



Fire Fighter Suffers Intracranial Cyst Bleed During Residential Fire Operations and Dies Three Days Later – Virginia

SUMMARY

On June 4, 2009, a 39-year-old male career fire fighter (the FF) drove a fire engine to a fire in an abandoned dwelling. At the fire scene, the FF performed driver/operator duties. Still at the fire scene approximately 3 hours later, the FF complained of a headache and of not feeling well. An ambulance transported the FF to the local hospital's emergency department (ED). A computed tomography (CT) scan revealed the FF was experiencing an intracranial bleed due to a "hemorrhagic colloid cyst" with "acute obstructive hydrocephalus." The FF was immediately transferred to a regional hospital for advanced care. Despite intensive treatment over 3 days, the FF's condition deteriorated, and he died. The death certificate, completed by the attending physician, listed "herniation" due to "obstructive hydrocephalus" due to "colloid cyst" as the cause of death. No autopsy was performed. NIOSH investigators agree with this conclusion and are unable to determine whether the physical exertion involved in performing driver/operator duties contributed to or triggered his death.

None of the following recommendations could have prevented the FF's death. Nonetheless, we offer the recommendations to address general safety and health issues at this and other fire departments across the country.

- *Provide annual medical evaluations to all fire fighters.*
- *Perform a preplacement and an annual physical performance (physical ability) evaluation.*
- *Ensure fire fighters are cleared for return to duty by a physician knowledgeable about the physical demands of fire fighting, the personal protective equipment used by fire fighters, and the various components of NFPA 1582.*
- *Phase in a comprehensive wellness and fitness program for fire fighters.*
- *Provide fire fighters with medical clearance to wear self-contained breathing apparatus (SCBA) as part of the Fire Department's medical evaluation program.*

INTRODUCTION & METHODS

On June 8, 2009, a 39-year-old male career fire fighter died after suffering an intracranial hemorrhage while working at a house fire. NIOSH was notified of this fatality on June 10, 2009, by the U.S. Fire Administration. NIOSH contacted the affected Fire Department (FD) on June 18, 2009, to gather additional information and on August 21, 2009, to initiate the investigation. On August 31, 2009, a safety and occupational



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health specialist from the NIOSH Fire Fighter Fatality Investigation Team traveled to Virginia to conduct an on-site investigation of the incident. During the investigation, NIOSH personnel interviewed the following people:

- Fire Chief
- FD Training Officer
- Crew Members
- FF's Spouse

NIOSH personnel reviewed the following documents:

- FD policies and operating guidelines
- FD training records
- FD annual report for 2008
- Witness statements
- Dispatch report
- Emergency medical service (ambulance) incident report
- Hospital ED records
- Death certificate
- Primary care provider medical records

RESULTS OF INVESTIGATION

Incident. On June 4, 2009, the FD was dispatched to a fire in an abandoned five-room, wood-frame dwelling (2156 hours). Engine 2 (driver operator [the FF] and a captain) responded. It arrived on scene at 2204 hours and

began operations. Medic 50, staffed with two emergency medical technicians, also responded. The dwelling was fully involved in fire. The FF stopped Engine 2 at a hydrant, where the Captain removed the four-way hose appliance with a 3-inch supply hose and wrapped the hydrant. The FF advanced Engine 2 to a location near the house and connected the supply hose. The Captain advanced a 1¾-inch attack line to a defensive position as the FF charged the line.

Eventually 18 personnel responded, including the Fire Chief, who first assisted with operations then assumed incident command as additional personnel arrived. Operations continued until 2257 hours, when the fire was declared under control. Several units and personnel, including Medic 50, were released.

At approximately 0102 hours, June 5, 2009, the Captain radioed the FF to shut down the hoses. According to witnesses, the FF looked at his radio, apparently unable to understand the order. The FF responded by asking the Captain to come to Engine 2 for a meeting. The FF told the Captain that he was not feeling well, his head hurt, and he had lost his vision on the right side. The Captain notified the Chief who radioed Dispatch to request an ambulance (0104 hours). Medic 50 returned to the scene, finding the FF complaining of a severe headache. His vital signs included a blood pressure of 124/98 millimeters of mercury (mmHg), a pulse rate of 68 beats per minute, a breathing rate of 18 breaths per minute, and pupils that were equal and reactive to light (normal). Ten minutes later, his blood pressure had lowered



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to 120/60 mmHg. Oxygen was administered as the ambulance departed the scene at 0110 hours en route to the hospital's ED.

