



Assistant Chief Dies as a Result of a Cardiorespiratory Arrest at the Scene of a Search and Rescue Operation - New Jersey

SUMMARY

On December 12, 1998, a 44-year-old male volunteer Assistant Chief responded to a request from the local police department for assistance in conducting a search of a wooded area for a person thought to be suicidal. After approximately 5 minutes of searching for the suspect, the victim suffered a witnessed cardiorespiratory arrest. Resuscitation efforts, begun immediately by EMTs at the scene and continued by paramedics and hospital personnel, were not successful. The death certificate listed an enlarged heart (cardiomegaly) as the cause of death. The autopsy revealed no coronary artery disease, an enlarged heart, and small areas of heart muscle scarring (myocardial fibrosis).

The following recommendations address preventive measures that have been recommended by other agencies to reduce, among other things, the risk of on-duty cardiac arrests among fire fighters. It cannot be determined, however, whether these recommendations could have prevented the sudden cardiac arrest and subsequent death of this fire fighter. These recommendations have not been evaluated by the National Institute for Occupational Safety and Health (NIOSH), but represent research presented in the literature, consensus votes of technical committees of the National Fire Protection Association (NFPA), and products of labor/management technical committees within the fire service. This preventive strategy consists of (1) minimizing physical stress on fire fighters; (2) screening to identify and subsequently rehabilitate high-risk individuals; and (3) encouraging increased individual physical capacity (fitness). Steps that could be taken to accomplish these ends include

- *Emergency response personnel should have annual medical evaluations to determine their medical ability to perform duties without presenting a significant risk to the safety and health of themselves or others. These evaluations should include an exercise stress test as recommended by NFPA 1582.*
- *Reduce risk factors for cardiovascular disease and improve cardiovascular capacity by offering a wellness/fitness program for emergency response personnel.*

INTRODUCTION & METHODS

On December 12, 1998, a 44-year-old male volunteer Assistant Chief had a cardiorespiratory arrest at the scene of a search and rescue operation. Despite cardiopulmonary resuscitation (CPR) and advanced life support (ALS) administered by the fire fighters, emergency medical technicians (EMTs)/paramedics, and hospital emergency department personnel, the victim died. The National Institute

The **Fire Fighter Fatality Investigation and Prevention Program** is conducted by the National Institute for Occupational Safety and Health (NIOSH). The purpose of the program is to determine factors that cause or contribute to fire fighter deaths suffered in the line of duty. Identification of causal and contributing factors enable researchers and safety specialists to develop strategies for preventing future similar incidents. To request additional copies of this report (specify the case number shown in the shield above), other fatality investigation reports, or further information, visit the Program Website at:

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for Occupational Safety and Health (NIOSH) was notified of this fatality by the United States Fire Administration on December 15, 1998. On June 28, 1999, NIOSH representatives telephoned the affected fire department to initiate the investigation. On July 9, 1999, a Medical Officer assigned to the NIOSH Fire Fighter Fatality Investigation Team traveled to New Jersey to conduct an on-site investigation of the incident. Additional information used to prepare this report was collected via telephone interviews and follow-up record review.

During the investigation NIOSH personnel interviewed the Fire Chief and reviewed

- Fire Department incident reports
- Police Department incident reports
- New Jersey Division of Fire Safety written statements
- Autopsy report
- Death certificate
- Past medical records of the deceased

INVESTIGATIVE RESULTS

Emergency Scene Response. On December 12, 1998, the local police department requested the assistance of the fire department to conduct a search of a wooded area for a person thought to be suicidal. After arriving at the scene, the victim (wearing bunker gear) took command of the operation and organized several members of the fire and police departments to begin the search. After climbing over a metal railing, the search and rescue team found the suspect approximately 100 feet into the woods. Soon after finding the suspect, the victim reported that he felt dizzy and lightheaded. After kneeling and then sitting down, the victim repeated this comment, then rolled on his side and became unresponsive at approximately 1614 hours. Resuscitation efforts were begun immediately at the scene by fire fighter/EMTs. At this time, resuscitation efforts consisted of the

application of an oral airway to restore the victim's compromised airway. An ambulance was requested at 1615 hours and arrived on scene at 1618 hours. The paramedics' initial assessment found the victim unconscious, without respirations, and with a peripheral pulse. A nasal airway was applied and artificial ventilation begun using a bag-valve-mask. The victim was placed in the ambulance, at which time he was noted to be pulseless, and CPR was begun. After application of a defibrillator, a shock was indicated and performed. CPR continued and a second shock was performed. After the second shock, a paramedic team (ALS) from the hospital arrived, took over patient care, and transported the victim to the nearest hospital. Further resuscitation efforts at the hospital were not successful and the victim was pronounced dead at 1720 hours.

