



Case Report

Fatal Positional Asphyxia Following Entrapment in an Inverted Body Position: Conventional Autopsy and Postmortem CT Cadaveric Examination

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ABSTRACT

Background: Positional asphyxia is a form of mechanical asphyxia resulting from body positioning that interferes with adequate ventilation and venous return, ultimately leading to fatal hypoxia.

Case Presentation: This report presents the case of a 45-year-old woman who died following accidental entrapment in an inverted position after falling head-first into a shallow trap-like domestic concrete structure. The unusual body position, combined with restricted thoraco-abdominal movement and impaired respiratory mechanics, led to fatal positional asphyxia. Postmortem computed tomography and conventional autopsy demonstrated pronounced signs of mechanical asphyxia, including brain and pulmonary edema, severe cyanosis of the face, intense livor mortis, and internal hemorrhages over the diaphragmatic muscle near the tendinous parts. Additional findings included bilateral nail injuries, while toxicological examination revealed no alcohol, drugs, or other toxic substances.

Conclusion: The case highlights the importance of scene investigation and correlation between radiological and autopsy findings in establishing positional asphyxia as the cause of death.

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Introduction

Positional asphyxia refers to a type of pathologic condition in which the position of the body prevents adequate external respiration, resulting in impaired oxygenation and sudden death [1-3]. Fatal cases are frequently associated with unusual body positions, entrapment, or situations in which thoracic expansion becomes compromised or completely blocked. Unlike other forms of mechanical asphyxia, positional asphyxia often requires careful interpretation of circumstantial evidence, detailed analysis of scene findings, and analysis of postmortem findings due to the absence of highly specific morphologic features [1]. Deaths due to positional asphyxia are rare and an interesting matter from a forensic expert's point of view.

Case Presentation

According to the available scene investigation and crime scene analysis by the forensic doctor and the prosecutor, the deceased was an adult woman who accidentally fell buttock-first into a narrow, shallow, concrete pit. The concrete pit measured 100 cm deep and 60 cm in diameter. Subsequently, closed-circuit television (CCTV) footage from a nearby residential property revealed that the woman made several instinctive escape attempts over a period of 1 minute and 25 seconds, ultimately resulting in her entrapment in a head-down position. At the time of discovery, her upper body was positioned downward within the confined space, while the lower part of the body remained outside the pit in an elevated position (Fig. 1). The body was reportedly discovered one and a half hours after the incident. The precise duration of

entrapment could be established with certainty based on the CCTV footage for about 12 minutes. The arriving emergency medical personnel only confirmed the victim's death.

The body's position upon discovery was photographed before removal. The available scene documentation indicated that the confined space and body position would have substantially restricted spontaneous movement and potentially limited thoracoabdominal respiratory excursions. (Fig. 1A). An additional 3D reconstruction figure shows the body position within the entrapment structure (Fig. 1B).

The position prevented self-extrication and resulted in prolonged immobilization. The body was discovered several hours after the incident. Emergency squad confirmed death at the scene. No signs of external intervention, assault, or struggle involving another person were documented. Scene findings strongly supported an accidental fall followed by entrapment. The decedent had no known recent history of severe trauma or acute medical illness that could independently explain sudden death. No evidence suggested suicidal intent. After the crime scene investigation, the body was transferred for routine forensic examination with CT (computed tomography) examination followed by conventional autopsy.

Conventional autopsy

External Examination

The deceased was an adult female over 45 years of age. Marked cyanosis of the facial region was observed above the thorax, while the face appeared intensely congested with dark bluish-purple discoloration



Figure 1. A) Position of the body on the crime scene, B) Reconstruction of the body position.

involving the lips, cheeks, and periorbital regions. Intense color of livor mortis was present and pronounced (Fig. 2).



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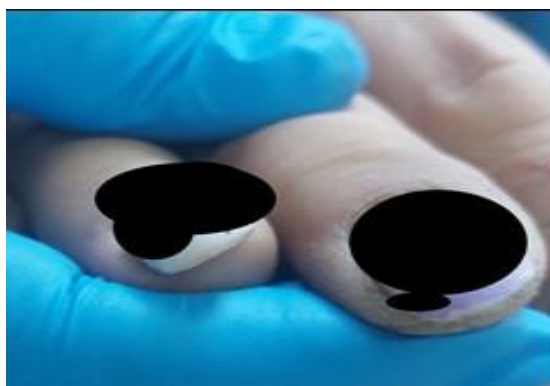
Figure 2. Intense color of livor mortis.

Distribution of lividity corresponded with the body position at the time of death and suggested prolonged maintenance in the inverted posture before discovery. No significant blunt force trauma was observed on the scalp, face, neck, thorax, abdomen, or extremities apart from minor superficial injuries. Nail injuries were noted bilaterally on several fingers. These included traumatic changes to the nail beds and periungual soft tissues (Figs. 3 and 4).