The ambulance arrived at the ED at 0120 hours. Inside the ED, a CT scan of the FF's head revealed a hemorrhagic colloid cyst causing obstructive hydrocephalus. The FF was stabilized and transferred to a regional hospital for advanced care.

At the regional hospital, the FF experienced seizure-like activity followed by a compromised airway; he was intubated. Throughout the next 3 days, the FF was treated and monitored while remaining on life support. No surgery was performed, but several CT scans were done. The FF's condition continued to deteriorate until June 8, 2009, when he died at 1430 hours.

Medical Findings. The death certificate, completed by the attending physician, listed "herniation" due to "obstructive hydrocephalus" due to "colloid cyst" as the cause of death. No autopsy was performed because of the availability of information from the extensive diagnostic testing performed in both hospitals.

The FF had no known medical problems, but over the past few weeks noted minor headaches.

DESCRIPTION OF THE FIRE DEPARTMENT

At the time of the NIOSH investigation, the FD consisted of one fire station with 34 uniformed

personnel (10 career and 24 volunteers) that served 12,700 residents in a geographic area of 67 square miles. In 2008, the FD responded to 359 calls: 18 structure fires, 8 vehicle fires, 10 brush/grass/wildland fires, 7 rubbish fires, 13 other fires, 109 hazardous condition calls, 43 false alarms, 25 hazardous materials calls, 14 rescue/medical calls, and 112 other calls.

Membership and Training. The FD requires new career fire fighter applicants to have or pass the following: completed application; high school diploma or equivalent; criminal background check; valid state driver's license; state-certified Fire Fighter II; Emergency Vehicle Operator's Course Class 1, 2, and 3; basic computer skills; and mechanical aptitude. Applicants must be nonsmokers, undergo a preplacement medical evaluation and a drug screen, be willing to continue advanced training and respond to off-duty alarms as needed, and be in good physical condition with weight in proportion to height.

The new member is placed onto a 24-hour on, 24-hour off shift, working 3 of 5 days, then is off-duty for 4 days. Shift work begins at 0745 hours and ends at 0800 hours the next morning. New volunteer members must attain the Fire Fighter II level within 3 years of joining the FD. The FF was certified as Fire Fighter II, Fire Officer I, in Hazardous Materials operations, and in Emergency Vehicle operations. He had 7 years of fire fighting experience.



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Pre-placement Medical Evaluation. In 2009, the FD began requiring preplacement medical evaluations for all members, regardless of age. Components of this evaluation include the following:

- History
- Vital signs
- Physical examination
- Urinalysis
- Resting electrocardiogram (EKG)
- Baseline chest x-ray
- Vision screen
- Hearing test
- Pulmonary function test
- Occupational Safety and Health Administration (OSHA) respirator clearance
- Other tests as indicated

These evaluations are performed by a city-contracted physician who determines medical clearance for fire fighting duties. The FF did not have a preplacement medical evaluation because the program was not in place when he joined the FD in 2002.

Periodic Medical Evaluations. Periodic (annual) medical evaluations are not currently required by the FD. An annual SCBA facepiece fit test is required for fire fighters, but no annual SCBA medical clearance is currently required. However, in 2008, the FF performed a pulmonary function test as part of the FD's respirator clearance program. The test revealed a possible early obstructive pulmonary impairment. How-

ever, he was cleared to wear a respirator.

Career members injured on duty must be evaluated by the City workers' compensation physician who makes the final determination regarding return to duty. Volunteer members are cleared for duty by their insurance physician. All members who are ill and miss work must be cleared for return to duty by their personal physician.

Health and Wellness Programs. The FD does not have a formal wellness/fitness program, and no exercise equipment is available in the fire station. Employee assistance programs, if requested, are available from the City for career members. No annual physical ability test is required.

