



## **Volunteer Fire Fighter Suffers Sudden Cardiac Death About 50 Minutes After Fighting A Grass Fire – Kansas**

### **SUMMARY**

On January 14, 2006, a 28-year-old male volunteer Fire Fighter (FF) responded to two alarms. The first alarm was cancelled when the FF reported to the station and the second involved strenuous physical activity at a grass fire. The FF then returned home, cleaned up, and left with his family to run errands. A call for a second grass fire was received. The FF called the fire station and was told there was no room for him on the apparatus. He continued with his errands and less than 50 minutes after responding to the first grass fire, the FF collapsed in his personally owned vehicle (POV). The Emergency Medical Service (EMS) was notified and arrived 4 minutes later to find cardiopulmonary resuscitation (CPR) being conducted by an off-duty nurse. Despite prolonged life support performed at the scene, in the ambulance, and in the emergency department (ED) of the local hospital, the FF died. The autopsy (completed by the Deputy Coroner-Medical Examiner) stated the FF's cause of death was "Probable heritable cardiac arrhythmia (Brugada Syndrome)."

The NIOSH investigator concluded an arrhythmia caused by Brugada Syndrome probably caused the FF's sudden cardiac death (SCD). It is also possible that the strenuous levels of physical exertion during the grass fire triggered his SCD. If the fire department (FD) had been performing annual medical evaluations consistent with the National Fire Protection Association (NFPA) 1582, *Standard on Comprehensive Occupational Medical Program for Fire Departments*, perhaps his heart condition would have been diagnosed and treated, thus preventing his death at this time.

NIOSH investigators offer the following recommendations to prevent similar incidents.

*Provide mandatory pre-placement and 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.*

Although unrelated to this fatality, the Fire Department should consider these additional recommendations based on health and safety considerations:

*Provide fire fighters with medical clearance to wear self-contained breathing apparatuses (SCBAs) as part of the FD's medical evaluation program.*

*Phase in a wellness/fitness program for fire fighters to reduce risk factors for cardiovascular disease and improve cardiovascular capacity.*

*Perform an annual physical performance (physical ability) evaluation for ALL fire fighters to ensure they are physically capable of performing the essential job tasks of structural firefighting.*

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

[www.cdc.gov/niosh/fire](http://www.cdc.gov/niosh/fire)  
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## **Volunteer Fire Fighter Suffers Sudden Cardiac Death About 50 Minutes After Fighting A Grass Fire – Kansas**

### **INTRODUCTION & METHODS**

On January 14, 2006, a 28-year-old male volunteer FF suffered a SCD after fighting a grass fire. On January 20, 2006, NIOSH contacted the affected FD. On May 16, 2006, an Occupational Advanced Registered Nurse from the NIOSH Fire Fighter Fatality Investigation Team traveled to Kansas to conduct an on-site investigation of the incident.

During the investigation, NIOSH personnel interviewed the following people:

- Fire Chief
- FF's wife
- The Deputy Coroner-Medical Examiner

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

### **INVESTIGATIVE RESULTS**

**Incident.** On January 14, 2006, a 28-year-old male volunteer FF responded to two alarms during the day, then collapsed shortly after observing a third fire. The first call of the day began at 1147 hours. The FF responded to the station, but the call was a “disregard” and he returned home. The second call of the day began at 1309 hours, for which he performed on-line (using rakes and shovels) firefighting at a grass fire. After fighting the fire for about 1 hour, it was

extinguished and the FF returned to the station for equipment clean-up and maintenance. He returned home at approximately 1441 hours. His exertional level throughout this response was characterized as very strenuous by the Fire Chief.

At approximately 1455 hours, the FF left home with his family to run errands, when his department was dispatched to another grass fire. He called his station from his POV and was told there was no room for him on the apparatus. He instructed his wife to drive around the fire to gauge its potential; then continued his errands. Less than 50 minutes after responding to the first grass fire, he collapsed in his POV at around 1531 hours.

EMS was notified and an Emergency Medical Technician (EMT) from a local FD arrived 4 minutes later, followed within 1 minute by an apparatus from the same department with more EMTs. They found the FF unresponsive with no pulse, agonal respirations, and receiving CPR by an off-duty nurse. An oral airway was inserted and respirations were continued using a bag valve mask. An automatic external defibrillator was applied, but no shockable rhythm was reported.

CPR and basic life support was continued until an ambulance with two paramedics arrived from the County EMS at 1539 hours. The paramedics re-assessed the FF. Finding no pulse or respirations, they attempted to intubate [place an endotracheal breathing tube (ETT) into the airway (trachea)]. This was not successful. The FF was placed on a cardiac monitor and his heart rhythm was found to be in ventricular fibrillation (VF) [a heart rhythm incompatible with life]. At 1545 hours, a series of stacked shocks was administered with no change in his heart rhythm. A second intubation attempt at 1549 hours was unsuccessful. An intravenous (IV) line was successfully inserted and IV medications consistent with life support protocols were given. At 1550 hours, an automatic compression device was placed on the FF and a 3rd attempt at ETT insertion was successful. The tube placement was confirmed via breath sounds and a CO<sub>2</sub>



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detector. At 1601 hours, the FF was defibrillated for VF resulting in asystole (no heart beat).