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Figure 3. Nail and softs tissue injuries over the finger.



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Figure 4. Nail and softs tissue injuries over the finger.

Internal Examination

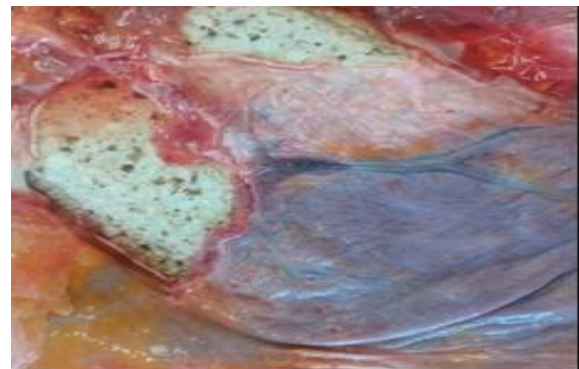
Internal examination revealed severe congestion of thoracic and visceral organs. The lungs were markedly congested and heavy. Both lungs demonstrated diffuse vascular engorgement with dark red-purple discoloration. On sectioning, blood-filled parenchyma and mild pulmonary edema were observed (Fig. 5).



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Figure 5. Severe congestion of the lungs on sectioning.

The diaphragm showed distinct hemorrhages in regions adjacent to the tendinous portions bilaterally. These bruises were most prominent near the central



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Figure 6. Bruising of the diaphragm.



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Figure 7. Bruising of the diaphragm.

tendons (Figs. 6 and 7).

The heart showed no significant pathological abnormalities. No acute myocardial infarction areas, major coronary thrombosis, or structural cardiac pathology were identified. The brain was diffusely edematous and congested, correlating with the postmortem CT findings. Mild flattening of gyri and narrowing of sulci were observed, consistent with cerebral edema. The abdominal organs demonstrated generalized congestion without major pathological abnormalities. No skeletal injuries, including rib or vertebral fractures, were identified. The combination of all external and internal morphological findings pointed exclusively to an asphyxial origin of death.

Toxicological Examination

Toxicological examination was performed on arterial blood and liver tissue specimens using gas chromatography at an independent toxicology laboratory certified by the Bulgarian Ministry of Interior. Neither ethanol nor any of the tested drugs or toxic substances were detected. Within the scope and analytical limitations of the investigation, no toxicological findings were identified that could provide an alternative explanation for the cause of death.

Virtual Autopsy Findings (Postmortem CT)

Prior to the conventional autopsy, a whole-body postmortem computed tomography (PMCT) examination was performed using a Philips CT scanner. The imaging protocol included a large scan field of view (FOV) for the thoracic anatomy, a routine non-contrast adult brain protocol, and 3D reconstruction of the thoracic region. The postmortem CT examination demonstrated marked cerebral edema with diffuse swelling of the brain parenchyma. Reduced differentiation between gray and white matter, especially in the area of basal nuclei, was observed, along with generalized narrowing of the cerebral sulci, consistent with brain edema secondary to terminal hypoxic injury. Thoracic imaging revealed bilateral diffuse pulmonary opacification with increased lung opacification. The lungs showed widespread increased density with pronounced bilateral parenchymal opacity, consistent with pulmonary congestion and edema associated with terminal respiratory failure (Figs. 8 and 9).

No evidence of intracranial hemorrhage, skull fractures, cervical spine injuries, rib fractures, pneumothorax, or traumatic skeletal injuries was identified during CT imaging (Fig. 10).



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Figure 8. These images show the described pathologic changes in the brain and lungs.



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Figure 9. These images show the described pathologic changes in the brain and lungs.



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Figure 10. Reconstruction of the human skeleton without bone injuries.

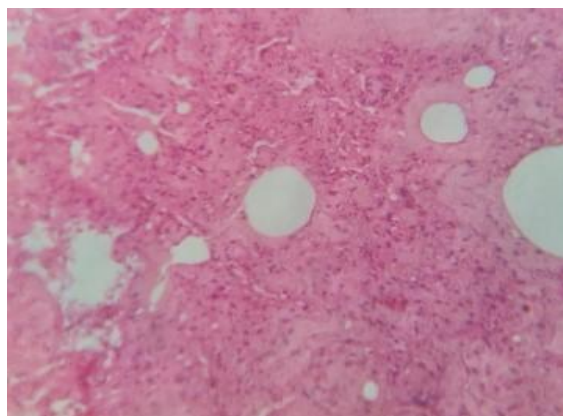
The imaging findings supported severe hypoxic and congestive changes associated with mechanical asphyxia and showed no evidence of alternative fatal traumatic pathology.

