

Accidental Carbon dioxide Poisoning in a Wine Brewery

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ABSTRACT

Carbon dioxide (CO₂) is a colorless, odorless, heavy gas, which is generated in the process of respiration, combustion, fermentation, and decomposition of organic matter. It gets collected in the lower levels of disused wells, mineral wells, damp cellars, mine shafts, brewer's vats, ship holds, sewage tanks, etc. Accidental poisoning due to CO₂ inhalation has been reported previously; however the incidence is rare. We report here a case of accidental CO₂ inhalation, which resulted in the death of a young man working in a wine brewery.

Key Words: Carbon dioxide, Wine brewery

The Case

A 29 year-old man was working in a wine brewery at Raia, Salcete, South Goa. One morning, as he opened the lid of a 7 feet tall fermentation tank to stir the fermentation products inside, he lost his balance and fell into the tank, as a result of which half his body became submerged. His colleagues immediately rushed to his help and removed his trapped body from the tank. He was unconscious but breathing. He was rushed to the medical college nearby, where the casualty medical officer declared him brought dead. The body was sent to the department of forensic medicine of the medical college for post mortem examination to ascertain the exact cause of death.

Post mortem findings:

The deceased was a man of average build. Rigor mortis was present all over the body, and postmortem staining well developed and fixed over the back of the body. There were no apparent external injuries on the body. Internal examination also did not reveal any injuries. The brain was congested without any evidence of intracranial hemorrhage. Dissection of neck did not reveal any pathological findings. Lungs, liver, kidneys, and spleen were congested. There were no other significant pathological features.

In view of the above, relevant viscera were set aside for chemical analysis. A blood sample was collected under liquid paraffin film for biochemical tests and gas analysis. The cause of death was reserved pending reports of the chemical analysis, biochemical tests, and gas analysis. While the former two were inconclusive, the gas analysis report revealed significant concentrations of carbon dioxide in the blood (**Table 1**). The final opinion on the cause of death based on it was given as follows: Death due to asphyxia consequent to excessive inhalation of carbon dioxide.

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Discussion

Although there were no significant postmortem findings in this case, it was not difficult to ascertain the cause of death, based on the circumstances and the gas analysis report. Since the reported $p\text{CO}_2$ was almost 14 times higher than normal, it clearly indicated the extent of CO_2 inhaled by the man when he lost his balance and fell into the wine fermentation tank.

Table 1
Gas Analysis Report

pH	7.42	<i>Normal: 7.38-7.44</i>
PO_2	39.7 mm Hg	<i>Normal: 80-100 mm Hg</i>
PCO_2	567.1 mm Hg	<i>Normal: 38-42 mm Hg</i>
SO_2	54.5% (Arterial)	<i>Normal: 95-99%</i>

Accidental inhalation of CO_2 is not very common. One of the cases described in literature concerns the deaths of three men who descended into an open drainage pit to recover a fallen grate lid. All of them died within minutes of their respective descent. Analysis of air samples taken at various levels of the pit revealed that as one descended, the O_2 level decreased from 20% at the top to 3% at the bottom. CO_2 content however increased progressively until it was 22% at the bottom.¹ Natarajan has reported deaths of five persons as a result of asphyxia, while trying to rescue a young man who got drowned in an old unused well. On analysis, the air 11 feet above the water level showed 8.8% by volume of CO_2 (Normal 0.4%), while the oxygen content was 5.4 % by volume.²

Accidental CO_2 poisoning can occur from mistakenly turning the valve of a CO_2 cylinder in place of an O_2 cylinder. CO_2 is also formed in badly ventilated and overcrowded rooms due to increased temperature, humidity and stagnation. In the infamous Black Hole of Kosti, 189 cotton growers died after imprisonment in a single Sudanese barrack following riots over the selling price of cotton. Heat, exhaustion, extreme deprivation of O_2 and formation of CO_2 were the cause of deaths of the subjects.³

In chronic CO_2 inhalation of small amounts, the lungs become progressively damaged and the respiratory centre becomes insensitive to CO_2 . The lungs therefore fail to clear the body of CO_2 and $p\text{CO}_2$ increases. This leads to CO_2 retention syndrome,⁴ characterized by flapping tremor, hyperdynamic circulation, delirium, coma, and convulsions. However, in acute inhalation as in our case, sudden entry into an atmosphere (or chamber) containing considerable amounts of CO_2 can lead to rapid unconsciousness and death due to asphyxia from deficiency of oxygen supply to brain and tissues.^{5,6}

CO_2 gas is not toxic *per se*, but acts as a simple asphyxiant preventing tissues from obtaining required amounts of oxygen. Above a concentration of 6%, CO_2 gives rise to headache, dizziness, mental confusion, hallucinations, dyspnea, increased rate and depth of respiration, and depression of central nervous system. Concentrations of about 30% may produce convulsions. Inhalation of 50% of CO_2 is reported to produce central effects similar to anesthetics. Higher concentrations may produce respiratory acidosis.⁷ When inhaled in high concentrations of 60 to 80% immediate insensitivity occurs, followed by death from glottic spasm causing suffocation.⁸ Sudden death can occur from vagal inhibition and spasm of glottis in the case of inhalation of pure CO_2 gas. Patients manifesting CO_2 toxicity must at once be removed into the open air and artificial respiration should be started with administration of oxygen.

Our case serves as a warning to the owners of liquor breweries where workers are exposed to the danger of CO₂ exposure during periodic checking of the fermentation level in tanks. It is advisable to have openings that do not permit entry of an adult human into such tanks. Oxygen cylinders should be kept ready for use in the event of a mishap. Although not very common, the workers in such breweries are always at risk for accidental fatal CO₂ poisoning.

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