e.g. hydatid), congenital lobe abnormalities
   - Spleen, e.g. viraemia
   - Mesenteric cysts (rare)
   - Other, e.g. intra-abdominal lymphangioma, benign cystic mesothelioma
2. Players with full bladders
3. Female players with enlarged or cystic uteri. Although not likely to be playing football late into their pregnancies, this would pose a risk.

Types of injury

In blunt abdominal trauma, the solid organs are more likely to be injured, and the literature reports injuries of the spleen, then liver, kidneys and pancreas. When the intestines are injured, the small bowel is more at risk due to the anatomical tethering. The large bowel tends only to be injured as a result of high-velocity trauma not occurring in football, and there have not been any reported cases. Solid-organ damage is usually recognised earlier than hollow organ injuries, with the former presenting with pain and sometimes haemodynamic compromise. Blunt trauma to the epigastrium may result in retroperitoneal haematoma, with subsequent onset of obstruction of the gastric outlet, biliary duct and even the vena cava.

Renal injury in sport occurs from direct flank blunt trauma, and is usually mild with spontaneous recovery. One has to consider the player with one kidney, and although football does not pose a high risk of abdominal injury, the player should be aware of the risks of injuring his single kidney.

Cases of pancreatic injury (isolated transection, duct laceration with pancreatitis developing, duodenal rupture, transverse colon rupture and even abdominal aortic rupture which may be fatal) are reported in football.

Symptoms and signs

Players with evolving major abdominal injuries may be relatively asymptomatic initially. Players who sustain a direct blow to the abdomen causing injury to spleen, liver or kidney may have immediate severe pain and can rapidly develop signs of shock and peritonism. However, direct blows may also cause slower bleeding, causing the player to collapse later on the pitch, on the sidelines or at home. They will be suffering from tachycardia, be pale and sweaty and complain of thirst.

In the case of non-solid-organ injuries, late and regular monitoring of the injuries is necessary in order not to miss intestinal perforation and other injuries. Intraperitoneal bladder ruptures, for example, may go undiagnosed for days to weeks. It should be remembered that initial investigations may not show the typical signs of perforation (ultrasound, free peritoneal air, blood analyses).

Investigations

Players suspected of having suffered intraabdominal injuries should be referred for:

- Ultrasound examinations: these are very useful for a number of injuries, especially solid-organ injuries, which occur more frequently than hollow-organ injuries. They may also be useful for assessing the extent of haematomas and the progression of the injury in such cases.

– CT of the abdomen: at present, this is probably the imaging method of choice for patients with blunt abdominal trauma. Radiology for free air and peritoneal lavage are used less frequently nowadays, with less information available about the specificity and sensitivity of injury evaluation.

Field-side management

In the acute situation of an abdominal trauma, it is important to identify players at risk of sudden deterioration. If blunt abdominal trauma is associated with abdominal pain, the player should be given nil by mouth (that includes liquids). If the player collapses or has clinical peritonism, he should be placed in a recumbent position with his legs elevated (Trendelenburg position). **The sideline medical personnel need to be able to resuscitate players developing hypovolaemic shock appropriately and immediately.**

Return to play

Due to the wide range of injuries and the different management requirements for each of them, return-to-play considerations will need to be made on an individual basis. Some injuries, such as renal trauma, may only require relative rest from sporting activity. These players may begin playing again as soon as they are pain-free. Other injuries may require surgical management. Surgical opinion is recommended in most cases where significant injury has occurred.

Summary

Abdominal injuries

Significant abdominal injuries in football are rare. As such, a high index of suspicion and careful observation of the mechanisms of injury are required by the team physician and sideline medical personnel. It is important to identify players at risk of sudden deterioration. If the player collapses or has clinical peritonism, he should be placed in a recumbent position with his legs elevated. The sideline medical personnel need to be able to resuscitate players developing hypovolaemic shock appropriately and immediately.

REFERENCES

Canty TG Sr, Canty TG Jr, Brown C.
Injuries of the gastrointestinal tract from blunt trauma in children: a 12 –year experience at a designated pediatric trauma center. J Trauma. 1999 Feb;46(2):234-240.

Houshain S.
Traumatic duodenal rupture in a soccer player. Br J Sports Med. 2000;34:218-219.

Saartok T, Pettersson L, Karlbom A, Karlsson L.
Blunt abdominal trauma in soccer causing duodenal rupture: a case report and review. Scan J Med Sci Sports. 2007 Jan; 2(1):40-43.

3.2 Musculoskeletal injuries requiring emergency treatment

Football has a comparably high risk of injuries depending on the level of play and the characteristics of the players. In English professional football, approximately a quarter of players incur a severe injury each season. In general, a player might expect to suffer at least one training or match injury per season, often with time loss (period out of action). Matches carry a considerably higher risk of injury than training. Injuries in football affect mainly the lower extremity. With regard to prevention, exercise-based programmes go a long way to preventing non-contact injuries in football whereas contact and foul injuries require strict enforcement of the rules and education of players to adhere to fair play.

This chapter is not intended to provide an overview of musculoskeletal injuries, as these are comprehensively described in the F-MARC Football Medicine Manual, but only addresses severe injuries which require immediate action and emergency management on the pitch and the sidelines prior to further work-up by specialists at a hospital.

REFERENCES

Dvorak J, Junge A, Grimm K (eds).
Football Medicine Manual. Zurich: Fédération Internationale de Football Association; 2009.

Hawkins RD, Fuller CW.
A prospective epidemiological study of injuries in four English professional football clubs. Br J Sports Med. 1999 Jun;33(3):196-203.

Hawkins RD, Hulse MA, Wilkinson C, et al.
The association football medical research programme: an audit of injuries in professional football. Br J Sports Med 2001;35:43-7.

3.2.1 Fractures and dislocations

Fractures and dislocations are very rare and account for about 4% of all football injuries.

Mechanism of injury

Fractures are caused by two types of mechanisms:

1. Repetitive overloading resulting in a **stress fracture**
2. Sudden extrinsic overloading resulting in an **overt fracture**

Types of fractures and dislocations

Fractures are normally classified according to their anatomical configurations:

- **Transverse fracture** caused by direct force
- **Oblique fracture** caused by angular force
- **Spiral fracture** caused by rotational force
- **Compression fracture** caused by compression force
- **Avulsion fracture** caused by a traction force through a ligament or tendon

Dislocations occur as a result of sudden overloading of a joint area with the result that the normal joint architecture is deranged, with one bone end slipping out of the joint cavity. Dislocations are not common in football. If they do occur, it is mostly in the shoulder, especially in goalkeepers. Other joints can also be affected and may be in other in-field players. For example, anterior dislocation of the head of fibula on the tibia has been reported in football players. Another more likely dislocation is that affecting the elbow joint, which may occur in any of the players.

The mechanism of action in a dislocation is thought to be sudden overloading resulting in derangement of normal joint architecture with one bone end slipping out of a joint. This is mostly associated with traumatic contact injuries involving a fall on the affected limb in a compromised position. For example, in shoulder dislocation, a tackle and falling with the arm in an abducted and externally rotated position may result in overloading of the shoulder joint.

Recurrent dislocations may occur often with minimal force as a result of ligament laxity around the joint. This is also particularly common in shoulder dislocations and more frequent in male players under 20 years of age.
Possible and more common fractures and dislocations in football:

- Fracture base of 5th metatarsal (foot)
- Fracture tip of medial/lateral malleolus (foot)
- Metatarsal stress fractures (foot)
- Tibial stress fracture
- Tibia and fibula fractures
- Dislocation of head of fibula
- Pelvic stress fractures
- Shoulder dislocation
- Acromioclavicular dislocation/subluxation
- Clavicle fracture
- Elbow dislocation
- Fracture of olecranon

Signs and symptoms

Observation of the mechanism of injury by the team physician is an important part of assessment of any injury in football. Fractures and dislocations will almost always be associated with contact-type injuries.

Stress fractures are usually characterised by localised/regional pain that is worsened by more activity. Pain may have been present and gradually worsening with time. Local pressure or loading of the bone will worsen the pain.

Other overt fractures may be characterised by the following:

- Severe pain at the site of fracture
- Swelling
- Deformity in displaced fractures
- Inability to bear weight on the affected side
- Bruising over the fracture site

Dislocations may be characterised by the following:

- Sudden pain and inability to move the joint due to pain, recurrent/habitual dislocations may be painless
- A feeling of "popping out"
- Loss of sensation (e.g. a feeling of lameness in the arm with shoulder dislocations)
- Abnormal surface anatomy of the joint area – e.g. a concavity in the surrounding musculature or a palpable hard swelling (bone)

Field-side management of fractures and dislocations

Direct observation of the injury may give important clues about the possible diagnosis and consequently management.

Where an overt fracture is suspected, care must be taken by the team physician to ensure that the fracture site is secure and there is no further damage of surrounding

structures by broken bone ends. This can be achieved by splinting the fracture site. Before attempting any splinting or manual reduction, it is imperative to always assess the neurovascular status around and beyond the fracture site.

Recurrent dislocations are often easily relocated, sometimes by the player himself. Acute dislocations, however, should always be properly assessed for distal neurovascular complications before any manual relocation is attempted. It may often be difficult to manually reduce dislocations due to pain and muscle spasm. In this case the player must be given analgesia (usually intramuscularly) and transported to an appropriate healthcare facility where reduction might be achieved under anaesthesia in theatre if necessary.

Some serious injuries such as a knee dislocation may be limb-threatening, especially if associated with neurovascular injuries. Knee dislocations carry a high incidence of neurovascular complications. Approximately 29% to 40% of all knee dislocations are associated with arterial injury and 9% to 49% with nerve injury.

