



Career Battalion Chief Suffers Sudden Cardiac Death at His Desk – Kansas

SUMMARY

On November 15, 2004, a 47-year-old male Battalion Chief (BC) arrived for duty at his office around 0700 hours. He performed administrative functions throughout the morning and was last seen working at his desk shortly before 0900 hours. At 0917 hours, he was found collapsed at his desk. Despite exhaustive cardiopulmonary resuscitation (CPR) performed at the scene, in the ambulance, and in the emergency department (ED) of the local hospital, the BC died. The autopsy, completed by the District Coroner-Medical Examiner, revealed an enlarged heart with left ventricular hypertrophy and 50%-75% occlusions of the left anterior descending and right coronary arteries. The death certificate, completed by the District Coroner-Medical Examiner, listed “atherosclerotic cardiovascular disease (CVD)” as the immediate cause of death. The NIOSH investigator concluded the BC’s underlying heart disease caused his sudden cardiac death (SCD). His death may have been avoided at this time if the fire department (FD) had followed National Fire Protection Association (NFPA) 1582, *Standard on Comprehensive Occupational Medical Program for Fire Departments*.

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

*Provide **MANDATORY** annual medical evaluations to **ALL** fire fighters consistent with NFPA 1582 to determine their medical ability to perform duties without presenting a significant risk to the safety and health of themselves or others.*

Ensure fire fighters are cleared for duty by a physician knowledgeable about the physical demands of firefighting, the personal protective equipment used by fire fighters, and the various components of NFPA 1582.

Provide fire fighters with medical evaluations and clearance to wear self-contained breathing apparatuses (SCBA).

*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 Initiative** to reduce risk factors for cardiovascular disease (CVD) and improve cardiovascular capacity.*

Collaborate with the local union to phase in an annual physical performance (physical ability) evaluation to ensure fire fighters are physically capable of performing the essential job tasks of structural firefighting.

Although unrelated to this fatality, the FD should also designate a City employee to administer the FD pre-placement and annual medical evaluations and their outcomes.

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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INTRODUCTION & METHODS

On the morning of November 15, 2004, a 47-year-old male BC suffered a sudden cardiac death at his desk. On January 19, 2006, NIOSH contacted the affected FD to gather information pertaining to the fatality, and on May 8, 2006, to initiate the investigation. On May 15, 2006, an Occupational Health Nurse Practitioner from the NIOSH Fire Fighter Fatality Investigation and Prevention Team traveled to Kansas to conduct an on-site investigation of the incident.

During the investigation, NIOSH personnel interviewed the following people:

- FD personnel
- BC's wife
- City administrators
- Third party insurance administrators

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 report
- Ambulance response report
- Hospital records
- Medical records
- Autopsy report
- Death certificate

INVESTIGATIVE RESULTS

On November 15, 2004, the BC arrived for duty at his office around 0700 hours. He performed administrative functions throughout the morning and was last seen working at his desk shortly before 0900 hours. At 0917 hours, after failing to answer a question from a co-worker in an adjacent office, he was found collapsed at his desk. He was assessed and

found to be unresponsive, without a pulse, and not breathing. The rescuer yelled for assistance and eased the BC to the floor. The second rescuer arrived carrying the automatic external defibrillator (AED) and emergency medical service bag; as the first rescuer was getting the BC to the floor, a third rescuer called 911 at 0918 hours.

An oral airway was inserted and two breaths were administered while the AED was unpacked and attached. The AED stated no shock was to be administered and advised continuing CPR. The rescuers administered oxygen via a bag-valve-mask and continued CPR until paramedics arrived at 0922 hours.

The paramedics found the BC unresponsive, not breathing, and pulseless. The paramedic's defibrillator was attached and pacing was attempted. Although the BC's muscles were twitching, there was no capture of a pulse and he remained in asystole. An endotracheal airway was inserted and placement was confirmed using auscultation and a carbon dioxide monitor. An intravenous (IV) line was inserted and advanced cardiac life support (ACLS) drugs were administered. At 0943 hours, the BC was loaded onto a stretcher, placed into an ambulance, and transported to the ED of the local hospital. Multiple rounds of ACLS IV medications were administered en route, with no change in heart rhythm or clinical condition.

The ambulance arrived at the hospital ED at 0947 hours, 30 minutes after the BC's collapse. Initial evaluation in the ED found the BC to be in asystole, unresponsive, and with no spontaneous respirations. He was given two further rounds of ACLS medications, but never regained a heart rhythm. After 16 minutes of resuscitation efforts in the ED, in addition to the 30 minutes of resuscitation efforts in the field, the BC was pronounced dead at 1003 hours.

