

BRIEF REPORT

Sudden Death Following Exercise; a Case Series

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Abstract

Introduction: Natural and unexpected death that happens within less than one hour of first symptom occurrence is called sudden death. Cardiovascular diseases are the main known reason of sudden death and more than 75% of sudden deaths in athletes are assigned to it. Here we reported the autopsy results of all cases with sudden death following exercise that were referred to forensic center of Tehran, Iran, from 2009 to 2014. **Methods:** In this cross sectional study all subjects who were registered to forensic medicine center of Tehran, Iran, from 2009 to 2014, as a case of sudden death following exercise were evaluated. Demographic data and medical history as well as autopsy and toxicology findings were retrospectively gathered using profiles of the deceased. Results were reported using descriptive analysis. **Results:** 14 cases were registered as sudden death following exercise in forensic medicine profiles during the study period. Exploring the files of the mentioned deceased, revealed five non-compatible cases in this regard. Finally, 9 eligible cases were enrolled (88.9% male). The mean age of the deceased was 28.66 ± 10.86 years (range: 7 – 40). Toxicological tests were available for 7 cases, one of which was positive for tramadol. Sudden death following football was reported most frequently (44.4%). Only 3 (33.3%) cases had herald signs such as chest pain, syncope, or loss of consciousness. 1 case (11.11%) had a positive history of sudden death in relatives. **Conclusion:** Although most sudden death victims are asymptomatic until the event, all those who suffer from symptoms such as chest pain, shortness of breath, dizziness, fatigue and irregular heart rate during physical activities, should be screened regarding common probable causes of sudden death.

Keywords: Sudden death; exercise; autopsy; forensic medicine

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Introduction:

Natural and unexpected death that happens within less than one hour of first symptom occurrence is called sudden death (1-4). Sudden death is more common among men and the black race (5, 6). In a systematic review based on data related to 1980-2007, annual incidence of sudden cardiac death (SCD) in the United States varied between 180000 and 450000 (7). In some other studies, SCD rate range was reported 50-100 per 100000 of general population in countries such as Netherlands, Ireland, and China (8). Cardiovascular diseases are among the main known causes of sudden death. Interestingly, in about 25% of patients who die of coronary artery atherosclerosis, the first sign is sudden death. After coronary artery diseases, cardiomyopathies including hypertrophic and dilated types are among the second cardiac causes of sudden

death (1). Dysfunctions of the heart valves, especially aortic stenosis, are considered as other underlying cardiac causes of sudden death (9). Hypertrophic cardiomyopathy is the most common cause of sudden death in people under thirty years of age (10). Most patients with hypertrophic cardiomyopathy are asymptomatic and death can occur at rest or with mild physical activity, however, sudden death often occurs during intense physical activity (10, 11). In many cases, hypertrophic cardiomyopathy is the only autopsy finding in young victims of sudden death and is the most common reason of sudden death during exercise (12). Drug abuse (such as stimulants, anabolic steroids, opioids, and etc.), bronchoconstriction, heat stroke, and drowning can be mentioned as non-cardiac causes of sudden death in athletes but cardiac causes are more important (9, 13-15).



About 69% of sudden deaths in general population are attributed to cardiovascular diseases, while more than 75% of sudden deaths in athletes are assigned to it (13, 16). To emphasize the importance of this topic, here we review the forensic reports of all cases of sudden death following exercise, referred to forensic medicine center of Tehran, Iran, from 2009 to 2014.

Methods:

In this cross sectional study, all subjects who were registered to forensic medicine center of Tehran, Iran, from

2009 to 2014, as a case of sudden death following exercise were evaluated. Demographic data (age, sex) and medical history as well as autopsy and toxicology findings were gathered using deceased profiles, retrospectively. Cause of death was reported based on final conclusion of forensic medicine specialists. There were not any age or sex limitations. The protocol of study was approved by the Ethics Committee of Shahid Beheshti University of Medical Sciences. Authors adhered to Helsinki declarations during the study period. Results were reported using descriptive analysis.