A limb with arterial compromise has a window of six hours from injury before irreversible tissue damage occurs. Therefore, it is important for the team physician to act swiftly and protect the player from any further damage.

Where there are neurovascular complications, the injured site must be safely secured and the player evacuated to hospital for further and more comprehensive evaluation. It may be necessary to administer some intramuscular analgesic where the player is in great pain.

Care must be taken with transportation of injured players off the pitch. No player with a suspected cervical vertebral fracture should be moved off the pitch before the neck is properly secured and the player logrolled onto a spinal board/scoop. Weight-bearing must be avoided in those fractures where players are unable to bear weight due to pain. This can be achieved by either using a stretcher, crutches or two people lending support to the injured player.

Further investigations

The standard investigation for fractures and dislocations is a plain X-Ray. This is also required in apparently stable acute dislocations to assess the possibility of a fracture. Other types of investigations include:

- Technetium bone scan (e.g. for stress fractures)
- CT scan (e.g. for stress fractures)
- MRI scan (e.g. assessing the neurological status in vertebral fractures)

Return to play guidelines

No player with a fracture or dislocation should be allowed to continue with play. With the exception of some with recurrent dislocations/sublaxations, all such players would need to be transported to hospital for further investigations and design of a definitive rehabilitation programme.

REFERENCES

Dvorak J, Junge A, Grimm K (eds).
F-MARC Football Medicine Manual. Zurich: Fédération Internationale de Football Association.

Keany JE, McKeever D.
Dislocation, elbow. Updated 2009 Apr 22. Cited on 2010 Jan 20. Available from: http://emedicine.medscape.com/article/823277-overview.

Meyers MH, Moore TM, Harvey JP.
Traumatic dislocation of the knee joint. J Bone Joint Surg Am. 1975;57:430-433.

Ogden JA.
Subluxation and Dislocation of the Proximal Tibiofibular Joint. J Bone Joint Surg Am. 1974;56:145-154.

Reeser JC.
Stress fracture. Updated 2009 Aug 10. Cited 2010 Jan 20. Available from: http://emedicine.medscape.com/article/309106-overview.

Sayegh FE, et al.
Reduction of acute anterior dislocations: a prospective randomized study comparing a new technique with the Hippocratic and Kocher methods. J Bone Joint Surg Am. 2009 Dec;91(12):2775-2782.

Torg JS, et al.
Fractures of the base of the fifth metatarsal distal to the tuberosity. J Bone Joint Surg Am. 1984; 66:209-214.

Wilson SR, Price DD.
Dislocation, Shoulder. Updated 2009 Dec 4. Cited 2010 Jan 20. Available from: http://emedicine.medscape.com/article/823843-overview.

Young JK.
Recurrent anterior dislocation of the shoulder. J Bone Joint Surg Am. 1913;s2(11):243-249.

3.2.2 Thigh muscle injuries

Muscle injuries, particularly to the thigh, constitute common injuries in football – up to 30% of all injuries in football are thigh muscle injuries.

Mechanism of injury, causes and risk factors

The mechanism of injury for quadriceps contusions is direct trauma (as in a direct blow with a knee). The quadcriceps muscles are more susceptible to direct blows (contusion injuries) because of their anterior and lateral location. Blows cause damage to the myofibrils, connective tissue and blood vessels, resulting in intra- or intermuscular bleeding. Intermuscular bleeds heal much quicker as compared to intramuscular bleeds. Injuries to the lower third of the thigh result in bleeding that may track down to the knee, causing patello-femoral joint irritation.

Hamstring strains occur mostly during sudden (maximal) sprinting or jumping and the actual mechanism is not clearly understood. The strain occurs at the myotendinous junction, anywhere along the belly of the muscle. Complete avulsions from the ischial tuberosity can also occur in rare cases.

Prominent risk factors for hamstring strains include:
- Previous history of a strain, especially in older players. This may result in reduced range of movement due to scar tissue formation.
- Muscle strength imbalances.

Other proposed risk factors include inadequate warm-up, poor flexibility, improper running technique and maximal speeds. However, there has been no clearly demonstrable cause and effect relationship.

Types of injury

- Muscle strains (mostly affecting hamstrings: 13-17% of all injuries at elite level)
- Muscle contusions (mostly affecting quadriceps: up to 16% of all injuries at elite level)
- Muscle cramps (mostly affecting hamstrings)

Signs and symptoms

Diagnosis of thigh muscle injuries is fairly easy and will often be obvious from mere observation and/or the player's history. There will either be a direct blow in the case of contusions or reduced sprinting performance and/or sudden stoppage of running in a strain. However, minor strains and contusions can sometimes be ignored by players and go unnoticed until they are reported to the team physician after the game.

Contusions may be characterised by:

- Localised bruising at the injury site
- Palpable hollow defect

Signs of a **strain** will be dependent on the grade of injury. See classification below.

Classification of hamstring strains

Grade I

Mild and involves a small number of muscle fibres
Localised pain, no loss of strength

Grade II

Significant number of muscle fibres damaged
Associated with pain and swelling
Pain worsened by muscle contraction
Reduced strength

Grade III

Complete tear of the muscle
Markedly reduced movement and strength
Palpable defect in avulsion injuries

It may sometimes be difficult to distinguish muscle strains from **muscle cramps.** However, the following features of muscle cramps might help in making the distinction:

- Muscle cramps usually occur towards the latter end of the second half of football matches.
- Fatigue is thought to be a major contributory factor for development of muscle cramps.
- Pain is usually diffuse and there is no swelling.
- Pain usually subsides with gentle sustained stretching.

Anterior compartment syndrome

Although very rare, acute anterior compartment syndrome of the thigh can follow a quadriceps strain. This is potentially a limb- and life-threatening condition and requires a high index of suspicion by the team physician. Prompt recognition and surgical intervention (fasciotomy) are critical in order to avoid permanent and irreversible ischaemic damage to the thigh muscles. The diagnosis should be suspected if the following clinical features are persistent:

- Pain out of proportion to the clinical situation
- Weakness and pain on passive stretching of the muscles of that compartment
- Hypaesthesia in the distribution of the nerves running through that compartment
- Tenseness of the fascial envelope surrounding the compartment

Figure 3.2.2.1 Field-side management of quadriceps contusion: PRICE therapy in maximal knee flexion

Field-side management of muscle injuries

The most accepted form of treatment of hamstring strains in the acute phase is protection, rest, ice, compression and elevation (PRICE). For minor contusions, it is useful for the team physician/physiotherapist to start cryotherapy (ice therapy) and compression as soon as he gets to the player and continue with it on the stretcher as the player is moved off the field. Pain resolution will often be within a very short space of time.

For more serious contusions and all strains, the player should ideally be withdrawn from the match to start a more definitive rehabilitation programme. In this case maximal compression with an ice pack should be started immediately. For quadriceps contusions, this must be maximal knee flexion as this increases compartment pressure and minimises intramuscular bleeding (see Figure 3.2.2.1).

It is also indispensable to closely monitor the player if any symptoms of compartment syndrome are present and that if persistent, the player should immediately be transported to hospital for immediate surgical intervention (fasciotomy).

Return to play

The most important decision to be made at the sideline is whether or not the player is fit to continue playing.

Players can only be allowed to continue playing if they satisfy the following criteria:

- Pain-free full range of motion
- No evidence of swelling or any defect
- Normal muscle strength and functional testing
- No possibility of worsening of the injury

Principles of further rehabilitation of more severe muscle injuries are:

- Control haemorrhage
- Restore and maintain pain-free range of motion
- Restore muscle strength
- Functional rehabilitation
- Gradual return to sport

It is important that there is adequate rehabilitation as complications of inadequate rehabilitation predispose a player to further injury, e.g. the re-injury rate for hamstring strains ranges between 12 and 31%. A complication of severe muscle contusions that are inadequately rehabilitated is myositis ossificans (calcification of a haematoma).

Summary

Thigh muscle injuries in football

The most accepted form of treatment of hamstring strains in the acute phase is protection, rest, ice, compression and elevation (PRICE). Acute anterior compartment syndrome of the thigh can rarely follow a quadriceps strain and requires a high index of suspicion by the team physician. As a potentially limb- and life-threatening condition, prompt recognition and surgical intervention (fasciotomy) are critical in order to avoid permanent and irreversible ischaemic damage to the thigh muscles.

REFERENCES

Burns BJ, Sproule J, Smyth H.
Acute compartment syndrome of the anterior thigh following quadriceps strain in a footballer. Case report. Br J Sports Med. 2004;38:218-220 doi:10.1136/bjsm.2003.004762.

DeBerardino TM, Milne L.
Quadriceps Injury. Updated 2010 Jan 19. Cited 2010 Jan 20. Available from: http://emedicine.medscape.com/article/91473-overview.

Dvorak J, Junge A, Grimm K (eds).
Thigh muscle injuries. In: Football medicine manual. Zurich: Fédération Internationale de Football Association; 2009.

Petersen J, Holmich P.
Evidence based prevention of hamstring injuries in sports. Br J Sports Med. 2005;39:319–323. doi: 10.1136/bjsm.2005.018549

Ruiz HB, Zaffer SM.
Hamstring Injury. Updated 2008 Jun 16. Cited 2010 Jan 20. Available from: http://emedicine.medscape.com/article/90881-overview.

Woods C et al.
The Football Association Medical Research Programme: an audit of injuries in professional football–analysis of hamstring injuries. Br J Sports Med. 2004;38:36–41. doi: 10.1136/bjsm.2002.002352.