Medical Findings. The death certificate, completed by the medical examiner, listed the immediate cause of death as "cardiomegaly, pending further studies." After an autopsy was completed the cause of death was listed as "dilated cardiomyopathy," and the manner of death was listed as "natural." Autopsy findings are notable for an enlarged heart with moderate dilation of both atria and ventricles, grossly normal coronary arteries, and acute pulmonary edema and congestion. Microscopic examination revealed scattered small foci of myocardial fibrosis (heart muscle scarring) and no evidence of coronary artery disease. The findings were suggestive to the medical examiner of a "primary cardiomyopathy, most likely a dilated cardiomyopathy." The toxicology report indicated that no carbon monoxide was detected in the blood and that no drugs were found in the blood, urine, or stomach contents.

The victim had a physical examination performed by his personal physician in February and March, 1998. At that time he was noted to have a 10-year history of smoking 1 ½ packs of cigarettes per day and to have stopped smoking in 1996. He was taking no



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medications regularly, had no pulmonary or cardiovascular symptoms, and had no history of medical problems. He was noted to be overweight and to have a weight gain of 23 pounds in the preceding 2 years. His blood pressure at the time of the examination was 140/98 (blood pressure from February 1996 was noted to be 100/60). Laboratory studies were notable for a normal glucose, triglyceride level of 86 milligrams per deciliter (mg/dl), total cholesterol level of 193 mg/dl, HDL-cholesterol level of 37 mg/dl, and LDL-cholesterol level (calculated) of 139 mg/dl. His total cholesterol/HDL-cholesterol ratio was elevated at 5.22 (normal < 4.98). Two years earlier he had an elevated triglyceride level of 202 mg/dl and a total cholesterol level of 194 mg/dl. An electrocardiogram from 1996 was notable only for leftward axis deviation.

DESCRIPTION OF THE FIRE DEPARTMENT

At the time of the NIOSH investigation, the fire department was comprised of 90 volunteers divided among 4 companies; one of the companies is an ambulance company which included 8 volunteers who were EMTs. The fire department serves a population of approximately 12,000 in a geographic area of 3 square miles.

Training, Medical Clearance and Physical Fitness. The victim was a certified Fire Fighter I and had 25 years of fire fighting experience. The State does not require basic fire fighter certification training. The individual fire department is responsible for training based on their local requirements. Before joining the department, all volunteers must submit an application for membership to the State Division of Fire Safety; this application includes a mandatory physical examination certifying that the applicant is in good health. There were no written materials detailing necessary components of that physical examination (such as cardiovascular evaluation). At

the time of the NIOSH investigation the department had no requirements for periodic medical surveillance or physical examinations after the initial examination. The department does not have a specific medical clearance evaluation for respirator use, nor do they have physical agility/fitness requirements for new or current fire fighters.

DISCUSSION

This victim had a witnessed cardiorespiratory arrest, presumably related to an underlying cardiomyopathy. Primary dilated cardiomyopathy is thought to result from myocardial (heart muscle) damage produced by a variety of toxic, metabolic, or infectious agents, although no cause is apparent in many cases.¹ Hypertension is thought to be a cause of dilated cardiomyopathy—in that situation, the cardiomyopathy would be termed a secondary dilated cardiomyopathy (cardiomyopathy of known cause or associated with a disease involving other organ systems).² Based on the information reviewed, it appears that the victim's cardiomyopathy was primary, although the victim did have an elevated blood pressure measurement on his most recent physical examination. Persons with dilated cardiomyopathy may develop symptoms of congestive heart failure gradually; however, sudden death is also known to occur.¹ Some general medical tests, such as a chest X-ray, as well as tests used for cardiovascular evaluations, such as echocardiography, would generally show an enlarged heart in a person with a dilated cardiomyopathy.

