Case Report

Take My Breath Away: A Case of Carbon Monoxide Poisoning

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Abstract

Carbon monoxide (CO) is a flammable gas that is colourless, tasteless, and odourless and slightly less dense than air. Accidental CO poisoning death rate increases in North India, especially in winter due to increased use of combustible fuels for heating. Survival time depends on the saturation of CO in atmosphere, usually downhill progress starts by 6 -7 min since exposure. The diagnosis of carbon monoxide poisoning is frequently missed unless proper circumstantial evidence or history collected. We present a case wherein adult man found dead in a open well with water at the bottom of it. But he died due to carbon monoxide poisoning rather than drowning.

Key words:Carbon monoxide; Accidental; combustible fuels; circumstantial evidence

Introduction

Carbon monoxide (CO) is a flammable gas that is colourless, tasteless, and odourless and slightly less dense than air. Carbon monoxide is formed by partial oxidation of carbon-containing compounds; it forms when there is insufficient oxygen to create carbon dioxide (CO2). The diagnosis of carbon monoxide poisoning is frequently missed unless proper circumstantial evidence or history collected. The primary sources of (CO) are vehicle exhausts, poorly ventilated heating systems and inhaled smoke in a closed space, such as when running a stove or an internal combustion engine. CO can rapidly accumulate even in areas that appear to be well ventilated and build up to dangerous or fatal concentrations within minutes. CO has been referred to as "the unnoticed toxin of the 21st century.[1] It is readily absorbed by the lungs and competes for binding to haemoglobin with oxygen.

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The haemoglobin affinity for carbon monoxide is between 200 to 250 times more than its oxygen affinity.[2]A large proportion of incidental deaths caused by carbon monoxide across the globe have been recorded.[3]Even exposure to CO for a short duration at high concentration may lead to coma or fatal events. In our case, the deceased stayed in the bore well with exhaust machine for about 10 minutes and was exposed to CO at high concentration.
Elevated levels of carboxyhaemoglobin (up to 13%) can also be found in police officers working in tunnels or workers in garages where motor vehicles are running.

Case Report

A 39-year-old man, who was hired to clean a well and was found lying unconscious inside the well filled with water. He was declared brought dead by the casualty doctors, and to find cause of death the autopsy was conducted.

At autopsy, on external examination, rigor mortis was present all over body. Postmortem lividity which showed a pinkish color (Figure 1), was present over the back and was not fixed.

On Internal examination, Cranium showedBilateral temporalis muscle showed cherry red discoloration. Brain showed multiple petechial hemorrhages over the white matter of cerebrum on cut section. Blood-less layer-by-layer flap dissection neck revealed cherry red discoloration all the neck muscles. Both the lungs were soft and edematous and showed cherry red discoloration on cut section. Chest and abdominal muscles showed cherry red discoloration (Figure 2 & 3).

