

CASE REPORT

Curse of the “occult gases” in fish meal industry: “Lessons to learn”

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ABSTRACT

Stored wet fish consume oxygen and releases noxious gases as they spoil. Various collective gases are released during the process of decomposition such as carbon dioxide, ammonia, hydrogen sulfide, sulfur dioxide, methane etc. Casualties are reported in fish meal industry due to accidental exposure to these invisible toxic gases. We report a rare case of uneventful escape of five workers, accidentally exposed to noxious gases while engaged in fish oil manufacturing tank, in Coastal district of Karnataka, India. The possible combination of noxious gases responsible for acute primary lung injury (acute respiratory distress syndrome) and occupational safety measures to be employed to prevent such accidental exposure have been highlighted.

Key Words: Accidental exposure, acute lung injury, fish meal industry, noxious gases

Introduction

The fish-meal industry involving potential health hazards are well-documented in the literature. Wet fish in storage tanks utilizes oxygen and undergo decomposition to produce various noxious gases such as carbon dioxide (CO₂), sulfur dioxide, ammonia (NH₃), methane (CH₄), hydrogen sulfide (H₂S) and cyanide. Factors that aggravate fish decaying are high temperature and closed container with lack of ventilation. CH₄ is a well-known product of putrefaction. In several circumstances H₂S and low concentrations of oxygen and high concentration of CO₂ were considered relatively hazardous to human life. The risk of accidental poisoning with these noxious gases seems to be greatest in fish meal plants and during landing and handling of trash fish.^[1-3] Exposure to industrial fish meal noxious gases produces acute inhalation injury ranging from mild irritation of the upper airways to non-cardiogenic pulmonary edema and death. We report a case of five workers employed in fish-meal industry who had sustained an acute lung injury following accidental exposure to noxious gases released from a fish oil manufacturing tank accompanied with hypoxia and hypercapnia.

Case Report

Late evening of one fateful day five gentlemen, all aged between 35 and 45 years, who were regularly working in a fish oil manufacturing unit in the coastal part of Karnataka, reported to the casualty with a picture of full blown acute respiratory distress syndrome (ARDS) due to accidental exposure (inhalation) of a noxious gas from a fish oil manufacturing tank within the factory premises. All the five workers were brought to casualty in an unconscious stage to regain consciousness only after 45 min of preliminary first aid to recollect the events of exposure.

As per their history, the tank was a rectangular shaped enclosed space with a height of approximately 8-9 feet with only one opening for fish to be thrown in and workers to enter into it. These workers used to clean the tank once or twice a fortnight. Fish was allowed to decay inside the tank to extract oil out of it. Oil with fish debris was present up to a level of 1 foot. The workers in the factory were aware of a noxious gas emanating from the foul smelling fish in the tank. The general norm therefore was to flush the tank with water properly to displace the gas before entering it. One of the workers among the five who was a newcomer to this field entered the tank without flushing it with water. When this person who entered the

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tank did not return even after 15 min, the other workers suspecting something fishy entered the tank one after the other never to come back.

The workers were able to recollect that they had a very pungent irritant odor on entering the tank associated with severe redness and watering from their eyes followed by throat pain, tightness in the chest and retrosternal burning sensation with loss of consciousness. On regaining consciousness, the workers complained of severe breathlessness and dry cough. One of the last worker to enter the tank was able to recollect that ropes were being tied around their legs by the rescue team and all the five workers were rescued and shifted to tertiary center. Two among five workers were shifted to private tertiary care for the need of mechanical ventilator support. And remaining three workers were managed in various tertiary centers uneventfully.

On examination: Day 1: Both the patients were conscious and oriented. Blood pressure (BP) = 140/90 mmHg, pulse = 120/min, respiratory rate (RR) = 30/min, SaO_2 = 91% in room air and 100% with 5 L/min of O_2 , respiratory system revealed coarse crepitation's all over the lung field. Blood picture showed hemoglobin = 17, total cholesterol = 12,300, N76, L18, M4, E2, platelet count = 2.45 lakhs, urea = 32, creatinine = 1, aspartate aminotransferase = 45, alanine aminotransferase = 45, alkaline phosphatase = 11, arterial blood gas (ABG) showed pH = 7.39, PaO_2 = 88 mmHg, PaCO_2 = 32 mmHg, BE = -4.4. Based on the afore said investigations and circumstantial evidence preliminary diagnosis of acute lung injury (primary pulmonary ARDS) secondary to combination of noxious gas inhalation or hypoxia associated with hypercapnia was ascertained. The patient was conservatively managed with mechanical ventilator (bi-level positive airway pressure) and broad spectrum antibiotics.