Medical Findings. The death certificate, completed by the District Coroner-Medical Examiner, listed "atherosclerotic cardiovascular disease" as



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the immediate cause of death. An autopsy was performed by the District Coroner-Medical Examiner on November 16, 2004. Pertinent findings from the autopsy included the following:

- Cardiomegaly (enlarged heart): heart weighed 534 grams (normal is <400 g)
- Left ventricular hypertrophy (LVH)
 - left ventricle thickness was 1.5 centimeters (cm) (normal is 0.6-1.1 cm)¹
 - interventricular septum thickness was 1.5 cm (normal is 0.6-1.1 cm)¹
- Essentially normal endocardium, myocardium, and epicardium tissue.
- Two vessel coronary artery disease (CAD) with 50%-75% narrowing of the left anterior descending and right coronary arteries by atherosclerotic plaque
- No evidence of thrombosis
- Mild fibrous thickening of the cusps of the aortic valve
- No evidence of a pulmonary embolus.

According to the family, the BC was seldom sick, had very little medical history, and no history of heart problems. In 1978, he had a normal pre-employment physical examination. Blood pressure readings from 1988 to 1993 and from 2000 to 2003, taken as part of an FD voluntary blood pressure evaluation, were normal. The BC was never off work long enough to warrant a return-to-work clearance. According to his wife and crew members, he had no complaints of chest pains or any other heart-related illness. On the day of his death, the BC did not report any symptoms suggestive of angina or any other heart problem. The BC did not exercise on a regular basis, weighed 240 pounds, and was 74 inches tall on autopsy, giving him a body mass index (BMI) of 30.8 kilograms per meters² (kg/m²).² A BMI of 30.0 kg/m² to 39.9 kg/m² is considered obese.²

DESCRIPTION OF THE FIRE DEPARTMENT

At the time of the NIOSH investigation, this career FD consisted of 397 uniformed personnel, served a population of 350,000 in a 154 square-mile area, and had 19 fire stations.

In 2005, the FD responded to 39,158 calls: 3,387 fires, 29,729 emergency medical calls, and 5,467 other service calls.

Employment and Training. The FD requires all fire fighter candidates to take a general aptitude test and physical ability test conducted by the local community college. The FD ranks applicants based on their scores on these tests. The FD then interviews the top 30% and gives credit for relevant college classes, experience, and technical training. A new list is formed, and depending on the number of fire fighters they are hiring, the FD offers the top candidates positions pending results of a physical examination and drug screen. License and background checks are conducted, as well as verification of Emergency Medical Technician (EMT) training. The recruit class is formed and attends a 10-week department academy. New recruits are then assigned to a station and, after one year of probation, are given the basic FF-I skills test. Further training to FF-II is conducted in the station until the FF-II examination has been passed.

Pre-placement Physical Examination. A pre-placement physical examination 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



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- Chest x-ray (posteroanterior and lateral views) with interpretation and report
 - 12-lead resting electrocardiogram (EKG) with interpretation and report
 - Treadmill exercise stress test (EST)
 - Audiometry
 - Vision test
 - Functional capacity evaluation
- 2) CAD leading to a Myocardial Infarction, then an arrhythmia, and finally, an SCD
 - 3) Combination of any of the above
 - 4) SCD of unknown origin

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 firefighting duties and forwards this decision to the FD.

Periodic Evaluations. Required medical evaluations are offered every other year to hazardous materials operations level responders. A City-contracted physician performs the medical evaluations and forwards the clearance-for-duty decision to the FD, who makes the final determination.

No annual physical agility test is required for members. The FD has a voluntary fitness program. Exercise equipment (strength and aerobic) is available in all fire stations. A return-to-duty medical clearance is required from the City-contracted physician for duty-related injuries. Fire fighters who miss more than five shifts due to illness must have a release from their primary care physician before they may return to work. There is no medical component to the SCBA program, but a fit test is performed annually. Health maintenance programs are available through the city employee assistance program.

DISCUSSION

There are four probable causes of death of this BC. Each of the following conditions is discussed further below:

- 1) LVH leading to an arrhythmia and then SCD

Left Ventricular Hypertrophy (LVH). On autopsy, the BC was found to have an enlarged heart and LVH. LVH is a relatively common finding among individuals with long-standing high blood pressure (hypertension), a heart valve problem, or chronic cardiac ischemia (reduced blood supply to the heart muscle). Since the BC's blood pressure readings were normal and the autopsy showed no signs of ischemia, his LVH was likely due to the valvular problem found on autopsy (mild fibrosis of the cusps of the aortic valve).

Coronary Artery Disease (CAD) and the Pathophysiology of Sudden Cardiac Death (SCD). In the United States, CAD (atherosclerosis) is the most common risk factor for cardiac arrest and SCD.³ Risk factors for its development include age over 45, male gender, family history of CAD, smoking, high blood pressure (systolic >140 mmHg or diastolic >90 mmHg), high blood cholesterol (total cholesterol >240 mg/dL), obesity/physical inactivity, and diabetes.^{4,5} The BC had three of these risk factors (age over 45, male gender, and obesity/physical inactivity).

