



## Case Report

# Helium Inhalation Suicide: Hypoxic Asphyxia and Gas Embolism as Dual Mechanisms of Death: A Case Report

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## ABSTRACT

**Background:** Helium is an inert gas without inherent toxic properties, which explains its widespread use in both industrial and medical settings. However, despite its chemical inertness, inhalation of helium can cause severe oxygen displacement within the respiratory system, leading to tissue hypoxia and potentially fatal outcomes.

**Case Presentation:** Cases of helium intoxication pose particular clinical and forensic difficulties because toxicological examinations may not always produce positive findings. Death associated with helium exposure is primarily caused by hypoxia resulting from the mechanical replacement of oxygen during breathing.

**Conclusion:** Due to the largely non-specific morphological findings observed at autopsy, establishing the cause and manner of death requires a multidisciplinary approach that integrates scene investigation, forensic pathology, toxicology, and criminalistic analysis.

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## Introduction

Helium is an inert gas with no intrinsic toxicity, which is why it is widely used in industry as well as in medicine. Despite its chemical safety, inhalation of helium leads to significant mechanical displacement of oxygen within the respiratory tract, resulting in tissue hypoxia and potentially life-threatening conditions.

In recent years, statistics have shown an increase in reported cases of self-inflicted death by asphyxia using various methods of helium inhalation. This trend is facilitated by its wide availability and the perception that it leads to a rapid and painless death. Cases of helium intoxication present a specific clinical and forensic challenge, as toxicological analysis does not always yield positive results. Therefore, diagnosis relies on a comprehensive evaluation of the crime scene, along with forensic examination of all collected evidence, including autopsy findings.

In this medico-legal report, we present a case of helium intoxication in the context of suicide, emphasizing the importance of confirming morphological findings and conducting a thorough analysis of all circumstances. This case also highlights the broader significance of the issue in public health and forensic medical practice.

## Case Presentation

This medico-legal case involves a 35-year-old man found deceased in his home in a village near Pazardzhik. The body was found in a supine position on a bed, with an oxygen mask placed over his face. A tightly sealed plastic bag was secured around his head and fastened at the neck. The mask was connected via



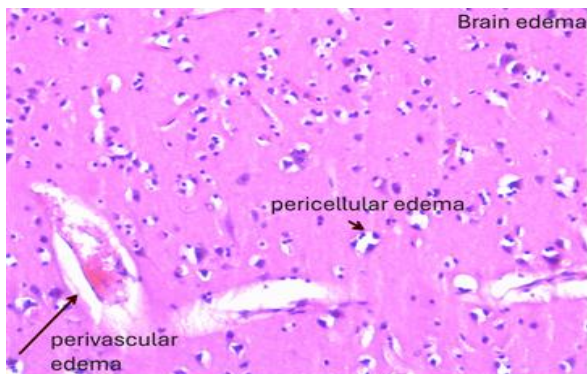
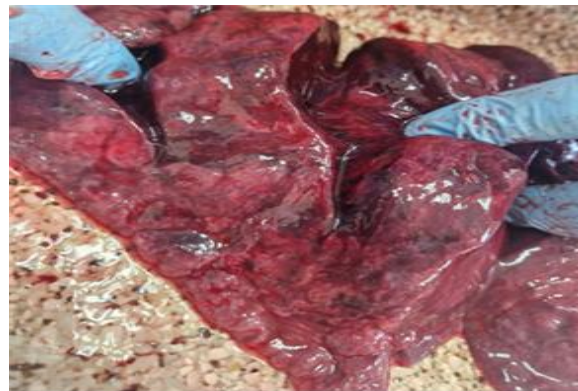
**Figure 1.** Showing the crime scene.



**Figure 2.** Shows the helium bottle at the crime scene.



**Figure 3.** Shows the outer surface of the lungs.



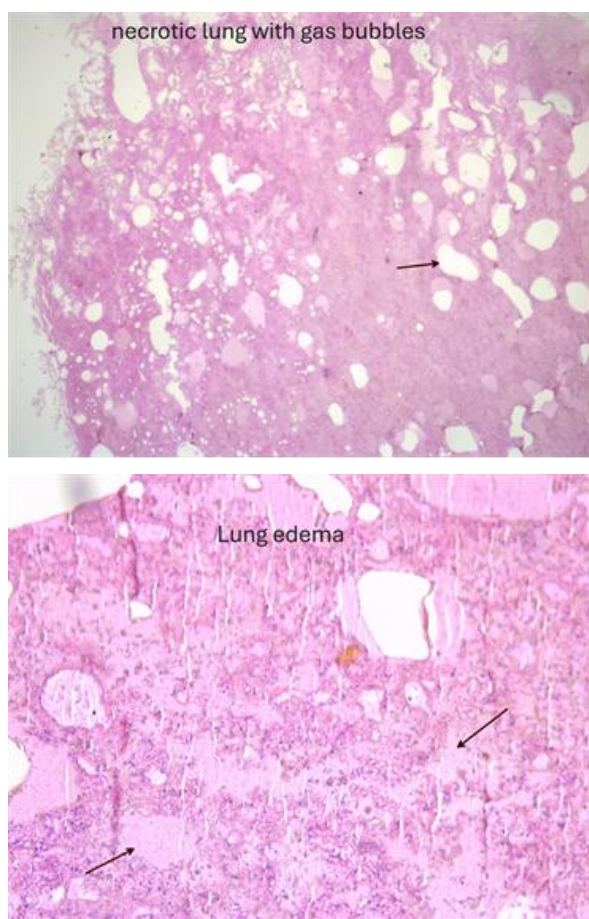
**Figure 5.** Shows microscopic pathological findings inside the brain.