The cause of primary dilated cardiomyopathy is unknown; therefore, specific therapy is not possible. Treatment, therefore, consists of treating symptomatic conditions that result from the cardiomyopathy, such as congestive heart failure or arrhythmias.^{1,2} Prohibiting strenuous exertion for persons with dilated cardiomyopathy has been recommended.¹



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Emergency response activities are strenuous and often require emergency responders to work at near maximal heart rates for long periods. In fire fighters, the increase in heart rate has been shown to begin with responding to the initial alarm and persist through the course of fire suppression activities.³⁻⁵ In the case described in this report, the physical exertion required by the fire fighters on the scene of the search and rescue appears to have been less than that required for other fire fighting duties, such as fire suppression. However, the physical exertion required in this case, in combination with the cardiomyopathy, appears to have been a trigger for this Assistant Chief's death.

In 1997, the National Fire Protection Association (NFPA) updated *Standard 1582, Medical Requirements for Fire Fighters*.⁶ This voluntary industry standard specifies minimum medical requirements for candidates and current fire fighters. Dilated cardiomyopathy is not specifically addressed in the standard. However, at a minimum it would be considered a Category B Medical Condition. A Category B Medical Condition is defined as "a medical condition that, based on its severity or degree, **could** (our emphasis) preclude a person from performing as a fire fighter in a training or emergency operational environment by presenting a significant risk to the safety and health of the person or others." It would not be unreasonable to consider dilated cardiomyopathy a type of "current congestive heart failure," which is a Category A Medical Condition. A Category A Medical Condition is defined as "a medical condition that **would** (our emphasis) preclude a person from performing as a fire fighter in a training or emergency operational environment by presenting a significant risk to the safety and health of the person or others." Irrespective of whether dilated cardiomyopathy would be considered a Category A or B Medical Condition, the issue is whether a periodic medical evaluation recommended by NFPA 1582 including exercise stress testing

(NFPA 1582 Appendix B [6]) would have prevented this unfortunate event from occurring. Although exercise stress testing would not be the test of choice used to diagnose cardiomyopathy, it is probable that it would have revealed decreased exercise capacity, and therefore provided an indication for performing other tests to determine the cause of the decreased exercise capacity.

RECOMMENDATIONS AND DISCUSSION

The following recommendations address preventive measures that have been recommended by other agencies to reduce, among other things, the risk of on-duty cardiac arrests among fire fighters. It cannot be determined, however, whether these recommendations could have prevented the sudden cardiac arrest and subsequent death of the fire fighter discussed in this report. These recommendations have not been evaluated by NIOSH, but represent research presented in the literature, regulations passed by enforcement agencies such as the Occupational Safety and Health Administration (OSHA), consensus votes of technical committees of the NFPA, and products of labor/management technical committees within the fire service. This preventive strategy consists of (1) minimizing physical stress on fire fighters; (2) screening to identify and subsequently rehabilitate high-risk individuals; and (3) encouraging increased individual physical capacity (fitness). Steps that could be taken to accomplish these ends include the following:

Recommendation #1: Emergency response personnel should have annual medical evaluations to determine their medical ability to perform duties without presenting a significant risk to the safety and health of themselves or others. This should include an exercise stress test as recommended by NFPA 1582.



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Guidance regarding the content and frequency of periodic medical evaluation for fire fighters can be found in *NFPA 1582, Standard on Medical Requirements for Fire Fighters*,⁶ and in the report of the International Association of Fire Fighters/International Association of Fire Chiefs wellness/fitness initiative.⁷ Although exercise stress testing, the testing recommended in NFPA 1582, would not be the test of choice used to diagnose cardiomyopathy, it is likely that it would have provided an indication of decreased exercise capacity, and therefore provided an indication for performing other tests to determine the cause of the decreased exercise capacity.

Applying this recommendation may involve legal and economic repercussions; they may be particularly difficult for volunteer fire departments, such as the one involved in this incident, to implement.

Recommendation #2: Reduce risk factors for cardiovascular disease and improve cardiovascular capacity by offering a wellness/fitness program for emergency response personnel.

NFPA 1500, Standard on Fire Department Occupational Safety and Health Program, requires a wellness program that provides health promotion activities for preventing health problems and enhancing overall well-being.⁸ In 1997, the International Association of Fire Fighters and the International Association of Fire Chiefs joined in a comprehensive Fire Service Joint Labor Management Wellness/Fitness Initiative to improve fire fighter quality of life and maintain physical and mental capabilities of fire fighters. Ten fire departments across the United States joined this effort to pool information about their physical fitness programs and to create a practical fire service program. They produced a manual with a video detailing elements of such a program.⁹ Fire departments should review

these materials to identify applicable elements for their department.

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INVESTIGATOR INFORMATION

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