Figure 1: Postmortem lividity on the back

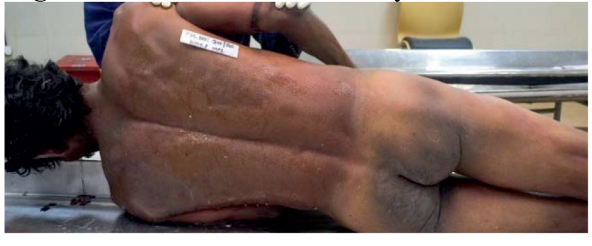


Figure 2: Cherry red discolouration of chest and muscles

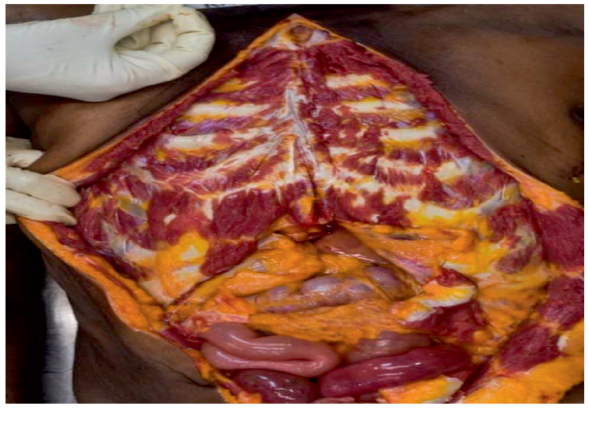
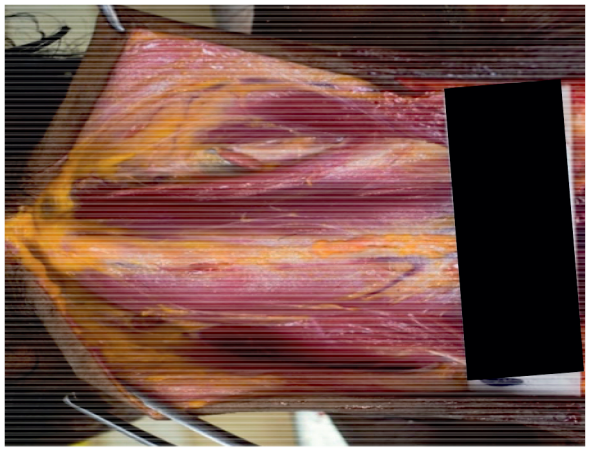


Figure 3: Cherry red discolouration of neck muscles



Investigations:

Postmortem blood sent for laboratory blood investigations revealed: Creatine phosphokinase (CPK) >2000 U/L, Troponin T 0.009 ng/ml, Creatine Kinase MB (CK MB) 41.0 ng/ml, N- Terminal B- type Natriuretic peptide 126 pg/ml.andCreatine phosphokinase was elevated suggestive of rhabdomyolysis.

Arterial blood gas analysis revealed:

Carboxy haemoglobin (CO Hb): 52.6 %

Routine viscera along with blood topped with liquid paraffin sent to RFSL for toxicology analysis revealed:

Colour tests and thin layer chromatographic methods of analysis have not responded for residues of ethyl alcohol, volatile poisons, pesticides, carboxyhaemoglobin, barbiturates, benzodiazepines group of drugs, alkaloids, phosphide ions, phosphorous, toxic metal ions and anions in the blood and viscera sent.

Mechanism of action:

Carbon monoxide produces tissue hypoxia by competing with oxygen for binding sites on the oxygen-carrying hemproteins, the oxyhemoglobin dissociation curve to left due to decrease release of oxygen because of carboxyhaemoglobin alters the oxygen affinity of haemoglobin.[4]

Severity	Signs and Symptoms
Mild Mild (COHb< 30%)	Throbbing headache, nausea, vomiting, drowsiness even at rest.
Moderate (CO Hb 30 to 40%)	Mental confusion, weakness, loss of coordination.
Severe (COHb> 40%)	Convulsions, Cheyne-Stokes respiration, Depressed heart action and respiratory failure.

Discussion:

As hemoglobin has a 250-fold greater affinity for CO (forming carboxyhaemoglobin (COHb)) than for oxygen, it reduces the oxygen carrying

capacity of hemoglobin, producing tissue hypoxia. A deep red, flushed skin color (cherry red) is the one telltale indicator of carbon monoxide poisoning. It comes from high levels of carboxyhemoglobin in the blood. Here inadequate ventilation inside the well must have caused incomplete combustion of diesel, causing accumulation of CO. The formulae below show the differences in complete and partial combustion of carbon containing compounds leading to production of carbon dioxide and carbon monoxide respectively.

$4\ C_{12}H_{23} + 71\ O_2 \rightarrow 48\ CO_2 + 46\ H_2O$ (complete combustion)

$4C_{12}H_{23} + 47\ O_2 \rightarrow 48\ CO + 46H_2O$ (ill-ventilated areas - incomplete combustion)

Conclusion:

Accidental poisoning due to carbon monoxide can be averted in workers by using safety precautions such as educating regarding common sources, early identification of signs and symptoms, switching from fuel powered equipments to electric or battery powered equipments, using respirators with appropriate cannisters etc.This case also highlights the importance of methods other than toxicological analysis to detect carboxy-haemoglobin levels such as CO oximeter and ABG. As most autopsy findings are non-specific for CO poisoning, except the cherry-red colour changes in the skin, organs and blood, the basic point of evaluation in forensic practice is CO-Hb saturation. The factors that enable the determination of the accurate cause of death in such cases is multi-factorial. The absence of the chemical analysis report or a negative chemical analysis report may weaken the prosecution case substantially due to lack adequate circumstantial evidence. However, this is where the role of different diagnostic techniques and their judicious use come into play.

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