

Swimming - Triggerred Acute Cardiovascular Complications in Elders

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Abstract

Background: Our aim was to analyze the prevalence and causes of sudden death due to recreational swimming in the elderly in Croatia in a 15-year period and to analyze what complications could we determine due to recreational swimming in elders, compared to other age groups.

Methods: In this period 22 persons from Croatia died suddenly due to recreational swimming in a summer time. In all of them forensic medicine autopsy was done. The data are a part of a retrospective study, collected from the whole population consisting of 4,500,000 persons from the registry of the Forensic Medicine Services, the Public Health Registry and from sport's clubs in Croatia.

Results: Nine of those suddenly deceased persons were aged 65-84: eight men and one woman. All have suffered from coronary atherosclerosis, myocardial fibrosis or myocardial scars, one of them had rupture of the thoracic aorta, and six of them had left ventricular hypertrophy. Ten were aged 30-64: seven of them have suffered from coronary atherosclerosis and seven had left ventricular hypertrophy. Three were aged 18-29: one had hypertrophic cardiomyopathy, the other had chronic myopericarditis, and the third had cardiomegaly and blood alcohol level of 1.7%. In Croatia, the death rate during swimming in men aged 65-82 is significantly higher than in other age groups: in men aged 30-64 and 18-29.

Conclusion: In Croatia in all eight elderly persons died suddenly, and in 7/10 middle aged, coronary heart disease was a leading cause of sudden death due to swimming. Left ventricular hypertrophy was found in 6/9 elders and in 7/10 middle aged persons. The death rate due to swimming in men aged 65-84: 2.10/1,000,000, is significantly higher than in those aged 30-64: 0.65/1,000,000 ($p=0.0209$), and in men aged 18-29: 0.44/1,000,000 ($p=0.0244$), and in two groups aged 18-64 put together: 0.59/1,000,000 ($p=0.0064$).

Keywords: Elderly; Youngers; Recreational swimming; Sudden death

Introduction

By the last census in 2011 year, in Croatia there is 17.7% elderly people aged 65 or more. The assumption is that by the year 2050, more than 30% inhabitants will belong to those chronological groups. Regular and controlled physical exercise, and adapted to organism, could protect the heart and blood vessels from incidents. Exercise training is useful in preventing sudden cardiac death, and it can protect the individual against numerous chronic diseases of old age, and it maximizes residual function [1-3]. Exercise is a very important component of healthy living for the elderly. Elderly people are specific group with regard to physical exercise, because numerous changes occur in the human organism with advancing age. Elderly people regularly engaged in recreational physical exercise have lower risk for cardiovascular complications than inactive persons [1,2,4,5]. In some instances, in elders who practice physical exercise, biological ages could be reduced by as much as 20 years. People engaged in physical exercise have a lower risk of cardiovascular complications than inactive persons. Exercise, especially swimming, is thus an important component of healthy living for the senior citizens. Life expectancy is increased, partial or total disability is delayed, and there are major gains in quality-adjusted life expectancy.

There are very rare acute complications during controlled physical exercise. The most common reasons for acute complications such is sudden death during recreational exercise are coronary heart disease and complications of arterial hypertension, including sequels of cardio-metabolic syndrome, and congenital heart diseases under ages of 30 [1-3]. Cardiovascular diseases are responsible for possible but rare complications due to recreational swimming [5-11]. In Croatia [5]

the death rate among athletes reached 0.19/100 000 yearly ($p=0.00005$), in the male population aged 15-40 engaged in recreational physical exercise: 0.71/100 000 ($p=0.00001$), in teenagers engaged in recreational exercise 0.37/100 000 ($p=0.00226$), in physicians specialists 24.8/100 000.

The aim of this study is to analyze the prevalence and causes of sudden death due to recreational swimming in elders in Croatia in a 15-year period, and to analyze what complications could we determine due to recreational swimming in elders, compared according to other age groups.