DISCUSSION

Colloid Cyst and Sudden Death. Colloid cysts are benign tumors found in the brain's third ventricle. They are rare, accounting for less than 1.0% of all intracranial tumors [Aronica et al. 1998]. Most colloid cysts are asymptomatic and are discovered incidentally during brain scans. However, some colloid cysts can block the flow of cerebrospinal fluid. This obstruction, typically intermittent and positional, increases the pressure inside the brain, resulting in a condition known as hydrocephalus. Clinically, this usually manifests as a headache or, in more advanced cases, severe headaches with nausea and vomiting [Humphries et al. 2008]. Rarely, a colloid cyst can cause acute complete obstruction, sometimes with bleeding (hemorrhage). This



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rapid rise in pressure and acute hydrocephalus can result in the sudden loss of consciousness, coma, and death [Büttner et al. 1997; Shemie et al. 1997; Stoodley et al. 1999].

The FF's history of intermittent headaches over the last few weeks was consistent with a colloid cyst. But, headaches are a very common and nondiagnostic symptom (only 5% of headaches are found to have a pathologic etiology) [Humphries et al. 2008]. Colloid cysts are diagnosed by brain scans such as CT or magnetic resonance imaging. Brain scans, however, are not routinely performed on asymptomatic individuals. Therefore, even if this FD conducted periodic medical evaluations, this FF's colloid cyst was unlikely to have been identified prior to this incident.

Other than family history, there are no known risk factors for developing colloid cysts and no known risk factors for their acute rupture and hemorrhage. Therefore, NIOSH investigators are unable to address whether fire suppression activities triggered the acute obstruction and hemorrhage of this FF's colloid cyst.

RECOMMENDATIONS

None of the following recommendations could have prevented the FF's death. Nonetheless, we offer the recommendations to address general safety and health issues at this and other fire departments across the country.

Recommendation #1: Provide annual medical evaluations to all fire fighters.

Guidance regarding the content and frequency of these medical evaluations can be found in NFPA 1582 and in the International Association of Fire Fighters (IAFF)/International Association of Fire Chiefs (IAFC) Fire Service Joint Labor Management Wellness/Fitness Initiative [IAFF, IAFC 2007; NFPA 2007]. These evaluations are performed to determine fire fighters' medical ability to perform duties without presenting a significant risk to the safety and health of themselves or others. However, the FD is not legally required to follow this standard or this initiative. Applying this recommendation involves economic repercussions and may be particularly difficult for small fire departments to implement.

To overcome the financial obstacle of medical evaluations, the FD could urge current members to get annual medical clearances from their private physicians. Another option is having the annual medical evaluations completed by paramedics and emergency medical technicians (EMTs) from the local EMS (vital signs, height, weight, visual acuity, and EKG). This information could then be provided to a community physician (perhaps volunteering his or her time), who could review the data and provide medical clearance (or further evaluation, if needed). The more extensive portions of the medical evaluations could be performed by a private physician at the fire fighter's expense (personal or through insurance), provided by a physician volunteer, or paid for by the FD, City, or State. Sharing the financial responsi-



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bility for these evaluations between fire fighters, the FD, the City, the State, and physician volunteers may reduce the negative financial impact on recruiting and retaining needed fire fighters.

Recommendation #2: Perform a preplacement and an annual physical performance (physical ability) evaluation.

NFPA 1500, Standard on Fire Department Occupational Safety and Health Program, requires the FD to develop physical performance requirements for candidates and members who engage in emergency operations [NFPA 2007a]. Members who engage in emergency operations must be annually qualified (physical ability test) as meeting these physical performance standards for structural fire fighters [NFPA 2007a].

Recommendation #3: Ensure that fire fighters are cleared for return to duty by a physician knowledgeable about the physical demands of fire fighting, the personal protective equipment used by fire fighters, and the various components of NFPA 1582.

Guidance regarding medical evaluations and examinations for structural fire fighters can be found in NFPA 1582 [NFPA 2007] and in the IAFF/IAFC Fire Service Joint Labor Management Wellness/Fitness Initiative [IAFF, IAFC 2007]. According to these guidelines, the FD should have an officially designated physician who is responsible for guiding, directing, and advising the members with regard to their health, fitness, and suitability for duty. The

physician should review job descriptions and essential job tasks required for all FD positions and ranks to understand the physiological and psychological demands of fire fighters and the environmental conditions under which they must perform, as well as the personal protective equipment they must wear during various types of emergency operations. This recommendation is made based on review of the FD health and medical programs.

Recommendation #4: Phase in a comprehensive wellness and fitness program for fire fighters.

