Firefighters & Esophageal Cancer

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GENERAL EPIDEMIOLOGY: ESOPHAGEAL CANCER

According to the American Cancer Society[1], cancers of the esophagus account for approximately 1% of cancers in the United States and have been decreasing slightly over the past decade. There will be an estimated 20,640 newly diagnosed cases of esophageal cancer and 16,410 deaths from esophageal cancer in 2022.

There are two types of esophageal cancer: squamous cell and adenocarcinomas. Squamous cell esophageal cancer develops in the squamous cells that line the esophagus, typically in the upper part of the esophagus. Adenocarcinomas typically develop in the gland cells that make up mucus and usually develop in the lower third of the esophagus.

INTERNATIONAL AGENCY FOR RESEARCH ON CANCER (IARC)

In June 2022, IARC convened an international meeting of scientists to re-evaluate firefighting as an exposure related to cancer. They determined the literature supports reclassifying ***firefighting to a Group 1 carcinogen (carcinogenic to humans) based on "sufficient" evidence***[2]. This is the ***highest*** classification of exposure only assigned when there is scientific certainty.

Their statement indicated:

There was also "strong" mechanistic evidence that occupational exposure as a firefighter shows the following key characteristics of carcinogens in exposed humans: "is genotoxic", "induces epigenetic alterations", "induces oxidative stress", "induces chronic inflammation", and "modulates receptor-mediated effects".

It should be noted that IARC criteria and classifications are focused on *scientific levels of certainty* which are more stringent than those focused on the "weight of the evidence"[3] which is often used in cases of workers compensation.

RISK FACTORS FOR ESOPHAGEAL CANCER

A number of risk factors have been identified that increase the chances of developing esophageal adenocarcinoma including the following[1,4,5].

- **Gender:** Males are more likely to contract esophageal cancer than females.
- **Race:** The incidence of esophageal adenocarcinoma is 5-times more predominant in whites than in blacks in the U.S.[6]
- **Age:** Risk of esophageal cancer increases with age. Less than 15% of esophageal cancers occur in people under the age of 55. Only 1.8% of esophageal cancers are diagnosed between the ages of 35 and 44.
- **Family History:** Having immediate family members who have developed esophageal cancer increases the risk of development.
- **Obesity:** Obesity is related to the development of esophageal adenocarcinoma, likely through the increased risk of reflux among those who are obese.
- **Gastroesophageal Reflux (GERD) & Barrett's Esophagus:** People who suffer from GERD, Barrett's Esophagus, or reflux symptoms are at increased risk of developing esophageal cancer.
- **Tobacco Use:** Similar to most other cancers, cigarette smoking is a significant risk factor for esophageal cancer. Smokeless tobacco use has some relationship to esophageal cancer in *some instances* as is explored later.

OCCUPATIONAL EXPOSURES RELATED TO ESOPHAGEAL CANCER

Firefighters are exposed to a broad range of chemicals both in the firehouse and during emergency response. Recent research conducted with live burns has begun to identify and quantify the presence of carcinogens that can be present on the fire ground. Most alarming are findings that, even when the air appears "clear" there often are ultra-fine respirable particles and gaseous chemicals of several known carcinogens present. Unfortunately, this time period when there is no visible smoke is typically the time when firefighters remove their personal protective equipment and self-contained breathing apparatus. Particularly noted in the research is the presence of carcinogens such as asbestos, benzene, polycyclic aromatic hydrocarbons, and heavy metals[7–14]. Firefighters also face several routes of exposure including inhalation, dermal absorption, secondary exposure through contaminated dust from particulates post incident, and potentially the semi-volatile off-gassing of gear.

While research is underway examining the exact mechanism of exposure and development of specific types of cancer, data on carcinogens and the development of esophageal cancer suggest a number of chemical exposures likely put firefighters at increased risk including:

Asbestos. A recent meta-analysis[15] found that those with occupational exposure to asbestos, particularly with extreme exposures, were at increased risk for esophageal cancer.

Benzene. Evidence exists that suggests exposure to gasoline and its components such as benzene places people at increased risk for the development of esophageal cancer[16]. Benzene is not only present on the fire ground, but also at high rates in many fire stations as trucks and ambulances are housed in the bay areas. While efforts are being made to increase the use of exhaust mitigation devices in the firehouse, their introduction and use is relatively new to the fire service.

FIREFIGHTING AND ESOPHAGEAL CANCER

Daniels and colleagues[20] conducted the largest and most comprehensive retrospective cohort study of firefighter cancer to date. Using records from three large metro departments (San Francisco, Chicago, and Philadelphia), they were able to look at both incidence and mortality among 29,993 firefighters. In this study, firefighters demonstrated increased mortality risk for esophageal cancer (SMR = 1.39, 95% CI = 1.14-1.67). ***This finding indicates that firefighters have a statistically significant 39% higher risk of dying from a malignancy of the esophagus than the general population.*** Firefighters also demonstrated significantly elevated risk for developing esophageal cancer overall (SIR = 1.62, 95% CI = 1.31-2.00) and for it being the first invasive cancer they developed (1.71, 95% CI = 1.36-2.13). ***These findings indicate a statistically significant 62% and 71% increase in contracting a malignancy of the esophagus for firefighters when compared with the general population***.

Tsai et al.[18] conducted a case-control study of cancer risk among firefighters in California from 1988-2007 using the California Cancer Registry (CCR). The study included 3,996 male firefighters with cancer and 48,725 non-firefighter controls. **The authors found that firefighters overall experienced a statistically significant and greater risk for adenocarcinoma of the esophagus** (OR = 1.85, 95% CI = 1.34-2.55) even after adjusting for age of diagnosis, race, and year of diagnosis. When the analysis was restricted just to white firefighters, the magnitude of the OR was nearly identical (OR = 1.84, 95% CI = 1.32-2.56). **Both results suggest that**

firefighters have more than 80% greater odds of developing adenocarcinoma of the esophagus than non-firefighter controls.

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