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40-Year-Old Firefighter Dies While Driving a Water Tender to a Fire—Michigan

Executive Summary

A 40-year-old volunteer firefighter (Driver) was driving a fire department (FD) water tender to a fire along with a candidate firefighter (Candidate) when he became unconscious and subsequently died. The Driver told the Candidate that he was not feeling well and then collapsed over the steering wheel. The Candidate was able to stop the water tender, set the parking brake, and then move the Driver out of the vehicle and to the ground. The Candidate noted that the Driver was pulseless and called on the fire radio for assistance as he started chest compressions. A fire crew that was also enroute to the fire arrived within minutes to assist the Candidate with cardiopulmonary resuscitation (CPR). As the fire crews were performing CPR, an advanced life support (ALS) transport ambulance arrived and initiated ALS care as the Driver was loaded in the ambulance and transported to the nearest hospital. Continued resuscitation efforts enroute and in the emergency department (ED) were unsuccessful and he was pronounced dead.

The medical examiner's report listed the cause of death as atherosclerotic coronary artery disease. The medical examiner found severe atherosclerosis of the left anterior descending coronary artery and left circumflex coronary artery. Mild atherosclerosis of the aorta was also noted.

Key Recommendations

The National Institute for Occupational Safety and Health (NIOSH) offers the following recommendations to reduce the risk of heart attacks and sudden cardiac arrest among firefighters at this and other fire departments across the country.

- *Key Recommendation #1: Implement comprehensive pre-placement and annual medical evaluations consistent with National Fire Protection Association (NFPA) 1582 Standard on Comprehensive Occupational Medical Program for Fire Departments, which should include a baseline electrocardiogram (EKG) in all individuals prior to engagement in any strenuous physical activity to rule out any underlying cardiac abnormalities [NFPA 2022].*
- *Key Recommendation #2: Consider a preplacement cardiac exercise stress test to determine the capacity for physical exertion and decrease the risk for sudden cardiac death.*
- *Key Recommendation #3: Implement an annual fitness evaluation consistent with NFPA 1582 Standard on Comprehensive Occupational Medical Program for Fire Departments to ensure personnel are physically fit to perform job expectations at emergencies [NFPA 2022].*

The National Institute for Occupational Safety and Health (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 Web site at www.cdc.gov/niosh/fire or call toll free 1-800-CDC-INFO (1-800-232-4636).

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40-Year-Old Firefighter Dies While Driving a Water Tender to a Fire—Michigan

Introduction

On November 18, 2020, fire department (FD) crews were dispatched to a reported camper on fire. The Driver was driving the water tender to the fire when he became unconscious and collapsed over the steering wheel. The Candidate riding in the front passenger seat on the water tender was able to safely bring the vehicle to a stop, remove the Driver, and start chest compressions. Personnel on an engine (Lieutenant [LT] and firefighter [FF]) also responding to the fire call, stopped, and assisted with basic life support (BLS). An ALS transport ambulance arrived and initiated advanced life support (ALS) care. The Driver was transported to the nearest emergency room where he was pronounced dead.

In July 2021, a contractor (National Institute for Occupational Safety and Health [NIOSH] investigator) for the NIOSH Fire Fighter Fatality Investigation and Prevention Program (the NIOSH investigator) conducted a series of telephone and email interviews to investigate the incident.

During the investigation, the NIOSH investigator interviewed the Fire Chief and reviewed written statements provided by the:

- *Candidate firefighter*
- *Firefighter*
- *Lieutenant*

The NIOSH investigator reviewed the following documents:

- *FD records*
- *Emergency medical services (EMS) (ambulance) report*
- *Emergency department (ED) records*
- *Autopsy report*

Fire Department

At the time of the NIOSH investigation, the FD consisted of 22 volunteer firefighters and officers working out of a single fire station. The FD serves a population of approximately 4,000 in a geographic area of about 100 square miles and responds to approximately 100 fires and 400 medical calls annually.

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Employment and Training

Applicants must be at least 18 years of age, have a clean driving record and no felonies. All firefighters can be certified to drive by the department after demonstrating proficiency. The Driver had been a member of the department for three years and was certified to drive and operate FD equipment.

Preplacement/Periodic/Return to Work Medical Evaluations

At the time of the interview, the FD did not require a pre-placement medical evaluation for applicants and/or annual medical evaluations for incumbents consistent with National Fire Protection Association (NFPA) 1582 Standard [NFPA 2022].

Wellness/Fitness Programs

At the time of the incident, the FD did not have a wellness/fitness program.

