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The Sudden Death of Young Persons-Epidemiology, Causes and Risk Factors

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Abstract

Background: The sudden death of young persons always results in a problem of detection of the cause of death and a lot of controversial questions of close relatives and doctors of various specialties: cardiologists, internists, neurologists, pediatricians. The death comes suddenly, very quickly, before the arrival of the ambulance, under an apparent external health, unexpectedly for other people, and in the absence of an external factor. Place of death - physical education classes, sports field, institutions for learning activities and public place. A 10-year-old study of the causes of sudden death in young persons has been carried out.

Objective: An objective of the work is to study the structure, causes and risk factors of the sudden death in a young age.

Results: The result of our own investigations of death cases of persons aged up to 39 years on the basis of forensic autopsies for 10 years allowed to find that the pathology of the cardiovascular system caused by connective tissue dysplasia is one of the causes of the sudden death of young persons. Arrhythmia is the main mechanism of sudden cardiac death in young persons. The factors that trigger the onset of death: sports activity, physical exercise, psycho-emotional stress, intake of low-alcoholic drinks.

Conclusions: Early detection of signs of connective tissue pathology and heart disease will allow to develop preventive measures against the onset of sudden death.

Keywords: Connective Tissue Dysplasia; Fatal Arrhythmias; Risk Factors; Morphological Signs; Sudden Cardiac Death; Young Age

Introduction

All cases of sudden death of young persons subject to autopsy study to exclude a violent character of death [1,2]. The unexpected, sudden death at young age causes suspicions about its violent character, such as intake of alcohol, drugs, psychoactive substances and an occurrence of trauma [3,4]. Under the investigation of the cases of sudden death in young persons, there are no coronary atherosclerosis, cerebral atherosclerosis, cardiosclerosis and other pathological processes, which are revealed at the age of more than 45 years [5-7]. According to many authors, the chronic myocarditis, long QT syndrome, anomalies of the coronary arteries, vascular aneurysms rupture were the causes of sudden cardiac death in suddenly died teens [8-10].

Rapidity and unexpectedness of the onset are the specific traits of sudden death of young persons [11]. According to time criteria, there are an instantaneous cardiac death (instantaneous death), i.e., the death within a few seconds and sudden cardiac death, i.e., death within hours [12]. Considering this time criteria, the foreign authors offer the following definition of sudden cardiac death: It is non-violent death, caused by heart diseases, manifesting sudden loss of consciousness within 1 hours from the onset of acute symptoms, wherein a primary heart disease may be known or unknown, but death is always unexpected. To date, WHO experts have clearly defined time criteria sudden cardiac death: "... death is considered to be sudden if it occurs within 6 hours from the beginning of heart disease symptoms".

Materials and Methods

We carried out a comparative analysis of mortality rates for the 10-year period (2005-2014). It was found that the diseases of the cardiovascular system took the leading position in the structure of the sudden death with an average value of 79.2% (Table 1).

Indicator	Years									
	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Non-violent death (number of cases a year)	16,707	16,354	16,519	16,688	16,390	17,990	15,263	17,515	17,792	18,104
Death of cardiovascular diseases (abs.)	13,314	13,147	13,077	13,033	12,839	14,375	11,898	14,095	14,038	14,360
%	79.7	80.4	79.1	78.0	78.3	79.9	77.9	80.4	78.9	79.3

Table 1: Indicators of sudden death in Moscow for 2005-2014.

Among men and women, the following consistent patterns in the structure of sudden death were revealed (Table 2).

	14-39 years	40-59 years	> 60 years
Men	78%	57%	54%
Women	22%	43%	56%

Table 2: Gender and age characteristics of sudden death.

The respiratory diseases take the second place in the structure of sudden deaths (6%). Mortality rates of digestive tract diseases are stable throughout the entire period and equal to 4%. Diseases of the central nervous system can vary from 1.2% to 3% in different periods. Over the past 10 years mortality of cancer increased by 2.2 times (Figure 1).

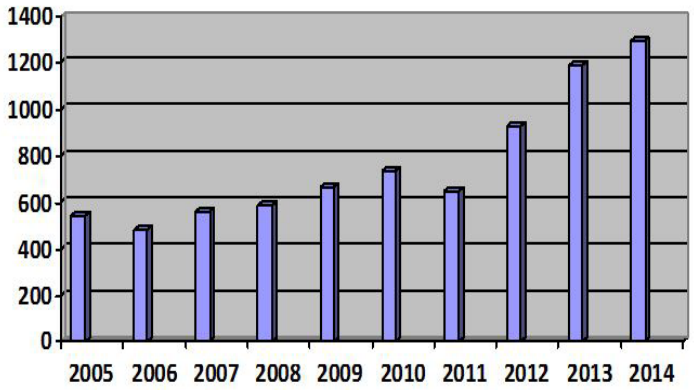

Figure 1: Diagram of mortality rates from cancer.