Subjects and Methods

From January 1, 1998 to December 31, 2012, the total numbers of 71 sudden and unexpected deaths during or immediately after sports or recreational exercise in males of all ages in Croatia were registered. Twenty two of them died due to or after recreational swimming in a summer time, from June to September, and the time and the place is recorded preciously. Eight men and one woman were aged between

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65-82, and thirteen between 18 and 64. In all of them forensic medicine autopsy was done. Histological finding and toxicological testing was done when necessary. The data are a part of a retrospective study, collected from the whole population consisting of 4,500,000 persons from the registry of the Forensic Medicine Services, the Public Health Registry and from sport's clubs in Croatia.

In the same period nine foreigner men and one woman died due to or after recreational swimming in the Adriatic coast of Croatia: five aged 65-82, and three aged 30-64. The data are a part of a retrospective study, collected from the whole population consisting of 4,500,000 persons. The statistical difference was calculated by using the Poisson rates. The death rates are calculated to 1,000,000 male inhabitants.

Results

In the 15-year period, twenty one males and one female in Croatia died due to recreational swimming. These lethal events occurred in summer time, and in each case all applied reanimation efforts were unsuccessful. Those data are collected from the registry of the Forensic Medicine Services, from the Public Health Registry of Croatia, and from Sport's clubs registry. In every case a forensic medicine autopsy was done and whole protocol was used for this retrospective analysis.

Eight elderly men and one woman from Croatia deceased due to recreational swimming: eight in the sea and one in a swimming pool. The first, aged 69, died suddenly due to swimming in the sea. The autopsy finding showed diffuse coronary atherosclerosis of a moderate degree and myocardial scar of the front wall. The second, aged 82, swam in the sea, and died suddenly. The autopsy finding presented diffuse coronary atherosclerosis of a medium degree, diffuse myocardial fibrosis and left ventricular hypertrophy (LVH) of 19 mm. The third, aged 82, swam in the sea, and died suddenly. The autopsy finding was diffuse myocardial fibrosis, coronary atherosclerosis of medium to heavy degree with myocardial scar of the anterior wall of the left ventricle. The fourth, aged 74, swam in the sea, and then died suddenly. The autopsy finding displayed severe coronary atherosclerosis, myocardial scar of the posterior wall and LVH of 19 mm. The fifth, aged 73, swam in the sea, and suddenly collapsed and died. The autopsy finding presented coronary atherosclerosis of a mild degree, with myocardial scars of the posterior wall of the left ventricle, and nephroangiosclerosis. The sixth, aged 69, swam and was found dead and floated in the sea. The autopsy finding was a generalized and coronary atherosclerosis, a heart enlargement: 550 g, rupture of the supra-ventricular part of the thoracic aorta of the area of 3.5 x 1.0 cm, hemopericardium of 350 ml, bilateral hemothorax: right 640 ml, left 480 ml, acute myocardial infarction of the posterior wall of the left ventricle of an area of 6.5 x 6.0 cm, myocardial scar of the left ventricle 4.5 x 1.0 cm, LVH of 16 mm, and pulmonary edema. The seventh, aged 68, swam in a swimming pool, and died suddenly. The autopsy findings demonstrated the whole enlarged heart, LVH of 19 mm, diffuse coronary atherosclerosis with narrowed left descending anterior coronary artery for more than 75%. The eighth, aged 77, was found dead, floated in the sea. The autopsy finding present generalized and coronary atherosclerosis, enlarged heart: 14 x 14 x 3.5 cm, diffuse myocardial fibrosis, bilateral liquidothorax: in the right pleural space 1160 ml, in the left 200 ml, LVH of 15 mm, and pulmonary edema. Ninth was a woman aged 66, found dead, and floated in the sea. The autopsy finding showed a generalized atherosclerosis, enlarged heart of 450 g, and dilated: 13 x 13 x 4 cm, LVH of 15 mm, pulmonary edema, liver enlargement of 2400 g (32 x 22 x 7 cm) with signs of micronodular cirrhosis with jaundice, esophageal varices, pancreatic fibrosis. Urine alcohol level was 3.03% or 303 mg/dL indicated heavily drunkness

(alcohol in the urine may be detected for 1 to 2 hours longer than it is detected in blood).