3.2.3 Severe knee injuries

Knee injuries are second only to ankle injuries as the most common injuries in football. There is ample evidence that previous injury is a risk factor for re-injury, as it is for most musculoskeletal injuries. Therefore, it is important that a pre-competition medical assessment of the player is performed to identify and proactively manage biomechanical and previous injuries in order to prevent new injuries. However, there is also ample evidence that prevention of non-contact injuries, particularly ACL injuries, is possible by implementing exercise-based warm-up programmes such as F-MARC's "The 11+", and this is of course encouraged. This comprehensive programme includes warm-up and warm-down exercises, as well as specific preventive exercises for core stabilisation, eccentric strength, neuromuscular control, agility and plyometrics. Rule enforcement and fair play, which may reduce unlawful and severe tackles, contribute to prevention of contact injuries and those caused by fouls. This chapter will concentrate on severe, acute injuries to the knee that require immediate pitch-side management to prevent further damage.

Mechanism of injury

1. Intrinsic forces: acceleration, deceleration, twisting, turning
2. Extrinsic forces: tackles that hit the lateral or medial side of the knee

Types of injury

It is possible to distinguish between the following types of injury, although severe knee injuries consist mostly of a combination of these:

- Ligament injuries
- Meniscus injuries
- Articular cartilage injuries
- Fractures

Signs and symptoms

On-field assessment of knee injuries consists firstly of observing the injury mechanism, finding out about the player's medical history and conducting a clinical examination:

- Look, feel, move
- Swelling, bruising, deformity
- Range of motion (ROM)
- Joint line tenderness
- Specific structure assessment
- Special tests (see below)

Anterior cruciate ligament (ACL)

Mechanism of injury

Intrinsic forces

- Twisting force in internal rotation or hyperextension
- External rotation and valgus with foot fixed

Extrinsic forces

- Tackle
- Impact on medial side of foot – two players kicking the ball at the same time

Types of injury

ACL injuries are isolated in 20-30% of cases. They occur in combination with meniscus injuries in 50% of cases. ACL injuries may also be combined with medial collateral ligament, lateral collateral ligament, posterior cruciate ligament or articular cartilage injury .

Signs and symptoms

- History of rotation, acceleration/deceleration or trauma
- Swelling immediate or within hours – degree of which may vary
- A giving way of the knee/feeling of instability
- Anterior drawer test positive (not very sensitive or specific): soft end point
- Lachmann test positive; pivot shift test positive.

Posterior cruciate ligament (PCL)

These comprise 5-10% of all major knee ligament injuries. There may be an avulsion of the tibial or femoral insertion, or an intra-ligament substance tear. PCL injuries may be combined with injuries to the medial collateral ligament, lateral collateral ligament, anterior cruciate ligament, articular cartilage and meniscus.

Mechanism of injury

Intrinsic forces

- Fall on flexed knee
- Hyperextension

Extrinsic forces

- Impact on anterior proximal tibia – tackle from front

Signs and symptoms

- History of rotation, acceleration/deceleration or trauma
- Swelling immediate or within hours – degree of which may vary
- A giving way of the knee/feeling of instability
- Posterior drawer test positive (not very sensitive or specific): soft end point
- Reverse pivot shift test positive

Field-side management of ACL and PCL injuries

The player may be assessed on the pitch if required. If an ACL/PCL injury is suspected, the player should be removed from the field of play. A more detailed evaluation can be made and if that confirms the suspected ACL/PCL injury, the approach is to protect the player from further injury. That is to avoid any potential twisting, hyperflexion or hyperextension (which, in clinical terms, may be limited at this stage). The player will often hold the knee in a slightly flexed position, which may be most comfortable, and this can be facilitated by using something under the knee while the player is supine. Applying ice/cold compression in whatever form is available (ice packs, Cryocuffs, cold packs, etc.) will alleviate the swelling and the pain. If a protective brace is available, this should be used. The player should avoid bearing weight. He should use crutches and be referred for X-rays to exclude bone injury, and possibly MRI in complex cases with multiple injuries, and to a specialist orthopaedic surgeon for further evaluation and treatment.

Meniscus injuries

Mechanism of injury

Intrinsic forces	Extrinsic forces
– Twisting or cutting	– Tackle to side of knee
– Rotation of the knee	
– Hyperextension/hyperflexion	

Signs and symptoms

- History of distortion by body contact or by twisting
- Medial or lateral joint pain with medial or lateral joint line tenderness
- Pain on hyperextension or hyperflexion, external rotation (medial) or internal rotation (lateral)
- Joint effusion

Cartilage injuries

These occur in 40-70% of ACL injuries and 40% of patients with meniscus injuries are reported to have associated cartilage injuries

Mechanism of injury

- Distortion, dislocation or contusion, often in combination with ligament injuries
- Intra-articular fractures – sequelae of premature arthritis development
- Overuse/overload injury – may present with acute pain during play

Signs and symptoms

- History of previous ligament injury
- Pain and swelling on or after activity
- Crepitus, catching or locking
- Malalignment of patella

Field-side management

Local application of ice for pain and swelling. The knee should be protected by splinting and avoiding aggravating movements, and the player referred for further evaluation and management by an orthopaedic surgeon.

Acute patella dislocation

Acute patella dislocation may be traumatic, in which case there will usually be more severe tissue damage, or related to ligament laxity, misalignment and biomechanical factors (more common in females, recurrent/habitual subluxation and luxation).

- Most commonly with medial patellofemoral ligament tearing
- Concomitant posterior patella cartilage injury – chondral or osteochondral
- Effusion and haemarthrosis are common signs (different from other patellofemoral conditions).

Field-side management

If the patella is found to be dislocated, it may be reduced by extending and straightening the leg. If it is still dislocated and the knee is extended, then one finger pressure may reduce it, but if not, it should under no circumstances be forced. If the attending physician is uncertain, it may be best not to attempt a reduction and to transport the player to hospital. The knee should be protected from further movement and if possible

splinted. Unless this aggravates the symptoms in an unreduced dislocation, ice should be applied for the swelling and pain. The player will need to be referred for radiological evaluation to assess bony injury and further management by an orthopaedic surgeon. If the patella subluxates, or spontaneously reduces, the urgency may appear less, however the player should be referred for radiology to exclude bony injury.

Further treatment may require arthroscopic surgery in an acute injury, or arthrotomy with re-alignment surgery and/or medial patellofemoral ligament reconstruction in habitual luxation.

Knee dislocation

- **Acute knee dislocation is a medical emergency!**
- There is not only significant and severe injury to ligaments, cartilage and possibly bone, but the neurovascular bundles around the knee are at a high risk of injury.
- Such vascular injury may lead to a limb-threatening situation, where if surgical repair is not performed within a few hours, the limb may be lost and require amputation.
- The diagnosis may be easy to make, with gross deformity and severe laxity in varus, valgus and antero-posteriorly. There are cases where there is spontaneous reduction, and the deformity may no longer be obvious upon examination. However, the structural damage will still be there. It is therefore important to ask the player if he has noticed this. One should not be tempted to vigorously assess this in clinical terms, as this may compromise tissues, especially the neurovascular structures.
- Popliteal artery injury may cause a cold and pulseless limb, hence the pulses are very important to assess. It must be noted, however, that an intimal injury of the artery may still result in a vascular-related threat, but not cause pulselessness. The pulse may be reduced as compared to the other limb.

Field-side management

The knee should be splinted in the most comfortable position, which is often in extension. Immediate transport to the closest appropriate medical facility is required.

Sideline evaluation of knee injury

A quick evaluation of whether a player can continue to play or needs to be removed can be made by assessing the likelihood of major injury – namely knee dislocation, complex ligament and combination injuries, and meniscal injury.

The player should be removed from play and further evaluated if:

1. There is gross ligament instability (medial, lateral, multidirectional).
2. There is immediate swelling/effusion.
3. There is medial or lateral joint line tenderness.
4. The McMurray test is positive.
5. The pivot shift or reverse pivot shift tests are positive.
6. The player is unable to walk unaided due to pain or instability.

If none of the above are present, the player can be strapped for protection and allowed to continue, but should be observed and advised to come off if any of the above occur.

Return to play

The return-to-play criteria for knee injuries are simple: a player is not to return to play if there is an effusion, ligament instability or positive patella apprehension.

Summary

Severe knee injuries

Knee injuries are frequent and, for the most part, field-side treatment involves local application of ice, compression for pain and swelling, protection by splinting and avoiding aggravating movements prior to referral for further evaluation and management in a hospital. Knee dislocation, though extremely rare, is a medical emergency. The knee should be splinted in the most comfortable position, which is often in extension, and the player immediately transported to the closest appropriate medical facility.

REFERENCES

Azubuike SO, Okojie OH.
An epidemiological study of football (soccer) injuries in Benin City, Nigeria. BR J Sports Med. 2009 May;43(5):382-386.

Ballas ER, Stillman CA.
Anterior cruciate ligament injury and bucket handle tear of the medial meniscus. J Orthop Sports Phys Ther. 2009 Oct; 39(10):766.

Dvorak J, Junge A, Grimm K (eds).
Knee injuries. In: Football Medicine Manual. Zurich: Fédération Internationale de Football Association; 2009.

Engstrom B, Forssblad M, Johansson C, Tornkvist H.
Does a major knee injury definitely sideline an elite soccer player? Am J Sports Med. 1990 Jan;18(1):101-105.

Hägglund M, Walden M, Atroshi I.
Preventing knee injuries in adolescent female football players – design of a cluster randomized controlled trial. BMC Musculoskelet Disord. 2009 Jun;23(10):75.