a plastic tube to a metal cylinder containing helium, positioned on a table next to the bed.

Subcutaneous emphysema was observed in the face, neck, and chest. Additionally, pronounced livor mortis and well-developed rigor mortis were present, along with nasal bleeding, without evidence of external traumatic injuries.

The internal examination revealed cerebral edema, pulmonary edema, and generalized visceral congestion. The lungs were markedly collapsed, with visible bullae on the surface in areas where epithelial integrity was compromised; subpleural petechial hemorrhages were also observed. Upon sectioning the lung parenchyma, when pressure was applied, the blood was dark and fluid. The remaining internal organs showed no significant pathological findings.

The pneumothorax test was positive bilaterally, as well as the test for air embolism in the cardiac ventricles. Histological samples, fixed in 10% formalin and stained with hematoxylin and eosin, demonstrated the following findings: brain—pericellular and perivascular edema; heart—autolytic changes; lungs—severe pulmonary edema with erythrocyte aggregation in small vessels and microscopic air bubbles within the



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**Figure 6.** Showing pathologic microscopic findings inside the lungs.

parenchyma; liver—preserved architecture with loss of hepatocyte nuclei, consistent with autolysis.

Toxicological analysis of tissue and blood samples did not detect narcotic or toxic substances. Based on autopsy and ancillary findings, the cause of death was determined to be helium intoxication, and the manner of death was ruled as a suicide.

## Discussion

In forensic medical practice, helium intoxication is rare but well documented as a cause of death, typically associated with hypoxic asphyxia as the primary mechanism rather than intrinsic toxicity of the gas.

Helium is an inert gaseous substance without significant toxic properties [1, 2]. However, when inhaled in high concentrations, it mechanically displaces oxygen in the lungs' alveolar-capillary interface. This leads to a significant decrease in blood oxygen levels and subsequent tissue hypoxia [3, 4]. Another mechanism of death is gas embolism, resulting from microtears in the lung parenchyma and subsequent entry of gas bubbles into the circulation, causing organ dysfunction [5].

Clinically, this pathophysiological process progresses rapidly, often within minutes, presenting as a typical asphyxial syndrome with loss of consciousness and signs of systemic hypoxia. The underlying mechanism of death is tissue hypoxia due to oxygen displacement by helium [6, 7].

Unlike carbon monoxide poisoning, where hypoxia occurs at a molecular level due to the high affinity of carbon monoxide for hemoglobin, helium-induced hypoxia results from a purely mechanical displacement of oxygen during respiration.

Determination of the cause of death in such cases requires careful examination of the death scene, identification of morphological signs of hypoxia, and exclusion of other causes of sudden death. While toxicological analysis may contribute, confirmation remains a significant forensic challenge [8].

Autopsy findings in helium intoxication are generally non-specific and may include cerebral edema, vascular congestion, pulmonary edema, and petechial hemorrhages on the serosa of the internal organs, such as /subpleural, subepicardial petechial hemorrhages/. These findings reflect generalized hypoxia and impaired circulation.

The absence of specific autopsy markers complicates the determination of both cause and manner of death, particularly when scene investigation

is incomplete or compromised. Even advanced techniques such as virtual autopsy may not provide definitive evidence. Furthermore, rapid loss of consciousness may result in an absence of defensive injuries, complicating differentiation between suicide and other causes of death. In such cases, detailed scene analysis and forensic DNA investigation are essential.

The widespread availability of helium in domestic and industrial settings raises concerns regarding public health safety. Increasing awareness of the risks associated with inhalation of non-oxygen gases, along with appropriate regulatory measures, is essential [9]. Preventive strategies, including public education and targeted psychological interventions for vulnerable populations, are crucial in reducing the incidence of such cases [10-16].

## Conclusion

In summary, death due to helium intoxication primarily results from tissue hypoxia caused by mechanical displacement of oxygen during respiration. Given the non-specific nature of morphological findings, determining the cause and manner of death requires a multidisciplinary approach, incorporating scene investigation, forensic pathology, toxicology, and criminalistics analysis.

## Conflicts of Interest

The authors report there are no competing interests to declare.

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