

Deaths During Sport and Recreational Activities in Istanbul

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ABSTRACT Sudden deaths can be simply explained as the rapid loss of heart functions of the individuals and recently an increase in sports-related sudden deaths is observed in forensic practice in Turkey. Reported here are six cases of sports-related sudden deaths to emphasize the pathological mechanisms with optimal screening strategies where a detailed postmortem examination were carried out for all. Except for one case, all cases occurred while playing soccer where coronary artery disease was established as the cause of death in four cases and as arrhythmogenic right ventricular dysplasia in the other case. Toxicological analyses revealed 60 ng/ml benzodiazepine concentrations in one case. Sports activities should be undertaken cautiously, particularly in the presence of risk factors. Beside professionals, screening of the recreational athletes is also important. By this way, early diagnosis of most cardiovascular abnormalities can be provided.

INTRODUCTION

Regular physical exercise is known to reduce the coronary incidents, but it is also well known that effort can also be a triggering factor for sudden death (SD) (Hull et al. 1994; Thompson et al. 2003; Turk et al. 2008). Heavy physical activity can eventually have fatal consequences including myocardial ischemia, infarction, ventricular tachyarrhythmia or SD (Candinas and Podrig 1990; Cobb and Weaver 1986; Hauer et al. 2000; Mead et al. 1976; Siscovick et al. 1984). In contrast to adults where physical activity appears to reduce the overall risk of SD by preventing or delaying the progression of atherosclerotic coronary artery diseases, physical exercise in young athletes with occult cardiovascular disease may increase both exercise and non-exercise-related SD (Corrado et al. 2006).

Although the descriptive criteria for “sudden” death in sports usually differs among various studies, it is suggested that the description should be standardized as “sudden cardiac arrest or sudden cardiac death occurring during or within a short period in relation to participation in sport” by the Sport Cardiology Section of the European Association for Cardiovascular

Prevention and Rehabilitation (Solberg et al. 2015).

Even differences in methodical aspects on definitions result in large variations in the reported incidences of sudden death in sports, between one and three in hundred thousand should be considered as an accepted value (Berdowski et al. 2013; Borjesson and Pelliccia 2009; Harmon et al. 2014).

Aetiology of sudden cardiac death (SCD) in sports, especially in young people is a wide spectrum with underlying congenital, inherited and acquired cardiovascular abnormalities (Corrado et al. 2005; Maron et al. 1996; Van Camp 1995). The leading causes include diseases of the myocardium, cardiomyopathy either arrhythmogenic right ventricular cardiomyopathy or hypertrophic cardiomyopathy, anatomic abnormalities of coronary artery, premature coronary artery disease (CAD), cardiac ion channelopathies (Brugada syndrome, catecholaminergic polymorphic ventricular tachycardia or long and short QT-syndrome), Marfan’s syndromes complications, and acquired disorders, acute myocarditis and commotio cordis (Corrado et al. 2009; Sheikh and Sharma 2011). However, the primary cause of SCD in master athletes is CAD (Burke et al. 1991; Kim et al. 2012).

The number of people involved in recreational physical activity is growing and it is not uncommon for a medical examiner to encounter sports-related SD (Fornes and Lecomte 2003). Despite death during sport representing a small

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proportion of unexpected sudden deaths, yet it still remains a major medico-legal problem (Tabib et al. 1999).

This paper aims to highlight the pathological mechanisms and optimal screening strategies as well as to emphasize the prevention of these sudden deaths in the light of autopsy data.

MATERIAL AND METHODS

Data of the Morgue Specialization Department of the Council of Forensic Medicine is reviewed in this paper. The age and sex of the deceased, the site and the manner of the incident, any findings in regards to the postmortem examination and eventually the cause of death have been analyzed from the records in all autopsied deaths occurred during or shortly after any sports or recreational activities between January 2006 and December 2008.

Coronary thrombosis, acute myocardial infarction, any extensive infarction scars, or more than seventy-five percent reduction of the lumen by an atheroma plaque in at least one of the main epicardial coronary arteries are accepted as diagnostic criteria for CAD as the cause of death (Burke et al. 1991; Suarez-Mier and Aguilera 2002).