Holmes CA, Bach BR.
Knee dislocation: immediate and definitive care. Phys and Sportsmed. 1995 Nov;23(11):69-82.

Junge A, Grimm K, Feddermann N, Dvorak J.
Pre-competition orthopaedic assessment of international elite football players. Clin J Sport Med. 2009 Jul;19(4):326-328.

Nielsen AB, Yde J.
Epidemiology and traumatology of injuries in soccer. Am J Sports Med. 1989 Dec;17(6):803-807.

Rochcongar P, Laboute E, Jan J, Carling C.
Ruptures of the anterior cruciate ligament in soccer. Int J Sports Med. 2009 May;30(5):372-378.

Soligard T, Myklebust G, Steffen K, et al.
Comprehensive warm-up programme to prevent injuries in young female footballers: a cluster randomized controlled trial. BMJ. 2008 Dec;9:337:a2469. doi: 10.1136/bmj.a2469

3.3 Facial injuries

Facial injuries usually occur when there is contact with either the ball or with another player. While not necessarily particularly frequent or relevant with regard to a player's career, they do nevertheless play an important role in so far as many facial injuries have to be treated as medical emergencies. At the outset it is important to have an appreciation of the facial anatomy when considering medical management of such injuries. Some injuries may be managed at the field-side with the slightly injured player returning to play, whereas other more severe facial injuries may need to be initially examined and treated in the player medical room (if available) and then referred for specialist treatment.

As opposed to other types of injuries, facial injury management must consider not only form and function but also the resulting aesthetics, in order not to leave the player patient with any unsightly scars or deformities. This chapter provides an overview of this complex topic, describing first clinical conditions typically occurring in the face and examination methods of the different facial parts prior to briefly describing the signs and symptoms and the assessment of facial injuries requiring emergency management.

Universal precautions

Because of the marked vascularity of the face, many facial injuries involve blood and other secretions. Although the risk of disease transmission from contacting blood with intact skin is minimal, universal precautions must be followed whenever appropriate. When contact with blood or body fluids is likely, gloves and eyewear represent standard protective equipment and should be used. Wherever possible, healthcare personnel who are treating injured players should attempt to establish a clean area (which may be in a player medical room, first aid room or equivalent area) where they can perform their assessment and offer treatment, as the football sports environment may easily be contaminated.

3.3.1 Facial injuries in general

Symptoms and signs

- The player may suffer from pain, swelling, bleeding, disturbed vision or avulsed teeth
- Airway obstruction
- Concussion
- Bleeding that may be significant

Players with facial injuries are usually lucid and are able to maintain and protect their airways. However, if there are features of head and neck injury, the potential for airway obstruction may exist. Therefore the ABCD of airway, breathing, circulation and disability (neurological) must be immediately assessed.

Field-side emergency management in general

1. Control bleeding with digital pressure. Extensive arterial haemorrhage from facial wounds usually results from injury to the maxillary artery, the superficial temporal artery, or the angular artery. Direct digital pressure is usually enough for initial haemostasis, followed by ligation of the bleeding vessel through the wound (if practically safe to do so). If there is no clear source of bleeding, the airway should be protected, a compressive facial dressing applied, and the player transferred to hospital for further evaluation and management.
2. Stabilise suspected fractures and refer player to hospital.
3. Neurological assessment, follow standard concussion guidelines if appropriate clinically.
4. Lacerations may be sutured if no obvious displaced tooth fragments are present. If tooth fragments embedded in oral mucosa are detected during wound care, refer to hospital.

Return to play

Fractures and severe concussions take priority over dental trauma and require immediate transport to hospital.

3.3.2 Clinical conditions

Contusions and abrasions

Contusions represent injuries of the soft tissue layers between the underlying skeleton of the face and the overlying skin. They are associated with varying degrees of tenderness, swelling and bruising. Keeping the head elevated and applying ice to the affected area for 15-20 minutes is the mainstay of treatment for facial contusions and the usual excessive bleeding encountered. Abrasions imply that there is partial-thickness loss of skin which is caused by shearing forces between the epidermal and dermal layers. Initial wound care would include cleaning with dilute antiseptic or antibacterial soap, followed by a topical antibiotic ointment.

Lacerations

- Lacerations are the most common type of facial injury encountered in a football setting. When blunt trauma occurs over a bony prominence of the facial skeleton, a linear or stellate laceration can result. A stellate laceration is a burst-type wound with jagged skin edges where repair and good aesthetic outcomes are more challenging.
- Due to abundant blood supply, bleeding from a facial laceration may be copious. Immediate management is to try and achieve haemostasis by applying direct digital pressure over the involved area with a sterile gauze pad.
- An assessment is made as to whether the injury requires suturing. If suturing is not required, applying a local moisture repellant ointment, e.g. petroleum jelly, and an appropriate dressing may allow the player to return to play.
- Once haemostasis is obtained, underlying structures can be better visualised and should be examined carefully. Facial lacerations may be adequately cleaned with sterile saline, and can be done using a syringe via an 18-gauge needle attached to a 20mL syringe. This is sufficient to remove bacteria and other debris from the wound.
- After cleaning, superficial lacerations without separation of the wound edges may be closed using adhesive bandages, e.g. sterile adhesive strips. Players with deeper lacerations with separated or jagged wound edges should be referred to hospital for precise alignment and suturing.
- Intraoral lacerations are treated similarly to skin lacerations. After thorough irrigation, re-approximate and suture the intraoral mucosa using absorbable suture material. To avoid delayed healing and excessive scar tissue, always attempt to primarily repair mucosal lacerations, including those of the tongue whenever practically possible, or refer the player to hospital for precise suturing.
- Determine the tetanus immunisation status of the player, and if necessary administer inactivated tetanus toxoid (0.5mL) subcutaneously. For players who wish to return to play with a repaired laceration, an adhesive and adequately padded bandage should be applied to prevent wound disruption.

Nasal bleeding

Most cases of simple epistaxis involve disruption of the Kiesselbach plexus in the anterior chamber of the nose. This is usually quickly and effectively controlled with direct pressure by pinching the nares together for a few minutes. Should this not stop the bleeding within 10-15 minutes, gauze packing may be necessary. Any nasal bleeding that cannot be controlled with simple direct pressure or gauze packing should be referred to hospital for further management.

Haematomas

These are collections of blood within the muscle, fascial, and dermal layers, which are generally present over the zygomatic and periorbital regions. These generally resolve with the application of ice and compression.

Auricular and nasal septal haematomas deserve specific attention because of their potential for perichondral injury and subsequent necrosis. A nasal septal haematoma appears as a purple, grapelike swelling on the nasal septum. The player should be referred to hospital for incision and drainage of these lesions.

3.3.3 Clinical examination

Examination of the upper face

This will evaluate the frontal branch of the facial nerve and the stability of the supraorbital rims. To test nervous innervations, ask the player to raise their eyebrows (assesses facial nerve and frontalis muscle) and assess light touch sensation of the forehead (assesses ophthalmic division of trigeminal nerve). The supraorbital rims are gently palpated for tenderness, pain, crepitus, or a step-off deformity.

Lacerations and haematomas of the scalp may indicate an underlying skull fracture.

Examination of the middle third of the face

This area of the face includes the eyes, the nose, the zygomatic bones and the maxillae. Examination of the eyes is important because injuries such as a hyphaema, ruptured globe, or intraocular haematoma are medical emergencies and require immediate hospital referral. Ask the player to read a scoreboard or appropriate signage and thereby assess the player's visual integrity. Orbital floor fractures present with double vision when the player is asked to look upwards. The ability to close the eyes tightly tests a functioning facial nerve and orbicularis oculi muscles. Test the presence of a full range of movement of the extraocular muscles by asking the player to follow your finger and move in quadrants. When undertaking the pupillary light reflex to assess ophthalmic neurological function, take the opportunity to look at the eye for any foreign material, corneal scratches, bleeding and the position of the eye, all of which may manifest with orbital fractures. Retinal detachment may also occur with trauma to the face in this area.

The infraorbital area is palpated for pain, crepitus and to ensure there is no abnormal bony movement. Gentle pressure on the eye (with eyelids closed) may reveal a very tense or soft globe, indicating either increased pressure or a rupture respectively.

Fractures of the zygomatic arch make the face appear wider than normal and the arch itself not well defined. It is useful to look cranially from the chin up to assess this anatomical feature. Asking the player to bite can assess deformity associated with mandibular fracture, and also pain that may be elicited.

Examination of the lower third of the face

The lips, tongue and cheeks are susceptible to lacerations from compression injuries, as well as injury to the underlying teeth. Lacerations involving the vermillion border of the lip must be carefully reconstructed if sutured on site or referred to hospital for definitive suturing to prevent scarring and deformity.

Instructing the player to smile broadly will assess the facial nerve branches in this area.

3.3.4 Dental injuries

These are often accompanied by lip lacerations, so bleeding around the mouth could result from either or both sources and must be examined for.

Tooth avulsion

Avulsion is the complete separation of the tooth from its socket. The tooth is knocked out of its socket and there is associated pain. This requires a sense of urgency, as the longer it takes to re-implant, the less successful the outcome.

If any teeth are missing, the healthcare provider should try, if possible, to find them. It is possible for traumatically extracted teeth to be embedded in the lips or tongue. Loose teeth may potentially result in airway obstruction if traumatically extracted or be inhaled into the lungs. If inhalation is suspected, the player should be referred for immediate radiological investigation. Swallowed teeth are of no major significance clinically. The injured teeth may have fractures of the crown or root, or they may be luxated or avulsed. Dentoalveolar fractures are considered open fractures. These wounds must be rinsed with saline or water and referred for dental care.