Day 2: Following day patient condition was clinically improved. BP = 130/90 mmHg, pulse = 90/min, RR = 20/min, minimal crepitations were felt all over the lung fields. ABG revealed pH = 7.37, PaO_2 = 162 mmHg, PaCO_2 = 35.1 mmHg, BE = -4.2. Both patients were discharged uneventfully on the 3rd day.

Discussion

The risk of exposure to toxic gases seems to be greatest in fish-meal industry and during handling of trash fish. Wet fish in storage tank consume oxygen and produce noxious gases as they decay.^[1] As a result of anaerobic decomposition of organic substances various toxic gases are produced such as CH_4 , H_2S , NH_3 and

CO_2 .^[2-4] H_2S is a colorless, flammable toxic gas. At low concentrations it has a characteristic "rotten egg smell." Low concentrations of H_2S causes an irritating effect on the respiratory tract mucosa. High levels of this compound causes a rapid loss of consciousness, neurological disorders, respiratory failure and death due to suffocation.^[2] On inhalation this compound gets distributed in the blood and taken up by brain, liver, kidneys and pancreas.^[3] Metabolism occurs by oxidation, methylation and reaction with metalloproteins. It is the metalloproteins that is responsible for the most serious toxic effects. Within the lungs, H_2S impairs the function of alveolar macrophages and cilia, avoids binding to mitochondrial cytochrome c oxidase producing cellular hypoxia.^[3]

NH_3 is a colorless gas with a characteristic pungent odor. On inhalation NH_3 binds with the humid surface of the mucous membrane and produces ammonium hydrate which has strong irritating properties, resulting in bronchitis, bronchial pneumonia, pulmonary edema, edema of the glottis and respiratory center depression. CH_4 is a colorless and odorless gas, absorbed mainly in the lungs and exerts a depressant effect on the central nervous system.^[2] CO_2 is a colorless, odorless and non-flammable gas. It is non-toxic in low concentration, however in high concentrations it is harmful for health or even lethal, causing the development of hypercapnia and respiratory acidosis.^[2,4] In closed tanks, such a fish oil manufacturing tank, where fishes are stored for few days to decay, naturally concentration of toxic gases may be high, even life-threatening, especially with the lack of adequate aeration. It is not advisable to enter such tanks, which has not been previously aired and cleaned. In our present case all the workers were exposed to highly irritant pungent odor gas on entering the tank and manifested with severe redness and watering from their eyes followed by throat pain, tightness in the chest, retrosternal burning sensation with loss of consciousness, features were conclusive of acute lung injury. On regaining consciousness, the workers complained of severe breathlessness and dry cough. Probably all the five workers might have been exposed to collective toxic gas poisoning as described above with low concentration of oxygen and high concentration of CO_2 . Fermentation of the fish could have induced the evolution of gases, including large amounts of CO_2 , which had displaced the fresh air inside the fish oil tank. The presence of further poisonous gases cannot be excluded.

In West Africa (2000) a rare fatal case of death due to CH_4 and cyanide poisoning among a group of deep sea trawler men were reported.^[1] In Florida (1968) five deaths were reported in the fishing vessel, due to inhalation of

H₂S produced in the wash water of the fish.^[4] In Chile (1971) workers working in fish meal industry were presented with eye diseases, skin eruptions and loss of consciousness on exposure to combination of noxious gases.^[5] This is first case in coastal part of Karnataka, India where five people suffered from acute lung injury following exposure to combination of noxious gases such as CO₂, CH₄, NH₃ and H₂S commonly emitting from the fish oil tank and later were recovered uneventfully. The individual noxious gas responsible for acute lung injury in this case was not determined. The fish meal product from the tank and blood from the victim should have been subjected to Forensic Science Laboratory for narrowing down the noxious gas responsible for acute lung injury.

Conclusion

The risk of accidental exposure to noxious gases seems to be greatest among the workers engaged in fish meal industry. To prevent such fatalities each worker entering the tank should be provided with safety belts with ropes for sudden rescue from the tank. Before entering the fish oil tank, it should be properly flushed to exhaust noxious gases collected. Fish meal manufacturing

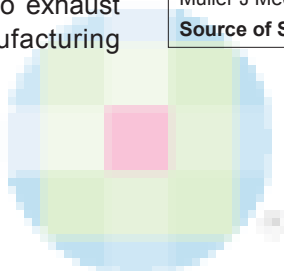
factories should be equipped with mechanical ventilation, apparatus to monitor the concentrations of CO₂, oxygen, H₂S, CH₄ and NH₃. Basic occupational education to the workers regarding knowledge of noxious gases emitting, after effects of exposure to these gases and emergency safety measures are to be imparted.

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