Guidance for fire department wellness/fitness programs to reduce risk factors for cardiovascular disease and improve cardiovascular capacity is found in NFPA 1583, Standard on Health-Related Fitness Programs for Fire Fighters, and the IAFF/IAFC Fire Service Joint Labor Management Wellness/Fitness Initiative, and in the National Volunteer Fire Council (NVFC) Health and Wellness Guide [USFA 2004; IAFF, IAFC 2007; NFPA 2008]. Worksite health promotion programs have been shown to be cost effective by increasing productivity, reducing absenteeism, and reducing the number of work-related injuries and lost work days [Stein et al. 2000; Aldana 2001]. Fire service health promotion programs have been shown to reduce coronary artery disease risk factors and improve fitness levels, with mandatory programs showing the most benefit [Dempsey et al. 2002; Womack et al. 2005; Blevins et al. 2006]. A study conducted by the Oregon Health and Science University reported a savings of more than \$1 million for



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each of four large fire departments implementing the IAFF/IAFC wellness/fitness program compared to four large fire departments not implementing a program. These savings came primarily from a reduction of occupational injury/illness claims with additional savings expected from reduced future nonoccupational healthcare costs [Kuehl 2007].

Given the FD's mix of volunteer and career members, the NVFC program might be the most appropriate model for its volunteers [USFA 2004]. NIOSH recommends a formal, structured wellness/fitness program to ensure all members receive the benefits of a health promotion program. The FD does not have exercise equipment in the fire station or a written wellness/fitness program. An issue facing volunteer fire departments is incorporating physical fitness training into their training programs. Physical fitness training could occur at other times in the station or at other locations such as a local fitness center or the fire fighter's home.

Recommendation #5: Provide fire fighters with medical clearance to wear SCBA as part of the Fire Department's medical evaluation program.

The OSHA Revised Respiratory Protection Standard requires employers to provide medical evaluations and clearance for employees using respiratory protection [29 CFR¹ 1910.134]. These clearance evaluations are required for private industry employees and public employees in States operating OSHA-approved State

plans. Virginia operates an OSHA-approved State plan; therefore the FD should ensure all members have been medically cleared to wear an SCBA.

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¹Code of Federal Regulations. See CFR in references.



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INVESTIGATOR INFORMATION

This incident was investigated by the NIOSH Fire Fighter Fatality Investigation and Prevention Program, Cardiovascular Disease Component in Cincinnati, Ohio. Mr. Tommy Baldwin (MS) led the investigation and co-authored the report. Mr. Baldwin is a Safety and Occupational Health Specialist, a National Association of Fire Investigators (NAFI) Certified Fire and Explosion Investigator, an International Fire Service Accreditation Congress (IFSAC) Certified Fire Officer I, and a former Fire Chief and Emergency Medical Technician. Dr. Thomas Hales (MD, MPH) provided medical consultation and co-authored the report. Dr. Hales is a member of the NFPA Technical Committee on Occupational Safety and Health, and Vice-Chair of the Public Safety Medicine Section of the American College of Occupational and Environmental Medicine (ACOEM).

The National Institute for Occupational Safety and Health (NIOSH), an institute within the Centers for Disease Control and Prevention (CDC), is the federal agency responsible for conducting research and making recommendations for the prevention of work-related injury and illness. In fiscal year 1998, the Congress appropriated funds to NIOSH to conduct a fire fighter initiative. NIOSH initiated the Fire Fighter Fatality Investigation and Prevention Program to examine deaths of fire fighters in the line of duty so that fire departments, fire fighters, fire service organizations, safety experts and researchers could learn from these incidents. The primary goal of these investigations is for NIOSH to make recommendations to prevent similar occurrences. These NIOSH investigations are intended to reduce or prevent future fire fighter deaths and are completely separate from the rulemaking, enforcement and inspection activities of any other federal or state agency. Under its program, NIOSH investigators interview persons with knowledge of the incident and review available records to develop a description of the conditions and circumstances leading to the deaths in order to provide a context for the agency's recommendations. The NIOSH summary of these conditions and circumstances in its reports is not intended as a legal statement of facts. This summary, as well as the conclusions and recommendations made by NIOSH, should not be used for the purpose of litigation or the adjudication of any claim. For further information, visit the program website at

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