Ten middle-aged men from Croatia deceased due to swimming: in the sea, in a river, in a lake or in a swimming pool. The first aged 33 died due to swimming in the sea. The autopsy finding showed LVH of 15 mm and punctate bleeding in the brain during drowning. The second aged 47 swam in the sea and drowned suddenly. The autopsy finding showed coronary atherosclerosis of a severe degree. The third aged 60, died suddenly due to swimming in the sea. The autopsy finding showed diffuse coronary atherosclerosis of a medium degree, myocardial fibrosis, and LVH of 18 mm. The fourth aged 60 swam in the sea and suddenly drowned. The autopsy finding showed diffuse coronary atherosclerosis of a severe degree. The fifth aged 57 died due to swimming in a lake. The autopsy finding showed obesity, coronary atherosclerosis, diffuse myocardial fibrosis, and lipomatosis cordis. The sixth aged 52 collapses and died due to swimming in a river. The autopsy finding showed enlarged heart: 350 g, LVH of 18 mm, and diffuse coronary atherosclerosis with narrowing up to 70%. The seventh aged 62, swam in the sea, then suddenly collapsed and died. The autopsy finding showed generalized atherosclerosis with coronary narrowing enlarged heart: 500 g, and dilated: 15 x 13 x 3.5 cm, diffuse myocardial fibrosis, LVH of 16 mm, heavy pulmonary and cerebral edema. The eighth aged 50 swam in a river and suddenly died. The autopsy finding showed enlarged heart of 500 g, coronary atherosclerosis with narrowed coronaries and LVH of 22 mm. The ninth aged 41 swam in the sea, and died suddenly. The autopsy finding showed obesity, a generalized atherosclerosis, an enlarged heart of 500 mg, and dilated: 13 x 13 x 7 cm, a LVH of 14 mm, and pulmonary edema. The tenth aged 61, swam in the sea, and suddenly drowned. The autopsy finding showed stroke: hemorrhage in cerebrum, in cerebellum and in subarachnoid space, an enlarged heart and LVH of 18 mm.

Three young men aged 18-29 years died due to swimming: two died in the sea and one in a swimming pool. All of them did not pass any recent medical examination, and have been without symptoms before the incident. The first aged 18, swam in the sea and kept jumping many times, then suddenly collapsed and died. The autopsy finding showed chronic myopericarditis with left ventricular fibrosis. The second aged 19 swam in the sea than suddenly collapsed and died. The autopsy finding showed the whole heart enlargement of 450 g, pulmonary edema and blood alcohol level of 1.7% indicating 2nd-3rd degree of drunkenness. The third aged 29, swam in a swimming pool, and suddenly collapsed and died. The autopsy finding revealed hypertrophic cardiomyopathy (HCM): the posterior wall of the left ventricle reached 25 mm, and with normal coronaries.

Out of 22 deceased persons from Croatia, 14 had LVH: twelve of 14-19 mm, and two of 22 and 25 mm. The death rate due to swimming in men aged 65-82 in Croatia amounted to 2.10/1,000,000 what is almost 4 times higher than in men aged 30-64: 0.65/1,000,000 ($p=0.0209$), and almost five times higher than in those aged 18-29: 0.44/1,000,000 ($p=0.0244$). The death rate in ages 65-82 was significantly higher than in whole group of persons aged 18-64: 0.59/1,000,000 ($p=0.0064$) (Table 1).