Thus, the pathology of the cardiovascular system consistently takes a leading position in the structure of sudden death. However, there is a particular interest in the cases of sudden death in young persons aged up to 39 years, which induce controversial problems among relatives, friends, law enforcement and are conditioned by the lack of any medical information about intravital disease, medical observation or reference to doctors. Under sectional study of these individuals, the pathological changes in the heart and great vessels in usual macro- and microscopic investigations are virtually absent or generally insignificant.

For 10 years, we have been selected and subjected to forensic autopsy the cases of sudden death in the group of the persons aged up to 39 years (1.914 cases). An analysis of the cases showed an increase in mortality over the past 10 years and allowed to reveal that 78% of these persons are men (Table 3), their average age was 32 years.

Indicators	Years									
	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Total number of the cases	199	159	175	182	211	299	154	166	183	186
Men%	83%	80%	83%	84%	84%	72%	72%	74%	76%	79%
Women%	17%	20%	17%	16%	16%	28%	28%	26%	24%	21%

Table 3: Indicators of sudden death in the age group up to 39 years.

Over the past 10 years, the structure of death causes has changed in the studied group, which made it possible to establish certain consistent patterns (Table 4).

Causes of death	2005 year	2014 year
Cardiomyopathy	42%	57%
Coronary failure	20%	15%
Vascular pathology (anomalies of the coronary vessels, brain blood vessels, aorta)	18%	11%
Myocarditis, myocardial dystrophy	10%	13%
Sudden cardiac death	7%	3%
Structural heart defects	3%	1%

Table 4: Dynamics and comparative analysis of the causes of sudden cardiac death in persons aged up to 39 years.

Cardiomyopathy is a leading cause of death of young persons. Under autopsy study, there are the signs of cardiac hypertrophy (increase in heart weight more than 360 g), dilatation of the heart cavities, sagginess and tarnish of myocardium, absence of atherosclerotic lesions of the heart vessels, valvular pathologies, and the histopathological signs: atrophy of cardiomyocytes and their uneven hypertrophy, pronounced lipomatosis of myocardium, lipofuscinosis, myocytolysis, perivascular cardiosclerosis and endocardial fibrosis (Figure 2).

Figure 2: Multiple abnormal chords in the cavities of the heart under the sudden death of a young man of 19 years old during physical exercise.

Intravital ECG revealed a prolonged interval R-R, conduction disorders, ventricular premature beats and paroxysmal tachycardias [2,6]. In the conditions of increased physical activity an arrhythmia develops, followed by acute cardiovascular insufficiency with symptoms of pulmonary edema. Increase in cases of cardiomyopathy in young people group can be due to frequent intake of low-alcoholic beverages (beer) and earlier beginning of its use [8,10]. Cobalt, as a foaming additive, has a direct toxic effect on cardiomyocytes, provoking their atrophy, as well as beer misuse leads to disturbances of energy and metabolic processes in the myocardium with its hypoxic damage.

The external and internal signs of systemic disease- connective tissue dysplasia-were revealed in 83% of sudden death cases of young persons. Under connective tissue dysplasia, pathology of the cardiovascular system in young persons is a main cause, and cardiovascular disorders are the key factors of lifespan reduction of these patients.

An external examination of the corpse revealed major and minor biological signs

- Asthenic type of constitution;
- Tall height;
- Flat, narrow, long chest;
- Poor development of the subcutaneous fat layer;
- The presence of the pathology of the sternum (hollowed chest);
- Pathology of the vertebral column (scoliosis, lordosis and their combined forms);
- Skin syndrome: the occurrence of striae; thin, pale, "marble" skin;
- "Blue sclera" symptom;
- Fused earlobe;
- The diastema between the first teeth, teeth overcrowding, compromised dentition, gothic palate;
- Cnemoscoliosis (X-shaped cnemis, O-shaped cnemis);
- All types of platypodia (transverse, longitudinal); valgus foot;
- Big toe longer than the first one;
- Sandal gap between first and second toes,

As well as other external signs of undifferentiated sudden cardiac death. The occurrence of 1-2 large and 3 external stigmas allow to consider this pathology as a preexisting condition in the onset of sudden death, because the external signs indicate the internal pathology of the heart and major blood vessels [11].