The narrowing of the coronary arteries by atherosclerotic plaques occurs over many years, typically decades.⁶ However, the growth of these plaques probably occurs in a nonlinear, often abrupt fashion.⁷ 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.⁸ This sudden blockage is primarily due to blood clots (thromboses) forming on the top of atherosclerotic plaques. On autopsy, the BC was noted to have occlusions of 50%-72% in two coronary arteries, but no evidence of a recent (acute) thrombosis (blood clot). Given his lack of a coronary artery thrombus, the BC's sudden



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death could be due to a heart arrhythmia associated with his underlying heart disease. Other tests used to confirm a heart attack such as blood tests (cardiac isoenzymes) or EKG findings were not helpful in this case because the BC died prior to cardiac isoenzymes becoming positive, and he had no heart beat to show the characteristic findings of a heart attack on the EKG. Since up to 20% of heart attacks are silent (i.e., no angina),⁹ the lack of symptoms in this BC cannot definitively rule out a heart attack.

Occupational Medical Standards for Structural Fire Fighters. To reduce the risk of sudden cardiac arrest or other incapacitating medical conditions among fire fighters, NFPA developed NFPA 1582.¹⁰ Since the BC did not have two or more NFPA defined CAD risk factors (elevated cholesterol, hypertension, smoking, diabetes mellitus or a family history of premature CAD), NFPA 1582 would not have recommended an EST. Although, an EST may have identified his underlying heart disease, thereby leading to further evaluation and possible treatment.

RECOMMENDATIONS

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

Recommendation #1: Provide MANDATORY annual medical evaluations to ALL fire fighters consistent with NFPA 1582 to determine their medical ability to perform duties without presenting a significant risk to the safety and health of themselves or others.

Guidance regarding the content and frequency of pre-placement and periodic medical evaluations and examinations for structural fire fighters can be found in NFPA 1582¹⁰ and in the report of the International Association of Fire Fighters/International Association of Fire Chiefs (IAFF/IAFC) wellness/fitness initiative.¹¹ Although the FD is not legally required to follow any of these standards, they provide effective

guidelines for implementing a medical evaluation requirement.

Applying NFPA 1582 involves economic issues. These economic concerns go beyond the costs of administering the medical program; they involve the personal and economic costs of dealing with the medical evaluation results. NFPA 1500, *Standard on Fire Department Occupational Safety and Health Program*, Chapter 8-7.1 and 8-7.2¹² addresses these issues.

The physical evaluation could be conducted by the fire fighter's primary care physician or a City-contracted physician. If the evaluation is performed by the fire fighter's primary care physician, the results must be communicated to a City physician, who makes the final determination for clearance for duty.

Recommendation #2: Ensure fire fighters are cleared for duty by a physician knowledgeable about the physical demands of firefighting, the personal protective equipment used by fire fighters, and the various components of NFPA 1582.

Physicians who provide input regarding medical clearance for firefighting duties should be knowledgeable about the physical demands of firefighting and should recognize that fire fighters frequently respond to incidents in environments that are immediately dangerous to life and health. They should also be familiar with a fire fighter's personal protective equipment and the consensus guidelines published by NFPA 1582. We also recommend the FD retain a physician to critically review all medical clearances. The FD physician should make return to work decisions independent of the opinions of specialists or other treating physicians and based on knowledge not only of the medical condition, but also of the fire fighter's job duties. Personal physicians may not be familiar with a fire fighter's job duties or with guidance documents such as NFPA 1582. In addition, they may overlook the potential public health impact of public safety officials who may become suddenly incapacitated.



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Recommendation #3: Provide fire fighters with medical evaluations and clearance to wear SCBA.

The Occupational Safety and Health Administration (OSHA)'s Revised Respiratory Protection Standard requires employers to provide medical evaluations and clearance for employees using respiratory protection.¹³ Such employees include fire fighters who utilize SCBA in the performance of their duties. These clearance evaluations are required for private industry employees and public employees in states operating OSHA-approved state plans. Kansas does not operate an OSHA-approved state plan, therefore, public sector employers are not required to comply with OSHA standards. Nonetheless, we recommend following this standard to ensure fire fighters are medically cleared annually to wear SCBA.

Recommendation #4: 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 Initiative to reduce risk factors for cardiovascular disease (CVD) and improve cardiovascular capacity.

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.¹⁴ 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.^{12,15}

In 1997, the 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.¹¹ 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.¹⁶⁻¹⁸ 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.¹⁹

Recommendation #5: Collaborate with the local union to phase in an annual physical performance (physical ability) evaluation to ensure fire fighters are physically capable of performing the essential job tasks of structural firefighting.

NFPA 1500 requires FD members who engage in emergency operations to be annually evaluated and certified by the FD as meeting the physical performance requirements identified in paragraph 8-2.1 of the standard.¹²

Although unrelated to this fatality, the FD should consider this additional recommendation based on health and economic considerations:

Recommendation #6: Designate a City employee to administer the FD pre-placement and annual medical evaluations and their outcomes.

This employee should maintain the confidentiality of the medical records. If this employee is a member of the FD and participating in the City's annual medical evaluation, a policy should prevent them from administering the program to themselves.

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