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A Fatal Case of Septic Tank Gas Poisoning: Critical Care Challenges

Abstract

Deaths due to poisoning continue to haunt the medical practice. Poisoning could be due to accidental, suicidal or homicidal reasons. Certain poisons do not have antidotes and can be rapidly fatal. The victims generally succumb either due to the deleterious effects of the toxic substance per-se or due to secondary phenomenon or multi-organ failure. Septic tanks are dangerous as they contain a variety of sewer gases which can be highly toxic when inhaled and result in various complications, including death. We hereby report a fatal case of accidental poisoning due to septic tank gases in a young patient and the associated critical care challenges.

Keywords: Septic tank; Poisoning; Sewer gases; Toxic; Hydrogen Sulfide; Methane; Fatal

Case Report

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Introduction

Septic tanks [1] are enclosed areas made for accumulation of decomposed domestic wastes, sewerage and its resultant gases. Sewer gases can be both toxic and non-toxic. Its major component is Methane [2], which can be extremely toxic in high concentrations. Sewer gas is a mixture of Hydrogen Sulphide, Ammonia, Carbon-dioxide, Nitrogen dioxide, Sulphur dioxide and sometimes, even carbon monoxide. The concentration of these components differs with the time, sewage composition, temperature and pH of the contents. Hydrogen sulphide [3] can be poisonous even in small concentrations in the form of irritation of the eyes, shortness of breath and incessant cough. Exposure to higher concentrations can be rapidly fatal. We hereby present a fatal case of septic tank gas poisoning in a young patient and the critical care challenges faced.

Case Report

A 24 years old, ASA grade 1, male patient was brought to the emergency in an unconscious state. There was history of the patient jumping into a septic tank to save a child who accidentally fell into the septic tank. As soon as he could evacuate out the child, he became unconscious and was trapped inside the septic tank for nearly fifteen to twenty minutes before he could be evacuated out by neighbours. There was no past history of any illnesses or allergies or hospitalizations. On examination, the patient was comatose, hemodynamically stable, with an oxygen saturation of 80% which improved to 90% with supplemental oxygen. In view of poor GCS (Glasgow Coma Scale) and oxygen desaturation, the patient was intubated with an 8.5mm cuffed endotracheal tube and put on assist controlled mode of mechanical ventilation. Maintenance isotonic intravenous fluids were given. His SpO2 improved and became 99% on an FiO2 of 80%. His bilateral pupils were mid-dilated and sluggishly reacting to light. There was no response to deep painful stimuli. Invasive monitoring with central venous catheter and arterial line were instituted. Ryles tube was inserted and nasogastric feeds were started to prevent gut bacterial translocation. Patient was kept adequately warm and hypothermia preventive measures were instituted. On the second day in the intensive care unit, the patient developed decerebrate posturing. His ABG (arterial blood gas analysis) showed moderate compensated metabolic acidosis. There was a fall in his urine output and he also demonstrated spikes of intermittent fever. There was no improvement in the GCS. All standard supportive therapies were instituted. Intensive monitoring was continued. On the third day, the patient developed basal chest infiltrates. Surgical tracheostomy was done due to failure to wean and for tracheobronchial toilet. His neuro logical condition further worsened and the patient did not demonstrate any respiratory efforts of his own. The computed tomographic (CT) scan of the patient`s brain was suggestive of hypoxic damage. He also developed hypotension requiring inotropic support and further oxygen desaturation requiring 100% inspired oxygen concentration on the fourth day. Finally, the patient succumbed to septic tank gas poisoning and developed cardiorespiratory arrest on the fifth day, which could not be revived.

Discussion

Septic tanks are quite common in residential and industrial areas to cater to sewage wastes. Natural decomposition and mixture of sewage leads to production of sewage gases. These gases can be toxic if inhaled in high concentrations or for a prolonged period of time. Septic tank gases contain methane, hydrogen sulphide (H2S), carbon dioxide, sulphur dioxide, ammonia, nitrogen dioxide and traces of carbon monoxide. Hydrogen sulphide has a characteristic smell of rotten eggs,

which is easily identifiable by human olfactory organs and serving as a warning signal for sewer gas leakage. It is a colourless gas, heavier than air, corrosive and flammable. Exposure to even low concentrations of hydrogen sulphide can cause irritation of the eyes, sore throat, dyspnea and cough. Prolonged exposure can even cause pulmonary edema, headache and dizziness [4]. Exposure to levels > 100ppm (parts per million) can be dangerous as it causes olfactory fatigue and the smell becomes undetectable. Exposure to higher concentrations (>300 ppm), results in rapid loss of consciousness and death. Even a single breath of a concentration higher than 1000 ppm can cause immediate collapse ('knock-down") and death. The toxicity of H_2S is due to inhibition of oxidative phosphorylation and cytochrome oxidase resulting in reduction in cellular ATP (adenosine tri-phosphate). Inhalation leads to a multitude of respiratory complications like organizing pneumonia and adult respiratory distress syndrome (ARDS). Exposure to high concentrations of methane can be dangerous as it reduces percentage of oxygen in the air and causes hypoxia [5]. Methane gas inhalation can cause asphyxia, loss of consciousness and pneumonitis.

Our patient had entered the septic tank to save a child accidentally trapped inside it. After evacuating the child, the patient became unconscious probably due to exposure to high concentrations of sewer gases for nearly fifteen to twenty minutes, before he was evacuated by neighbours. He was brought in a comatose state to the emergency where he was managed according to standard protocol and given all supportive treatments. The patient would have already suffered hypoxic brain injury as indicated by his CT scan. There is no specific antidote to septic tank gas poisoning. Hypoxic injury to brain and other organs is usually irreversible and hence the patient could not be saved.

There is paucity of literature on the diagnosis and management of septic tank gas poisoning. In several areas, especially developing nations, there are no standard guidelines or protocols for designing, construction, cleaning and maintenance of septic tanks. Casualties [6] occurring due to septic tanks may not even be reported, which may be responsible for the lack of accurate statistical data on the health hazards caused by them. All septic tanks should have a display board highlighting the dos and don'ts as well as the possible hazards due to sewer gases. Only authorized and trained personnel wearing personal protective gear should be allowed inside the septic tanks. All necessary precautions should be taken by the septic tank workers to prevent themselves and others from getting trapped inside the septic tanks. The government agencies should formulate special rules and regulations for safe use and maintenance of septic tanks. Measures for quick evacuation must be ensured in the event of any accident. As health professionals, our aim must be to provide adequate ventilation and oxygenation to the patient, prevent secondary brain injury, maintain hemodynamic stability and circumvent multi-organ damage. The general principles of critical care management consist of administering 100% oxygen, endotracheal intubation to protect the airway, adequate ventilation to prevent hypercarbia, ensuring normothermia, instituting invasive monitoring, regular GCS charting, maintaining adequate mean arterial pressure and urine output. Hyperbaric oxygen therapy [7] may be useful in some hemodynamically stable patients with persistent neurological deficits. Apart from supportive therapy, amyl nitrite and sodium nitrite inhalation may be beneficial in hydrogen sulphide poisoning if the patient is evacuated early.

Conclusion

Septic tanks continue to be health hazards as they produce sewer gases which can be toxic to human beings and also cause greenhouse effect. Septic tank gas poisoning can be fatal if inhaled in high concentrations or for prolonged periods. Proper precautions should be taken before entering septic tanks and all people must be educated about the health hazards of sewer gases. Hypoxic damage to the vital body organs can be extremely difficult to treat and a favourable outcome may not be possible in severe poisoning cases.

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