Arrhythmogenic right ventricular dysplasia (ARVD) was diagnosed when there was gross or histologic evidence of regional or diffuse full thickness replacement of the myocardium of the right ventricular free wall by fat and fibrous tissue, in the absence of other known cardiac or non-cardiac causes of death (Corrado et al. 1998; Thiene et al. 1988).

RESULTS

Six male cases were detected aged between 18 to 43 years old (33 ± 8.3). All deaths occurred

while playing soccer except for one case (Case 4) where it happened during bowling. The age, gender, and other details of incidents are listed in Table 1.

All deaths occurred either on the incident site or during the transportation of the patients to the hospital except for Case One according to the judicial investigation data. He was operated for an acute subdural hematoma and died on the 4th day of his treatment. Case Four had a history of congenital cardiac disease, however all the other four deceased were recreational soccer players and none of them had a history of any substance or drug intake or any known disease in terms of familial hyperlipidemia, hypercholesterolemia or any symptoms suggesting these while there were not any sudden cardiac deaths in their families either.

Preoperative radiological evaluation, surgical operation records and postmortem examination revealed acute subdural hematoma, wide traumatic subarachnoid hemorrhage, cerebral contusion and diffuse axonal injury of brain stem in case one. The cause of death was diagnosed as traumatic brain injury in this case.

The mean heart weight was 413.4 ± 51.35 g (range 370-500 g) in the other five cases. Post-mortem findings are represented in more detail in Table 2. In the light of all postmortem examinations, CAD was determined as the cause of death in four cases and ARVD in one case.

DISCUSSION

Sudden death in association with sporting activity appears to be primarily of cardiac origin although occasionally pulmonary, central nervous system or drug related deaths could also occur. These deaths are occasionally reported

Table 1: The age and the gender of cases, incident site, and information about the course of the incident

Case No.	Age/Gender	Incident site	Course of incident
1	31/ M	Artificial turf pitch	Tried an overhead kick and fell down on his head. Felt well, but admitted to hospital with nausea, vomiting and headache after hours. Acute subdural hematoma was diagnosed and operated, died after 4 days.
2	36/ M	Artificial turf pitch	Collapsed at the end of soccer game, death at arrival to hospital.
3	35/ M	Artificial turf pitch	Chest pain while playing soccer, death at arrival to hospital.
4	35/ M	Bowling club	In treatment for heart disease for 1 year, A surgical operation was planned. Collapsed while bowling.
5	18/ M	Soccer pitch	Collapsed while playing soccer, death at arrival to hospital
6	43/ M	Ground of prison	Collapsed while playing soccer, death at arrival to hospital

Table 2: Macroscopic, microscopic evaluation of heart, toxicological analysis and cause of death

<i>Case No.</i>	<i>Weight of heart (gr)</i>	<i>Macroscopy of heart</i>	<i>Histopathology of heart</i>	<i>Toxicological analyses</i>	<i>Cause of death</i>
1	-	No pathological feature.	Hyperemia	-	TBI
2	500	Moderately obstructive atheromatous plaques of all coronary arteries, subepicardial petechiae and scarring of LV.	Hyperemia, hypertrophy, scarring and interstitial fibrosis of myocardium	Negative	CAD
3	407	Descending LCA was completely obstructed with an atheromatous plaque. Scarring of middle part of IVS and distal LV.	Heavy autolysis.	60 ng/ml diazepam in blood.	CAD
4	380	Almost complete obstruction of main branches of LCA, extensive atherosclerotic plaques in all coronary arteries. Scarring and dense colorization of LV.	Hypertrophy, scarring and granulation of myocardium. Atherosclerotic plaque completely obstructing LCA main branches.	Negative	CAD
5	410	Permeable coronary arteries Dilatation of RA and RV, thinning of RV wall.	Replacement of the right ventricular myocardium by fibrofatty tissue, hypertrophy	Negative	ARVD
6	370	Moderately obstructive atheromatous plaques of the coronary arteries.	Hypertrophy, focal interstitial fibrosis, hyperemia, moderately obstructive atheromatous plaques of the coronary arteries.	Negative	CAD

(LV: left ventricle, IVS: interventricular septum, LCA: left coronary artery, CAD: coronary artery disease, RA: right atrium, RV: right ventricle, ARVD: Arrhythmogenic right ventricular dysplasia), TBI: Traumatic brain injury

in apparently fit individuals, often well trained athletes who have been performing at an accustomed level of activity for years (Halabchi et al. 2011; Marijon et al. 2011; Özdemir et al. 2008; Suarez-Mier et al. 2013; Turk et al. 2008; Whittington and Banerjee 1994).