Field-side emergency management

1. Find the missing tooth if at all possible.
2. Control bleeding if present.
3. Rinse the tooth with sterile or clean water.
4. Do not scrub tooth or handle by the root.
5. The primary goal is to replace the tooth immediately into the alveolar socket if no fracture is present.
6. Do not replace primary ("baby") teeth, as this may affect the future growth of the permanent teeth.
7. Press tooth firmly back into the socket, but make certain that the tooth is correctly positioned.
8. Ensure proper positioning; the provider should feel a palpable click when the tooth is properly seated.
9. If successful on-field implantation occurs, the tooth must be temporarily splinted to the adjacent stable teeth, or between the cheek and gums, and player referred to a dentist. If the player cannot hold his tooth this way, it could be placed in fresh cold milk, sterile saline, or cool tap water and transported that way.
10. Splints may be makeshift, such as by using mouth guards or sugar-free gum.

11. Avulsions require immediate dental consultation, and if on-field re-implantation is unsuccessful, transport the player and tooth to a qualified provider or dentist for re-implantation within 30 minutes to two hours; after two hours the tooth has a low likelihood of survival or successful re-implantation

Return to play

Immediate return to play is generally not recommended.

Crown injury

These are fractures. The exposed dentin has a yellow hue, and the presence of a pink dot or bleeding in the centre of tooth implies pulp involvement. Pain may occur with or without sensitivity to cold water and air.

Field-side emergency management

1. Recover fragments.
2. Handle only by enamel surface.
3. Control bleeding.
4. Rinse tooth gently with sterile saline or clean water. If dirty, transport the fragments in saline soaked sterile gauze, and refer for dental care.

Return to play

The player may return immediately if bleeding is controlled and he has a properly fitting mouth guard; refer for dental care after the match.

Root injury

The tooth may or may not be loose; can be painless, very painful, or numb.

Field-side emergency management

The tooth should be secured to adjacent teeth with an improvised splint, such as a mouth guard, dental wire, or sugar-free gum. Refer for dental care.

Return to play

Immediate return to play is not recommended; eventual return to play should be determined by a dental provider.

Tooth luxation

This is displacement of a tooth, which occurs when the tooth is malpositioned in its bone socket. This implies damage to the periodontal ligaments and underlying neurovascular structures.

Field-side emergency management

1. Determine the number of teeth affected and the stability of the row of teeth.
2. Gently reposition tooth/teeth into original position with a dry, gloved hand.
3. If repositioning is too painful or not possible, refer the player for dental care.

Return to play

If the player has a custom mouth guard, immediate return to play may be considered. Return to play is not recommended for players without custom mouth guards or if severe alveolar injury is suspected they should be referred for dental care.

Alveolar fracture

Pain is likely. Detected with careful palpation of sockets and gum line.

Field-side emergency management

1. If fracture is suspected, do not replace an avulsed tooth.
2. Do not attempt to reduce displaced alveolar fragments on the field.
3. Refer for dental care immediately.

Return to play

Immediate return to play is not recommended.

3.3.5 Facial fractures

If a diagnosis of a facial fracture is made clinically, the player should be removed from the field of play, neurologically assessed and referred to hospital for further evaluation. Bleeding, facial asymmetry, abnormal extraocular eye movement, abnormal bite alignment and, in case of concomitant concussion, altered mental status may occur.

Nasal fractures

Nasal fractures account for 50% of all facial fractures. They should be referred to hospital after the match for evaluation and treatment.

Signs and symptoms

Diagnosis of a nasal fracture can be made at the field-side clinically. There is usually epistaxis, swelling and tenderness

of the bridge of the nose. There may be visible deformity, but this may be obstructed by swelling. There may be periorbital bruising that develops over minutes to hours. Palpation can reveal increased movement with pain, palpable deformity and crepitus. If there is difficulty with airflow on inspiration, one should suspect a nasal/septal fracture or dislocation.

Field-side emergency management
The above-mentioned approach to bleeding and swelling applies, with cold application and possibly compression. Fractures need to be referred to hospital for management.

Orbital fractures

A travelling ball or player's elbow making contact with the face over the orbital region will be too wide to cause direct injury to the eye. However, the structures surrounding the eye may be injured if these forces are severe enough, as may the eye be injured indirectly.

Signs and symptoms
Orbital fractures may present with bruising, enophthalmos (sunken eye), inability to "look up to the ceiling/sky" and numbness over the cheek on the same side as the fracture.

There may also be diplopia (double vision) when attempting to look upward.

Field-side emergency management
Refer to hospital for further evaluation and management.

Zygomatic and maxillary fractures

These fractures involve the cheekbones. Direct force in this area may lead to fracture of this bony complex.

Signs and symptoms
The cheekbone may be depressed with bruising around the eye, there may be cheek numbness, enophthalmos, and the eye may be deviated downwards.

Field-side emergency management
Refer for hospital evaluation and management.

Mandible fractures

The mandible, which is arched in shape, is narrow at its angles, at the neck of the condyles, and at the distal portion. As a result, it is often fractured in several areas when traumatically injured.

The tongue is attached to the lingual surface of the mandible anteriorly. If this area is fractured and posteriorly displaced, life-threatening airway obstruction may occur.

Signs and symptoms
Mandibular injuries often present with pain over the fracture site and numbness of the mandible and teeth. If the player cannot oppose the upper and lower teeth adequately, a temporomandibular joint dislocation or fracture is likely. Malocclusion and trismus (jaw held tight by muscle spasm) may cause consequent difficulty in opening the mouth. It should be noted that a sublingual (below the tongue) ecchymosis/bruising is pathognomic (specifically diagnostic) of a mandibular fracture.

Field-side emergency management
A life-saving manoeuvre in a situation with airway obstruction by the tongue would be to pull the tongue or anterior jaw forward. In this situation, emergency evacuation to hospital is required, maintaining the airway en route. Spine immobilisation is also indicated in this situation due to the likelihood of a concomitant cervical spine fracture. In general, players suspected of having a mandibular fracture should be referred for hospital evaluation and management.

3.3.6 Ear injuries

The external ears are prone to developing haematomas if traumatically compressed. Due to the closed space, if a haematoma is not drained, it will result in a deformity often referred to as "cauliflower ear". With ear injuries, hearing may be difficult to assess at the field-side, but should be evaluated clinically at least when the opportunity arises. An otoscopic examination should be performed to look for blood, cerebrospinal fluid, canal laceration, or tympanic membrane perforation. Any fluid in the ear canal or behind the ear drum may indicate an underlying base of skull fracture. Refer for hospital evaluation if the above are present.

3.3.7 Eye injury

- Any eye injury must be regarded as a medical emergency and referred for immediate ophthalmological management.
- When using an eye shield, do not put pressure on the eyeball.

– If an eye shield is unavailable, use the bottom half of a styrofoam or plastic cup.
– Keep the player in the sitting position.
– Try and keep the player calm to avoid any Valsalva manoeuvre, which would increase intraorbital pressure.
– Before referral, keep the player nil by mouth as they may have to have surgery.
– In chemical injury, irrigate the affected eye with copious volumes of water or normal saline in a syringe or run under a tap holding the eyelids open. If possible, try to irrigate from medial to lateral.

Alert: facial injuries that require immediate referral to a specialist physician

1. All eye injuries or associated with acute medical conditions (such as airway obstruction).
2. All fractures that require radiological investigation, reduction and fixation (and maintain nil by mouth).
3. Any distortions of the facial skeleton.
4. Any neurological symptom or sign post-injury, e.g. loss of normal sensation, motor function, diminished reflexes.
5. If you have any doubts about any injury with regards to severity or nature.

REFERENCES

Burke MJ, Sanitato JJ, Vinger PF, Raymond LA, Kulwin DR.
Soccerball-induced eye injuries. JAMA. 1983 May 20;249(19):2682-2685.

Camp JH.
Diagnosis and management of sports-related injuries to the teeth. Dent Clin North Am. 1991 Oct; 35(4):733-756.

Cerulli G, Carboni A, Mercurio A, et al.
Soccer-related craniomaxillofacial injuries. J Craniofac Surg 2002;13:627-630.

Delilbasi C, Yamazawa M, Nomura K, Iida S, Kogo M.
Maxillofacial fractures sustained during sports played with a ball. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2004;97:23–27.

Fasalo AO, Obiechina AE, Arotiba JT.
Sports related maxillofacial fractures in 77 Nigerian patients. Afr J Med Sci. 2000; Sep-Dec; 29(3-4):215-217.

Ranali DN.
Dental injuries in sports. Curr Sports Med Rep. 2005; Feb; 4(1):12-17.

Reehal P.
Facial Injury in sport. Curr Sports Med Rep. 2010; Jan-Feb; 9(1):27-34.

Shriniwas SL, Senqupta D, Lal S.
HIV Infection control in health care settings. J Indian Med Assoc. 1994 Jan;92(1):33-6.