The ambulance departed the scene at 1607 hours arriving at the ED at 1620 hours, without change in the FF's clinical status. In the ED, the FF was unresponsive with no heart beat or spontaneous respirations. ETT placement was verified and CPR continued. Since the FF had no effective heart beat for 55 minutes, resuscitation efforts were stopped, and the FF was pronounced dead at 1626 hours.

***Medical Findings.*** An autopsy was performed on January 16, 2006 by the Deputy Coroner-Medical Examiner. Significant findings from the autopsy report included the following:

- Probable heritable cardiac arrhythmia (Brugada Syndrome)
  - History of two syncopal episodes in September 2005 and January 2006
  - Electrocardiogram (EKG), September 2005, indicating sinus bradycardia with first degree block and other abnormalities
- Cardiomegaly (heart weighed 478 grams [g]; normal range is 261-455 g)
- Coronary arteries free of significant atherosclerosis or thrombus
- No pulmonary embolus

In September 2005 the FF experienced a syncopal (unconscious) episode at home and was rushed by ambulance to the hospital. A computerized tomography (CT) scan was negative for intracranial abnormalities. An EKG showed a first degree AV block (by computerized reading), but this finding was not mentioned in the ED encounter form. The FF was diagnosed with a "Severe Tension Headache and Dental Decay" and released from the ED with pain medications, antibiotics, and instructions to follow-up with his dentist. His most recent blood pressure reading (taken in the emergency room in September 2005) was 126/76 millimeters of mercury. According to his family and FD personnel, the FF seldom exercised. He had

expressed no signs or symptoms of chest pain, shortness of breath, or any other discomfort to his wife, co-workers, or health care providers prior to this incident. He had no family history of cardiac disease, although his father did have a history of syncope. At the time of his death, his body mass index was 23.4 kilograms (kg)/meter (m)<sup>2</sup> (normal).<sup>1</sup>

## **DESCRIPTION OF THE FIRE DEPARTMENT**

At the time of the NIOSH investigation, the FD consisted of three career and 25 volunteer fire fighters. Its two fire stations served a population of 8,000 in a geographic area of 71 square miles.

In 2004, the FD responded to 147 calls: 50 fires, 45 rescue and medical calls, 3 hazardous condition calls, 28 false alarm/good intent calls, 2 service calls, and 19 other calls and incidents.

***Training.*** The FD requires all new volunteer fire fighter applicants to complete an application and to interview with the Assistant Fire Chief and two Volunteer Captains. Accepted applicants must attend the FD fire school one night a week for 4 hours for 16 weeks, which certifies them at the equivalent level of Fire Fighter I (FFI). Fire Fighter II (FFII) training is taught in the FD during drills. Interior fire attack training is allowed only for specific fire fighters who are designated for this training by the leadership. The FF was trained in apparatus operation, first aid/CPR, Hazardous Materials Operations, FFI, and FFII. He had 5 years of volunteer firefighting experience.

***Pre-placement Medical Evaluations.*** The FD does not require a pre-placement medical evaluation for volunteer fire fighters. Career applicants however, are required to have a medical evaluation. Components of that evaluation include:

- Complete medical and occupational history
- Height, weight, and vital signs
- Physical examination



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- Blood tests: complete blood count, lipid panel, and liver profile
- Urine tests: urinalysis and urine drug screen

**Periodic Medical Evaluations.** The FD does not require periodic medical evaluations for career or volunteer FFs. However, fire fighters are encouraged to receive a complete physical examination through their employer, or at their own expense, and to provide a medical clearance form to the FD. Medical clearance for SCBA use is not required. All FFs who are injured while performing FD duties are evaluated and cleared for return to duty by a FD contract physician.

**Fitness/Wellness Programs.** Although aerobic and strength training equipment is available at the stations, there is no organized fitness program. Similarly, the FD does not provide a wellness program.

## **DISCUSSION**

The FF's autopsy revealed no reason for his sudden death. None of the following risk factors for sudden death were identified:

- CAD
- thrombus (blood clot in any of the coronary arteries)
- blood clots in his lungs
- cerebral hemorrhages (stroke)

Postmortem, the FF's family had the 2005 ED records reviewed by a cardiologist, who felt that the FF's EKG showed repolarization patterns similar to Brugada Syndrome (see below). The cardiologist issued a consultation letter stating that he believed the syncopal episodes were due to Brugada Syndrome.