In this period, eight male foreigners and one woman died due to swimming in the Adriatic sea of the Croatian coast: five elders and three middle-aged. The first elderly aged 69, has suffered of arterial hypertension and had stroke six months earlier. The autopsy finding showed generalized atherosclerosis, the heart enlargement of 500 g, and LVH. The second, aged 74 had a spongy pulmonary edema typical for drowning, coronary atherosclerosis with narrowing less than 1 mm,

Age (years)	Died due to swimming	Total
65 - 82	8 (2,10/1,000.000) ^a	3 802 980
30 - 64	10 (0,65/1,000.000) ^b	15 281 685
18 - 29	3 (0,44/1,000.000) ^c	6 856 215

a : b, p=0,0209; a : c, p=0,0244; b : c, p=0,7523; a : b+c, p=0,0064

Table 1: The death rates in men died during or after swimming in Croatia in a 15-year period.

a myocardial scar in the posterior wall, and LVH of 21 mm. In the third aged 83, the autopsy finding showed generalized atherosclerosis of a heavy degree, a heart enlargement of 310 g, and dilated: 21 x 10 x 4.5 cm, a right ventricular hypertrophy (RVH) of 5 mm, a hydropericardium of 120 ml, a LVH of 15 mm, pulmonary edema (he drowned due to congestive heart failure). The fourth aged 72, was found dead floated in the sea. The autopsy finding showed an enlargement of the whole heart: 550 g, and dilated: 15 x 13 cm, generalized atherosclerosis of heavy degree, especially involved all coronaries, an acute myocardial infarction of posterior wall of the left ventricle, with the area of 5 cm, LVH of 18 mm, pleural effusions: left 240 ml, right 80 ml, cerebral edema. The fifth aged 69, was found dead, floated in the sea. The autopsy finding showed generalized atherosclerosis, a whole heart enlargement of 450 mg, and dilated: 14 x 12 cm, RVH of 5 mm, LVH of 15 mm, pulmonary edema, and cerebral edema. One woman aged 82 died due to swimming in the sea. The autopsy finding showed generalized and coronary atherosclerosis of severe degree, narrowed to 1 mm, with myocardial scar of 2 cm of the posterior left ventricular wall, LVH of 22 mm, pulmonary edema, and nephroangiosclerosis.

Three middle-aged foreigners died due to recreational swimming in the sea. In the first aged 74, the autopsy finding showed diffuse severe coronary atherosclerosis with narrowing less than 1 mm, myocardial scar of the posterior wall, LVH of 21 mm, and signs typical for drowning. The second aged 69, suffered of arterial hypertension, and died six months after cured stroke. The autopsy finding showed generalized atherosclerosis of a medium degree, enlarged heart: 500 g, and LVH. The third aged 55, was found floated in the sea. The autopsy finding showed acute myocardial infarction of posterior left ventricular wall, coronary atherosclerosis and enlarged heart: 500 g (14 x 13 x 5.5 cm), lipomatosis cordis, and LVH of 15 mm.

Discussion

By our results, the primary reason for death due to recreational swimming is an organic heart disease. One man aged 61 drowned in the sea because of stroke, and had a hemorrhage in both cerebrum and cerebellum and in the subarachnoid space as well, with heart enlargement, LVH and coronary heart disease. All other 6 elderly and 7 middle-aged men died suddenly because of coronary heart disease. Three youngsters died suddenly due to swimming: two because of HCM, and one from chronic myopericarditis.

The death rates due to swimming in Croatia are calculated to 1,000.000 male inhabitants - not to 100.000 people included in sports or recreational activities, because we do not have data how many people could swim and how many of them swim regularly or periodically. That is why calculation of a death rate and comparison, is done according to whole Croatian male population according to age groups.

The death rate due to swimming was proportionally greater in the elderly than in youngsters [1,2], but it is still less frequent than in other sports or recreational activities in Croatia. The death rate during swimming in elders reached 2.10/1,000.000. Those data are less frequent than in elders involved in sports or recreational activities

in Croatia during 27 years: 2.99/100 000 males those who practice physical exercise. By our results, it seems that sudden cardiac death in the elderly involved in recreational swimming, are rare [1].

