

Manual Snow Removal and Sudden Death

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ABSTRACT

The aim was to analyze the causes of sudden death in middle-aged and elderly men during manual snow removal. During snowy winter months in Zagreb, from January 2013 to January 2014, four males aged 52, 65, 72 and 81, died suddenly while manually removing snow. They were all autopsied. All of them have suffered from arterial hypertension and coronary heart disease, and one suffered from metabolic syndrome. The cause of death in two was probable malignant ventricular arrhythmia. In the third who fell down on the icy surface, consequences were cerebral contusion and neck vertebral luxation. In the fourth who fell down from the top of a 15 m tall building during snow removal, the cause of death were multiple injuries: fractures of both clavicles, ribs and vertebrae's Th5, Th6, hemothorax, cardiac contusion, hemopericardium, thoracic aorta rupture, contusions and ruptures of both lungs, rupture of the diaphragm, liver rupture, hemoperitoneum and cerebral edema. The estimated death rate in the City of Zagreb for males aged 30–64 years is 5.44/1,000,000 inhabitants, which is less than in those aged 65–85 years (40.03/1,000,000; $p=0.2269$). Sudden strenuous physical effort due to manual snow removal in two non-trained persons, who have suffered from arterial hypertension and coronary heart disease, was the cause of sudden death. Manual snow removal is an important cause of sudden death, as it is a very arduous effort in non-adapted middle-aged and elderly persons.

Key words: men, manual snow removal, strenuous physical exercise, sudden death

Introduction

Regular and controlled physical exercise protects the organism from acute cardiovascular incidents. But, sudden strenuous physical effort like manual snow removal and/or shoveling could have a harmful impact in non-trained persons and even lead to traumatic injuries or have a proarrhythmogenic cardiac effect. Manual snow removal is an important cause of sudden death as it represents a heavy effort in non-adapted persons, especially in middle-aged and elderly people. The strength of the cardiac muscle decreases after the age of 30, for example in persons biologically aged 70 years, the potential of performing physical strains could be about 50% lower than in people of younger age. However, if elderly persons have been practicing physical exercise throughout their life, they have far greater maximal aerobic lung capacity than persons who neither exercise nor take walks, but mostly sit. Elderly people engaged in exercise have a lower risk for cardiovascular complications than inactive persons^{1–6}. In persons with a healthy heart that are trained and functionally fit, health-related incidents are very scarce. The relative risk of mortality due to cardiovascular or any

other diseases is opposite to mortality rate related to physical activity^{5,6}.

The aim of this report is to analyze causes of sudden cardiac death in middle-aged and elderly men during manual snow removal in 2013 and 2014 winters in Zagreb, and to stress the fact that heavy physical effort in non-trained persons could be extremely dangerous and can lead to sudden cardiac or traumatic death.

Case Reports

In the period from January 1, 1984 to January 30, 2014, 75 cases of sudden and unexpected deaths in men were registered in Croatia during or immediately after physical activity. Similar incidents were not observed in women. Four men died in the period from January 2013 to January 2014 in the City of Zagreb, due to manual snow removal during two long and snowy winters. All were autopsied.

TABLE 1
MEN WHO DIED DUE TO MANUAL SNOW REMOVAL IN THE
CITY OF ZAGREB FROM JANUARY 2013 TO JANUARY 2014

| Age (yrs) | Deceased | Total |
|-----------|----------------------------------|---------|
| 30–64 | 1 (5.44/1,000,000) ^a | 183,614 |
| 65–85 | 4 (40.03/1,000,000) ^b | 49,960 |

Statistical analysis done for men who died due to manual snow removal, in relation to the total number of male inhabitants in the specific age groups in Zagreb, according to the 2011 census (Table 1). Statistical difference was calculated by using the Poisson rates. Death rates are calculated per 1,000,000 male inhabitants. The death rate in males aged 30–64 reached 5.44/1,000,000 inhabitants, being lower than in those aged 65–85, where it amounted to 40.03/1,000,000. The difference is not significant ($p=0.2269$) in spite of the existing difference in rates (5.44 vs. 40.03), probably due to a small number of cases. Thus it is not possible to make a reliable conclusion.

a : b; $p=0.2269$

Case 1

A 65 year old man, who suffered from arterial hypertension and coronary heart disease for many years and has been on medicamentous therapy suddenly fell, kicked his head on the icy surface and died during manual snow removal in January, 2013.