Table 1: Baseline characteristics and autopsy findings of the studied deceased

Age*	Sex	Activity	History	Toxicology	Autopsy	Conclusion	
1	31	Male	Football	- Sudden drop one year ago - 2 weeks intermittent chest pain - father sudden death	Negative	- Aortic stenosis - Left ventricular hypertrophy	Aortic stenosis and hypertrophic cardiomyopathy
2	35	Female	Swimming	Negative	NA	- Lung congestion - Liver stiffness - Hepatocyte necrosis - Coronary atherosclerosis	Acute coronary syndrome
3	7	Male	Gymnastics	Negative	Negative	- Lung congestion - Brain edema - Liver stiffness - Plural effusion - Ascites	Acute cardiopulmonary syndrome
4	40	Male	Football	- Transient chest pain during last year	Negative	- Congested cranial vessels - Edematous lungs - Enlarged heart - Aortic entrance plaques	Ischemic cardiovascular disease
5	17	Male	Football	Negative	Negative	- Congested spleen - Coronary atherosclerosis - Myocarditis - Hepatocyte necrosis	Acute cardiac syndrome
6	36	Male	Fitness	Negative	NA	- brain congestion - Emphysematous lung - Coronary atherosclerosis	Ischemic heart disease on coronary atherosclerosis
7	24	Male	Football	- Congenital heart disease - Cardiac surgery	Tramadol	- Emphysematous lung - Cardiac hypertrophy - Aortic valve calcification - Aortic valve dilatation - Dilated ventricles	Acute heart syndrome due to advance heart disease
8	30	Male	Lifting	Negative	Negative	- Brain edema - Subarachnoid hemorrhage - Edematous lung - Cardiac hypertrophy - Fatty liver changes	Diffuse cerebral hemorrhage
9	38	Male	Swimming	Negative	Negative	- Stomach erosion - Brain vascular congestion - Lung congestion - Fatty liver - Coronary atherosclerosis changes - Cardiomyocytes fibrosis	Acute myocardial syndrome

*: Year; NA: not available.



Table 2: Necessary questions to figure out warning signs of sudden death in athletes

1	Do you have a positive family history of sudden death or not?
2	Is there any family history of congenital heart disease or not?
3	Is there any history of chest pain after activity or not?
4	Do you experience dizziness or loss of consciousness for a moment following activities or not?
5	Is there a history of dyspnea with physical activity or not?
6	Do you have a history of severe heart palpitations during physical activity or not?
7	Is there a history of connective tissue diseases such as Marfan syndrome in the family or not?
8	Have you become ill during exercise or after it?
9	When you exercise, do you get tired more quickly than your friends?
10	Do you have high blood pressure?
11	Has any doctor ever prohibited you from participating in sports due to heart reasons?

Results:

14 cases were registered as sudden death following exercise in forensic medicine profiles during the study period. Exploring the files of the mentioned deceased, revealed five non-compatible cases in this regard. The cause of death was homicide in one case (4.5 years old boy), drowning in another (38 year-old female), and myocardial infarction in the last three cases (all above 40 years old). Finally, 9 eligible cases were enrolled (88.9% male). The mean age of the deceased was 28.66 ± 10.86 years (range: 7 – 40). Toxicological tests were available for 7 cases, which was positive for tramadol in one case. Table 1 summarizes the baseline characteristics, pathology and autopsy findings of the deceased. Sudden death following football was reported most frequently (44.4%). Only 3 (33.3%) cases had herald signs such as chest pain, syncope, or loss of consciousness. 1 case (11.11%) had positive history of sudden death among relatives.

Discussion:

In recent years, concerns and interests of the people and physicians regarding causes of sudden death in athletes have impressively increased. Causes of SCD in athletes can be divided into two groups according to age. Congenital heart defects, hypertrophic cardiomyopathy, coronary artery disease, and myocarditis are among the most prevalent causes of SCD in patients under 35 years of age. On the other hand, acquired coronary artery disease is a common cause of sudden death in over 35 year old population (13-16).

Sudden death can occur in approximately all types of sports but it has been more frequently reported in sports like football and basketball. In the current study, most deaths had occurred after football and swimming. In some studies, the risk of sudden death following exercise in men has been reported to be 5 times more than women and the findings of this study has demonstrated this matter (16). Two new studies have confirmed the efficacy of screening before participation in matches. Bag-gish and colleagues studied cardiovascular screening effects with and without electrocardiography (ECG) in the

510 collegiate athletes of United States. Involving ECG, compared to its non-use in the screening, increased identification of cardiomyopathy cases, sensitivity of screening program (from 45.5% to 90.9%), and negative predictive value (from 98.7% to 99.8 %) (17). Mild symptoms such as slight chest pain and other symptoms that indicate heart problems such as exertional dyspnea should be seriously regarded and taught to all people, so that similar cases can be prevented. The authors of this article recommend asking the necessary questions listed in table 2 for primary screening of at risk patients for sudden death following exercise. In case of any positive answer to the mentioned questions, the participant should be referred for further medical investigations.

Limitation:

It should be mentioned that not all cases of sudden death are referred to forensic medicine center for autopsy, especially in cases of clear diagnosis such as acute myocardial infarction or brain insults (hemorrhagic, ischemic, etc.).

Conclusion:

Although most sudden death victims are asymptomatic until the event, all those who suffer from symptoms such as chest pain, shortness of breath, dizziness, fatigue and irregular heart rate during physical activities, should be screened regarding common probable causes of sudden death.

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