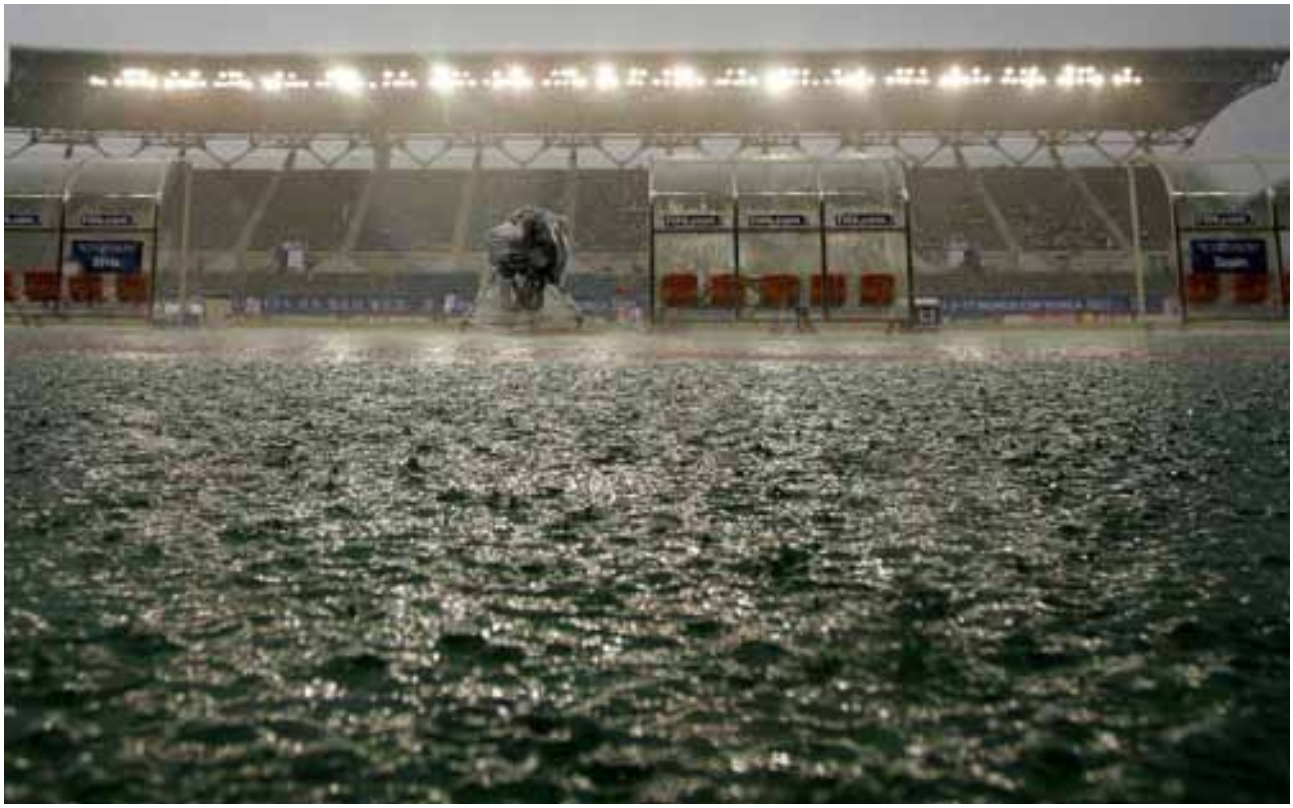
Vinger PF, Capão F.
The mechanism and prevention of soccer eye injuries. Br J Ophtalmol. 2004 Feb;88(2):167-168.

4. Environmental factors

In this context environmental factors does not refer to "going green", but to the playing environment that may have an effect on the player and the football team. FIFA consists of 208 member associations all around the world, all of whom organise football competitions. Because of the geographic locations, the visiting national teams are confronted with playing not only at different altitude, but also under different environmental conditions such as heat, cold and different relative humidity as compared with their home country.

Thus, these are issues related to:

- Weather: heat; cold; humidity; rain; wind; lightning
- Altitude
- Pollution
- Aeroallergens



4.1 Heat

With today's international match schedule, travelling teams and staff might be exposed to hot and tropical climates they are not used to. Protection of the travelling party is an important consideration for team and event physicians alike. Particularly with high humidity, risk may be increased due to the reduced effects of sweating. Wet bulb globe temperature (WBGT) should be used to assess environmental heat stress as it considers wind, humidity and solar radiation.

Exercise in hot ambient temperatures

During exercise, body core temperature rises with maximal oxygen uptake and may exceed 40°C. In hot temperatures, an increasing fraction of cardiac output is directed to the skin to ensure heat exchange, thereby limiting performance.

In football, the intermittent character of the effort, with short bouts of sprinting and running in between periods of walking, limits energy expenditure and allows players to adjust their speed according to the thermal load. However, modern football playing is more athletic and therefore energy expenditure may increase compared to previously recorded levels. Also, stadiums impose a higher risk on players because the playing field is shielded from winds, walls may reflect radiation and there is additional thermal radiation from heated walls.

Risk factors to consider:

- Being unacclimatised
- Being unfit
- Hypohydration
- Use of a variety of medications that may influence thermoregulation (anticholinergic drugs, sympathomimetics)
- Certain medical conditions (e.g. thyroid disease, multiple sclerosis, Parkinson's disease)

Prevention of impairment and illness due to heat

- Avoid dehydration. Adequate fluid supply is key to heat tolerance.
- Drinking carbohydrate and electrolyte fluids may be beneficial in avoiding heat trauma. No hypertonic fluids.
- Wearing light breathable clothing is advised.
- Warning flags could be posted on the field as follows:
  - green – proceed with caution, heat stress possible
  - amber – moderate risk of heat stress
  - red – high risk of potential heat stress
  - Should be posted at locations easily seen by participants, support staff, medical staff and spectators.

Signs and symptoms

Players suffering from heat exhaustion and/or dehydration who are at risk of more severe heat disease may show the following signs:

- Flushed face
- Hyperventilation
- Headache
- Dizziness
- Tingling arms
- Goose bumps
- Feeling of chilliness
- Incoordination
- Confusion, agitation, uncooperativeness

Ambient dry temperature	WBGT	Risk of thermal injury
25° – 31.9°C (77 – 89.4°F)	24.0 – 29.3°C (75 – 85°F)	Moderate
32° – 38°C (89.6 – 100°F)	29.4 – 32.1°C (85 – 89.9°F)	High
38°C and above (>100°F)	32.2°C and above (> 90°F)	Extreme

Table 4.1.1: Risk evaluation related to ambient temperature or wet bulb globe temperature (WBGT)

Acute severe dehydration (hypovolaemia)

Signs and symptoms

Confirm the diagnosis if possible by taking into account the clinical picture: reduced blood pressure, vasoconstriction or dilation if very hot, weak and thready pulse.

Field-side management

Remove player from play. If possible, oral fluids should be attempted rather than using intravenous fluids. A 6 to 8% carbohydrate-electrolyte solution, which may be hypotonic or isotonic, can be used.

Return to play

Dehydration may lead to heat exhaustion. With dehydration in a hot environment, the player should rest in the shade. The need for hospital admission is absolute if circulation cannot be stabilised. Assessment of cardiac output and serum sodium will only be possible at the hospital.

Heatstroke is a medical emergency

Severe dehydration may lead to heatstroke. It is due to the failure of the heat-controlling mechanism and occurs with body temperatures above 40°C. There probably exists a genetic predisposition to develop heatstroke when exposed to certain environmental conditions. Core temperature may be over 42°C. Damage to critical organs can occur if organs remain overheated for extended periods of time – hence the need for rapid cooling. If rapid cooling does not occur, cellular damage to organs could be extreme. Any delay in cooling therefore increases the risk of a fatal outcome.

Signs and symptoms

Dry and hot skin as the sweating mechanism has failed.

- Mental confusion to delirium
- Headache
- Incoordination
- Collapse
- Convulsions

Field-side management

- Immediately cool the player by whatever means possible, but be careful to avoid inducing hypothermia (rectal lags behind core temperature).
  - Ice bath (holding head out of bath). Large plastic bins may be used.
  - Ice packs over as much of the body as possible
  - Cool shower if assisted and under supervision
  - Cool, wet towels
  - Water spray (with fan)
- One can attempt to administer oral fluids, but be aware that nausea and vomiting are extremely common. When administering an IV infusion with 0.5-0.9% saline, one must consider impaired cardiac function in heatstroke with the risk of inducing pulmonary oedema.

Return to play

With immediate and adequate cooling, a player will recover rapidly within less than one hour. The need for observation at the nearest hospital depends on the individual situation. Hospital admission is mandatory for any player who shows increasing rectal temperature after cooling, who does not regain consciousness within half an hour of normal rectal temperature, whose circulation cannot be stabilised and who shows signs of cardiogenic shock.

Role of the event physician

In hot climates, the event physician should ensure adequate infrastructure and set-up for accommodating travelling teams, particularly those not acclimatised.

- Rescue and first aid teams should be trained in diagnosis and treatment of temperature-related illnesses and problems.
- Facilities for intravenous infusion and intravenous fluids (e.g. Ringer Lactate solution) have to be available at the player medical centre.
- Training fields should be closed for training (usually during the hottest time of the day; 11.00am – 3.00pm), when dry air temperatures exceed 38°C (>100°F).
- Provide sun-protected rest areas in buildings, tents, or natural shade.
- Cool and/or air-conditioned rooms should be available at outside temperatures greater than 32°C.
- Fans to enhance air movement in rooms and resting areas are recommended when room temperatures exceed 22°C. Room temperatures should not exceed 25°C.
- At ambient dry air temperatures greater than 32°C (89.6°F), the room facilities of the medical centre should be air-conditioned.
- For cooling, crushed ice, water and fans should be provided in the medical room.

– At the stadium, only sealed drinks in bottles or cans should be provided. The bottles should be cooled appropriately and shielded from the sun.

At WBGTs greater then 28°C (37°C ambient dry temperature), additional precautionary measures should be taken:

– Additional shading for coaches and substitutes (sun sails)
– Supply of crushed ice and water to the teams at the side line
– Cooling mist at both sides of the pitch

The FIFA Medical Committee recommends that the event physician measures (or calculates) WBGT two hours prior to the match. When WBGT is expected to be greater than 31°C during the match, an additional drinking and cooling break should be considered after 30 minutes of play in each half. Before kick-off, the WBGT measurement should be repeated and the break confirmed to the teams.