The age, gender, ethnicity, discipline and intensity of the sport may affect the incidence of SCD during sports. It is reported that the rate of SCD incidence is 4 or 5 times higher in athletes who are aged 35 years or older (Berdowski et al. 2013; Vuori 1995). This difference can be explained by the underlying cardiovascular diseases due to myocardial ischemia consistent with increasing age. Male predisposition to SCD with ratios between 10:1 and 20:1 is a well known entity in the literature (Berdowski et al. 2013; Marijon et al. 2011; Maron et al. 1996) and all five SCD cases were males, and four of them were over 35 years old in the researchers' series.

Besides the age and gender, the type of sport is another important factor for SCD. Bille et al. (2006) reported that the highest number of cases was in basketball, soccer and running. Five out of six cases were also playing soccer in this study, however, it is believed that relationship between the risk of SCD and the type or level of sports are multifactorial and further studies are required.

The main cause of soccer related sudden deaths in Turkey was found to be CAD in the researchers' previous autopsy-based retrospective study (Özdemir et al. 2008). In that recent paper, old infarction scars and severe atherosclerotic narrowing of the coronary arteries were even detected in very young athletes without cardiovascular risk factors. High frequency of premature CAD in young athletes was also observed in a prospective study by Corrado et al. (2003) and confirmed by the studies of Solberg et al. (2010) and Meyer et al. (2012) as well.

Old infarction scars or severe atherosclerotic narrowing of the coronary arteries were detected in three cases, pointing towards the presence of underlying coronary atherosclerosis and past myocardial infarctions in the current study. In Case 6 without old infarction scars, the diagnosis was based on the obstructive atheromatous plaques observed in the coronary arteries. Briefly, in researchers' series CAD is found to be responsible for most cases of SD, which is also compatible with the study carried by Suárez-Mier et al. (2013).

Several leading pathologies related sudden cardiac death in athletes show an age-dependent prevalence in the literature. The primary causes in athletes under the age of 35 are various types of cardiomyopathies such as hypertrophic cardiomyopathy or ARVD and congenital coronary artery anomalies (Bohm et al. 2013). ARVD, a rare inherited disease characterized by right ventricular dysfunction and ventricular arrhythmias (Calkins 2006) was determined as the cause of death in Case 5 who was 18 years old.

There is a risk of head, neck, orofacial injury in many sports, but such injuries are more likely to happen when body contact is a major component of the game (Braham et al. 2004). *Head injuries due to a blow* or a fall are especially prevalent in contact and collision sports. The most common sports-related head injury is concussion where it includes mild traumatic brain injury and the most serious sequela, acute subdural hematoma (Nagahiro and Mizobuchi 2014). According to Bailes and Hudson (2001), an acute subdural hematoma within 48-72 hours, is the most common major head injury and is associated with severe neurologic disability and death in sports related head trauma cases. Lethal injuries may also occur while trying difficult actions without any body contact as in Case 1. In this case, the deceased tried a reverse shot and fell down on his head. Although a surgical operation was performed in a short time after admission to hospital, he died on the 4th day of his surgical and medical treatment.

CONCLUSION

Sports activities should be undertaken cautiously, particularly in the presence of risk factors. In many countries, amateur and recreational athletes do not undergo systematic health check-ups. Most of the professional athletes and

sport clubs are experienced and aware of the risks, but it is necessary for recreational athletes, the public and medical professionals to be aware of the risks and dangers.

RECOMMENDATIONS

The knowledge of the recreational soccer players should be increased about the warning symptoms for situations such as having a chest pain, palpitations or syncope, which can generally be seen during heavy physical exercise. Besides professionals, screening of the recreational athletes is also important. By this way, early diagnosis of most cardiovascular abnormalities can be provided.

LIMITATIONS OF THE STUDY

This study was conducted only with male patients with the lack of available data for females and the sample size of the study was relatively low since there were only six cases. This may be related with the fact that some sport related deaths are certified without an autopsy depending on the circumstances. In addition to these, the usual autopsy does not include a detailed dissection of cardiac conduction system and immunohistochemical examination in Turkey.

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