Investigation

On November 18, 2020, at approximately 2030 hours the FD was dispatched to a camper on fire. A chief brush truck, water tender, and fire engine responded to the camper fire. The water tender left the station first, and the brush truck followed. As they were responding to the reported fire, the Driver asked the Candidate if he was buckled in because a seatbelt alarm was sounding. After unbuckling and buckling the seatbelt again, the alarm turned off. The brush truck passed the slower water tender once they were outside of the city limits. The Candidate was seated in the front passenger seat of the water tender. The Driver asked the Candidate for the address of the fire, the Candidate found the address, and entered it into his phone to provide directions. The Candidate said everything seemed fine as they made a few turns to get to the fire, but then the Driver told the Candidate that he needed to pull over. The Candidate initially thought the Driver was having difficulty with his seatbelt, but then realized there was another problem when the water tender began to slow down and veer to the left, crossing the oncoming lane. The Candidate watched as the Driver slumped over the steering wheel and called out to him a couple of times with no response. The Candidate then reached over from the passenger seat and steered the moving vehicle off the road, put the water tender in neutral, and set the air brakes.

After stopping the water tender, the Candidate jumped out of the passenger seat and walked to the driver's side, opened the door, and pushed the Driver back against the seat and away from the steering wheel. The Driver was unresponsive, and the Candidate got on the radio and called for dispatch. After three attempts with no response from dispatch, a LT responding to the camper fire in the fire engine got on the radio and asked the Candidate what he needed. The Candidate stated the Driver was down and unresponsive. The LT told the Candidate that they were only a couple blocks away and they would be there shortly to help. As the LT was talking with the Candidate, he told the FF with him in the engine to call dispatch on the fire channel for EMS assistance. The FF called dispatch and requested an ambulance as the LT continued to assure the Candidate that EMS was enroute. The Candidate was able to remove the Driver from the water tender, lay him on the pavement, and begin chest compressions.

As the engine approached the scene, the LT could see the lights from the water tender on the opposite side of the road and the Candidate doing chest compressions on the Driver. Once the engine stopped, the LT went to get medical equipment and the FF assisted with compressions. The FF noticed the

Driver's face was blue and he had agonal respirations. After doing compressions for a few minutes, the FF noticed that the Driver was beginning to breathe and discontinued compressions. The FF and Candidate removed the Driver's boots, bunker pants, coat, and ripped open his T-shirt. The Driver's skin was pale and sweaty, and although his breathing was beginning to become relatively normal, his face still appeared cyanotic. He had a slow and weak carotid pulse, and his left arm would move sporadically. The FF asked the Driver several questions, including if his chest, back, or head hurt. At each question, the Driver would respond with a faint, unintelligible verbal sound. The Driver attempted to roll onto his right side, and then there was no additional noticeable responses.

The ambulance arrived at 2103 hours, and the Driver was placed on the cardiac monitor. The initial rhythm was idioventricular. The Driver was placed on the stretcher and cardiopulmonary resuscitation (CPR) was continued until the automated CPR machine was set up. After unsuccessful attempts at starting an intravenous (IV) line, an intraosseous (IO) line was placed in the Driver's left tibia. A supraglottic airway device was placed in the Driver's airway and he was suctioned due to profuse vomiting. Four doses of epinephrine were administered on scene at 2109 hours. While enroute to the hospital, another two doses of epinephrine were administered with one dose of 300 milligrams (mg) Amiodarone, and the automatic external defibrillation (AED) indicated a shock when the rhythm changed to pulseless electrical activity. The ambulance arrived at the ED at 2126 hours. Recusation efforts were unsuccessful, and he was pronounced dead.

Medical Findings

The medical examiner's report listed the cause of death as atherosclerotic coronary artery disease. The medical examiner found severe atherosclerosis of the left anterior descending coronary artery and left circumflex coronary artery. The left anterior descending coronary artery had 80 to 85 percent luminal atherosclerotic stenosis and the left circumflex coronary artery had 70 to 75 percent luminal atherosclerotic stenosis. Mild atherosclerosis of the aorta was also noted.

Discussion

Sudden Cardiac Events

Sudden cardiac arrest (SCA) and sudden cardiac death (SCD) refer to the sudden cessation of cardiac activity with hemodynamic collapse, usually due to sustained ventricular tachycardia/ventricular fibrillation. These events mostly occur in patients with structural heart disease (that may not have been previously diagnosed), particularly coronary heart disease (CHD). If corrective measures are not taken rapidly, this condition progresses to SCD.

SCD accounts for 300,000–400,000 deaths annually in the United States. Most sudden deaths are cardiac, and most SCDs are related to arrhythmias secondary to structural heart disease or primary electrical abnormalities of the heart [Isbister and Semsarian 2019; Jazayeri and Emert 2019; Kuriachan et al. 2015; Podrid 2022]. SCA usually occurs in people with some form of underlying structural heart disease, and as much as 70 percent of SCAs have been attributed to CHD. The risk of experiencing SCA increases dramatically with age and with underlying cardiac disease. Men are two to three times more likely to experience SCA than women. SCD is the mechanism of death in over 60 percent of patients with known CHD. In addition, SCA is the initial clinical manifestation of CHD in approximately 15 percent. Even among the young, CHD is a relatively common cause of SCD. In one

study, CHD was the second most common condition (22%) underlying SCD among subjects aged 5 to 34 years. In this study, the most common SCA-related conditions were sudden arrhythmic death syndrome (31%), coronary artery disease (22%), and hypertrophic cardiomyopathy (14%). There was a high overall prevalence of established cardiovascular risk factors (obesity, diabetes mellitus, hypertension, hyperlipidemia, smoking) with ≥ 1 risk factors in 58% of all SCA cases [Jayaraman et al. 2018].