Forensic autopsy revealed a deep laceration on the left front part of the head, 4–5 cm long, with surrounding hemorrhage around it. There was a pyramidal fracture of the temporal bone through sella turcica, on the right part of the cranial cavity. Pathological motility of the joints in the head and neck region was also found. Hemorrhagic zones of the occipito-temporal and frontal bilateral regions of the soft membranes were registered. In the cerebrum three contusion zones were located sub-cortically: left occipital, right frontal and right temporal, basally and apically. Cerebral liquor was hemorrhagic, as were the soft membranes surrounding the medulla oblongata. The heart was enlarged and weight 400 g, the region of the left posterior ventricle and the part of interventricular septum contained fibrous tissue and local fibrous foci. Both main coronary arteries were narrowed, and a thrombus was located about 1 cm from the outflow of the right coronary artery, partly occluding the arterial lumen. Death was caused by the consequences of cerebral contusion and luxation of the connection between head and neck, as a sequel of the fall.

Case 2

A 52 year old man, who suffered from the consequences of metabolic syndrome: heavy obesity (body weight of 120 kg with average body height), arterial hypertension, hyperlipoproteinaemia (generalized atherosclerosis), and type 2 diabetes mellitus for years collapsed and died suddenly in the early morning, during manual snow removal around his house in February, 2013.

Forensic autopsy showed heavy obesity, enlargement of the heart (dimensions 16.5 x 14 cm) with a weight of 800 g. Coronaries were widened, with a thrombotic mass 1.0 x 0.3 cm large in the descending part of the left coronary artery, and myocardial fibrosis of a medium degree.

Case 3

A 81 year old man, suffering from arterial hypertension and coronary heart disease for many years. Few years ago, pectoral angina was diagnosed, and after a coronarography, a stent was placed in the descending part of the left main coronary artery. Recently he has had intermittent chest pains during physical exercise and psychical arousal. In March, 2013 he was manually removing snow on the terrace at the front of his house, collapsed and died suddenly.

Forensic autopsy showed a lacero-contusion wound of the left auricular region, dilatation of the whole heart: 15 x 15 x 6.5 cm, left ventricular hypertrophy of 15 mm, right ventricular hypertrophy of 6 mm, and the medium degree thickness of the valvular apparatus. There were signs of generalized atherosclerosis, especially in the coronaries, and the left descending coronary artery had an implanted stent, but was almost completely occluded. The right coronary artery was narrowed up to 70%. There was a myocardial scar 4 x 3 cm large, located in the posterior part of the left ventricle, through the whole ventricular wall.

Case 4

In January 2014, a man aged 72 manually removed snow on the top of his 15 m high residential building; he slipped on the ice and fell down from the terrace to the ground beside the building, and died suddenly. Forensic autopsy showed multiple rib fractures, fractures of both clavicles, hemothorax, vertebra Th5 – Th6 fractures, rupture of thoracic aorta, both lung contusions and ruptures, heart contusion, hemopericardium, rupture of the left part of the diaphragm, hemoperitoneum, hepatic rupture, cerebral edema.

Discussion

Our results revealed that in the first three months of 2013 and in the first month of 2014, four men died during or immediately after manual snow removal. The primary reasons for these deaths are complications of pre-existing heart diseases. Those men have not been prepared for heavy physical efforts such as snow removal, and the lethal events came suddenly and unexpectedly. Three of four presented cases had coronary heart disease and arterial hypertension, what was the cause of sudden death in two. In the third one, the main cause of death was cerebral injury due to the fall on an icy surface, resulting with cerebral contusion and neck vertebral luxation, and in the fourth polytrauma was the cause of death.

