




Carbon Monoxide Poisoning: A Case Study

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ARTICLE INFO	ABSTRACT
<p>Article History Received: 30/04/2026 Revised: 22/06/2026 Accepted: 23/06/2026</p> <p>Keywords: Carbon monoxide poisoning, Carboxyhemoglobin, Forensic pathology, Medicolegal investigation, Accidental death</p> <p>Correspondence Setyo Trisnadi (setyo.trisnadi@dsn.dinus.ac.id)</p> <p> This work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.</p>	<p>Introduction: Carbon monoxide (CO) is a colorless and odorless gas that often becomes a cause of injury and even accidental death worldwide. CO poisoning remains an important cause of injury and accidental death worldwide.</p> <p>Case study: A case is reported of death of an adult woman and her family who were found dead inside a vehicle on a toll road. The victims were found in a closed car without any obvious signs of external violence. External examination showed some parts of the body with bright red discoloration (cherry red lividity), and no blunt force injuries were found. Based on witness information around the scene, the victims were suspected to be exposed to carbon monoxide gas due to prolonged exposure to vehicle exhaust in a closed space. Forensic examination and medicolegal findings indicated death due to carbon monoxide poisoning.</p> <p>Discussion: Carbon monoxide poisoning is a cause of death that is often difficult to recognize because clinical and postmortem findings are not specific. The mechanism of death is mainly due to tissue hypoxia caused by formation of carboxyhemoglobin and also direct cellular toxicity. The classic sign such as cherry-red lividity is rarely found and not pathognomonic, so toxicological examination by measuring COHb level is important for diagnosis. In deaths occurring in enclosed spaces without signs of violence, consistency between environmental condition, autopsy findings, and high COHb levels supports the conclusion of accidental carbon monoxide poisoning. This finding emphasizes the importance of forensic awareness and prevention efforts to reduce mortality from CO poisoning.</p> <p>Conclusion: Carbon monoxide poisoning is an important cause of accidental death in forensic practice. Establishing diagnosis requires comprehensive evaluation including crime scene investigation, forensic examination of the body, and medicolegal analysis to determine the cause and mechanism of death.</p>

INTRODUCTION

Carbon monoxide (CO) is a colorless and odorless gas known as a “silent killer”. CO poisoning remains an important cause of injury

and accidental death worldwide, often originating from defective heating systems, vehicle exhaust, or fire in poorly ventilated areas. In Indonesia, cases

are often related to the use of generators or air conditioning in parked or stopped vehicles.¹⁻⁵

In America estimate of intentional CO poisoning is 15,000 cases with two third of it resulted in death.⁶ Eastern Europe has highest incidence with 37.98 per 100,000 population. The highest ranking of mortality was on Republic of Moldova and Russia with 2 per 100,000 population.⁷ Based on data from Global Health Data Exchange (GHDx), the global incidence of carbon monoxide poisoning in 2017 was 137 cases per one million population, with mortality rate reaching 4.6 deaths per one million population. Many cases of death due to CO poisoning are reported as accidental or suicide. These cases are commonly found in or around garages with running vehicle engines, or in enclosed spaces with active CO sources such as water heaters or fireplaces.³

CO can also be produced naturally in the body as a result of hemoglobin breakdown, but in very small amount.⁸ It is also generated from incomplete combustion of fuels such as gasoline, wood, charcoal, and propane. In daily life, CO can be found in vehicle exhaust, stoves, cigarette smoke, oil lamps, and vapors from thinner or solvents.¹⁻³

Inhaled CO is rapidly absorbed and distributed throughout the body by binding to heme proteins. In blood, CO binds with hemoglobin forming carboxyhemoglobin (COHb), while in muscle it binds with myoglobin forming COMb. In fatal CO poisoning cases, COHb levels are usually above 30%. A typical finding is reddish discoloration of the skin (cherry red).^{6,9,10}

RESULTS AND DISCUSSIONS

Carbon monoxide (CO) is a toxic gas produced from incomplete combustion of carbon-containing materials such as gasoline, diesel, gas, wood, and charcoal. It is colorless, odorless, and non-irritating, making it a “silent killer.” CO exposure is one of the leading causes of gas poisoning deaths worldwide, whether accidental, suicidal, or rarely homicidal. The toxicity mechanism of CO is mainly related to its strong binding to hemoglobin. CO has about 200–250 times higher affinity than oxygen, forming carboxyhemoglobin (COHb).^{9,11-13} This reduces oxygen-carrying capacity of blood and shifts oxygen dissociation curve to the left, preventing oxygen release to tissues. This results in severe tissue hypoxia even when partial oxygen pressure appears normal. Besides hypoxia, CO also has direct cellular toxicity. It binds to myoglobin and mitochondrial cytochrome oxidase, inhibiting electron transport chain and ATP production. This leads to cellular respiration failure, oxidative stress, and apoptosis, especially in organs with high oxygen demand such as brain and heart.^{6,11,13-15} Epidemiologically, CO poisoning is still a significant public health problem. Most deaths occur in enclosed or semi-enclosed spaces such as homes, bathrooms, garages, and vehicles.

Cases of families found dead inside cars or closed rooms are frequently reported due to accumulation of exhaust gas, leakage, or poor ventilation. In forensic context, diagnosis of CO poisoning is challenging because findings are non-specific. The classic cherry-red lividity is not always present and is not pathognomonic. Common findings include organ congestion, pulmonary edema, and blood stasis, which are also

seen in other asphyxia causes. Therefore, toxicological examination is essential. COHb level measurement is the gold standard. Normal COHb level is <2% in healthy individuals and 5–10% in smokers. Levels above 25% cause severe symptoms, while levels above 50–60% are often fatal, although death can occur at lower levels depending on individual condition and exposure duration.⁶

In this case, the victims were found dead inside a vehicle without signs of trauma. The absence of fatal injury, supported by environmental condition and autopsy findings, strongly suggests CO poisoning. The presence of pulmonary congestion and absence of structural abnormalities support systemic hypoxia mechanism. This case is similar to other reports where victims appear “sleeping” without signs of struggle. This is due to non-irritating nature of CO, causing gradual loss of consciousness.

From forensic perspective, it is important to differentiate CO poisoning from other sudden deaths such as ischemic heart disease, stroke, or mechanical asphyxia. The absence of violence, consistent findings, and high COHb level support accidental CO poisoning as the cause of death. CO poisoning is preventable.^{16,17}

Prevention includes regular vehicle maintenance, ensuring proper exhaust system, avoiding running engines in enclosed spaces, and using CO detectors in high-risk areas. Public education and awareness among law enforcement and medical personnel are important to reduce incidence and improve early detection.¹⁰

CONCLUSION

Carbon monoxide poisoning is a dangerous cause of accidental death and often difficult to

recognize because it does not produce specific warning symptoms. In this case, death of an adult woman and her family inside a closed vehicle without signs of violence, along with cherry-red discoloration, supportive environmental condition, and correlation between chronology, forensic findings, and toxicology, is consistent with acute carbon monoxide poisoning with accidental manner of death. This case highlights the importance of comprehensive forensic approach and prevention efforts to reduce mortality from CO poisoning.

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