Risk factors for SCA include dyslipidemia, hypertension, cigarette smoking, physical inactivity, obesity, diabetes mellitus, and a family history of premature CHD or myocardial infarction. There is also some evidence that acutely stressful situations increase the risk of SCA. Individuals of African American descent appear to have a higher rate of SCD, and poorer outcomes compared to those of Caucasian or Hispanic descent [Wong et al. 2019].

The approaches to preventing SCA and SCD are focused on identifying underlying risk factors and severe CHD that increases the risk of a fatal event. There are several risk factors that can be used to calculate a risk score for CHD, including the BMI, blood pressure, serum lipids and glucose. Based on age and risk factors, the American Cardiology Association/American Heart Association (ACC/AHA) atherosclerotic cardiovascular disease (ASCVD) risk calculator can estimate the percent 10-year risk of heart attack or stroke [ACC/AHA 2021; Andrus and Lacaille 2013].

An exercise tolerance test can identify the presence of CHD that increases the risk of fatal and non-fatal cardiac events. An abnormal EKG that shows myocardial ischemia with exercise (loss of blood flow to the heart muscle) increases the risk of future CHD events, especially in those individuals with other risk factors for heart disease (high blood pressure, high lipid levels, elevated blood sugar or obesity) [Balady et al. 2004; Bruce et al. 1980; Mégnien and Simon 2009; Michaelides et al. 1990, 1995, 2005; Sumanen et al. 2005; Van Campen et al. 1996].

Recommendations

Recommendation #1: Implement comprehensive pre-placement and annual medical evaluations consistent with NFPA 1582 Standard on Comprehensive Occupational Medical Program for Fire Departments, which should include a baseline EKG in all individuals prior to engagement in any strenuous physical activity to rule out any underlying cardiac abnormalities [NFPA 2022].

Discussion: NIOSH recommends that all new and incumbent personnel participate in annual medical evaluations to determine that personnel are healthy enough to participate in strenuous activity and to identify potential injuries or illnesses. Guidance regarding the content and frequency of the medical evaluations for firefighters can be found in Chapter 7 of NFPA 1582. At the time of the incident, the volunteer department did not have medical examination requirements for personnel. The Driver suffered from atherosclerotic cardiovascular disease, a condition where the arteries become narrowed and hardened due to buildup of plaque (fats) in the artery wall. When detected, atherosclerotic cardiovascular disease is treatable [NFPA 2022].

Recommendation #2: Implement a preplacement cardiac exercise stress test to determine the capacity for physical exertion and decrease the risk for sudden cardiac death.

Discussion: In an individual with CHD, an exercise stress test can detect ischemia (areas of the heart where the blood supply is not adequate) that increases the risk of fatal and non-fatal cardiac events. An

exercise stress test should be considered for new firefighter job applicants (preplacement), especially for those individuals who have risk factors for heart disease ((high blood pressure, high lipid levels, elevated blood sugar or obesity). If the stress EKG indicates ischemia, the individual should be referred to a heart specialist for additional evaluation to determine if there may be an increased risk for SCA and SCD while performing firefighter job tasks.

Recommendation #3: Implement an annual fitness evaluation consistent with NFPA 1582 Standard on Comprehensive Occupational Medical Program for Fire Departments to ensure personnel are physically fit to perform job expectations at emergencies [NFPA 2022].

Discussion: Although fire department personnel are exempt from commercial vehicle medical requirements when driving fire apparatus in Michigan, MIOSHA R408.17411(b) states, "*Duties of employer - assure that prospective fire service personnel are physically fit and have the ability to perform assigned emergency operations"* [MIOSHA 2022]. NIOSH recommends that fire departments phase in annual fitness evaluation program that is consistent with *NFPA 1582-Chapter 8-Annual Occupational Fitness Evaluation of Members* to ensure personnel can meet state and job requirements. NFPA 1582 [NFPA 2022].

NIOSH recognizes the challenges that volunteer departments face regarding funding and finding personnel. One consideration to meet the fitness evaluation standard, is to utilize recommendations for fitness assessments outlined in the annex section of *NFPA 1583 - Standard on Health-related Fitness Programs for Fire Department Members*. Although the annex is not a NFPA requirement, it does provide many benefits for fitness assessment [NFPA 2022].

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Investigator Information

This incident was investigated by the NIOSH Fire Fighter Fatality Investigation and Prevention Program, Cardiac/Medical Team, in Cincinnati, Ohio. TJ Welch is a Firefighter Safety Specialist and worked in volunteer, industrial and municipal fire departments and co-authored the report. Mr. Welch is a State Certified Fire Officer, founding member of the California Incident Command Certification System, and chaired the CICCS committee on Physical Fitness Standards. Dr. Robert Harrison MD, MPH (California Department of Public Health) provided medical consultation, and Laura Styles, MPH (Public Health Institute) also contributed to this report.

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