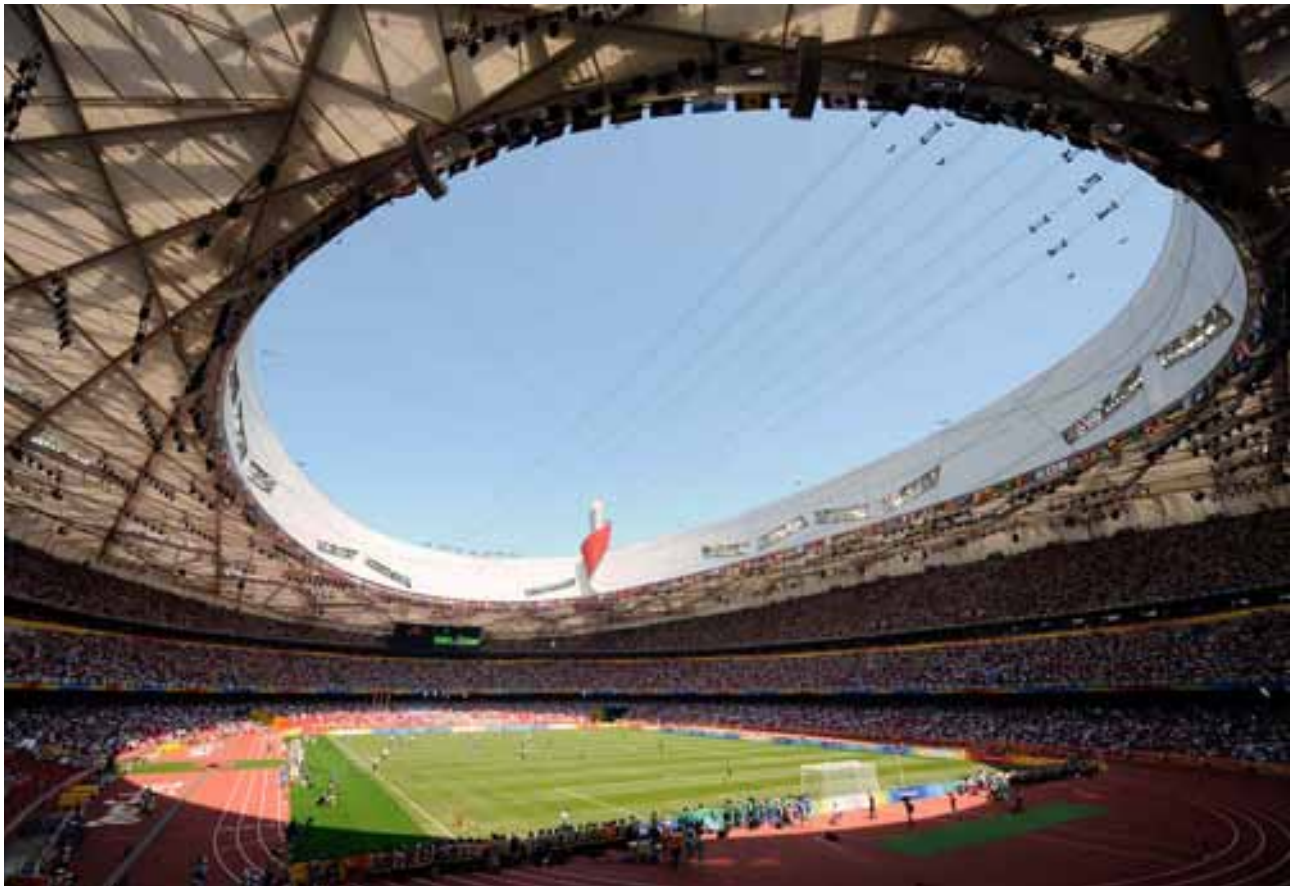


Figure 4.1.1 The final of the men's tournament at the Olympic Games in Beijing was played at noon with a WBGT of 34°C at 11.30. An additional cooling break was introduced in each half.

4.2 Cold

Football is played in different climate zones from tropical to the cold subarctic and polar climates. A cold climate is not only found near the poles, but also at high altitude, which is important to consider for travelling teams. It is characterised by long, cold winters and summers with only a few months with average temperatures over 10 degrees Celsius (°C).

Most cold-related injuries result from insufficient protection against the environment. It is important to know when to withhold players from play to prevent further damage. When a decision is to be made as to whether it is too cold to safely play football, attention must be paid to temperature and wind as well as humidity, rain and snow if the temperature is around, above or below freezing point. The actual temperature combined with wind speed are necessary when calculating the effective temperature. High humidity and especially rain increase the heat loss to the air and ground and lead to higher risk of hypothermia. Wind chill further accelerates heat loss. The risk of injury due to cold is increased in children. When playing in snowfall, visibility is reduced, especially in combination with wind, leading to an increased risk of injury from body contact.

Therefore, playing football at sub-zero temperatures and on snowy fields requires attention to both the players' equipment, maintenance of the field and adjustment of the rules to prevent injuries associated with the cold. In the sport of bandy, a match is cancelled if the temperature is below -22°C. For children the limits are -15°C and -20° respectively.

Exercise in cold ambient temperatures

Humans are classified as homeotherms. They maintain a constant core temperature, despite wide fluctuations in ambient (environmental) temperatures, of about 37°C. Humans adapt less readily to cold than to heat. As the body cools, the shell (skin, subcutaneous tissue, and muscles) adapts to protect the core, maybe at the expense of the shell.

When playing in a cold climate, there is a risk of both general hypothermia and local frostbite. It does not have to be below freezing for players to be at risk of hypothermia. A player suffering from mild hypothermia has a 1-2°C lower body temperature and experiences mild or strong shivering. His coordination, especially in the arms and legs, is reduced. If the body temperature is lowered to 2-4°C below normal, the shivering becomes more violent and his coordination is reduced further. The player may move more slowly, stumble and fall with risk of musculoskeletal injuries. His skin will be pale and lips and ears may become blue.

When playing, it may be easy to maintain a high core body temperature. However, as described above, the temperature may not be maintained at the hands and feet and local frostbite is possible even with a high core body temperature.

Signs and symptoms

Common cold-induced conditions that might require emergency intervention include:

- Raynaud's phenomenon
- Cold-induced urticaria: allergic reaction to cold. Urticaria can result in potentially serious, or even fatal anaphylactic shock.
- Chilblains
- Frostbite: local skin and tissue damage, usually at extremities. White skin, numbness and sometimes gradual onset of pain, but player may also be unaware of the injury.
- Exercise-induced asthma is a condition that is worsened by low temperatures. When breathing cold air the nerve ends in the airways are cooled, which triggers a reflex that makes the airways constrict.

Prevention of injuries and impairment due to cold

The Laws of the Game state basic compulsory equipment for players but further equipment is allowed provided that it poses no danger to him or another player (Law 4). The referee may allow gloves, caps and long trousers as indicated. Any agreement to alter the periods of play must be made before the start of play and must comply with competition rules (Law 7). In other outdoor winter sports, the referee has the authority to decide that the game should be played over

a higher number of shorter periods, with breaks in between to allow for warm-up at low temperatures.

Field-side management

A player suffering from hypothermia should immediately be taken indoors and change into dry and warm clothes. The player should move and activate his muscles at room temperature. Local heat (e.g. immersing in hot/warm water) should not be applied. Drinks should be warm, but not hot. If the hypothermia is severe, the player should be referred to the nearest hospital.

Players suffering from cold urticaria have to be closely monitored after removal from play at room temperature. Severe reactions developing into hypovolaemic shock present a medical emergency that requires immediate resuscitation. Players with cold urticaria should ideally avoid the cold, and be encouraged to carry an injectable form of epinephrine for use in emergency.

Asthma attacks triggered by cold may be prevented or mitigated by use of a mouthpiece warming and moistening the inhaled air and by adequate treatment (see 3.1.6 Acute asthma) with inhaled glucocorticosteroids and beta-2-agonists as indicated. Depending on the substance chosen, beta-2-agonist use might require a therapeutic use exemption (TUE). However, in case of an acute attack the use of prohibited substances should never be delayed or withheld because of such considerations. In an emergency, TUEs can be applied for retroactively.

A player with local frostbite should immediately be removed from play and taken inside. Excessive movement of frostbitten tissue can cause further damage, however splinting and/or wrapping frostbitten extremities will only rarely be required in cases of football players suffering from frostbite. Treatment focuses on re-warming the tissue but caution should be taken not to do so too rapidly. Passive warming by placing a warm hand on the affected area at room temperature is helpful, but rubbing, massaging or shaking in an attempt to re-warm is contraindicated. Players may also help themselves, i.e. by placing a frostbitten hand in their armpit. Blisters may appear after a few hours or days.

4.3 Altitude

In 2007, the FIFA Medical Committee and F-MARC invited 12 international scientists and clinicians to review the current body of literature and reach a consensus on playing at altitude. It was found that much research on altitude and athletic performance has been conducted, but not into team sports or football.

Playing at different altitudes and the effects on performance – and more importantly, health – have a number of variables including the altitude that the player is acclimatised to (and living at), other environmental conditions, the arrival and playing dates at the new altitude and the elevation level itself.

The different altitude zones (Table 4.3.1) are in general known to have certain physiological effects. There is, however, considerable inter-individual variability.

