



Career Lieutenant Suffers Sudden Cardiac Death At His Home After Finishing His Shift – Tennessee

SUMMARY

On March 9, 2006, a 42-year-old male career Lieutenant (LT) arrived for duty at his station around 0700 hours. Throughout his shift, he performed normal station training and duties and responded to three calls. The first call (0936 hours) was a non-emergency arcing power line, the second call (1038 hours) was a residential stove top fire, and the third call (2028 hours) was assisting ambulance personnel in transporting an agitated patient down stairs to the ambulance. The LT returned to his home on the morning of March 10th. He exercised both in the morning and afternoon, and had dinner and visited friends that evening. He returned home to his wife at 2100 hours. He was last seen alive, sleeping on his couch around 2200 hours.

At 0900 hours the following morning, his wife found him unresponsive on the same couch. He had rigid muscle tone and was cold to the touch. She called the police; upon arrival they called the Medical Examiner's office to transport the LT to the morgue. The death certificate (completed by the Medical Examiner) listed "hypertensive heart disease" as the immediate cause of death. The NIOSH investigator concluded the LT's hypertension and left ventricular hypertrophy (LVH) precipitated his sudden cardiac death (SCD).

NIOSH investigators offer the following recommendation to prevent similar incidents and/or to address general safety and health issues:

Collaborate with the local union to develop a wellness/fitness program consistent with

National Fire Protection Association (NFPA) 1583, Standard on Health-Related Fitness Programs for Fire Fighters and/or the Fire Service Joint Labor Management Wellness/Fitness Initiative.

INTRODUCTION & METHODS

Late in the evening of March 10, 2006, a 42-year-old male LT suffered an SCD at his home. On March 13, 2006, NIOSH contacted the affected Fire Department (FD) to gather information pertaining to the fatality. On July 31, 2006, an Occupational Advanced Practice Registered Nurse from the NIOSH Fire Fighter Fatality Investigation and Prevention Team traveled to Tennessee to conduct an on-site investigation of the incident.

During the investigation, NIOSH personnel interviewed the following people:

- FD personnel
- LT's wife

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. The program does not seek to determine fault or place blame on fire departments or individual fire fighters. 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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During the site visit, NIOSH personnel reviewed the following documents:

- FD policies and operating guidelines
- FD training records
- FD annual report for 2005
- FD incident reports
- Hospital records
- Medical records
- Autopsy report
- Death certificate

INVESTIGATIVE RESULTS

On March 9, 2006, a 42-year-old male career LT arrived for duty at his station around 0700 hours. Throughout his shift, he performed normal station training and duties and responded to three calls. The first call (0936 hours) was a non-emergency arcing power line, the second call (1038 hours) was a residential stove top cooking fire confined to the pan, and the third call (2028 hours) was assisting ambulance personnel in transporting an agitated patient down stairs to the ambulance. The LT's crew stated that he complained during the shift, of worse than normal indigestion.

On March 10th, after his shift, the LT returned home. As he was accustomed, he did not sleep while on-shift and stayed awake during the day following his shift. He exercised using free weights in the morning and ran three miles with his son that evening. He again complained of indigestion to his family; they reported that he appeared more fatigued than normal. The LT visited friends and returned home to fall asleep with his wife on the couch at 2100 hours. He appeared to "spit up" sometime around 2200 hours, and his wife cleaned and repositioned him before she went to bed, thinking he was asleep. Between 0100-0200 hours she saw her husband had not

moved and assumed he was still sleeping. She found her husband in the same position cold, ashen, and rigid at 0900 hours. Because of the LT's color and temperature, his wife called the police. When they arrived, they called the Medical Examiner's office to the home; he was pronounced dead and transported to the morgue.