Brugada Syndrome, identified in 1992, is an ion channelopathy diagnosed by EKG changes of the right bundle branch block and ST-segment elevation in V1-V3.<sup>2,3</sup> It is an autosomal dominant disorder with a high incidence of SCD, typically striking

in young adulthood.<sup>4</sup> Syncopal episodes or EKG abnormalities are frequently the presenting findings of Brugada syndrome.<sup>5</sup> In one study, up to 80% of Brugada Syndrome patients presenting in cardiac arrest had a previous syncopal event.<sup>6</sup> Given the FF's prior syncopal episode coupled with his EKG abnormalities, he should probably have been referred for further cardiac evaluation. It is possible that an EKG, conducted as part of a fire fighter medical evaluation, could have shown abnormalities that would have resulted in further evaluation, diagnosis, and treatment (implantable defibrillator). On the other hand, the EKG findings of Brugada syndrome can be masked.<sup>4</sup>

## **RECOMMENDATIONS**

NIOSH investigators offer the following recommendations to prevent similar incidents.

**Recommendation #1: Provide mandatory pre-placement and 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.<sup>7</sup>**

Guidance regarding the content and frequency of pre-placement and periodic medical evaluations and examinations for fire fighters can be found in NFPA 1582 and in the report of the International Association of Fire Fighters/International Association of Fire Chiefs (IAFF/IAFC) wellness/fitness initiative.<sup>8</sup> However, the FD is not legally required to follow any of these standards.

The success of medical programs hinges on protecting the affected fire fighter. The FD must: 1) keep medical records confidential, 2) provide alternate duty positions for fire fighters in rehabilitation programs, and 3) provide permanent alternate duty positions or other supportive and/or compensated alternatives if the fire fighter is not medically qualified to return to active firefighting duties.



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This recommendation involves economic repercussions and may be particularly difficult for small, rural, volunteer fire departments to implement. To overcome the financial obstacle, the FD could ask the volunteer FFs to complete the brief annual medical evaluations recommended by NFPA 1582 themselves. The FFs would complete the medical and occupational history portions, and EMT's from the county's emergency medical service would complete the portions for vital signs, height, weight, visual acuity and resting EKG. This information could then be provided to a community physician, perhaps volunteering his or her time, to review the data and provide medical clearance (or further evaluation, if needed). The more extensive medical examinations could be performed by a private physician at the fire fighter's expense, provided by a physician volunteer, or paid for by the FD. Sharing the financial responsibility for these evaluations between volunteers, the FD, and willing physician volunteers should reduce the negative financial impact on recruiting and retaining needed volunteers. These and other suggestions can be found in the National Volunteer Fire Council (NVFC) and United States Fire Administration's (USFA) *Health and Wellness Guide for the Volunteer Fire Service*, FA-267/January 2004.<sup>9</sup>

***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 understand that fire fighters frequently respond to incidents in IDLH environments. They should also be familiar with a fire fighter's personal protective equipment and the consensus guidelines published by NFPA 1582.<sup>7</sup> To ensure physicians are aware of these guidelines, we recommend that the FD or the fire fighter provide the personal physicians with a copy of NFPA 1582.

Although unrelated to this fatality, the Fire Department should consider these additional recommendations based on health and safety considerations:

***Recommendation #3: Provide fire fighters with medical clearance to wear self-contained breathing apparatuses (SCBAs) as part of the FD's medical evaluation program.***

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.<sup>10</sup> 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.<sup>11</sup> Nonetheless, we recommend following this standard to ensure fire fighters are medically able to wear SCBA.

***Recommendation #4: Phase in a wellness/fitness program for fire fighters to reduce risk factors for cardiovascular disease and improve cardiovascular capacity.***

Physical inactivity is the most prevalent modifiable risk factor for CAD in the United States. Physical inactivity, or lack of exercise, is associated with other CAD risk factors: obesity and diabetes.<sup>12</sup> NFPA 1500 requires a wellness program that provides health promotion activities for preventing health problems and enhancing overall well-being.<sup>13</sup> Wellness programs have been shown to be cost effective, typically by reducing the number of work-related injuries and lost work days.<sup>14-16</sup> 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 their disability pension costs.<sup>17</sup> Guidance for how to implement and components of a wellness and fitness program include:



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- NFPA 1583, *Standard on Health-Related Fitness Programs for Fire Fighters*; <sup>18</sup>
- International Association of Fire Fighters/ International Association of Fire Chiefs (IAFF/IAFC), *Fire Service Joint Labor Management Wellness/Fitness Initiative*; <sup>8</sup>
- National Volunteer Fire Council (NVFC) / United State Fire Administration (USFA) *Health and Wellness Guide for the Volunteer Fire Service*.<sup>9</sup>

NIOSH has supplied the FD with these documents.

**Recommendation #5: Perform an annual physical performance (physical ability) evaluation for ALL fire fighters to ensure they 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.<sup>13</sup>

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