There are only few reports in the literature dealing with manual snow removal and sudden death^{7,8}. In three Detroit area counties, USA⁷, during snowfalls from January 1999 to December 2000, 271 sudden deaths were observed among patients suffering from coronary heart disease (from the population of 4.1 million people), and 36 persons of that number (13.3%) were engaged in snow removal: 33 men and 3 women. Authors reviewed records one week before (N=73), during (N=102), and after two heavy snowfalls (N=96). The incidence of sudden cardiac deaths was related to the weeks with two snowstorms, and increased mortality was observed a week after snowstorms as well. Sudden cardiac death was most often seen in men: 93:7% (p=0.0001). The results were compared with non-exertion related sudden cardiac deaths, which were higher in men: 63%, compared to women: 37%. Authors estimated an increase in the number of sudden cardiac deaths comparing the week before, during and after the storms. They concluded that strenuous physical effort after heavy snowfalls is more dangerous for human health than cold winter temperatures alone⁸. Authors deduced that exhausting physical activity during manual snow removal (≥ 6 METs) could be responsible for acute cardiac deaths^{7,8}. Shoveling acutely increases fibrinolytic system activity, but not to such a degree as could be seen in maximal physical exercise^{9–11}. According to our data, in patients suffering from arterial hypertension and coronary heart disease, an increase in that system could be high enough to lead to acute cardiovascular complications, as are malignant ventricular arrhythmias.

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

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Study limitations

This is a retrospective study performed by using forensic medicine protocols from the Forensic Medicine Service of the School of Medicine, University of Zagreb. Often we had no data about immediate previous symptoms leading to sudden death, as we had no data of recent physical findings, because neither of them has been examined by a physician in recent time. So we have very often only information available at the time of the autopsy. We do not have information on the patients' family history, premortal symptoms, clinical status few days before the event and laboratory findings (ECG, an ambulatory ECG, ECHO, stress test etc.). Besides, the number of cases is too small to make a definite conclusion according to statistical analysis.

Conclusions

Sudden consuming physical effort due to manual snow removal in four non-trained men, who have suffered from arterial hypertension and coronary heart disease, was the cause of sudden death in two, probably due to malignant ventricular arrhythmias. The third man, who fell down on icy surface, suffered cerebral contusion and neck vertebral luxation. In the fourth polytrauma with multiple bone fractures and multiple rupture of parenchymal organs was the cause of death. Manual snow removal is an important reason leading to sudden death as it represents a heavy physical effort for non-adapted middle-aged and elderly persons. The death rate in the City of Zagreb reaches 5.44/1,000,000 in males aged 30–64, what is less than in those aged 65–85 yrs: 40.03/1,000,000 (p=0.2269).

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MANUALNO ČIŠĆENJE SNIJEGA I NAGLA SMRT

SAŽETAK

Od siječnja 2013 do siječnja 2014 g. četiri muškarca u dobi od 52, 65, 72 i 82 godina su preminula u gradu Zagrebu tijekom manualnog čišćenja snijega oko svojih kuća, te su svi obducirani. Trojica su bolovala od arterijske hipertenzije i koronarne bolesti, jedan na bazi podležećeg metaboličkog sindroma. Maligna ventrikularna aritmija bila je vjerojatni uzrok smrti u dvojice. Treći se poskliznuo i pao, udario glavom o zaleđenu površinu i zadobio kontuziju mozga i luksaciju vratne kralješnice. Četvrti se poskliznuo i pao s vrha zgrade od 15-ak metara i zadobio frakture obiju ključnih kostiju, serijske frakture rebara i kralješaka Th5, Th6, izljev krvi u prsnu šupljinu, nagnječenje srca, izljev krvi u osrčje, razdor aorte, nagnječenja i razdore oba pluća, razdor dijafragme, razdor jetre, izljev krvi u trbušnu šupljinu i edem mozga. Stopa smrtnosti za vrijeme manualnog čišćenja snijega u Zagrebu u muškaraca dobi 30–64 g. iznosila je 5.44/1.000.000 stanovnika, što je sedam puta niže nego u dobi 65–84 g.: 40.03/1.000.000 ($p=0.2269$). Manualno čišćenje snijega je jedan od značajnijih razloga iznenadne smrti, jer se radi o izuzetno zahtjevnom relativno statičkom naporu u prethodno netreniranih muškaraca srednje i starije dobi.