Prevention of altitude-related disease

Staged ascent (300m/day above 2,000m above sea level (a.s.l.) is generally recommended for altitudes above 3,000m in order to prevent altitude disease, but might be difficult with international match schedules. The same applies for acclimatisation, which would usually be recommended for one to two weeks at moderate and high altitude, depending on the altitude difference for the travelling team. Acetazolamide 125 to 250mg twice daily starting one or two days before and continuing for three days once the highest altitude is reached, is sometimes given. However, acetazolamide features on the WADA Prohibited List (S5 Diuretics) and therapeutic use exemptions are usually not granted for preventive purposes.

With regard to emergency situations that might occur with teams playing at altitudes they are not acclimatised to, the following conditions need to be considered:

Acute Mountain Sickness (AMS)

Although rarely encountered in football, AMS can occur when players, officials and dignitaries attend competitions or matches at high altitudes. The threshold value for occurrence of AMS has been established at 2,100m a.s.l, with a 10-30% risk of AMS at between 2,500 and 3,000m. The risk increases considerably above 4,000m a.s.l., not only with regard to the probability but also the severity of the disease. There is further increased risk with:

- Exertion (playing football)
- Previous history
- Children
- Women in premenstrual phase
- Very rapid ascent, or brief stay at altitude (causing adverse effects, but rarely typical AMS)

0-500m	"Near sea level"
Above 500-2,000m	"Low altitude": minor impairment of aerobic performance becomes detectable
Above 2,000-3,000m	"Moderate altitude": mountain sickness starts to occur and acclimatisation becomes increasingly important for performance
Above 3,000-5,500 m	"High altitude": mountain sickness and acclimatisation become clinically relevant, performance considerably impaired
Above 5,500 m	"Extreme altitude": prolonged exposure leads to progressive deterioration

Table 4.3.1 Altitude zones as defined by consensus meeting

Signs and symptoms

In the context of recent gain in high and extreme altitude, AMS can present with

- A headache and at least one of the following:
- Gastrointestinal (anorexia, nausea or vomiting)
- Fatigue or weakness
- Dizziness or light-headedness
- Difficulty sleeping
- Dyspnoea
- Tachycardia and palpitations
- Interstitial oedema (asymptomatic), which precedes alveolar oedema
- Cerebral oedema
- Papilloedema
- Petechial and splinter hemorrhages above 5,000m a.s.l.

Field-side management:

The disease is rarely severe unless a player is heavily dehydrated or hyperventilates and therefore a need for emergency treatment will rarely occur.

Return to play

Mild AMS usually resolves spontaneously within one to three days with rest and no further ascent. Oxygen and painkillers are often used to reduce symptoms. Investigations at the nearest hospital may only be recommended if severe AMS is present, to assess for: radiological symmetrical chest hilar butterfly changes, or patchy asymmetrical, even unilateral changes; platelet and fibrin microemboli; reversible derangement of liver and renal function.

HAPE (high-altitude pulmonary oedema)

HAPE is a non-cardiogenic pulmonary oedema due to capillary leak caused by abnormally high hypoxic pulmonary vasoconstriction. It rarely occurs below 3,000m a.s.l.

Signs and symptoms

In the context of a recent altitude ascent, the presence of at least two of the following:

- Dyspnoea at rest
- Cough
- Weakness or decreased exercise performance
- Chest tightness or congestion

and at least two of:

- Crackles or wheezing in at least one lung field
- Central cyanosis
- Tachypnea
- Tachycardia

HACE (high-altitude cerebral oedema)

HACE can be considered the "end stage" of severe AMS. In the context of a recent altitude ascent, it presents with either the presence of change in mental status and/or ataxia in a person with AMS or the presence of both mental status changes and ataxia in a person without AMS.

Emergency management

Both HAPE and HACE will rarely be encountered at a football stadium. However, the team and event physician should be familiar with the symptoms and signs in order to evaluate the need for descent and treatment in members of the travelling party. Treatment at the hospital will start with supplemental oxygen, dexamethasone and pulmonary dilatators as needed prior to descent.

4.4 Lightning

Lightning injuries are one of the top three environment-related causes of death and the second most common storm-related cause of death.

Three factors predispose to being struck by lightning: height of an object, isolation and "pointiness" (not a factor with people). Still, while there is the tendency for lightning to hit the tallest object, this 30-50m radius from the last branch point means "tall" objects such as a mountain top up to 1km away, a television tower up to 250m away or a tree up to 70m away are outside the range for protecting anyone. For football, this means that the goal posts may not protect a player standing in the middle of the football field if lightning is coming down over the player's head.

Lightning may cause injury in six ways:

1. Direct strike (3-5% of injuries)
2. Side splash from another object (30% of injuries)
3. Contact voltage from touching an object that is struck (1-2%)
4. Ground current effect as energy spreads across surface of earth when lightning hits a distance away from person (40-50% of injuries)
5. Upward leader that does not connect with downward leader to complete lightning channel (20-25% of injuries)
6. Blunt trauma if person thrown and barotrauma from being close enough to experience explosive force of lightning

The fatality rate of lightning is 8-10%. Cardiac arrest at injury is the usual cause of death. Furthermore, there may be additional injury from blunt trauma (e.g. when falling).

Lightning injury is primarily a neurologic injury, affecting all parts of the nervous system: the brain, the autonomic nervous and the system peripheral nervous system, all with potential long-term consequences.

Signs and symptoms

Acute lightning injury affects various tissues and organs:

– **Cardiopulmonary**
  - Transient hypertension
  - Myocardial injury
  - Dysrhythmia
  - Transient asystole
  - Atrial fibrillation
  - Ventricular fibrillation
  - Frequent premature ventricular contractions
  - Apnoea
  - Hypoxemia

– **Neurologic**
  - Loss of consciousness
  - Confusion
  - Paraplegia, quadriplegia
  - Retrograde amnesia
  - Hemiplegia, aphasia
  - Coma
  - Seizures
  - Intraventricular hemorrhage
  - Hematomas

– **Vascular**
  - Arterial spasm
  - Vasoconstriction, vasodilatation

– **Dermatologic**
  - Cutaneous burns

– **Ophthalmic**
  - Corneal lesions
  - Iritis
  - Vitreous hemorrhage
  - Retinal detachment
  - Optic nerve injury

– **Ear complications**
  • Ruptured tympanic membrane
  • Temporary hearing loss

– **Intra-abdominal complications**
  • Gastric perforation

Less than one third of affected persons have signs of burns, and when they occur, they are usually superficial.

Clinically, the following may be observed:
– Cold, pulseless extremities, which suggest vasomotor instability.
– Confusion, amnesia, paralysis, and loss of consciousness due to direct current through the brain.
– Temporary hearing loss from shockwave created with accompanying thunder.
– Hypotension implies intra-abdominal or thoracic haemorrhage, a fractured pelvis, extremity fractures, rupture of internal organs, or spinal cord injuries.
– Prolonged paresis or paralysis of the extremities indicates possible spinal cord injuries.
– Fixed and dilated pupils imply transient autonomic disturbances, and not usually serious head injuries.
– Skin burns present as Lichtenberg figures (fern pattern).

Field-side management

The injured do not retain electrical charge, so it is safe to touch the player.

Depending on the situation and safety of the sideline medical personnel with regard to further lightning risk:
– ABCD assessment
– Rescue breathing and/or cardiopulmonary resuscitation
– Evacuate player from field of play as indicated by his state of consciousness and injuries
– First aid for bleeding wounds or burns

Any player injured by lightning is referred to hospital for
– Observation (up to several hours after injury)
– Blood sampling for electrolyte abnormality or extensive rhabdomyolysis
– Cardiac monitoring
– X-rays if fell or thrown

Summary

Managing environmental factors: preparing and reacting appropriately

- Data collection and prediction (weather, pollution, types of pollens and grasses)
- Acclimatisation whenever possible
- Appropriate and relevant clothing
- Adequate hydration
- Sunblock agents
- Hotel selection, with pollen-filtered air-conditioning and humidity control
- Desensitisation in players with severe allergies
- Atopia treatment: nasal sprays, antihistamines
- Optimal asthma management in asthmatic players
- (Face masks)

REFERENCES

Al-Jaser TA, Hasan AA.
Fluid loss and body composition of elite Kuwaiti soccer players during a soccer match. J Sports Med Phys Fitness. 2006 Jun;46(2):281-285.

Bärtsch P, Saltin B.
General introduction to altitude adaptation and mountain sickness. Scand J Med Sci Sports. 2008;18(Suppl 1):1-10.

Bärtsch P, Saltin B, Dvorak J.
Consensus statement on playing football at different altitude. Scand J Med Sci Sports. 2008;18(Suppl 1):96-99.

Cooper MA.
Lightning injuries. http://emedicine.medscape.com/article/770642-overview. Accessed on 28 January 2010.

Dougherty KA, Baker LB, Chow M, Kenney WL.
Two percent dehydration and six percent carbohydrate drink improves boys basketball skills. Med Sci Sports Ex. 2006 Sep;38(9):1650-1658.

Dvorak J, Junge A, Grimm K (eds).
Environmental factors. In: Football Medicine Manual. Zurich: Fédération Internationale de Football Association;2009.

Evans GH, Shireffs SM, Maughan RJ.
Postexercise rehydration in man: the effects of osmolality and carbohydrate content of ingested drinks. Nutrition. 2009 Sep;25(9):905-913. Epub 2009 May 31.

Newell M, Newell J, Grant S.
Fluid and electrolyte balance in elite gaelic football players. Ir Med J. 2008 Sep;101(8):236-239.

Von Duvillard SP, Arciero PJ, Tietjen-Smith T, Alford K.
Sports drinks, exercise training and competition. Curr Sports Med Rep. 2008 Jul-Aug;7(4):202-208.

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