The prevalence of sudden cardiac death reached about 250.000 persons in USA every year [12]. In one study performed in USA among athletes involved in Triathlon, of 38 nontraumatic deaths occurred from 2003-2011, water swimming was a cause of death in 30 [13]. In our study, sudden death due to swimming could occur in any age groups, but is more often seen in elders. The death rate due to swimming in elderly men in Croatia is more than 3 times higher than in middle-aged men, and more than 4.5 times higher than in younger's.

Reasons for sudden death due to swimming could be different, but an important reason is swimming in cold water [14], what could be present even in a summer. The consequence could be hypothermia, general vasoconstriction, partly by the cold water's high viscosity, and worsening of preexistent cardiovascular disease leading to malignant ventricular arrhythmia. It is an opinion that sudden death occurs often at an average about 60 years [10]. A result of our study goes to this direction also. About half of all sudden cardiac deaths are a consequence of coronary heart disease, and at a second place is a myocardial consequence of arterial hypertension, as in our results: LVH. LVH probably as a consequence of arterial hypertension, were detected in two third of deceased elders (6/9) and 7/10 in middle-aged persons. LVH is a predictor of cardiovascular mortality [4].

Our results with the prevalence of sudden cardiac death almost exclusively in males, is probably consequence of two factors: males are doing heavier physical exercise than females, and coronary heart disease is more frequently presented in males.

When cardiovascular incidents do occur due to swimming, the most frequent causes are acquired or congenital cardiovascular diseases. A great number of persons with coronary disease engage in physical exercise, and only a few experiences any discomfort. These data are supported by the analysis of the health-related condition of the Croatian population: the so-called healthy persons of both genders aged 65-84 have six diagnoses on the range 0-17, including cardiovascular diseases [1,2]. Relative risk for cardiovascular complications seems to be higher in exertion than at rest. Besides the fact that the heart is not trained for such efforts, the role of coronary spasm and reperfusion could be perhaps taken into account in the pathogenesis of sudden death especially in middle-aged persons and in elders. Many possibilities exist in defining an exertion-related sudden death [15]. The time period needed for the cardiovascular system to return to resting steady state varies with many factors such as the type, intensity and duration of swimming, along with the health status and physical condition of the individual.

We are unable to find similar data in the literature, and we could not make any comparison.

Study limitations. This is a retrospective study performed by protocols from Forensic Medicine Services, the Public Health Registry and from sport's clubs in Croatia. This registry is probably not complete because some persons died suddenly are not autopsied, for example when a reason of sudden death is natural and not violent, but we think that we collected data of every person died suddenly and have been autopsied. Often we had no data about previous symptoms leading to sudden death, as we had no data of recent physical finding, no one of them have not been examined by physician in a recent time. So we have had very often information available at the time of autopsy from the forensic medicine specialist who is pathologist at the same time. So very

often we do not have information of the patient positive family history, cardiovascular risk factors before they died, premortem symptoms, clinical status, laboratory findings (ECG, an ambulatory ECG, ECHO, stress test etc.), and medications.

Conclusion

In a period of 15 years, twenty one men and one woman from Croatia died suddenly due to recreational swimming in a summer time. Nine of them were elders. By the autopsy, cardiovascular diseases are responsible for all deaths due to swimming in the elderly and in 7/10 middle-aged persons. Left ventricular hypertrophy as the second leading cause of sudden cardiac death in the adult population, was found in 6/9 elderly, and 7/10 middle-aged deceased persons. In Croatia, the death rate due to swimming in elderly men reached 2.10/1,000.000, what is significantly higher than in middle-aged and younger men: 0.59/1,000.000 ($p=0.0064$).

Conflict of Interest

We are disclosed any financial and personal relationship with other people or organizations that could inappropriately influence our work.

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