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Diagnosing Silo-Filler's Disease[1]

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Respiratory hazards that farmers and family members may be exposed to include various grains that can be contaminated with fungi, bacteria or microbial toxins; pesticides; solvents; gasoline and diesel fuels; and irritant gases such as oxides of nitrogen and ammonia. The specific issue to be discussed in this CMASH newsletter is silo-filler's disease.

Silo-filler's disease is a chemical pneumonitis from exposure to oxides of nitrogen. These gases are produced within hours and sometimes up to two weeks after fresh plant material is placed in silos.

The typical clinical presentation is that the patient is acutely ill with symptoms of shortness of breath and cough and may also have chest pain and tightness in the chest. On physical exam they are dyspneic and typically have rales. They may be febrile and have wheezing. Typical laboratory findings are hypoxia on arterial blood gases, leukocytosis and pulmonary edema or diffuse reticulonodular infiltrates on the chest x-ray. Methemoglobineuria has been described in some patients.

On history, the patient will typically relate having entered a silo or the silo chute within 1-3 days after the silo had been filled. At the time of exposure, a patient may be overcome and die from the fumes, or may have symptoms of a cough, light-headedness, shortness of breath, chest tightness and choking, or may be entirely symptom free. Many times there is a symptom free period that ranges from ½ to 42 hours between the time

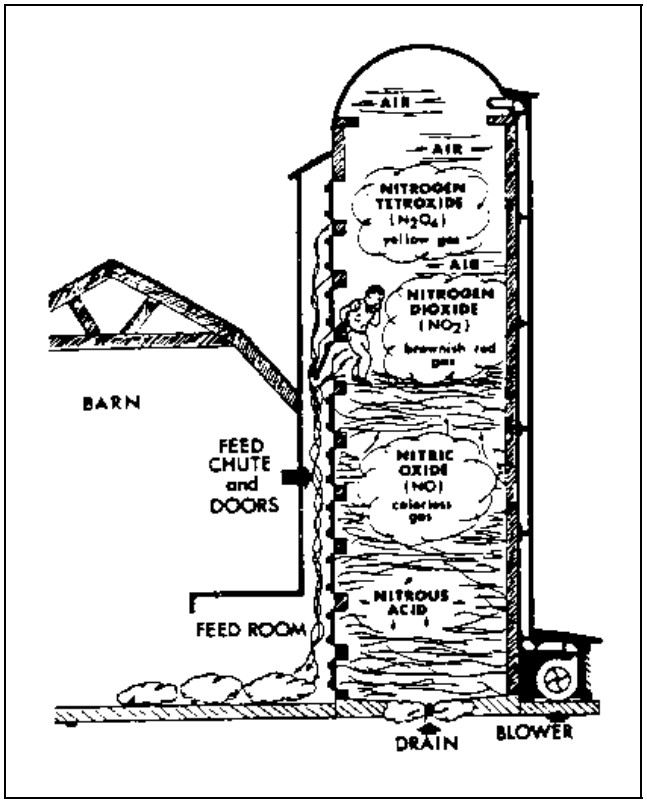

Figure 1. Silo gases

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of entering the silo and development of the chemical pneumonitis. If the concentration in the air of oxides of nitrogen are high enough, the patient may have smelt a bleach-like odor, otherwise they may have noted a yellowish or reddish vapor on top of the plant material, or noted dead birds or insects near the base of the silo (see Figure 1).

Patients with acute hypersensitivity pneumonitis may present with a similar onset of acute shortness of breath, fever and lung infiltrates as silo-filler's disease. However, with hypersensitivity pneumonitis the patient will have been exposed to dust and not gas and the time of the year will typically be different. Silo filling of corn silage generally begins in late August and continues throughout the fall in Michigan. Some farmers begin filling silos with grass silage in the spring and continue throughout the growing season. Hypersensitivity pneumonitis is an immunologic reaction to moldy grain dust and there would need to be time for the grain to become moldy (see Physician's newsletter vol. 1, issue 1, Winter 1992).

In addition to supplemental oxygen and mechanical ventilation, high doses of corticosteroids are generally given for silo-filler's disease although no controlled clinical trials have been performed. Fever has been reported to persist for up to six days and the pulmonary infiltrates to persist up to five days.

Some authors recommend continuing oral steroids for three to four weeks after an acute presentation to prevent bronchiolitis obliterans which can be a late sequela. Patients with bronchiolitis obliterans present two to six weeks after exposure with shortness of breath, cough, and sometimes fever. Chest x-ray may show a diffuse reticulonodular or miliary pattern on the chest x--ray. Some patients, however, show only hyperinflation. With bronchiolitis obliterans, pulmonary function testing may show restriction or obstruction, although typically lung volumes are normal. The diffusing capacity is frequently reduced. On biopsy there is a patchy fibrosis involving the air spaces and terminal and respiratory bronchiolus.