Heart pathology was presented in form of the heart deformation and its size changes, such as heart hypoplasia with decrease in its size, torsion of the heart, pathology of cardiac conduction system. The multiple abnormal chords (3 and more) in various localization with endocardial fibrosis were revealed in the cavities of the heart (Figure 2), as well as valvular pathology: prolapse of mitral, bicuspid aortic and tricuspid valves.

Vascular pathology was detected at the level of the coronary and cerebral vessels and aorta. Under the study of coronary vessels, congenital aneurysms were detected, as well as a pathological transposition of the coronary vessels, the changed course of blood vessels and tortuosity of them. Coronary failure, thrombosis of coronary vessels, hemopericardium because of aneurysm rupture were the causes of death.

Pathology of the aorta manifested by hypoplasia, thinning of the wall of aorta (Figure 3), the formation of double aorta arch, an-

eurysms of arch and ascending segment of aorta, aneurysm rupture of sinus of Valsalva under physical exercises with the development of hemorrhagic shock and the onset of death [12].

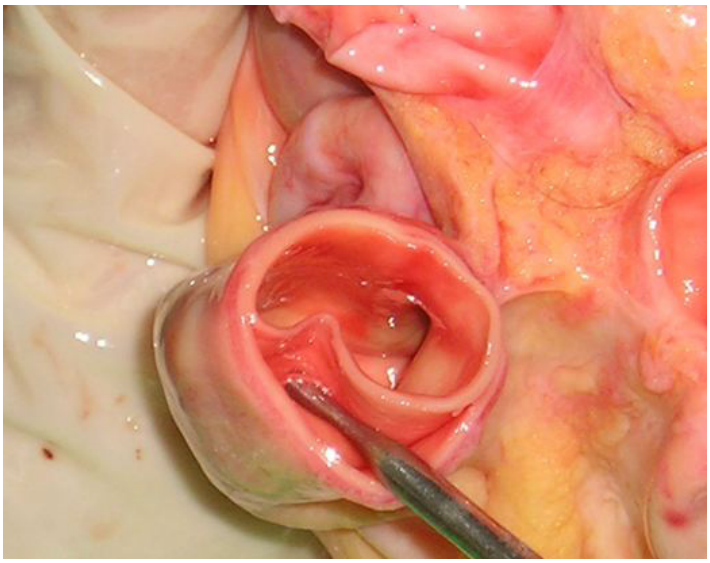

Figure 3: Duplication of aorta with hypoplasia.

Under the study of cerebral vascular, the malformations, congenital aneurysms, thinning and rupture of the vessel wall and pathological vessel tortuosity of the base of brain were detected. The basal subarachnoid hemorrhage and blood breakthrough into the ventricular system of the brain were the main causes of death.

The major elements of the formation of vascular aneurysms in persons with sudden cardiac death are: congenital defect of the muscular layer of the vascular wall, damage of the internal elastic membrane, a change in the collagen fibers of the vessels with focal destruction of the elastic membrane (Figure 4) and hemodynamic disturbances, occurring in the conditions of overlay of precipitating risk factors, such as physical load, psycho-emotional stress, smoking, intake of low-alcoholic drinks (beer, energy drinks) [13,14].

Figure 4: A rupture of pathological wall of the vessel. Basal subarachnoidal haemorrhage.

In our studies, the death occurred during the sports activities, e.g, during training sessions, sports competitions, on the lessons physical culture in school or educational institution. The victims had no complaints before death; the data about the occurrence of diseases were absent. The onset of death was recorded in such sports as hockey, volleyball, basketball, as well as in process of training in the fitness and sports halls, for example, under weight lifting, physical exercises in army unit, forced foot march. Therefore, physical activity is a major factor in provoking the onset of sudden cardiac death in patients with connective tissue dysplasia.

Conclusions

Thus, the study and analysis of the sudden death over the last 10

years allowed to establish the following features:

- Pathology of the cardiovascular system in the structure of the sudden death is main in all age categories.
- Connective tissue dysplasia is a basic pathology among young persons, forming a high risk of sudden death.
- Under connective tissue dysplasia, the main pathology in sudden death is found in the heart and large vessels. Being timely non-diagnosed intra vitam, this pathology is the cause of development of terminal conditions during physical exercises and the onset of sudden death.

All authors agree to submit this paper for publication. All research results are the author's personal achievement of Shilova M.A. et al.

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