Microscopic examination

Representative tissue samples were collected during the conventional autopsy from the lungs, brain, heart, and diaphragm, including samples from areas corresponding to the macroscopically identified hemorrhagic lesions of the diaphragm. The specimens were fixed in 10% neutral buffered formalin, routinely processed, dehydrated through graded alcohol concentrations, cleared, embedded in paraffin, sectioned, and stained with hematoxylin and eosin (H&E). Histological sections were examined by light microscopy.

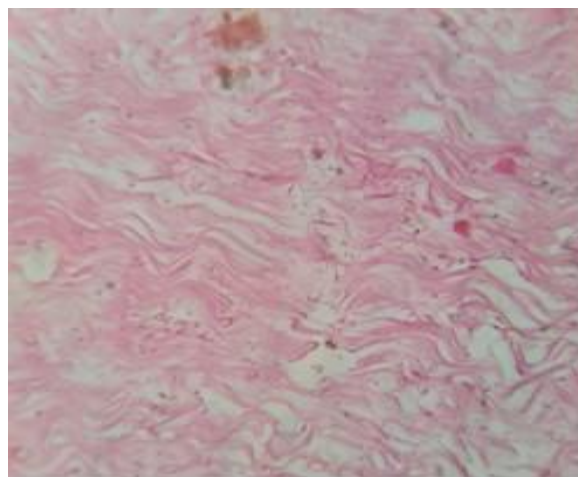
The microscopic examination demonstrated marked vascular congestion and blood stasis in the examined organs. The pulmonary sections showed diffuse vascular congestion and pulmonary edema involving both the alveolar spaces and interstitial tissue, with thickening of the interalveolar septa. Brain sections showed edema involving the perivascular and pericellular compartments, along with marked vascular congestion. Sections obtained from the macroscopically abnormal diaphragm demonstrated focal interstitial hemorrhage with extravasation of erythrocytes into the muscle tissue. The myocardial sections demonstrated marked cardiac adipose tissue infiltration/lipomatosis without a histological finding of acute myocardial necrosis.

These microscopic findings were interpreted in conjunction with the scene circumstances, postmortem CT findings, conventional autopsy findings, and toxicological examination. Because pulmonary edema,



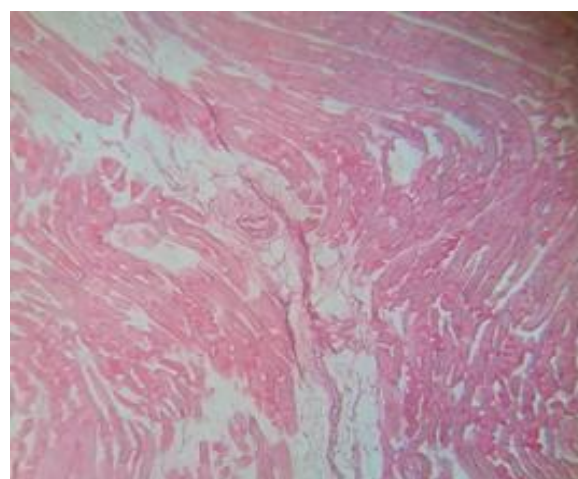
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Figure 11. Microscopic pathologic findings inside the lungs with severe pulmonary edema involving both the intra-alveolar spaces and the interstitial (interseptal) tissue.



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Figure 12. Microscopic pathologic findings inside the diaphragm muscle with focal hemorrhages with extravasated erythrocytes.



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Figure 13. Microscopic pathologic findings inside the heart with marked cardiac lipomatosis.

cerebral edema, vascular congestion, and focal hemorrhage are nonspecific findings, they were not considered independently diagnostic of positional asphyxia (Figs. 11-13).

Discussion

Positional asphyxia in most cases is almost always an accident. This type of asphyxia is commonly seen in cases that involve alcohol or drug intoxication. During alcohol or drug intoxication, the state of consciousness is compromised. Brain activity is depressed, which may cause a comatose state or cause someone to fall asleep in a position that can prevent breathing—for example, the jackknife position.

During positional asphyxia, the body becomes trapped in small or restricted spaces, or the body is put in a specific position that doesn't allow or severely

restricts the purely mechanical ability to breathe. In cases of positional asphyxia, the victim cannot move themselves out of the entrapment or the specific position they are put in. All of this causes an inability to breathe and eventually death. Commonly seen during the conventional autopsy are severe congestion, cyanosis, mostly of the face, and petechial hemorrhages on the skin and sclera of the eyes. These findings during the external examination of the body are usually seen, but they are not enough to conclude that the cause of death is positional asphyxia. The other commonly seen findings during the external examination of the body may be traumatic injuries to the fingers and nails. In most cases, these mechanical injuries are explained by the victim being conscious and trying to escape the entrapment or position they were put in. A very important factor in cases that are suspicious of positional asphyxia is the crime scene investigation and witness reports.