Silos were first built in the United States in 1875. The first deaths from exposure to gases from silos were reported in the medical literature in 1914. The initial deaths were attributed to asphyxiation from build up of carbon dioxide. A report in 1949 mentioned a brownish gas from a silo was the cause of the patient's respiratory disease. In the mid 1950's a number of case reports were published which recognized that oxides of nitrogen were the causal agent for the death and/or respiratory disease associated with silos. In air tight silos, which are typically unloaded from the bottom, carbon dioxide is the toxic gas which is normally produced. Carbon dioxide replaces oxygen and the patient may asphyxiate. Carbon dioxide does not cause lung disease. However, the more common type of silo is the non-airtight silo which is unloaded from the top. Oxides of nitrogen are concentrated in the chamber above the silage.

The percent of nitrate in the plant material ensiled determines how much oxides of nitrogen are produced. Weeds have the highest percentage of free nitrate (7.5%); corn and sorghum (5.5%); oats, wheat, barley and rye (4.0%), brome, orchard grass, timothy (3.0%); and alfalfa, red clover (1.0%). Most reports of silo-filler's disease have been reported with silos filled with com silage where the entire plant is chopped into small chunks. Factors which increase the nitrate content of plants includes drought followed by rain and prolonged cloudy weather, plants with leaf and root damage, and plants grown in soil with high levels of nitrogen.

Most farmers are aware of the hazards of entering a silo soon after filling stops. No data are available on how many Michigan farmers have had silo-filler's disease; however, case reports continue to be reported in the medical literature. The Mayo Clinic reported seeing 12 patients with silo gas exposure from 1980 - 1987. There are an estimated 15,000 silos on dairy farms in Michigan. Approximately 60 percent are the non-airtight top unloading type of silo where oxides of nitrogen are formed.

SELECTED LITERATURE REVIEWS

An excellent review of silo-filler's disease patients seen at the Mayo Clinic has been reported (Douglas WW, Hepper NGG, Colby TV. *Silo-Filler's Disease*. Mayo Clin Proc 1989; 64:291-304.).

Author Abstract. Between 1955 and 1987, 17 patients were examined at the Mayo Clinic shortly after exposure to silo gas. All exposures had occurred in conventional top-unloading silos. Acute lung injury occurred in 11 patients, 1 of whom died; early diffuse alveolar damage with hyaline membranes and hemorrhagic pulmonary edema and acute edema of the airways were found at autopsy. In one patient, hypoxemia and transient obstruction of the airways developed, but no pulmonary infiltrates were noted. One patient had symptoms for 5 weeks and diffuse confluent pulmonary infiltrates; many years later, chronic obstructive pulmonary disease developed (he had, however, been a heavy smoker before exposure).

Bronchiolitis obliterans was not observed in the other patients, probably because of less severe exposure or early corticosteroid therapy. Prophylactic corticosteroid therapy is advised for workers who have been exposed to silo gas.

The management of patients with established acute lung injury is reviewed. Previously unreported patterns of exposure to silo gas in conventional silos are described, and recommendations for avoiding exposure are suggested.

PATTERNS AND RISKS OF CANCER IN FARMERS IN ALBERTA

There continue to be studies reported of increased risks of cancer among farmers. A recent study from Alberta (Fincham SM, Hanson J, and Berkel J. *Patterns and Risks of Cancer in Farmers in Alberta.* Cancer 1992; 69:1276-1285.) reported elevated lip and prostate cancer. This study did not show elevated melanoma, leukemia, lymphoma or brain cancer. All these other cancers have been reported in other studies to be increased among farmers.

Author Abstract. Data on occupations and life styles of patients with cancer have been collected since 1983. To investigate cancer patterns and risks in farmers in Alberta, all farmers were abstracted and compared with nonfarmers in the data base, using case-control analysis. Controls were patients with cancer at any site except the index site. Significantly elevated odds ratio (OR), adjusted for age and smoking, were found among the farmers for cancers of the lip (OR = 3.22, 95% confidence interval (CI) = 2.14 to 4.84) and prostate (OR = 1.31, 95% CI = 1.11 to 1.55). Crude risk for lung cancer was significantly lower in farmers, but statistical significance disappeared when risk was adjusted for smoking (OR = 0.81, 95% CI = 0.65 to 1.02). Farmers were at considerably lower risk of malignant melanoma of the skin, compared with non-farmers (OR = 0.57, 95% CI 0.36 to 0.91).