Medical Findings. The death certificate (completed by the Medical Examiner) listed "hypertensive heart disease" as the immediate cause of death. An autopsy was performed by the Medical Examiner on March 13, 2006. Pertinent findings from the autopsy included the following:

- Cardiomegaly (enlarged heart): heart weight of 441 grams (g) (normal weight is <400 g)
- Left Ventricular Hypertrophy
 - left ventricle thickness was 1.5-2.0 centimeters (cm) (normal thickness is 0.6-1.1 cm)¹
 - Myocardial perivascular and patchy interstitial fibrosis
- Mild bilateral dilatation of left and right ventricles (no measurements were listed)
- Moderate to severe coronary artery disease (CAD) with 75% narrowing of the left anterior descending (LAD) artery
- Mild aortic sclerosis
- No evidence of thrombosis (blood clots) in his coronary arteries
- No evidence of a pulmonary embolus

The LT had an FD pre-hire medical evaluation (including an exercise stress test [EST]) in 1998, which was unremarkable, as was his FD annual medical evaluation in 1999. In February 2000, his blood pressure (BP) was first noted to be elevated at 138/100 millimeters of mercury (mmHg). The FD-contract physician medically certified the LT for 1 month with instructions to have his BP



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re-checked. After multiple return visits, he was cleared for unrestricted duty in August 2000, with a BP of 110/83 mmHg.

In April 2001, the LT's BP was again noted to be high (166/110 mmHg). He was again certified for one month and instructed to see his primary care physician (PCP) for further evaluation and treatment. He was prescribed antihypertensive medications and medically cleared to return to duty by the FD-contracted physician. At his 2002 FD medical evaluation, the LT's BP remained elevated (146/100 mmHg) despite taking antihypertensive medications. From 2003-2005, the LT was noted to have persistently high BP; he continued to work without restrictions.

On the day before and on the day of his death, the LT reported his "heartburn hurts worse than normal," and his wife said he seemed more fatigued than normal. In addition, he vomited shortly before he died. While not typical symptoms of a heart attack, it is possible they were the LT's "anginal equivalent." The LT exercised regularly, weighed 210 pounds, and was 71 inches tall on autopsy, giving him a body mass index (BMI) of 29.3 kilograms per square meters (kg/m^2). A BMI of 30.0 kg/m^2 to 39.9 kg/m^2 is considered obese.²

DESCRIPTION OF THE FIRE DEPARTMENT

At the time of the NIOSH investigation, this career FD consisted of 380 uniformed personnel, served a population of 155,000 in a 145 square-mile area, and had 17 fire stations.

In 2005, the FD responded to 23,640 calls: 38% for fires, 44% for rescue, 8% for hazardous materials, 8% for service, and 2% for false calls.

Employment and Training. The FD requires all fire fighter candidates to take a general aptitude test, physical ability test, polygraph test, and then be interviewed. All applicants are ranked and, depending on the number of open positions, the FD offers the top candidates positions on the condition they pass a pre-placement medical evaluation. Once hired, a recruit class is formed and attends a 26-week academy, where they are trained to Intermediate Emergency Medical Technician, Fire Fighter-I, and Hazmat Technician levels. They are then assigned to a station, where further training to Fire Fighter-II level is conducted until the Fire Fighter-II examination has been passed.

Pre-placement Medical Evaluation. A pre-placement medical evaluation is required by this FD for all applicants. The contents of the examination are as follows:

- Complete medical and occupational history
- Height, weight, and vital signs
- Physical examination
- Blood tests: complete blood count, lipid panel, and liver profile
- Urine tests: urinalysis and urine drug screen
- Chest x-ray (posteroanterior and lateral views) with interpretation and report
- 12-lead resting electrocardiogram (EKG) with interpretation and report
- Treadmill EST
- Spirometry
- Audiometry
- Vision test
- EPIC Lift Capacity Evaluation

These evaluations are performed by a physician under contract to the City. Once this evaluation is complete, the physician makes a determination regarding medical clearance for



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fire fighting duties and forwards this decision to the FD.

Periodic Evaluations. Annual medical evaluations are required by this FD for all members. The contents of the examination are the same as for the pre-placement exam, except there is no urine drug screen, no EPIC Lift Capacity Evaluation, the chest x-ray is performed every 5 years, and an EST is conducted according to the 2003 NFPA guidelines (suggested if the fire fighter has two or more CAD risk factors).

Health/Wellness. An annual physical agility test is required for all members. The FD has a voluntary fitness program; exercise equipment (strength and aerobic) is available in some fire stations. A return-to-duty medical clearance is required from the City-contracted physician for duty-related injuries. Fire fighters who miss shifts due to illness may be required to have a release from their PCP before they may return to work, particularly if they have missed work for an extended period. Health maintenance programs are available through the City Employee Assistance Program.