Commonly, during the crime scene investigation, if the body is not moved by the police, the person who found it or the paramedics, even the forensic pathologist, can see the actual position of the body in the particular entrapment. In cases where the person was put in a position that prevents the normal breathing process /for example, during police arrest when the person is put on the ground face down and handcuffed/. In those cases, a very valuable feature is the witness's report that can give the forensic pathologist information about the exact position that the body was put in right before death.

During the internal examination of the body in cases of positional asphyxia, the most common findings are the so-called nonspecific signs of asphyxia – brain edema, pulmonary edema, petechial hemorrhages /Tardieu spots/ on serous membranes of the internal organs – epicardium, anterior interventricular groove of the heart, visceral pleura of the lungs, thymus gland, on the subcapsular surface of the kidneys. Tardieu spot formation is due to high blood pressure, which causes capillary rupture and increased permeability. Other findings during the autopsy may be diaphragm hemorrhages near the regions adjacent to the tendinous portion or intramuscular hemorrhages. These diaphragm findings are explained by severe mechanical overexertion and acute hypoxia as the individual desperately tries and struggles to breathe. When a body is trapped in a position that compromises the airway or restricts chest and abdominal expansion, the diaphragm is forced to work against overwhelming physical resistance, leading to distinct physiological, mechanical, and hypoxic changes. This explanation is supported by the absence of any other externally or internally observed thoracic injury.

This case demonstrates a classic presentation of fatal positional asphyxia associated with accidental body inversion and entrapment. The circumstances, together with radiological and autopsy findings, strongly support fatal respiratory failure caused by abnormal body positioning.

The mechanism of death in positional asphyxia is multifactorial [4,5,6]. The prolonged inversion of the body most likely produced progressive venous congestion in the head, neck, and upper thorax due to impaired venous return, explaining the severe facial cyanosis and marked lividity. This entrapped body position significantly impaired respiratory mechanics and normal ventilation, which requires coordinated thoracic expansion and effective diaphragmatic movement. In an inverted, restricted position, diaphragmatic excursion is limited, and chest wall motion is compromised or completely blocked. The postmortem CT findings of brain changes and diffuse pulmonary opacification provided additional objective evidence of severe hypoxic injury and terminal respiratory failure [7,8]. These radiological findings correlated closely with conventional autopsy findings of cerebral edema and severe pulmonary congestion. The diaphragmatic hemorrhages near the tendinous regions are particularly important. These hemorrhagic lesions indicate forceful and prolonged inspiratory effort against mechanical restriction, one of the described pathophysiologic mechanisms of death [9, 10]. The nail injuries further support a period of consciousness with active struggle and attempt at self-extrication. Negative toxicology excluded exogenous contributing factors such as alcohol or sedative agents, which are commonly associated with positional asphyxia. In every case of suspected positional asphyxia, all other potential causes of sudden asphyxial death must be ruled out as part of the differential diagnosis using toxicological and histological analyses; these include sudden cardiac death, occult neurological disease, traumatic asphyxia, and other causes of hypoxic death. The diagnosis of positional asphyxia often remains challenging because no single autopsy finding is pathognomonic [11, 12]. Therefore, scene investigation and reconstruction of the events remain essential. In the present case, the unusual, inverted body position, inability to make effective movements, evidence of struggle, and supportive radiological and autopsy findings collectively establish the diagnosis.

Conclusion

This case illustrates the fatal consequences of accidental inversion and entrapment of a victim in a confined domestic concrete trap-like structure. This recent case underlines the importance of both methods

of body assessment — conventional autopsy and CT examination as helpful supportive imaging technique, while, if the particular case allows it, in combination with crime scene investigation. CT postmortem imaging has wide usefulness in forensic medicine [13]. The forensic pathologist must have in mind that CT has its limitations in determination of the cause of death in such cases. CT examination is partly limited for soft-tissue injuries or findings, especially when they are minimal (for example, when determining Tardieu spots). But CT is useful for detecting brain and pulmonary edema. Another example of CT's usefulness is fast, nontraumatic detection of bone injuries. This case emphasizes the diagnostic value of integrating scene investigation, postmortem CT, conventional autopsy, and toxicological analysis as key steps in determining such rare and interesting cases from an expert point of view [14]. Without adequate and detailed assessment and analysis, such cases can lead to serious expert difficulties and mistakes in determining the cause, mechanism, and manner of death.

Ethical Approval

The study was conducted in accordance with the Declaration of Helsinki, and the ethical approval was obtained from the Scientific Ethics Committee, MU Plovdiv (proposal: 25.04.2025), for studies involving humans.

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Conflicts of Interest

The authors report no competing interests to declare.

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