DISCUSSION

The following are two probable causes for this LT's death:

1. LVH leading to an arrhythmia and SCD
2. CAD leading to a myocardial infarction, an arrhythmia, and SCD

Left Ventricular Hypertrophy (LVH). On autopsy, the LT was found to have an enlarged heart and LVH. LVH is a relatively common finding among individuals with chronic cardiac ischemia (reduced blood supply to the heart muscle), a heart valve problem, or long-

standing high BP (hypertension). Since the LT showed no definitive signs of ischemia or heart valve problems on autopsy and he had a medical history of poorly-controlled high BP, his LVH was likely due to hypertension. LVH increases the risk for a cardiac arrhythmia and SCD.³

CAD and the Pathophysiology of SCD. In the United States, CAD (atherosclerosis) is the most common risk factor for cardiac arrest and SCD.⁴ Risk factors for its development include age over 45, male gender, family history of CAD, smoking, high BP (systolic >140 mmHg or diastolic >90 mmHg), high blood cholesterol (total cholesterol >240 mg/dL), obesity/physical inactivity, and diabetes.^{5,6} The LT had two of these risk factors (male gender and hypertension).

The narrowing of the coronary arteries by atherosclerotic plaques occurs over many years, typically decades.⁷ However, the growth of these plaques probably occurs in a nonlinear, often abrupt fashion.⁸ Heart attacks (myocardial infarctions) typically occur with the sudden development of complete blockage (occlusion) in one or more coronary arteries that have not developed a collateral blood supply.⁹ This sudden blockage is primarily due to blood clots (thromboses) forming on the top of atherosclerotic plaques. Although the LT was noted to have an occlusion of 75% in the LAD coronary artery on autopsy, he had no evidence of a recent (acute) thrombosis (blood clot). Given his isolated CAD (75% LAD lesion), atypical symptoms, and lack of a coronary artery thrombus, the LT's sudden death was probably not due to a heart attack.

Occupational Medical Standards for Structural Fire Fighters. To reduce the risk of SCD or other incapacitating medical conditions among fire fighters, the NFPA developed NFPA 1582, *Standard on*

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*Comprehensive Occupational Medical Program for Fire Departments.*¹⁰ The 2003 edition of NFPA 1582 recommends EST for FF with two or more NFPA-defined CAD risk factors (elevated cholesterol, hypertension, smoking, diabetes mellitus or a family history of premature CAD). Since the LT had only one CAD risk factor, NFPA would not have recommended an EST. However, an EST may have identified the LT's underlying heart disease, thereby leading to further evaluation and possible treatment. This guidance is similar to recommendations from the American College of Cardiology/American Heart Association (ACC/AHA) and the Department of Transportation regarding ESTs in asymptomatic individuals.^{11,12}

RECOMMENDATIONS

NIOSH investigators offer the following recommendations to prevent similar incidents and/or to address general safety and health issues:

Recommendation #1: Collaborate with the local union to develop a wellness/fitness program consistent with NFPA 1583, Standard on Health-Related Fitness Programs for Fire Fighters and/or the Fire Service Joint Labor Management Wellness/Fitness.

Physical inactivity is the most prevalent modifiable risk factor for CAD in the United States. Additionally, physical inactivity (or lack of exercise) is associated with other risk factors: obesity and diabetes.¹³ NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program*, and NFPA 1583 require a wellness program that provides health promotion activities for preventing health problems and enhancing overall well-being.^{14,15}

In 1997, the International Association of Fire Fighters/International Association of Fire Chiefs (IAFF/IAFC) published a comprehensive *Fire Service Joint Labor Management Wellness/Fitness Initiative* to improve fire fighters' quality of life and maintain physical and mental capabilities of fire fighters. Ten FDs across the United States joined this effort to pool information about their physical fitness programs and create a practical fire service program. They produced a manual and a video which detail elements of such a program.¹⁶ We recommend the FD and union review these materials to identify applicable elements. Other large-city negotiated programs can also be reviewed as potential models. Wellness programs have been shown to be cost effective, typically by reducing the number of work-related injuries and lost work days.¹⁷⁻¹⁹ A similar cost savings has been reported by the wellness program at the Phoenix FD, where a 12-year commitment has resulted in a significant reduction in disability pension costs.²⁰

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